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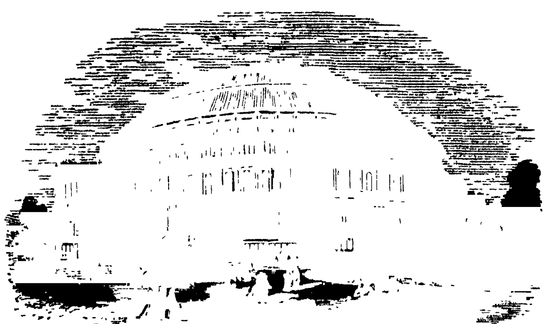

The Royal Albert Hall of Arts and Sciences.—(*See* p. 11.)

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THIS distinguished traveller, whose journeys and adventures in Eastern and Central Africa form one of the most interesting portions of the recent history of British enterprise in foreign lands, is the eldest son of the late Samuel Baker, Esq., of Thorngrove, Worcestershire, and was born on the 8th of June, 1821. At a very early age he evinced a strong predilection for travel, with the high ambition of making geographical discoveries, and the manly pursuit of slaying the fiercest and mightiest savage animals. He first visited Ceylon, and after his return from thence he tells us:—"I wanted the change to my former life. I constantly found myself gazing into gunsmiths' shops, and these I sometimes entered, abstractedly, to examine some rifles exposed in the window; and often have I passed an hour in boring the unfortunate gunmakers with my suggestions for various improvements in rifles and guns, which, as I was not a purchaser, must have been extremely edifying." This pleasant confession of his "gipsy-like love of wandering and complete independence" must be received with a grain of allowance; for, with his brother, now Colonel Baker, in 1848, he undertook the organisation of an extensive agricultural settlement at Newera Ellia, a neglected station in the salubrious mountain district above a hundred miles from Colombo, still within easy reach of abundance of the mightiest game. Of his experiences in this country, he gives a very interesting record in his *Eight Years' Wanderings*, published in 1855. In 1864 he made preparations for an expedition to Africa, in the hope of meeting Captains Speke and Grant at the true source of the Nile. "Traveller after traveller," says Sir Roderick Murchison, "from the days of the Egyptian priests and of the Roman emperors down to modern periods, had endeavoured to ascend the Nile to its source, and all had failed; but, by reversing the process, and by proceeding from the east coast of Africa, near Zanzibar, to the central plateau land between North and South Africa, Captains Speke and Grant solved the problem."

It was, however, reserved for Mr. Baker to ascend the course of the river, from Khartoum, the chief town of the Egyptian province of Soudan, all the way to Lake Albert Nyanza, a distance of more than 1,000 miles, in the years 1863 and 1864. The narrative of this journey, with the discoveries Baker succeeded in making, were published on his return to England, and have gained him the Gold Victoria Medal of the Geographical Society. He was also made an honorary M.A. at Cambridge, and received ghthood, honours which he has so well deserved. The first oblem of the Nile is therefore solved, if the Nyanza lakes, those never-failing reservoirs, fed by the ten months' rainfall the equator," be considered its source, having power sufficient to keep the grand river constantly supplied, at all seasons of the year, despite the vast amount of evaporation and absorption under a burning sun as it rolls on through the arid sands of Nubia and

Upper Egypt, where the parched ground and the ever dry atmosphere might have been expected to imbibe a large share of its waters.

But the second problem is that of the cause of the annual overflow in July, August, and September, on which the proverbial richness of that strange land of Egypt entirely depends. This question also has been practically solved by Sir Samuel Baker, in accordance with the conjectures of men of science and students of geography, who had ascribed the summer rise of the Nile to the melting of the snows in the Alpine region of Abyssinia, whence the most important group of its tributary rivers pour forth, like other Alpine streams, a volume of water that varies immensely at different seasons. Abyssinia is almost as mountainous as Switzerland, which it equals in size and population. With one exception, all the rivers rising either in the hollow middle of this upland basin of rock, or in the deep ravines and gorges of the mountains, some of them 13,000 ft. or 14,000 ft. high, which inclose it on three sides, find their way to the Nile, and not to the Red Sea or the Indian Ocean. The waters emerging from Abyssinia on its south-western side, with the surplus of Lake Dembea and the drainage of the Amhara, which forms King Theodore's particular dominion, form what is called the Blue Nile, which afterwards receives the Dinder and Rahad from the outer slopes of the Abyssinian Alps, and joins the White Nile at Khartoum. Of the rivers from the north of Abyssinia, the most important is the Settite, which, passing out from the Abyssinian high lands, receives, like the Blue Nile, from the outside or northern and western slopes of the mountain circle, several other rivers: from one of these, the Atbara, it subsequently borrows its name, and falls into the Nile a little above the town of Berber, on the verge of the Nubian desert. The Royan, the Angarep, and the Salaam, are its other tributaries. The country watered by these streams, with its fertile soil, capable of producing any amount of cotton, Sir Samuel Baker makes known to us in his second work, *The Nile Tributaries of Abyssinia*, published in 1867.

In the summer of 1861, Sir Samuel Baker, accompanied by his heroic wife, travelled to Berber, on camels, across a most horrid desert, having left the Nile at Korosko, not far above the well-known ruins of Philœ and the First Cataract. Nubia, which separates the habitable region of the Thebaid and Upper Egypt from Soudan and Sennaar, was the only disagreeable part of their whole journey, so far as we are told. A march of 230 miles, from Korosko to Abou Hamed, all the way over sand and volcanic rocks, without a single drop of water, except at the halfway pool of Moorahd, and with skeletons of dead camels at every mile, was not a pleasant introduction to African travel in the last week of May. At Berber, which is almost a city, with a garrison of 1,500 Egyptian troops, Sir Samuel and his wife were allowed to pitch their tents in Halleem Effendi's beautiful garden, and to repose awhile and muster their camels, horses, and servants before starting on their tour around the plains of the Atbara.

No positive hardships or privations are recorded in their journal from June 10, 1861, when they quitted Berber, to June 11, 1862, when they arrived at Khartoum, after sojourning a whole twelvemonth at different places, and often living many days and nights under canvas, on the banks of the rivers of that region. The only interruption of their usual good health was a severe attack of fever suffered by Lady Baker during their stay at the village of Sofi, where they remained three months.*

At Gondokoro, Sir Samuel and Lady Baker were joined by Captains Speke and Grant, when the former told Sir S. Baker he was assured by the natives that a larger lake existed to the west, which was believed to be a second source of the Nile. Captain Speke had traced the river leading thereto, as far as 2° 20′ N., when it diverged to the west; and he relinquished, very unwillingly, his task, which was at once undertaken by Sir S. Baker. The organisation of the expedition was a matter of great difficulty, as he could only induce about 17 natives to go east, and none would go south. Finding that it was the intention of those he had engaged, to desert him, Sir S. Baker and his wife, nothing daunted, prosecuted their journey, and overtook the traders, arriving in the Latooka country 110 miles east of Gondokoro, 17th March, 1863. After a sojourn in this part they made their way to Kamrasis country, lying between the Sobat and White Nile rivers. Descending the valley Asua, they, on the eighteenth day after leaving Kamrasis country, 14th March, 1864, and tracking the river upwards, sighted the desired lake, lying very low in a depression of the country. Descending the cliff for 1,500 ft., Sir S. Baker and his wife reached the shore of the lake, which he named (subject to Her Majesty's permission) the Albert N'Yanza, and drank of the sweet waters. The western shore is distant 60 miles, and is lined by mountains 7,000 ft. in height. This lake and the Victoria N'Yanza constitute the two great reservoirs of the Nile.†

Sir Roderick Murchison thus lucidly explains the relations of the two equatorial African lakes. Speke places the Luta Nzigé (now the Albert) on his map as a great sheet of water of which he had heard, and into which the Nile, from the point where he was obliged to quit it, descended by rapids, and then re-issued a little to the north to flow to Gondokoro.

Now, in every essential point the researches of Baker have confirmed the accuracy of the views of Speke as regards the Luta Nzigé; for the Nile, leaving its first great and lofty reservoir, the Victoria, at a height of 3,740 ft. above the sea, is found to descend 1,670 ft. into the deep rock-basin of the Luta Nzigé, or Albert Nyanza, which is placed by Baker at the elevation of 2,070 ft. Thence the stream flows downwards and

* Review of *The Nile Tributaries of Abyssinia*; *Illustrated London News*.

† See the interesting Memoir, in *Men of the Time*, seventh edition, just published.

northwards to Gondokoro, from which place to Khartum, where it is joined by the Blue or Abyssinian Nile, it becomes, as is now well known, a perfectly navigable stream.

The representations of ancient geographers, as seen on old maps, of two streams issuing from two separate and unconnected lakes, these streams uniting farther north to form the Nile, is proved to be erroneous; since we now know that, whether in the form of lake or river, the White Nile consists of one continuous system, the waters of which descend in the first instance from a higher into a lower lake, and thence into the main stream, which in its course to Gondokoro and Khartoum is fed by many other affluents.

How Sir Samuel Baker, accompanied by his intrepid wife, set forth on his famous expedition to find out the sources of the Nile, braving perils and difficulties innumerable, made good their way into the heart of the continent, and, having solved the geographical problems left undetermined by Speke and Grant, beheld the head of the mighty stream issue from the gigantic Albert Nyanza, is a tale not to be soon forgotten by thousands in the present generation. This renowned journey settled a question which had been a mystery since the dawn of history: it showed conclusively that the origin of the Nile is to be found in two lakes of immense size—the Victoria and Albert Nyanza, in the centre of equatorial Africa. Before, however, the whole system of the Nile could be said to have been explored, another question remained obscure—namely, what was the cause of the extraordinary rise of the great river at settled periods, and where the fountains of its prolific overflow? It has been the good fortune of Sir Samuel Baker to put this question also to rest, and thus to have completely unfolded one of the most remarkable secrets of geography.

Sir S. Baker's latest work, the *Nile Tributaries*, to which we have referred, is a narrative of adventures in the border countries of Abyssinia, preparatory to the exploration of the Upper Nile. Its narratives of wild animals are intensely interesting; as in the attacks upon elephants, hippopotami, rhinoceroses (with one and two horns), lions, giraffes, buffaloes, antelopes "of thirteen varieties," crocodiles, turtles, fishes of various descriptions, not to speak of small game, that all fell victims. On one occasion, we read of "a mixed bag of elephants, hippopotami, buffaloes, giraffes, and great numbers of the large antelopes." The result of another day's sporting "was, in all, seven elephants killed;" on which the sportsman quietly remarks,—"We had done pretty well. I had been fortunate in bagging four from this herd, in addition to the single bull in the morning; total five."

Sir Samuel Baker's work also contains an account of the Sword Hunters of the Hundran Arabs, whom Bruce, in his *Travels*, describes, though Baker could never have read this account, or had the slightest idea of its existence, or he would not have said that he "could not understand how it could be possible to kill an elephant with the sword, unless the animal should be mobbed by a crowd of men and hacked to death."

Notwithstanding a few immaterial differences, the two descriptions are substantially the same, and in some particulars they are identical. It must be recollected that there is an interval of nearly a century between the two dates, a distance of 60 miles between the two localities, and it is not certain that the hunters are of the same tribes.

Sir Samuel Baker married first Henrietta, daughter of the Rev. Charles Martin; secondly, Florence, daughter of Finnian Von Sass; the latter lady, with extraordinary hardihood and devotion, shared with her husband every difficulty of African travel. Sir Samuel Baker is a Fellow of the Linnæan and Geographical Societies. At the late Meeting of the British Association at Dundee, he was President of the Section E. (Geography and Ethnography), and read a highly interesting address, picturesquely illustrating the scenes of his late adventures and discoveries.

Sir Samuel Baker began by an eloquent assertion of the importance of Geography as a branch of science, and by pointing out its action on other sciences. "Theology," he remarked, "is closely interwoven with the study of geography; the history of man from the remote beginning is linked with a description of the creation of the world, when God said, 'Let us make man in our own image.' From that time the very elements of our creed are connected with particular positions upon the earth's surface. In tracing the progress of geographical science from earliest history we are,' he said, "struck with the marvellous strides effected during the last three centuries. In the short period of 380 years, a small practical portion of the interval assigned to the existence of man upon our earth, what vast changes have occurred, not only in geographical discovery, but by its results! America has become a giant, an irresistible Power upon her own soil, separated from Europe by an ocean that renders her secure from hostile aggression. The first steps of a young colony are slow and full of difficulty; but if in 300 years America has attained her present high position from an utterly savage state, what part will that vast continent assume in tho future history of the world? If possible, more wonderful in rapid advancement than America is that extraordinary country beneath our very feet. Within the memory of many who are here present the now important cities of Australia were mere buds upon the family tree of colonies. Blessed with the favourable conditions of temperature and geographical position, they have burst suddenly into bloom. Not only have we that vast pyramid of gold exposed in the Paris Exhibition as proof of the value of Australia, but we possess a more lasting testimony of the importance of that fifth section of the globe in the imports of wool of the finest quality. This is the most complete proof of success, as the locality most favourable to the fine wool-bearing species of sheep is that most favourable to the development of the great Anglo-Saxon race."

Speaking of the future of our great colonies, the very science we represent, said Sir Samuel, whispers this warning in our ears:—"That as we have peopled distant lands and nursed these infants until they have become great, the mother should no longer hold them in the leading-strings of childhood; but as stalwart sons grown into manhood launch independently upon the world, so should our great offsprings, Canada and Australia, regard the old mother with affection, but finally assume their position of independence. Geography is the base of diplomacy. There are things difficult, but possible; but there are obstacles of nature that are impossible to overcome. The Atlantic declares the independence of Canada, as no support could be afforded by Great Britain in a contest with America."

Coming to speak of our Indian possessions, Sir Samuel said:—"It appears to many of us as the affair of yesterday that the overland route to India was established by the indefatigable Waghorn (whose name should ever be held in honour), but in the short space of about 15 years the camel has ceased to be the 'ship of the desert' upon the Isthmus of Suez. A railroad connects the Red Sea with the Mediterranean; a canal already conveys the sweet waters of the Nile through deserts of arid sand to Suez; and a fleet of superb transports upon the Red Sea convey our troops to India. Who can predict the future? Who can declare the great French work to be impossible, and deny that, within the next half century, the fleets of the Mediterranean will sail through the Isthmus of Suez upon the Lesseps Canal? England has been the first to direct to general use the power of steam. Our vessels were the first to cross the Atlantic, and to round the stormy Cape to India. The name of Stephenson will live for ever as the inventor of the railway, and that of Wheatstone as the adaptor of electricity to the telegraph; but, proud as we may be of these great inventions, which by the reduction of space bring distant countries into close communication, and tend to civilisation, have we not thus destroyed the spell that kept our shores inviolate? Not only ourselves, but the French also, possess a magnificent line of transports upon the Red Sea. We can no longer match the dexterity of our sailors against overwhelming odds. Steam breaks the charm. Wars are the affair of weeks or days. There are no longer the slow marches that rendered inaccessible far distant points. The railway alters the former conditions of all countries. Without yielding to exaggerated alarm we must watch with intense attention the advances of Russia upon the Indian frontier, and, beyond all geographical enterprises, we should devote extreme interest to a new and direct route to India by the Euphrates valley and the Persian Gulf, thus to be independent of complications that might arise with Egypt.

"Thanks to the devotion and zeal of the distinguished President, Sir Roderick Murchison, the Royal Geographical Society has of late years received so great an impulse that it comprises at this moment 2,130 members. There is no exploration of any importance that can be undertaken throughout the world without the knowledge and the attention of this Society; thus, not only are we forewarned of the encroachments of neighbouring Powers should their expeditions be pushed beyond the limits of necessity, but we form a nucleus for all geographical information, should the Government resort to us in an emergency. Free from all jealousy, and above suspicion, we have this year awarded to the Russian General Boutakoff the founder's gold medal, for having been the first to launch a steamer on the Sea of Aral, and to conduct his vessel upwards of 1,000 miles along the course of the river Iaxartes. The Victoria Gold Medal has been conferred upon that eminent Arctic voyager, Dr. Isaac Hayes, who, by reaching the highest northern latitude hitherto attained (81 deg. 35 min.), in his arduous voyage towards the open Polar Sea, has nobly sustained the honour of America. Thus the year 1867 affords an interesting proof of the unprejudiced patronage of the Society, as both the founder's and the patron's medals have been bestowed upon these distinguished foreigners.

"It is not my intention to enter into the details of the geographical explorations of the past year, that have been so ably enlarged upon by Sir Roderick Murchison in the exhaustive review contained in his annual address of May 27, but it is my duty to bring to your notice those most important geographical facts which, from their recent occurrence, claim our present attention. In Africa we have to record the noble expedition of Mr. Gerhard Rholf, who has safely returned from his remarkable journey across the Sahara, from Tripoli *viâ* Ghadames and Murzuk to Kuka, on the shores of Lake Tchad; thence south to Benué, down that stream to its junction with the Niger, and thence across by land to Lagos in the Bight of Benin. In Abyssinia we are about to commence a military expedition, to which we trust Her Majesty's Government will attach a staff of men of science that may return with valuable results. The importance of exploration was never more forcibly exemplified than in the present instance, when a war is about to commence in a wild country, of which the military authorities are utterly ignorant, and solely dependent upon the accounts of private travellers. In Asia we have to remark upon the extraordinary progress by the Russians in geographical enterprise, who by their settlements in Manchuria and explorations of the Khinka Lake, and the navigable rivers Usuri and Amoor, are laying the foundations for the development of that hitherto neglected portion of the world. When we regard the vigorous steps that have been adopted by Russia in Northern Asia, we turn with increased attention to the energetic appeal of General Sir Arthur Cotton for an exploration of that unknown land between the Burhampooter and the Yangtze, with a view to open a free communication between India, with its 200 millions, and China, with its 400 millions of inhabitants. In America we devote increased attention to inter-oceanic communication across the Isthmus, upon which interesting subject papers will be read before this Society by Lieutenant Oliver, on a recent exploration of a new route across Nicaragua, under the direction of that well-known explorer, Captain Bedford Pim."

Sir Samuel then touchingly refers to the reported death of Dr. Livingstone, and pays a warm tribute to his distinguished services. He then continues:—

"And now before I close this address I must refer with pride and satisfaction to the vigour and alacrity that have been exhibited not only by the Royal Geographical Society, at the instigation of our sterling President, Sir Roderick Murchison, but also by Her Majesty's Government in despatching, without a moment's unnecessary delay, an expedition to Eastern Africa to investigate the fate of Livingstone. Should he be no more, the arrival of an armed expedition in his search will be a lesson to the savage tribes that no Englishman can disappear without an enquiry into the cause, and good service will be done to Geography by the party under Mr. Young, who, provided with a steel boat, will be able to decide whether the Nyassa is fed by a river from the north.

"The most interesting African problem yet remains to be solved. Within the last few years we have determined the great reservoirs of the Nile, and we have proved that the river, hitherto so mysterious, is the offspring of two great causes, the vast equatorial reservoirs the Victoria and Albert lakes, and the effect of the sudden rains of Abyssinia that in July, August, and September cause the inundation in Lower Egypt. But, much remains to be explored. We know but a portion of those immense reservoirs, and geographers will not remain content with the bare fact that the Nile issues from those lakes: but England that has untied the knot must gather in the extremity of the line.

The accompanying Portrait has been copied from a photograph, by permission of the Stereoscopic Company.

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THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

THE ROYAL ALBERT HALL OF ARTS AND SCIENCES.

THIS stately edifice will be one of the results of the Exhibition of 1851, and is intended to form a prominent feature in the scheme contemplated by the Prince Consort for perpetuating the success of that Exhibition, by providing a common centre of union for the various departments of Science and Art.

The first stone of the building was laid by Her Majesty, in state, on May 20, 1867, when an address of the Provisional Committee to the Queen was read by the President, the Prince of Wales, to Her Majesty, who made the following reply:—

"I thank you for your affectionate and dutiful address. It has been with a struggle that I have nerved myself to a compliance with the wish that I should take part in this day's ceremony; but I have been sustained by the thought that I should assist by my presence in promoting the accomplishment of his great designs to whose memory the gratitude and affection of the country are now rearing a noble monument, which I trust may yet look down on such a centre of institutions for the promotion of art and science as it was his fond hope to establish here. It is my wish that this hall should bear his name to whom it will have owed its existence, and be called 'The Royal Albert Hall of Arts and Sciences.'"

The site of the Hall is land belonging to the Commissioners for the Exhibition of 1851, on the north side of the Royal Horticultural Gardens, and just in front of the Albert Memorial. The Hall is to be available for the following objects:—Congresses, both national and international, for purposes of science and art; performances of music; the distribution of prizes by public bodies and societies; conversazioni of societies established for the promotion of science and art; agriculture, horticultural, and the like exhibitions; national and international exhibitions of works of art and industry, including industrial exhibitions by the artisan classes; exhibitions of pictures, sculptures, and other objects of artistic or scientific interest; and generally any other purposes connected with science and art. The Hall will be elliptical in plan, and the central portion will be occupied by an arena 100 ft. long and 65 ft. wide. Above and around the arena will rise the amphitheatre, extending over four-fifths of the ellipse in a gradually increasing curve of ascent. The remaining part of the ellipse will be occupied by sittings for an orchestra of 1,000 performers, and by an organ, which is to surpass any instrument yet built. Above the amphitheatre again will rise two tiers of boxes. Above the boxes will be a corridor 21ft. wide, which is to be fitted with movable seating. This arrangement will allow it to be used for a sitting audience, a promenade, or exhibition space. It will give space for seating 2,700 persons. The wall of the corridor may be considered to bound the hall proper; and from wall to wall on the longer diameter of the ellipse it will measure 230 ft., and on the shorter 130 ft., which enormous stretch is all to be covered in with a roof in one span, resting on piers. A gallery and promenade run completely round the Hall; the gallery will conveniently accommodate 1,000 persons. The total number, therefore, that could be conveniently seated in the building will be 8,000, including the orchestra. From the top of the piers, which separate the upper galleries from the main body of the Hall, the ceiling will rise in an elliptical curve to the great central skylight, both ceiling and skylight being suspended from wrought-iron arched ribs, which all converge on a central ring. The total height from the floor of the arena to the skylight will be 135 ft. Colonel Scott, R.E., is the designer of the Hall.

THE PARIS INTERNATIONAL EXHIBITION.

THIS grand display, the Building for which was engraved in the *Year Book of Facts*, 1867, was inaugurated April 1, by the Emperor Napoleon, in a very incomplete state. By the early part of May, however, it was most effectively completed.* The Distribution of the Prizes, by the Emperor, took place, last autumn, not in the Palace of the Exhibition, but in the Palais de l'Industrie, which was built for the Exhibition of 1855, in the Champs Élysées. The progress of the International Exhibition has received attention from our Press commensurate with its merits and significance. It has been chronicled in journals, daily, and weekly, and monthly. The *Illustrated London News* has presented to its readers "the Reports on the Classes, prepared by order of the Committee of Council on Education," from which we have selected the details of many novelties in the Exhibition, which will be found under the several sections of the present volume. These reports are of very unequal merit, and are, in many instances, from hands unfitted for the labour, by experience in this class of writing. Nevertheless, to the management of the above Journal great credit is due for availing themselves of this official source, although it may have fallen short of public expectation. The Engravings of the Departments, Models, Costumes, and other characteristic subjects —very noteworthy features of the Exhibition—contributed to

* The earthworks of the Paris Exhibition, including the Park, amount to upwards of half-a-million cubic yards. The ironwork amounts to 13,200 tons, of which 10,000 tons are in the great machinery gallery. The windows of this gallery present a surface of 53,700 square yards, and those of the other galleries 25,000. The palace itself occupies an area of 140,184 square yards. Of this, 61,000 square yards were occupied by France, 21,653 by England, and 2,900 by the United States.

the Illustrations much novelty and attraction; and the individual objects exhibited have been well selected. Altogether, the result is satisfactory; though it could hardly be expected to bear comparison with the *Illustrated London News'* picture of the Great Exhibition of 1851, which possessed the charm of novelty in its most striking forms. The several French Exhibition Supplements in the *Illustrated London News,* it should be added, have been liberally presented to the public gratuitously.

Following the plan adopted by the Editors and Proprietors of the *Art Journal* on preceding Exhibitions, they commenced, in April 1867, the publication of an Illustrated Catalogue of the recent Paris Exhibition, which has been continued monthly during the year, and will be completed in about the middle of the present year. The Catalogue appeared as a portion of the Journal, and without any increased cost to the subscribers. When finished, it will contain no fewer than two thousand highly-finished wood-engravings of the most elegant productions of Art-manufacture exhibited in the Palace on the Champ-de-Mars:—cabinet-work, bronze-work, gold and silver-work, jewellery, porcelain, pottery, tapestry, and other textile fabrics, &c. These illustrations are accompanied by essays on the various departments of manufactures, from the pen of those whose knowledge and experience of such matters well qualify them for the task. The Catalogue is dedicated, by express permission, to the Emperor of the French, and editions of it are published in the German, Russian, and other foreign languages.

Concurrently with the monthly issue of the Catalogue there appeared in the pages of the *Art Journal* itself, reviews of the different picture-galleries that formed a part of the Exhibition; and under the title of "Notabilia," critical examinations of many of the most important and interesting features of the Exhibition which could not be classified under any special head; the whole comprehending a complete epitome of all that the public generally would care to learn, of the magnificent display that last year attracted the attention of the multitudes visiting Paris.

THE ALEXANDRA PALACE.

This second "Palace of the People" is in a great measure the result of the philanthropic exertions of Mr. Francis Fuller, who had a large share in the successful carrying out of the Great Exhibition of 1851, and the Crystal Palace at Sydenham.*

* To Mr. Fuller the good people of Portsmouth are indebted for his getting a piece of ground placed at their disposal, on payment of a nominal sum, as rent to the Crown, for a Park. The matter had been agitated for some time, when Mr. Fuller, in October last, in a professional visit to Portsmouth, discovered an area of about 50 acres of meadow-land, studded with large elm-trees, in the midst of a densely crowded population of 100,000; he learnt that this land belonged to the Government, and that several attempts had been made to procure it for the use of the inhabitants of the town, but without success, although the first application by the local authorities had been made about twenty years ago. Mr. Fuller, believing that the best way of attaining this object was by placing the facts bef.re Her Majesty the

Desiring that the inhabitants of the northern side of London should enjoy advantages similar to those afforded by the Crystal Palace at Sydenham, Mr. Fuller, in the year 1859, selected one of the most beautiful sites in the neighbourhood of London, at Muswell Hill, comprising about 475 acres, embellished with noble oak, beech, chestnut, and elm-trees, which Mr. Loudon described as amongst the finest in the kingdom.

A year or two previously the idea of establishing a "Palace of the People" at Muswell Hill had occurred to others, and Mr. Owen Jones had prepared designs for such a building. Lord Brougham had, in fact, accepted the office of President, and inaugurated the intended building in the cause of education, of which he has been so illustrious a champion; but these efforts had completely failed.

Mr. Fuller, having first secured the land, by means of the "Muswell Hill Land Company," then purchased from Messrs. Kelk and Lucas the Exhibition Building of 1862, and established the "Alexandra Park Company."

During the past year the Alexandra Palace (designed by Messrs. Meeson and Johnson, architects and engineers) has made rapid progress. The gardens and grounds have been skilfully and tastefully laid out under the superintendence of Mr. Alexander McKenzie, a landscape-gardener of great ability, by whom two magnificent terraces surrounding the building have been formed. One of those is 1,200 and the other 1,500 ft. in length, by a width of 160 ft., and have been constructed at a cost of nearly 4,000*l*., involving the removal of 100,000 cubic yards of earth. Three beautiful lakes have been formed; upwards of four miles of carriage drives and walks have been made; excellent cricket and archery grounds, with the requisite pavilions, &c., have been provided; about 60,000 trees, shrubs, &c., have been planted, including large trees weighing from seven to nine tons each; and 10 greenhouses (80 ft. each in length) are in course of construction for the growth of plants for the decoration of the interior of the Palace.

Music and the Fine Arts will contribute to the attractions of the Alexandra Palace, which will be opened in May next. The most novel feature of the undertaking is the establishment of Races, for which purpose a Race Course has been prepared by Mr. McKenzie. The Grand Stand is an edifice of much importance and architectural character. The principal room on the first floor is 130 ft. long by 25 ft. wide, and above it is a graduated lead roof of the same dimensions. The Races will take place on the 30th of June and 1st of July next. 700*l*. will be added to the stakes by the Company, who have deposited

Queen, he opened a correspondence with Lieut.-General the Honorable Charles Grey; and immediately the subject became known to Her Majesty, the promptest action was taken, and within a month the land was placed by the Government at the disposal of the Corporation of Portsmouth for the purpose of being converted into a Park for the recreation and enjoyment of the people.

1,500*l.* with Messrs. Weatherby as security for the fulfilment of their arrangements, and the entries are so numerous as to promise a most successful result.

The Palace itself, which is constructed of brickwork in two colours, with stone dressings and ornamentations, is 900 ft. long by 85 ft. wide. It has a centre transept 430 ft. long and the same width as the nave, and two shorter transepts. At the junction of the nave and centre transept is a dome 170 ft. in diameter, and 220 ft. high from the ground.

The Park is close to the Wood Green Station of the Great Northern Railway. A branch from the Edgware and Highgate Railway is in course of construction, and will give direct access to the building; and other arrangements are in progress by which all the metropolitan railways will be placed in direct communication with the Palace. The Chairman of the Company is Mr. William Hawes, Vice-President of the Society of Arts, and it only requires a liberal and judicious system of management to make this undertaking both financially and socially a great success. Muswell Hill is rapidly becoming the centre of a dense population, and is the same distance north as the Crystal Palace is south of St. Paul's.

THE ALBERT MEMORIAL IN HYDE PARK.

The canopy-roof, with its tower and spire, of this magnificent monument is not only a very great and a very important work, but, in all probability, it is the greatest and the most important artistic work in metal in existence in the world. In these days of iron-building, the framing of a structure in that metal which should combine absolute strength with the utmost consistent lightness, would not present any serious difficulties. Wrought-iron was employed for the whole of the framework, and cast-iron for the structural parts that were to be built upon this framework. All the more distinguished visible portions of the work, the bases and capitals of columns, the cornices, crestings, finials, and other similar details, and with them the cross that was to crown the entire edifice, were to be of a fine bronze. Then was to be taken into consideration the principle that was to govern the production of the general surface ornamentation, and with which the means to be employed for the protection of the iron work from the atmosphere was to be associated. Like a true master of his art, Mr. Skidmore converted this grave difficulty into an element of his success. He covered with lead the whole of the iron-work that otherwise would be visible, and consequently exposed to atmospheric action. Lead and bronze are the only visible, and therefore the only assailable, metals. This same lead-work is wrought into an elaborate series of exquisite surface-designs, of which the leading motive is to form settings for innumerable pieces of polished agate, onyx, jasper, cornelian, crystal, marble, granite, and other richly-coloured hard substances, together with inlays of enamels of various hues. The cross, that forms the finial of the memorial is a work of great dignity, executed in bronze, with inlays of stones and rich gilding; it is a Latin cross, somewhat severe in outline, and yet at its head and other extremities, and also at the intersection of its limbs, a strict simplicity of form is not maintained. It stands upon a highly-enriched globe, which, in its turn, rests upon the foliated capital of a single cylindrical shaft, wreathed towards its head with spiral enrichment, and, lower down, wrought to an octagonal section, having four of its faces studded with gem-work, while a statue is placed in front of each of its other four faces. Sixteen bronze statues of various heights, the four principal ones being eight feet high, are grouped about the several stages of the spire, and add greatly to the dignified beauty of the whole composition. —*Art Journal.*

CHUBB'S DIAGONAL SAFE.

MESSRS CHUBB have patented a new Lock for Safe-doors. The principal objection to Iron Safes as heretofore constructed, has been the greater or less possibility of wedging away their sides from the doors, so as to introduce powerful levers with the view of tearing out the doors. In Chubb's Safes the frames are so strengthened with angle iron as to present a great amount of resistance to any such attempt, and no instance has occurred of one of their Safes being so forced.

In the *Engineer* this new Safe is described more in detail, as follows:—"The body of the Safe is constructed with the usual casing for fire-proof non-conductors, and the outer casing is made of two plates of iron with hard steel plates fastened between them, of a total thickness of one inch, firmly riveted and secured all round by strong angle iron inside, and the outer plate—half-inch—dovetailed in addition. The solid frame into which the bolts go is made to overlap and bind all round the four sides, so as to make practically one piece. The rebated door is constructed in the same way as the sides, only it is 1½ in. thick; the locks are gunpowder-proof.

"The most important feature is the system adopted to prevent the Safe being opened by the burglars' new plan of inserting wedges. It will be observed that the bolts are thrown diagonally all round the four sides of the door, so that the bolts act as dovetails, and will effectually prevent the action of wedges or any other means used to open the door by robbers. The lockcase is fastened to the door by a great number of screws and screw-bolts, so that it cannot be moved.

"It will be noticed that there is great simplicity of construction combined with certainty of action in this plan. The ordinary Chubb's wheel lock, throwing the bolts at right angles, was invented by Mr. Charles Chubb forty years since; by merely altering the position of this wheel the diagonal motion and its far superior effects are obtained."

RESEARCHES IN MECHANICAL SCIENCE.

At the late Meeting of the British Association, Prof. Macquorne Rankine, President of the Mechanical Section, gave the following brief summary of the researches which had been made or recorded at the instance of the Mechanical Section since 1850. As that was the year in which he became a member of the Association, he refrained from extending the summary to earlier years, because that duty could be better performed by some member who had taken part in the proceedings of those years.

Strength of Materials.—This subject had received, as its importance deserved, a large share of the attention of the Section. The following were the reports which the Section had received, and the dates of the meetings at which they had been read:—1. Mechanical Properties of Metals as derived from Frequent Meltings, 1853. 2. Tensile Strength of Wrought-Iron at different Temperatures, 1856. 3. Resistance of Iron Tubes to Collapse, 1857, 1858. 4. Resistance of Glass Globes and Cylinders to Collapse, 1858. 5. Effect of Vibratory Action and Long-continued Changes of Load on Wrought-Iron Girders, 1860, 1861. These five reports were the work of Dr. Fairbairn, and they combined the solutions of questions of the highest importance, practical as well as scientific. The third of them, in particular, contained the discovery of a new law in the strength of materials, that which connects the resistance of a flue to collapse with its thickness, diameter and length, and the correct application of which is essential to the safety of steam-boilers. The fifth of them contained the first determination with any approach to precision of the *factor of safety* in engineering structures of wrought iron. (The corresponding factor for cast iron had been determined by the Parliamentary Commissioners on the Application of Iron to Railway Structures.) 6. Adaptation of Suspension Bridges to Railway Trains, 1857, 1858, by Mr. Vignoles. Along with this report there should be mentioned, as having contributed to the solution of the same question, a paper by Mr. P. W. Barlow, read in 1860. 7. Strains in the Interior of Beams, 1862, by the Astronomer Royal. 8. Strength of Materials in Iron Shipbuilding, 1865, by Dr. Fairbairn. Next followed a series of reports of very high interest, relating to the application of materials to the art of national defence. 9. Durability and Efficiency of Artillery, 1855, a provisional report by a committee, containing suggestions for researches. 10. Resistance of Iron Plates to Pressure and Impact, 1866, by Dr. Fairbairn. 11. Mechanical Properties of Iron Projectiles at High Velocities, 1862, by Dr. Fairbairn. 12. Rifled Guns and Projectiles, 1862, by Mr. Aston. 13. Penetration of Armour-Plates and Iron-Clad Ships, 1866, by Capt. Noble. It was unnecessary to enlarge upon the value and interest of the results recorded in the last-mentioned report, which must be fresh in the recollection of the members, having been read at Nottingham, and printed in the latest volume of Reports. They constituted the greatest step in advance which had hitherto been made towards accurate knowledge of the quantity of work required in order to pierce a given target with a given projectile, and the quantity of powder required in order to do that work. 14. Mechanical Properties of the Atlantic Telegraph Cable, 1864, by Dr. Fairbairn.

Motive Power.—The obtaining of motive power by means of steam had to a great extent been considered in connection with the propulsion of vessels, and came under the head of steam navigation, which would be mentioned further on. The following were the reports relating specially to motive power:—1. On the Vortex Water-Wheel, 1852, by Prof. James Thomson. 2. On Water-Pressure Machinery, 1854, by Sir W. G. Armstrong. Two reports containing valuable information as to two classes of hydraulic prime movers. 3. On the Density of Steam, 1859-60, by Dr. Fairbairn and Mr. Tate. These communications had not been printed amongst the Reports, but only in the *Proceedings* of this Section, being merely abstracts of researches which appeared in detail in the *Philosophical Transactions*; but the importance of the results contained in them makes it necessary to refer to them now. These results constituted the first direct determination of the density of steam; and besides their practical value, they furnished a most remarkable confirmation of the dynamical theory of heat. 4. Steam-Bòiler Explosions, 1863, by the Astronomer Royal, showing the great explosive energy possessed by a mass of liquid water at a high temperature. The President here observed that it had been established beyond a doubt, according to the second law of thermodynamics, that the utmost quantity of work which can be got by the expenditure of a given quantity of heat depends solely on the limits of temperature between which the engine works, and is independent of the nature of the fluid to which the heat is applied, such as water, ether, air, &c. The means of improving the economy of heat in thermodynamic engines are of three kinds:—First, working expansively, so as to obtain from the heat applied to the fluid all the work that is possible between given limits of temperature—this has probably been already carried to the utmost extent practicable; secondly, increasing the range between those limits of temperature—to this there are bounds set in practice by the conditions of durability and safety; and thirdly, diminishing the quantity of heat which goes to waste from the furnace. The last is probably the means which at present holds out the greatest probability of improving upon the economy of the most economical steam-engines of the present time. It is probable that the use of rock-oil as fuel may contribute towards that result, and something may perhaps be hoped from the direct use of the products of combustion to drive the engine. 5. Gun-cotton, 1863-4-5. In these reports by a committee, it is shown how gun-cotton is adapted to various purposes by suitable mechanical preparation.

Hydraulic Engineering.—1. On the Water-Supply of Towns, 1855, by Mr. Bateman. A report of great interest on a subject worthy of the continued attention of the Association. 2. On Rainfall, 1864–5–6. A series of reports by a committee, based chiefly on observations collected by Mr. Symons. These will probably be continued annually. 3. On Weir-Board Gauges, 1856, 1858, 1860–61, by Prof. James Thomson. Reports containing the results of experiments on the gauging of the flow of water in streams by means of "notch-boards," showing how accuracy is to be ensured in such gauging; and, in particular, the properties and advantages of triangular or V-shaped notches. 4. Tides on the Trent and Humber, 1864, by Mr. Oldham.

Shipbuilding and Steam Navigation.—1. The strength of materials in iron shipbuilding, and the resistance of armour-plated ships to penetration, were referred to under another head. 2. Tonnage of Ships, 1856-7, by a Committee. 3. Steam Navigation at the Port of Hull, 1853, 1859, 1861, by Mr. Oldham. 4. Iron Shipbuilding on the Tyne, Wear and Tees, 1863, by Mr. Palmer. The three preceding subjects partake of a statistical as well as a mechanical character. 5. Life-Boats, 1854, by General Chesney. 6. Statistics of Life-Boats and Fishing-Boats, 1857, by Mr. Henderson. 7. River Steamers, 1858, by Mr. Henderson. 8. Mercantile Steam Transport Economy, 1856-7, 1859, 1861, by Mr. Atherton. 9. Shipping Statistics, 1858, by Admiral Moorsom. 10. Resistance of Water to Floating and Immersed Bodies, 1865–6. Report of Experiments by a Committee. 11. Steam-ship Performance, 1857–8–9–60–61–2–3. A series of reports of data collected from various quarters by a committee, presided over at first by the late Admiral Moorsom, and afterwards by his Grace the Duke of Sutherland. Referring more especially to this last-mentioned series of reports (and also to the reports of the experiments of Mr. Scott Russell on Waves, published previously to the period to which this summary is limited), it may be held that the reports and archives of the British Association contain, perhaps, the greatest mass of data of experiment and practice ever brought together for the purpose of improving the science of the designing and propulsion of vessels. The bulk of that mass of information is so great that it was advisable to appoint a committee last year for the purpose of condensing it; and a report by that committee will be laid before this meeting. The use of the jet-propeller has lately been revived and extended; and in future reports it is highly desirable that examples of its performance should be recorded.

Conveyance.—1. Railway Brakes, 1859, by Dr. Fairbairn. 2. Sound Signals at Sea, 1861, by Prof. Hennessy. 3. Fog Signals, 1863, 1866, by a Committee. All these reports contain results of great importance to the public safety. The attention of the Association was called last year to Mr. Fell's method of ascending steep gradients on railways by the help of a central rail. That invention appears to have been perfectly successful.

Metallurgy.—The President said that although no report upon metallurgy had been presented to this Section within the period to which this summary referred, he considered it essential to its completeness to mention two ordinary communications to the Section, in 1856 and 1865, by Mr. Bessemer, on his method of making iron and steel, a subject to which the Section might well devote a large share of their attention.

Agricultural Machinery.—No report on this subject had ever been laid before the Section, but an ordinary paper had been read in 1853 on the history of reaping machines, by Mr. Crosskill. The inventor of the first practically successful reaping machine, the Rev. Patrick Bell, resided at no great distance from Dundee; and he hoped that the meeting would, if possible, be favoured with the presence of so great a friend to agriculture. Reports had been made on the following subjects, at the instance of the Mechanical Section, in conjunction with various other Sections of the Association:—Weights and Measures, 1864–5–6. Patent Laws, 1858–9, 1861. Scientific Evidence, 1866.

THE CHALMERS TARGET.

The inventor of the Chalmers Target says:—The necessity for a better armour for our iron-clads is apparent from two indisputable facts. First, the 6½-ton gun, with the moderate charge of 16 lb. of powder, can send the Palliser shot of 115 lb., broken up into ten thousand fragments, through the side of the *Warrior* at 500 yards. Secondly, in a list of thirty of our iron-clads—about all we have afloat—twenty are weaker than the *Warrior* in resistance to shot, five are equal, and four superior. Thus, twenty-six of our iron-plated ships can be penetrated by the 6½-ton gun with a very moderate charge of powder, and the remaining four would be pierced by the same gun and shot by increasing the charge to 22 lb. If, then, every ship we have afloat can be penetrated by this comparatively light weapon, we can imagine the effect of the 12-ton gun, with 250 lb. chilled shot and 43 lb. charge; but no one can imagine the effects of the langridge of these terrible missiles between the decks of a crowded iron-clad, or contemplate the scene without a feeling of horror. In view of such results the question ceases to be a mere scientific contest for superiority. It is a question of life and death, which seriously affects our position as a first-class naval power. It would be silly in the extreme to suppose that we can long retain the exclusive use of such projectiles, and our true wisdom will be seriously to grapple with the difficulties and meet them with the best resistance we can offer. Should some great national disaster overtake us, it would be no consolation to learn, when too late, that we had in our possession the means of preventing it, and failed to use them.

MEASURING MINUTE INTERVALS OF TIME.

Very minute intervals of time are now accurately measured. We know at what rate sensation travels along a nerve, and how long it takes to arrive at the sensation of pain. "Quick as thought," and "quick as lightning" are definite measures of velocity; and now, M. Blaserga has determined how long it takes to establish an induced current of electricity. Regnault years ago found out that when the contact between the inducing circuit and the circuit to be induced was too short, there was no induction. He made contact between two circuits by firing a ball against a laminated spring, and found that the duration of the contact was too short to allow of induction. M. Blaserga, however, states that the contact need only endure for one fifty-thousandth of a second to establish an induced current. The total duration of the current is only one two-hundredth of a second, and, short as is this interval of time, he states that he has been able to determine that the induced current begins weak, rapidly increases in intensity, and gradually diminishes.—*Mechanics' Magazine.*

MEASURING MACHINES.

Mr. Whitworth has addressed to the Science and Art Department the following letter:—"Feeling the national importance of maintaining the position which England has reached in the manufacture of machinery in general, I desire to do as much as may be in my power towards effecting this object. I should therefore feel obliged if you would inform the Lord President of the Council that I am willing to deposit in the South Kensington Museum, to be there perpetually preserved, three original true planes and a measuring-machine or instrument demonstrating the millionth part of an inch; and I propose, subject to some conditions, to make a sufficient endowment to provide for the delivery of lectures to explain such instruments. Their importance will be manifest when it is considered that the value of every machine, when made of the best materials, depends on the truth of its surfaces and the accurate measurement of its parts."

ROLLING A FIFTEEN-INCH ARMOUR-PLATE.

Sir John Brown's knighthood has been rapidly followed by the production at the works of which he is the head of the largest and thickest Armour-plate ever made. This plate, which was most successfully turned out, measured in the furnace over 20 ft. long by 4 ft. wide and 21 in. thick, the weight being about 21 tons. When rolled it was reduced to the ultimate thickness of 15 in.

In the year 1862, 4½-in. plates were produced at Sir John Brown's Atlas works, whilst subsequently 5, 7, 8, and even 12-in. had been attained. This latter thickness has now been exceeded by 3 in., and a plate of unprecedented thickness has been produced with facility. A few of the 12-in. plates are in use, but the manufacture of plates 15 in. in thickness was not contemplated until the iron-clad fort system was determined upon. These forts are designed with a plating of 5-in. armour, backed with a layer of 5-in. horizontal and another of 5-in. vertical bars. This system of construction we all know to be far inferior to the solid, inasmuch as 8 in. of built-up plates are not equal in power of resistance to 4½ in. of solid. But it is accounted for by the fact that it was thought impossible to make plates to give the total thickness of 15 in. This, however, has been accomplished by the energy which has carried Sir John Brown through all other difficulties.

The process of manufacture of these plates at the Atlas works is very interesting. The peculiar characteristics of Sir John Brown and Co.'s plates are that they combine the hardness of iron with the toughness of copper, and these features have given to them a world-wide reputation. The peculiar metallic ingredients are kept a secret, but the basis of the composition is the best cold blast pig-iron, from different districts, mixed in given proportions. These metals are first puddled in masses of from three to four hundred-weight each. They are then worked under the steam hammer, after which they are heated and passed through the small rolls. Three or more plates thus produced are then reheated, and passed through larger rolls. These slabs are then ready for forming the final armour-plate, the number used being governed by the thickness of plate required. In the present instance, one 6-in. and five 3-in. plates were used. In making these thick plates a difficulty is experienced in the welding process in securing a uniform heat throughout the mass, so that the centre shall be sufficiently heated without the upper layers being overheated. This difficulty is ingeniously met at the Atlas works by placing cubes of highly carbonized iron between each layer of plates, which keeps them apart. The flame and heat thus circulate freely between them, and every plate attains the same degree of heat about the same time. Another object is served by this process, for as the cubes melt they restore a certain amount of carbon to the iron, of which it has been deprived by the previous processes. The plates gradually settle down, and the melted cubes form a cement between them, helping to perfect the weld.

The monster plate thus prepared was drawn from the furnace and conveyed to the rolls, through which it was passed and repassed, the rolls being gradually brought closer to each other, until at the end of a quarter of an hour the perfect armour-plate, 15 in. thick, was produced. During the rolling, quantities of sand were thrown upon the plate, which formed a coating of silica upon it; water was also thrown on after the sand, and the surface of the plate is swept to free it from every particle of oxidation. This enormous plate was produced by the labour of nearly 200 men, and involved the consumption of about 250 tons of coal.—*Mechanics' Magazine.*

THE AMERICAN RODMAN GUN.

We abridge from the "Scientific Results," in the *Illustrated London News*, the following account of this new weapon:—The Rodman Gun, it may be explained, is a smooth-bore, formed of cast iron, which is, of course, a weaker material than wrought, but vastly less expensive; and the strength of the Rodman guns is greatly increased by the mode of casting adopted, and in which the metal is cooled from the inside of the bore by passing water through a central pipe, while the exterior of the gun is kept hot by fires. The effect of this process is, first, to solidify the metal of the bore; and each succeeding layer, as it cools, contracts upon that previously solidified, whereby the internal parts of the gun are put into compression, and the external parts into extension. The effect of this is greatly to increase the strength, as the whole metal of the gun is strained equally at the point of rupture, whereas in common guns, from the compressibility of the metal the barrel is torn in detail. The 9-inch English gun, of wrought iron, has succeeded in piercing an 8-inch plate with 43 lb. of powder, at 200 yards range, whereas the American cast-iron gun, with 48 lb. of powder, has failed to pierce it; whence it is maintained by the advocates of the English system that the English is preferable to the American. On the other hand, however, it is contended that it obviously requires more force to make a 15-inch hole than to make a 9-inch hole; that a pound of powder of given strength has been proved to have more dynamic efficacy if burned in the American gun than if burned in the English, from the greater expansion of the gases which the large bore permits; but that the American gun should have been fired not with 48 lb. of Rodman powder, which is weaker than the American service powder, but with twice that quantity at least. While the Rodman gun was comparatively untested, the maximum charge of service powder permitted to be used in the American navy was 60 lb. for the 15-inch gun. But 100 lb. of mammoth powder have since been used as a charge without the least injury to the gun, and such a charge it is contended should have been used in this case, and with chilled shot. It is true that, in contending with armour-plates, the point is the power of penetration; and it is better that the hole should be smaller than that the shot should be unable to go through. But, by using piston-shot, which rifle themselves in the air, pointed bolts can be thrown by the Rodman gun as well as spherical shot; and the dynamic effect of the powder may thus, if found desirable, be concentrated upon a sort of thunderbolt missile of as small a diameter as the punching-strength of chilled metal will warrant.

In experiments made with the 15-inch Rodman gun at Shoeburyness, a ball propelled by 48 lb. of powder was unable to pierce an 8-in. plate with 18-inch oak backing. The result was inconclusive, as the guns ought to be fired with twice that charge, at least. Since that time experiments have been with 100-lb. charges; and it is now found that the shot can with ease go through the target. The doctrines put forth by English artillerists have been completely overturned by the results of these experiments. Thus Captain Noble states, at page 30 of his report, that with "a 50-lb. charge and a 484-lb. shot an initial velocity of 1,070 ft. per second will be the result." This is equivalent to a force represented by 8,658,760 lb. raised 1ft. high, which divided by 50 gives only 173,175 ft.-pounds as the energy exerted by each pound of powder. When, however, the gun was fired at Shoeburyness with 50 lb. of powder and a ball weighing 450 lb. the velocity of the shot was 1,214 ft. per second, giving a dynamic value of 10,328,400 ft.-pounds, which divided by 50 gives 206,570 ft.-pounds per lb. of powder. Again, Captain Noble says of the 15-inch Rodman gun that 50 lb. of powder "is as heavy a charge as it will stand." But it has been repeatedly fired with 100 lb. of mammoth powder, which, in explosive strength, is equal to 83 lb. of the powder on which Captain Noble based his calculation. It is no doubt true that the 8-in. plate is penetrable by the English 9-inch rifled wrought-iron gun, whence it is concluded that it is inexpedient to employ the American gun, which is much heavier and takes more powder. But the American gun makes the larger hole, and is much cheaper in the manufacture; while the dynamic efficacy of each pound of powder burnt in it is also greater. We are persuaded that rifled guns are a mistake, as they put a greater strain on the barrel, and involve much waste of powder in friction. The right plan is to make the bore smooth and to rifle the projectile, by casting skew arms upon it, which would rotate the shot in the way in which an arrow is rotated in its flight by a spiral feather. Such a projectile would combine great penetrating power with a moderate pressure in the gun and a large dynamic efficacy of the powder, as the powder gases would act expansively.

THE PALLISER CONVERTED GUNS.

The conversion of cast-iron smooth-bore guns into thoroughly efficient rifled artillery, by Major Palliser, is an accomplished fact. Our arsenals and dockyards, our harbours and forts, can never be deemed approaching to security until something is done with their cast-iron smooth-bore guns. What should be done with them has been now put by Major Palliser beyond all doubt or question, if success realised be admitted in this instance as the test of the value of what has been practically accomplished. To take the last example, we may refer to a trial at Shoeburyness, of a 32-pounder, converted by the Elswick Company by boring up and lining in the same calibre as before, namely, 6·3-in., with a coiled wrought-iron tube. The original service charge of this piece as a cast-iron smooth-bore gun was 8 lb. of powder projecting a 32-lb. shot. On the day referred to, above 70 rounds were fired from the converted arm. Fifty of these were with 8 lb. charges and 64 lb. common shell; and 20 with 16 lb. of powder and 80 lb. chilled iron shell. The range, with 10 deg. elevation, was about

4,200 yards; and the working of the gun was admirable to the completion of the experiments, when the metal was so hot that the hand could not be borne upon it. The object of the experiments was to lay down the range tables for the gun, which will form part of the armament of her Majesty's frigate *Nelson* (Captain Payne, R.N.), transferred by our government to the colony of Victoria. The complement of this vessel consists of 20 of these 64-pounder Palliser guns on her broadsides, and 2 7-in. Palliser guns on her main deck, on pivots. She also carries on her voyage out 5 Armstrong muzzle-loading 9-inch 12½-ton guns in her hold, which are to be mounted for the harbour defence of Melbourne. This vessel's armament is the most powerful of any wooden ship in the world, and was decided upon under the advice of Major Paisley, R.E., and Major Scratchley, R.E.

The enormous strength of a coiled iron tube, *per se*, has been experimentally proved by Major Palliser on a small scale, and he has found that a tube equal in thickness to the radius of the bore withstood charges which burst cast-iron guns of the same calibre with the usual thickness of metal, *i.e.* one and a-half times the diameter of the bore. To refer, however, more directly to the main experiments upon which the reliability of the Palliser guns depend, we may take, first, the case of the 68-pounder, converted by the government, in 1862, into a 9-in. smooth bore. This gun passed through, without bursting, the ordinary test to destruction of cast-iron strengthened gun, viz. 100 rounds, with the service charge of 16 lb. of powder, increasing every ten rounds the weight of shot by an additional 68-pounder. Thus the first ten rounds would be with one shot; the second, with two, equal to 136 lb.; the third, with three, equal to 204 lb.; and so on up to the last ten, which were with ten shots, or 680 lb. weight of metal. The recoil of the Palliser gun under this frightful charge was so violent that several carriages were smashed, and, finally, when the piece was slung, it pitched out of the chains and buried its muzzle upwards of two feet in the ground, but suffered no injury whatever itself. It is always considered that the increased weight of shot is the greatest cause of the destruction of the arm, and no cast-iron gun has ever endured such a test. If an inordinately large charge of powder, combined with heavy shot, be considered a severer trial, the Palliser guns have come out of that ordeal, too, with flying colours. A 32-pounder converted into a rifled 64-pounder has been subjected to every conceivable hardship. Thus, after numerous and trying tests—such as firing with the shot half rammed home, with air spaces between the shot and the powder, or firing shells, with 16 lb. charges, purposely burst in the gun—the charge was increased, by 5 lb. at a time, from 10 lb. up to 30 lb. of powder, fifteen rounds of each series being fired with rifled projectiles increasing from 50 lb. to 150 lb. in weight. At last the cast-iron casing, or original fabric of the gun cracked under a charge of 30 lb. of powder and 150-pounder shot, but this without any explosive properties whatever.

There was merely the appearance of a slight fissure on the outside of the metal. The common danger of cast-iron guns is thus obviously overcome by Major Palliser's system, and complete warning by fissuring will take place in this class of weapons at a stage in the life of the gun antecedent to a state of absolute peril to the detachment of serving gunners. The coiled wrought-iron barrel lining the piece was bulged in the instance referred to fully a quarter of an inch, but there was no sign of the least fracture in it. Had this been a steel or ordinary iron barrel, it would undoubtedly have cracked instead of stretching, in which case the gun would have given way instantaneously and explosively. Considering this was a private experiment of Major Palliser, it must be conceded to him that he has fairly demonstrated on the large scale the extraordinary endurance and reliability of what is technically termed a coiled wrought-iron tube. It is now just thirteen years since he commenced constructing his guns with coiled tubes which were then, in their smaller conditions, as adapted to fowling-pieces, known in the sporting gun-trade as "twist" barrels, the fundamental principle of construction being in both cases the same—namely, the obtaining of a grain in the iron running spirally round the bore. This is the common principle the development of which, on the large scale of coiled tubes for heavy ordnance, was accomplished in the first instance by Sir William Armstrong.

The last experiment with the Palliser guns for endurance was with a 10-inch shell gun, converted into an 8-inch rifled gun at the Elswick factory. It was fired at the Arsenal proof-cells, being placed at the bottom of a platform, inclined at about 15 degrees. Two rounds were fired with 37½ lb. of powder and 180-pounder shot, and fifty rounds with 30 lb. charges and the like shot. At the conclusion of the experiments the gun was not strained or injured. It recoiled from 30 to 40 feet up the plane; and it is true to the letter to say that no gun, whether of cast or wrought iron, of the same weight, has ever been tried with such enormous charges. The weight of this converted Palliser gun is 4½ tons, and the above firing charges of 30 lb. are the same as those for the 8-inch wrought-iron Woolwich muzzle-loader, weighing 9 tons, and throwing the same weight of shot (180 lbs.). This mode of conversion, which may now be said to be properly perfected, is, in the language of engineers, a straightforward mechanical work. A cylindrical cut is taken down the bore of the cast-iron gun, and a cylindrical tube, slightly smaller, is passed down and retained in its place by a screw-collar at the muzzle. This tube is then brought to a mechanical fit by what is termed a "setting-out" proof. The gun is finally bored to remove the bulge, and then rifled. Major Palliser also takes advantage of the principle which he introduced in his screw bolts to further secure the full longitudinal strength of the material of his gun. This mode of closing the breach of his tubes has been adopted by the government in all their wrought-iron artillery, and is quite as important in respect to the construction of cannon as it is in the bearing of strain in the screw-bolts, tending in the highest degree to the safety and longevity of the gun; in fact, in itself, it would constitute all the difference between the blowing off the breech of a piece not so constructed and the perfect endurance of another so constructed, although both weapons were otherwise alike.—*Mechanics' Magazine.*

THE RUELLE GREAT GUN.

In the collection of arms at the French Exhibition was an enormous cannon, produced at the Imperial foundry at Ruelle. It consists of a cast-iron body, strengthened by two steel coils. The weight of this piece, which is intended for port service, is said to be 37 tons; the diameter of the chamber is rather less than 17 in. It is a smooth-bore breech-loader. Its projectiles are a solid spherical shot, of 600 lbs. weight, and a shell of the same form, weighing 420 lbs., and containing 18 lbs. of powder; and the charges for the two respectively 100 lbs. and 66 lbs. It is mounted on a cast-iron carriage; and a small crane, like that employed in England, fixed on one side of the carriage, serves to place the projectile in the mouth of the gun. This enormous piece of ordnance is of a long bottle-like shape, longer in proportion to its diameter than either the Prussian or English monster gun. The weight of the carriage and its appurtenances is given as 29 tons, making a total weight of 66 tons.

THE SNIDER RIFLE.

A sufficient number of Enfield Rifles have now been converted on the Snider system to admit of the whole of the infantry at home, a large number of the troops on foreign service, and the Royal Marines, being armed with them. Of the naval rifles a good many thousands have been converted and issued, and the conversion of the Lancaster rifles for the Royal Engineers was next proceeded with. The conversion of artillery carbines on the same system for issue to the Royal Artillery was commenced, and when this was completed the cavalry carbines were to be taken in hand. In round numbers the arms of all sorts converted on the Snider system up to the present time amount to little short of 200,000. The total number set down for conversion in the financial year is 100,000. Arrangements are made for the supply of machinery to each Presidency of India for the manufacture of the Boxer cartridge, and arms will be supplied from England. The reliefs leaving for India were armed with the Snider rifle. A slight change has been made in the construction of the cartridge, with a view to cheapening the manufacture. The quantity of brass in the coiled case has been reduced by nearly one-half, a stout brown paper is substituted for the thin white paper hitherto employed, the cup at the base is made of thinner copper, and the disk at the base is made of iron, instead of brass. A material reduction has thus been effected in the cost of the cartridges, while their efficiency has been rather increased than diminished. A slight alteration has been made in the bullet, which will have four *cannelures* instead of three, but will continue to weigh 480 grains. The object of this change has been to provide a bullet suited equally to the short naval rifle with its quick pitch and the slow twist Enfield, the present bullet being less well adapted for the naval rifle than the original 530 grain-bullets. The ammunition embodying these improvements will be designated Pattern V.; but its introduction in no way involves the suppression of preceding patterns, every round of which (except a few of Pattern I., with the Potet base) is perfectly serviceable and trustworthy. The reports from regiments as to the working and shooting of the arms continue to have been in the highest degree satisfactory.—*Pall Mall Gazette.*

NEW BREECH-LOADING RIFLE.

A NEW Rifle Musket, the invention of Messrs. Carter and Edwards, has undergone an official trial in the Woolwich Marsh, in competition with the Snider-Enfield rifle, with results which are reported in the *Times* as follows:—The Snider rifle was fired by Lieutenant Lecky, assistant instructor of musketry to the Royal Marine division at Woolwich; the time, two minutes, when 16 rounds were fired, 14 hits were made, and 34 points were obtained. Carter and Edwards' rifle was fired by Sergeant Bott, 27 rounds, 24 hits, and 54 points. The object was a third-class target with a Wimbledon bull's-eye. The superiority of the Carter and Edwards' rifle over the Snider in rapidity of fire appears to be fully established, as the rifle, which is on the bolt system, cocks itself in the withdrawal of the cartridge. The lock is entirely concealed, and the weapon is fired with a needle through the bolt. Another advantage, equally important, and also an entire novelty in small arms, is that a line or party of skirmishers, in the event of their being taken prisoners or surrounded by the enemy at a disadvantage can, with a turn of a screw, take out the bolt and cast it away, leaving the arm as totally useless as the Armstrong field-gun without its vent-piece. For simplicity of construction it surpasses the Snider, as there are fewer springs. In fact, the only springs it contains are the main-spring of the lock and the rear spring. The inventors, it is stated, are fitting up a spacious manufactory in Birmingham, to construct arms on their principle, in order to fulfil a large contract which they have entered into with a foreign government. They were disqualified from contending at the late competition at Woolwich, by not having sent in their arms in time, according to the regulations. The new rifles above named are adapted equally with the Snider to use the Boxer ammunition, Enfield bore.—*Mechanics' Magazine.*

THE CHASSEPOT RIFLE.

The French Report of the battle of Mentana states that the Chassepot Rifles did wonders. On this report the *Mayence Gazette* makes the following commentary:—According to the statement of General Du Failly, the Chassepots, at the battle of Mentana, fired eleven shots a minute during the first half-hour of their coming into action. If we assume two French battalions at 800 strong, this would give 1,600 Chassepots. But it is probable that not more than a quarter of that number were engaged at the same moment, and so we will assume the number to have been 400 for the half hour. This would give 132,000 shots as the whole number fired. Now, according to the most authentic accounts, the entire number of Garibaldians killed and wounded was about 600, of whom about one-half may fairly be attributed to the previous action with the Papal troops, which had lasted five hours before the Chassepots came into play. These 132,000 shots, therefore, took effect in about 300 cases—that is to say, one shot in 440. If these calculations of the above-mentioned paper are at all correct, the wonders of the Chassepot are evidently its success in missing. You may fire 440 times in the direction of a body of men, and fire wide 439 times for the once that you hit anybody. The probability is that the rapidity of the fire excited the men too much to allow of their taking any aim.

The firing of the Chassepot rifle has astonished the Emperor of the French by its destructiveness. In two minutes a battalion of 500 men, at 600 yards from the mark, had fired 8,000 balls, of which 1,992 had struck the line of aim. The ground in front of the mark was so cut up that not a blade of grass could be seen; and the Emperor, perhaps having in his mind's eye 500 Prussians standing in that dangerous spot, is reported to have exclaimed, "It is frightful! It is a massacre!" The Steinheil cannon is also said to be a success. This mysterious weapon. says the *Globe*, smokeless and noiseless, is based on the application of centrifugal force. The balls are propelled by the motion of a circular disk traversing a groove from its centre to its periphery, whence they pass through the barrel of the gun. It is merely a scientific application of the weapon with which David killed the gigantic Philistine. Just as a stone, whirled round and round in a schoolboy's sling, leaves it with enormous velocity, so this rotatory disk propels cannon balls with enormous momentum. A German artillerist has made cannon on the same principle, but with four barrels instead of one. There is something curious in this return to first principles. Our steam-rams are reproducing on a mightier scale the beaked galleys of Athens. Even steam itself is sometimes superseded—Ericsson, the famous Swedish engineer, having invented for the narrow sea-channels of his native country gunboats which are worked by the motive power of men. And now powder is to be beaten out of the field by the very earliest and simplest form of centrifugal propulsion.—*Mechanics' Magazine.*

HOT-AIR ENGINES.

THIS improved engine, which has been shown at Messrs. Edwards and Company's, 531 Oxford Street, is described as an adaptation of the principle of Ericsson, without its defects. One of the chief improvements is that the motive-power, instead of being derived from the expansion of air heated in a separate generator, is produced by the air being expanded by contact with the fuel itself, and in addition to this source of power, by the action of the expansive force of the gaseous products of the combustion of the fuel, which heretofore have been allowed to escape. It is difficult to describe intelligibly an invention of this character without the aid of diagrams. We therefore leave technical details, and sum up in a few words what appeared to be its advantages:—The engine, which works with exceeding smoothness and precision, is very compact, is simple in construction, and not liable to get out of repair. There is no necessity for a chimney, an ordinary stove-pipe being sufficient to carry off the hot air. It is free from danger, there being no boiler to explode; it is very economical in use, a one-horse power engine costing not more than a shilling a-day, and a two-horse power but a trifle more; it requires no water or gas, and is so simple in its working that a boy may be left in charge of it; indeed, it requires scarcely any attention, except at starting and stopping. A printer who was present on the occasion referred to, and who has used one of the engines for several months, bore high testimony to its usefulness. Where moderately small power only is required, the hot-air engine appears to put steam entirely in the shade.

There have been two Air-engines on Ericsson's plan exhibited for blowing fog-horns, and a good number of these engines have now been introduced by the Trinity House for lighthouse purposes, as they are exempt from the risks of a boiler, and can easily be managed by uninstructed persons. Mr. Philander Shaw, of Boston, in America, exhibited an air-engine, in which the entering air first comes in contact with the stuffing-boxes of the great plungers, which act as pistons in order to prevent the packing from being burnt or overheated. It then encounters the heat delivered by the escaping air to a tubular heater, or regenerator, and finally it enters the furnace chamber, which is replenished with fuel by the aid of an air-tight hopper with two valves, the upper of which valves is opened and the lower closed to enable the hopper to be filled, and the upper is then shut and the lower opened to enable the fuel to fall into the fire. With petroleum fuel the liquid may be forced in with a pump.—*Illustrated London News.*

ROAD LOCOMOTIVES.

A ROAD LOCOMOTIVE has been started by Mr. R. W. Thomson, C.E., of Edinburgh, of which the main peculiarity is that the driving-wheels are encircled by tires of india-rubber, five inches thick and twelve inches wide. It is stated that these wheels are able to run over broken stones without injury, and that the sinking in soft ground is very small, being no doubt reduced by the virtual enlargement of the surface of contact from the compressibility of the india-rubber. The adhesion, also, upon the road is very great. India-rubber tires for carriages were tried some years ago in London, and one benefit resulting from their use was that they made little noise. But the project was finally abandoned.

THE RAILWAY CUT ACROSS AMERICA.

The last, the longest, and by far the most costly of the excavations along the line of the Central Pacific Railway is the great tunnel which has been completed. This tunnel is 1,660 ft. in length, and the work upon it occupied about a year. The material which had to be drilled and blasted was granite of the hardest grain. Advantage was taken of a depression in the centre, and a working shaft of 159 ft. was sunk so as to present four working faces. The average rate of progress with powder was about one foot per day to each face, or from 20 ft. to 30 ft. per week in all. In March, 1867, the company accepted the services of an experimenter in nitro-glycerine, which article was manufactured on the spot, and the average was increased to nearly 50 ft. per week. The workmen, principally Chinamen, laboured in three gangs for eight hours each, and proved very serviceable in this kind of work. At times the consumption of powder reached 400 kegs per day. The Pacific Railroad is thus making rapid strides to a successful completion.—*Builder.*

LUBRICATION OF RAILWAY WHEELS.

The axles of the wheels of railway carriages are in this country generally lubricated by grease, which is placed in a receptacle over the axle, and which, melted by the heat generated by the friction of the rubbing surfaces, runs down upon them and effects their lubrication. On some of the French lines oil-cups with cotton wicks (such as are usually employed for lubricating the bearings of steam-engines) have been widely introduced, with a saving, it is said, of 40 per cent. in the cost of lubrication. To obviate the risk of heating, however, from the oil-holes becoming accidentally choked, a grease-box is also introduced; but the passage leading from it to the surface of the axle is stopped up by a fusible plug, which is melted out if the axle should heat, and thereby brings the repository of grease into operation. The plugs are in some cases composed of fusible metal, made by mixing 37 parts of lead, 37 parts of pewter, and 26 parts of mercury; and sometimes they are composed of hard grease, made by melting together 70 parts of Marseilles soap and 30 parts of stearine. On the South-Western Railway, Mr. Beattie has introduced a species of axle-box, formed with a receptacle for oil below the axle and a receptacle for hard grease above. A piece of wood is placed beneath the axle, through which cotton wicks pass, the lower ends of which dip into the oil, while their upper ends touch the surface of the axle; and the piece of wood with the wicks in it is pressed against the lower surface of the axle by springs. The axle is thus oiled. But, should the oil fail, or the wicks act imperfectly, the heat generated by the friction then produced will melt the hard grease, which will then become the lubricant.—*Illustrated London News.*

THE MONT CENIS RAILWAY.

An account has been published of the first ascent of the Mont Cenis Tunnel Railway over its whole length of 48 miles. Mr. Fell's system consists of the application of a central double-headed rail placed on its side in the middle of the way, and elevated about 14 inches above the ordinary rails. There are four horizontal driving-wheels on the engine, under the control of the engine-driver, which can be made by pressure to grasp the central rail, so as to utilise the whole power of the engine, and so enable it to work up incredibly steep gradients without slipping. The carriages also have four horizontal wheels underneath, which, with the central rail, form a complete safety-guard. In addition to the ordinary brake there are brakes upon the central rail. It would appear, therefore, impossible for the engine or carriages to leave the rails where the central one is laid. After leaving the deep valley in which St. Michel is situated, the line passes by a gradient of 1 in 30 to the Pont de la Denise, where an iron bridge spans the River Arcq near the site of that which was carried away by the inundations of 1866. The first very steep gradient of 1 in 12 was seen in passing Modane; but the engine proved equal to the task, and, clutching the central rail between its horizontal wheels, it glided quickly up, under a pressure of steam of not more than 80 lb. to the square inch, without apparent effort. The progress was purposely slow, because no engine or carriage had previously passed over the line, and also to give opportunity for examining the works. The train entered Lanslebourg station under a triumphal arch, having accomplished twenty-four miles of distance and attained an elevation of 2,100 ft. above St. Michel. From this point the zigzags of ascent commence, and the gradients over a distance of four miles were for the most part 1 in 12. Looking down from the train near the summit, as if from a balloon, four of the zigzags were visible at the same instant to a depth of 2,000 ft. The power of the engine was satisfactorily tested in this ascent, and the summit was reached under salvoes of artillery from an improvised battery, and amid the cheers of French and Italians who had gathered to welcome the English on the frontier. The engine again came to a stand under a triumphal arch, at an elevation of 6,700 ft. above the sea. The hospice, the lake, and the plateau of the summit, surrounded by snow-clad peaks and glaciers, rising to an elevation of from 10,000 ft., 13,000 ft. were passed, and the portion of the descent commenced from the Grand Croix. The railway here follows the old Napoleon road, which was abandoned long since for diligence traffic on account of the dangers from avalanche. Masonry-covered ways of extraordinary strength had here been specially provided for the railway. The descent to Susa was a series of the sharpest curves and steepest gradients, on which the central rail had been continuously laid. Susa was entered amid the acclamations of multitudes of spectators.

In reply to some observations in the *Times* on the plan of working this railway, Mr. Heppel remarks :—

"It is said that no sufficient *data* exist for distinguishing the amounts of work done respectively by the horizontal and vertical wheels, but that the latter have probably the greater efficiency from their better adaptation to the use of sand as a means of obtaining adhesion. It is further said that the horizontal wheels, from the circumstance of their gripping on a rigid rail, must be more apt to slip from any small accidental inequality in their dimensions.

"I am not aware whether it is intended to use sand as a means of giving increased adhesion, but should think that the use of it would be at any rate very limited and exceptional, as the construction of the engine is such as to enable an amount of adhesion quite capable of absorbing its full power to be obtained without recourse to that expedient.

"The vertical and horizontal wheels of Mr. Fell's engine are all driven from one pair of cylinders, and so coupled that they must all revolve exactly together, so that, abstracting for a moment from the slip or scrub of the vertical wheels which takes place on curves, if one slips they must all slip; and so long as the total adhesion is sufficient to take up the power of the engine, it is a matter of very little importance how it is distributed among them.

"The adhesion of the vertical wheels is due to the weight of the engine, and for any given condition of the rails is a constant quantity. On the other hand, the adhesion of the horizontal wheels is, within its *maximum* limit, completely under control, and is given by a powerful screw motion acting upon springs which keep them always pressed against the rail with a force practically uniform. Notwithstanding any small inequalities of dimension, all therefore that is requisite in ascending a heavy incline is to set up the screws till the adhesion of the horizontal wheels makes up, together with that of the vertical ones, the total required for utilizing the traction power of the engine.

"One obvious advantage of this arrangement is that it admits of all improvements of construction by which an engine at the same time powerful and light is obtained—a most important point on steep gradients where gravitation is so formidable an obstacle, and one which has, as far as I am aware, been obtained by no other system in a way to be practically useful.

"Another great advantage is the power of regulating the adhesion so as to suit the requirements of the case, thereby avoiding superfluous and useless friction, which is always the necessary concomitant of adhesion, and, where the latter is in excess, must, so far as it goes, both absorb the power uselessly and wear out the machinery unnecessarily."

PETROLEUM AS FUEL FOR LOCOMOTIVES.

THE *Titusville Herald* describes the fourth of a series of experiments made at the shops of the Warren and Franklin Railway at Irvine, as follows:—The apparatus used was Spencer's burner. It was described as consisting of a pan covering the bottom of the firebox in the locomotive, and taking the place of grates. On the pan are placed heaters or gas generators, six in number, consisting of inclined plates of cast iron supported at an angle of forty-five degrees. Opposite to each heater is an injector, conveying the oil to the heater, where it is instantly converted into gases, oxygen being only furnished to the gases in their nascent state for combustion. The oil is contained in a tank on the tender, from which it is conveyed by feed pipes to the injectors, each pair of injectors being controlled by a throttle, by means of which the fire is regulated as readily as the light of a lamp. The locomotive used weighed thirty-one tons, and was of one hundred and fifty horse-power. No cars were attached. Under eighty-five pounds of steam the locomotive passed over four miles of track in less than eleven minutes. All in the party agree that oil may supersede wood and coal in railway use. There is at present no better field for invention than the contriving of furnaces for producing combustion safely and economically from petroleum; also in the feeding from the construction of tanks for conveying the liquid.

CHERRY-STONING MACHINE.

AN ingenious little machine for removing the stones from cherries has recently been brought out by Herr Gruelin, of Carlsruhe. It consists of a wheel revolving on a horizontal axis, in the periphery of which are depressions large enough to hold one cherry. Each cherry is brought by the revolution of the wheel under a vertical rod, which being suddenly depressed forces out the stone through a hole in the bottom of the cavity. The rod returns to its original position by means of a spiral spring, and at the same time the wheel is rotated through a portion of a revolution so as to bring the next cherry underneath the pricker. It is stated that the machine is capable of stoning one hundred cherries per minute, and that the fruit is not torn in the operation. The cherries are fed on to the wheel by a shoot.—*Mechanics' Magazine.*

COAL SUPPLY.

The question started some time since as to the length of time our Coal was likely to last has led to inquiries by our government as to the coal supply of other countries, and the result must be very reassuring to those (if there be any such) who fear that the world will be short of coals some three or four thousand years hence. The information appears in the form of a blue-book, containing reports which have been received from secretaries to various British Embassies and Legations respecting the prospects of a supply of coal, if need be, from abroad. The return includes reports from Austria, Baden, Bavaria, Belgium, Brazil, France, Prussia, Russia, Spain, the United States, and the Zollverein. France, in 1865, produced 11,297,052 tons, and imported 7,108,286 tons, of which 1,455,206 tons were imported from Great Britain. Every year shows an increase of coal consumption in that country. Prussia is rich in mineral fuel, especially in very good coals. The working of the coal-pits is rapidly and continuously increasing. No coal is exported from Russia, which is supplied in a great degree from other countries, prominently Great Britain. During 1863, the latest date from which statistics are supplied, the coal produce of Spain amounted to 401,297 tons. No coal is exported from that kingdom. Austria, Bavaria, Belgium, and other continental countries, all seem to have well stocked coal-cellars to fall back upon.

In the year ending June 30th, 1866, the produce of the United States was 20,553,550 tons, being an increase of 3,447,049 tons as compared with the previous year. It has been estimated that the capacity of the Pennsylvania mines alone is fully equal to 20,000,000 tons a year. In nine counties of the State of Missouri there are about 3,500 miles of coal lands, which average a mean thickness of 11 ft. Professor Snealow's computation makes out 38,000,000,000 tons of coal in these nine counties alone. In forty counties of the same State there is said to be sufficient coal to last 3,000 years of 300 working days each, if an average of 100,000 tons were mined every day. Professor Rogers has estimated that the Illinois coal-fields are six times as extensive as those of Great Britain, and that it would take 100,000 years to exhaust them. South America, too, has abundance of coal.

British Columbia, Falkland Islands, Mauritius, Newfoundland, New South Wales, and New Zealand, are all reported on in an Appendix. In none of these, however, is there coal in any quantity, with the exception of New South Wales, where this valuable mineral is described as abounding. The exports of coal from the colony are extensive, and are rapidly increasing. Coal, too, has been discovered in Natal, so that the notion prevalent among men of science in England that there is "not an inch of coal in Africa" requires qualification. The coal of Natal is of good quality and large quantity, forming a huge watershed, draining a very large area into one natural outlet, the channel of the Tugela river. The coal occurs in seams over 6 ft. thick, which alternate with beds of shale, and it may be seen running directly into the face of the hills. It is richly bituminous, burns readily, makes excellent fires, and cokes well. It is already in almost universal use among the blacksmiths of the colony. There are no engineering difficulties between the coal-field and the sea which would prevent the speedy construction of a railway, and the coal could thus be sold at the port for about 1*l.* sterling per ton. Steam-vessels of large burden could be made to perform profitable voyages of six and seven thousand miles, with a speed of twenty miles an hour, if they could obtain coal at this price; and Natal is less than 7,000 miles from England, and much less from India.

So much for the world's coal supply, and for our own position even were we to run short of coals at home.—*Builder*.

COAL IN AMERICA.

The Reports presented to Parliament by her Majesty's Secretaries of Embassy and Legation in reference to coal possess considerable interest. A statistician who believed in Mr. Jevons, and held that coal was of the essence of civilisation, might derive from them conclusions as to the probable duration of certain European nations. But what is most striking to the reader of these reports is the enormous wealth of coal existing in the United States. It really seems as if America were more fertile in all material products than the elder continent; as if, in the old age of the world, there were revealed an opulence more immense than any previous era knew. Rightly so, doubtless; since science, though productive, is always extravagant, freely using the resources of nature to compass her end. Acting Consul Wilkins reports that the Great Illinois Coal-Field contains 55,000 square miles of coal, which would on an average yield 5,000 tons of bituminous coal per acre. This would give 176,000,000,000 tons as the carbonaceous wealth of the district. But a few pages earlier the same coal measures are estimated, on the authority of Professor Rogers, at rather more than 1¼ billion tons—about seven times the former quantity. Whom, says the *Globe*, shall we believe, Consul or Professor? The latter holds that the Illinois coal-fields are good for a thousand centuries to come. The immense difference in the two estimates—both, we assume, carefully calculated—may at least teach us how untrustworthy are such speculations. However, that the United States possess a prodigious wealth of coal of the very finest quality is clear enough; and as yet they raise annually about twenty millions tons only, a fifth of the produce of Great Britain. The prophets of the exhaustion of coal, and consequent extinction of men, will have some time to wait in America.—*Mechanics' Magazine*.

ECONOMY OF HEAT AND FUEL.

Professor Rankin has read to the Mechanical Section of the

British Association a brief summary of the researches made by the Section since 1850, and particularly in the direction of the economy of Heat and Fuel. Alluding to the position of steam power, he said that at the present time they only got about 60 per cent. of the whole heat created by the combustion of the fuel—indeed, it was common to get only 50 per cent.—but by special contrivances for securing economy, 70 and 80 per cent. of the whole heat had been realised in steam boilers; but that had been rare, and required boilers of peculiar construction. Very probably, means for saving the heat which now goes to waste might be brought about, and it was also probable they might have to look to a more useful article than coal for furnace purposes, namely rock-oil; and from the experiments which had already been made, and were still in progress, there could be no doubt that, with proper apparatus for burning it, they would get a far larger percentage of the heat arising from combustion than had ever been got from coal.

SMOKE CONSUMPTION.

A NEW appliance for the Consumption of Smoke has been in operation at the works of Messrs. J. Wade and Sons and Messrs. Rouse and Co., of Bradford. The design has been for some time patented by Mr. Charles Gall, an engine tenter, of Bridgenorth, Shropshire, and has, it is said, been already applied with success at various establishment, in Bridgenorth, Wolverhampton, and Blackburn. The bridge is fitted with an air-valve below the level of the fire-bars, the valve being slung in the same manner as an ordinary throttle-valve. A short distance behind the main bridge is formed another of considerable height, this second bridge being fitted with a "striking plate," which deflects upwards the air entering the air-valve. When the air-valve is opened, the air entering through it is directed upwards, and mixed with the heated gases escaping from the fire, thus supplying the oxygen necessary for their complete combustion. The simple self-regulating arrangement which forms the principal feature of the plan is to admit the quantity of air required according to the state of the fire. This consists of a pair of vessels capable of containing water, the pair being connected by a bar which turns in a centre fixed to the boiler. The bottoms of the vessels are also connected by a small pipe furnished with a stopcock, and another pipe of large diameter leads from the bottom of one vessel to the top of the other. The bar connecting the two vessels is furnished with a couple of tappets, these being acted upon by the pin of a small crank fixed at the upper end of the hinge-pin of the fire-door, this pin being prolonged upwards for the purpose of carrying it. To the underside of the one vessel there is attached a link, the lower end of which is coupled to a lever fixed in a slight shaft which extends along the ash-pit to the bridge, this shaft carrying near its inner end another bent lever. This bent lever acts upon another lever, which is connected to the upper part of the air-valve by a short link and staple, and thus by depressing the lever the air-valve will be closed, the manner in which the valve is hung tending to make it fall open. —*Builder*.

NEW GREEK FIRE.

In the *Progrès de Lyons* has appeared a description of "New Greek Fire" of such destructive efficacy that by its use an army of 100,000 men, at a distance of 1,000 mètres, could in less than five minutes be enveloped in a sea of flame and entirely annihilated; an enemy's fleet as easily disposed of; the "fortress of Luxembourg" emptied of its garrison in less than one quarter of an hour, and other equally wonderful and marvellous results obtained. Chimerical and fabulous as this announcement sounds, we have reason to think that the statements are well founded, for the subject was some years ago brought before our notice, and the invention is consequently not so novel as the *Progrès* would represent it to be. Whether the materials and means employed by the "Chemist of Marseilles" be identical or not to those used in the process alluded to, it curiously happens that the language of the paragraph in question, making allowance for florid epithets, to a nicety describes a patent that was granted to Mr. John Macintosh by the English government in the year 1855, and which attracted at the time considerable attention amongst the scientific bodies of the kingdom. It formed in the session of 1858 the subject of an animated discussion at the meeting of the British Association presided over by Professor Fairbairn, and in the year following the subject was again debated at the United Service Institution. Previous to these discussions an extensive series of experiments had been carried out at Shoeburyness and Portsmouth, by order of the Admiralty and of the War Office, to test the efficacy and practicability of Mr. Macintosh's inventions, and, excepting that the system was pronounced diabolical and barbarous, with highly satisfactory results, and Lord Panmure, then Secretary of State for War, was so impressed with the importance of the subject, and with the consequences that might follow the adoption of such a terrible agent of destruction, that he suppressed the patent on the grounds that the publication of it would be prejudicial to her Majesty's service. Mr. Macintosh went out purposely to the East with a cargo of his materials for the purpose of rendering the fortresses of Sebastopol untenable, but for the reasons previously mentioned it was not thought desirable to allow him to execute his plans, otherwise the war might probably have been terminated at a far less expenditure of money and life than it unfortunately cost.—*Mechanics' Magazine*.

Dr. Medlock states this inflammable compound to be not so dangerous as is represented. It consists of phosphorus dissolved in a very volatile liquid known to chemists as bisulphide of carbon. When thrown upon any combustible material the liquid rapidly evaporates, and the phosphorus, being left in a comminuted con-

NEW FUEL.

Some experiments are in progress with regard to a new kind of Peat-fuel, known as Lee's patent, which is alleged to possess great advantages over coal, both as regards power and economy, for generating steam. According to an account in the *Shipping Gazette* of a trial of this fuel—"The results arrived at were considered to prove that peat, when properly dried and submitted to a certain process, and then saturated in oil, has greater heating power than the best Welsh coal. The advantages possessed by this peat fuel are the rapidity with which a fire can be lighted, and the economy in working and space. Put a few blocks in the furnace, apply a match, and in an instant the whole is in a mass of flame. Very little stoking is required."

FIRE-PROOF THEATRES.

The reports of the destruction of Her Majesty's Theatre by fire, on December 6, 1867, have brought forth a host of preventive suggestions, most of which are based upon circumstances and conditions which are not likely to occur, and have consequently little practical value. The following remarks, in the *Engineer*, are, however, not liable to this objection:—In the first place all the floors, from the pit to the gallery, should be of iron, or iron and stone. In order to prevent cold feet the stone or metal should be covered with felt, or better still, some preparation of india-rubber. Oil-cloth is inadmissible, as it is liable to spontaneous combustion. All the chairs or benches should be of brass or iron, upholstered in wool or silk. It may be urged that metal chairs would not be tolerated in the boxes or stalls, but we believe that chairs of hollow brass, richly ornamented, would enjoy quite as much favour as those of dingy gilded wood now in use. The box fronts might either be fitted up with light iron trellis-work, used already in many theatres with good effect, or with zinc sheeting worked into panels. All the hangings should be of some woollen material, or if vegetable fibre in any form is to be used, then let it be chemically treated, so that it will not flame under any circumstances. In a theatre so constructed there would be nothing to catch fire, and little to be burned even by the application of an intense heat. Still the audience would be nearly as far off as ever from safety, simply because a fire on the stage would fill the whole house with flame and smoke and sparks. It follows then that unless the stage portion of the building can be dealt with satisfactorily it is little more than folly to attempt to render the rest of the house really fire-proof. We believe it to be utterly impossible to make stage fittings incombustible. Matters there are in the hands of the scene-painter and the manager; and the engineer should not attempt to interfere with the arrangements of these gentlemen, which upon the whole are excellent. His course is clear. Let him provide a wall of iron ready to be dropped at a moment's notice between the stage and the auditorium. In other words, let the stage front be fitted with a revolving iron or steel curtain, which may be let down, as sailors say, "by the run," at a moment's notice. Long before flame could pass this barrier the audience could escape from the building, while the chances of extinguishing the fire behind it would be greatly increased by its action in cutting off the supply of air. Such a curtain is already in use in one Scotch theatre. There is but one objection, as far as we are aware, to their general adoption, and that is the expense. But in the construction of well-appointed theatres this should be a matter of secondary importance, and would probably be met by a reduction in the rate of insurance.

NEW FIRE ESCAPE.

A PUBLIC trial of Messrs. Jones and Hedge's patent Fire-escape has taken place at Scotland-yard, Whitehall. It is small and portable, weighing but a few pounds. The most useful size contains 40 ft. of wire rope, and is 10 in. in diameter and 1½ in. thick; and its arrangements are such as to enable those going down by it to descend at whatever speed they please, or, if required, to stop at any window they may pass in descending, and take out any other person that may need rescue, and then reach the ground in safety. In descending the apparatus is fastened to the body by a leather strap, and the wire made fast to something above. The apparatus can also be made fast above, and a basket or bag slung to the rope, so that when its load is safely landed, the person above can wind it up and let himself down. It can be fastened to any article of furniture, to the bars of a grate, or to a permanent crook or pin fixed in the wall or window-frame. In appearance the whole apparatus is little more than a flat wire rope, to which any sort of conveyance can be attached.

NEW SIGNAL LIGHT.

SUCCESSFUL trials have been made at Portsmouth, by order of the Admiralty, with a night Signal Lamp which has just been introduced into this country; the results of which appear to promise what has long been wanted to perfect the night telegraphic system of Her Majesty's fleets—a certain and reliable, economical, brilliant, and simply working flash light. It has been introduced to the notice of our Admiralty by one of the inventors, a Captain H. H. Doty, and it is so far well known that it is now the signal light of the Imperial Navy of Russia, and is known as "the Spakowsky Marine and Army Night Telegraph."

The instrument itself weighs not over 7 lbs. avoirdupois weight, is about 3 ft. in length, and in shape resembles an ordinary civic mace, the resemblance to which is heightened by its being made of brass. The staff of the instrument, of about 2 in. diameter, is a hollow cylinder, inside which is fitted a piston that can be pressed down to two separate distances in the cylinder, but which, when not in use, is kept in the upper portion of the cylinder by a strong spiral spring in the lower part of the cylinder or staff. Immediately over the top of the piston, and at the upper part of the cylinder, is a projecting nozzle pipe, through which the air finds entrance on the opening of a valve, by drawing the piston downwards. The upper portion of the cylinder is now full of air, which will be driven out on the piston being released by the operator's hand, and left to the upward pressure of the spiral spring underneath. Let us look at the upper portion of the instrument first. Here a cotton wick is burning from a small spirit-of-wine lamp fixed in the head of the mace-looking instrument. Opposite to the small flame of the spirit lamp is about an inch of horizontally fixed brass tubing of about the thickness of whipcord, terminating in a needle point from another piece of the same tubing—one being a continuation of the other—and pointing direct at the spirit flame. A reservoir in the head of the instrument contains a little over half a pint of petroleum, and this reservoir is connected with two small pieces of tubing, and by means of them subsequently with the air from the cylinder below. Now, the piston being released, it is driven upward by the spring underneath, and forces the air through the small tubes in the face of the flame, and with it the petroleum in the form of a vapour. The result of this is, a column of flame of full 2½ inches in diameter darts upwards from the point of contact between the petroleum vapour and the flame of the lamp, and this column of light lasts just so long as the piston is moving upwards again to its normal position in the cylinder.

The length of time during which the column of light is shown depends upon the length to which the piston is pressed downwards in the cylinder. Thus a two-inch movement of the piston may be said to give a short flash —, and a 6-inch movement to give a long flash ——. A mechanical catch in the cylinder warns the signalman when he has reached the proper distance for a short or a long flash. On the first night of the trials signalling was carried on after 9 p.m. between the *Duke of Wellington* in Portsmouth harbour and the *Minotaur* at Spithead, Captain Fellowes being provided with a Spakowsky lamp on board the *Duke*, and Captain Goodenough on board the *Minotaur*. The lights read and repeated, the signals made from ship with extraordinary clearness and quickness to the operators, and its success as a "light" simply and without regard to other considerations, which are rightly the province of Captains Fellowes and Goodenough to decide upon, was at once placed beyond a doubt. The second experiments were made for the purpose of examining some of the smaller details connected with the working of the light, and were made in the presence of Admiral Sir Thomas Pasley and other officers, and were also quite satisfactory.

The entire cost in the first instance, including the flame shade, is stated to be about *5l.* The cost of its working can best be shown by an experiment made with it by Captain Fellowes, who, commencing with its reservoir newly filled with petroleum (a little over half a pint), flashed 1,470 long and 1,460 short flashes before the petroleum gave out. This would average about 400 words telegraphed at under a shilling cost.

SUPPLY OF AIR TO MINES.

Mr. J. Rofe writes to the *Geological Magazine*, and shows that colliery proprietors have only to watch the barometer, and provide in accordance with its indications for the supply of air to the mines. Alluding to the well-known "Blowing Well" of Preston, in Lancashire, he states that some time since, in a well recently constructed by him as a cesspool to some chemical works, he observed the phenomena characterising the "Blowing Well!" When the atmospheric pressure diminished, the air came from the well loaded to a disagreeable extent with the offensive vapour from the cesspool. On continuing his observations with a barometer, he found similar results. He concludes from these facts that a coal mine must be regarded as a gigantic well, from which, when the atmospheric pressure diminishes, the air expands and rushes out with great violence. This circumstance is not of itself dangerous, but if there be an excess of gas in the mine, and at the same time, from accident or carelessness, a means of ignition, then, indeed, the consequences are very likely to be serious. Hence the barometer becomes the miner's safest guide.

GAS REVERBORATORY FURNACES.

Attention is being directed in this country to the Gas Reverboratory Furnaces of Silesia, which are used there for the manufacture of iron and for various other purposes, with a saving of about 30 per cent. in the fuel consumed. The coal, instead of being placed upon a grate, as in our furnaces, is placed in a chamber in the same situation as that which the grate usually occupies, and a weak blast of air is directed upon it by a fan or otherwise. This air being insufficient for the rapid combustion of the coal, generates carbonic oxide, which passes into the furnace. and meeting there with a powerful stream of air from the blowing-machine, the carbonic oxide gas is inflamed, and generates intense heat within the furnace. A rapid circulation of air is maintained through channels beneath the hearth and within the bridge of the furnace to cool those parts, and thus to prevent the intensity of the heat from burning them out rapidly. The pressure of the air-blast directed into the furnace is about 4 lb. per square inch. Carbonic-oxide furnaces are now employed in the arts to a considerable extent. Their first introduction was in the iron-smelting furnaces in France, where the smelting is carried on by means of wood; and the gases escaping from the top of the furnace were then conducted down by a pipe, and used beneath the boiler. Subsequently a similar expedient was employed in many of our own iron-smelting furnaces, though there coal is the fuel consumed. The top of the blast-furnace is closed by a great conical mouthpiece or valve, upon which the coal, iron, and limestone intended to replenish the furnace are laid, and, the valve being then momentarily lowered a little by suitable apparatus, the charge falls into the furnace, off the conical surface. The carbonic-oxide gas generated in the furnace, being unable to escape at the top by reason of the valve, passes down through a great sheet-iron pipe and escapes through perforated pipes beneath the boiler, where being inflamed, and an adequate supply of air being admitted, sufficient heat is generated to maintain the supply of steam required by the works. A similar species of furnace has been proposed by M. Beaufumé, in France, for the generation of steam in ordinary boilers, carbonic oxide being generated in a special chamber as in the Silesian furnaces, and being subsequently burned beneath the boiler by the aid of a suitable apparatus. But this species of furnace has not yet come into use. In ordinary furnaces about half the air passes through the fire unchanged, and as this air is received at a low temperature, and delivered at a high, a considerable waste of fuel is thus produced.—*Illustrated London News.*

METAL-FOUNDING.

A VERY curious fact has been discovered by a German founder, H. Heberland. When a little lead is melted with iron it rises and floats on the surface of the iron in the shape of small spheres. These, however, are not solid; they are hollow vesicles with only thin walls of lead. The supposition is, that at the temperature of the fusion of iron lead is vapourised, and condenses in the vesicular state as water does to form rain-clouds. The phenomenon resembles, too, the spheroidal condition which water assumes on a red-hot metal plate.

IRON AND STEEL MANUFACTURE.

MR. J. FERNIE has laid before the Mechanical Section of the British Association his views in reference to the Iron and Steel shown at the French Exhibition. He stated that a great deal had been said about the advance the French had made in this department, but he thought this was erroneous. Coal was sent into France free of duty, and English raw iron with a very small duty. When, however, the English came to send their finished iron into France, it was practically prohibited by the very high duty imposed. The only iron in the Exhibition from England was from a few of the best Yorkshire houses, and one or two other specimens. He first called attention to the large girders. There were several specimens of these exhibited in the French department, which were far larger than any ever rolled in this country. These girders were 3 feet 7 inches in depth, but only 12 feet long—a length wholly inadequate in proportion to their depth. The length for all practical purposes should be at least fifteen times the depth. These were mere *tours de force*. He believed that the process of building up such masses of iron, and the frequent reheatings and coolings necessary for the purpose, would not produce a girder anything like equal to a girder made in the ordinary way—of boiler-plate, riveted together. These girders, in the opinion of Mr. Fernie, had been made for the purpose of going beyond the English people, and not so much for their practical value—in short, to excel the English in this respect. Another process of the manufacture was that of stamping, lately introduced, and which has been very largely carried out by the French. This process was to make a complicated forging in small pieces fixed together; putting it in the furnace, then raising it to a welding heat, bringing it under an immense die or hammer, and then completing the process of forging. This process had not come into use in this country; but one English house had shown several specimens quite equal in manufacture to those exhibited by the French. The manufacture of steel in large masses, exhibited by Krupp and the Bocum Company, far exceeded in size anything as yet manufactured in England. The specimens from the Bocum Company were, in the opinion of Mr. Fernie, deserving of special mention. Twenty-two railway wheels of cast steel, in one casting, were, he believed, the finest ever exhibited. So far as France is concerned, England had not been excelled in any department in the manufacture of iron or steel.

Mr. F. Kohn has read to the British Association a paper on the Iron and Steel at the French Exhibition, which, he said, formed only a supplement to the excellent paper on the same subject submitted by Mr. Fernie. The collection of iron and steel in the French Exhibition was one of the most complete and instructive representations of the present state of iron metallurgy in all its branches which could have been brought together at any one spot under any circumstances. The writer then spoke of the main cause of the great industrial revolution now witnessed—an invention with which the British Association had an historical connection—the Bessemer process, which process had been most successful during the eleven years of its existence. He next referred to those much-admired steel castings of Rhenish Prussia, which had caused so much interest and curiosity by their extraordinary sizes and qualities, and he referred to the secrecy and mystification which surrounded their manufacture, arising, in his opinion, from the want of an effective patent law in Prussia. In conclusion, he remarked that the vague notion now *existing in* Britain that the superiority and predominance of British iron manufacture had ceased to exist, or was threatened to be overthrown by continental competitors, had no foundation, *judging* by the state of things in the French Exhibition.

Mr. Graham has made the discovery that metals absorb gases in the same way in which a sponge absorbs water, and he finds that pure iron is capable of taking up at a low red heat, and retaining when cold, over four times its volume of carbonic oxide. It appears probable that wrought iron, in the course of its manufacture, takes up six or eight volumes of carbonic oxide, which it contains for ever after. In converting iron into steel, carbonic oxide must be present, and the gas is decomposed, carbon is taken from it, and carbonic acid is liberated. This decomposition can only take place at a high temperature; and Mr. Graham thinks that the process of cementation will be accelerated if the metal be alternately heated and cooled.

While speaking on iron we may briefly refer to the extraordinary discovery recently made by Mr. Graham, in experimenting on a piece of meteoric iron. We have before referred to his experiments on the "occlusion" of gases by red-hot and melted metals. Under such circumstances of course metals absorb, or, as Mr. Graham puts it, "occlude" the gases in which they find themselves. Thus, iron made red-hot in a charcoal fire takes up carbonic oxide with a little carbonic acid and some nitrogen, the two former resulting from the combustion of the charcoal, the last coming from our atmosphere. Gases so absorbed are given out again on the application of heat, and they may thus be collected and examined. On submitting a piece of the Lenarto meteoric iron to heat, Mr. Graham found that 86 per cent. of the gas given off was hydrogen. The inference is that the meteor came from an atmosphere of hydrogen, or of which hydrogen was the principal ingredient. Moreover, the fragment experimented with was found to have absorbed 2·8 of its volume of the gas. Now, as Mr. Graham has found it difficult, under the pressure of our own atmosphere, to impregnate iron with more than an equal volume of hydrogen; the further inference is that the meteor was extruded from a dense atmosphere of hydrogen, such as we are told we must look for beyond the light cometary matter floating about within the limits of our solar system.—*Mechanics' Magazine.*

CHILLED CAST-IRON.

The President of the Royal Astronomical Society writes to the *Times* to say that in 1847 the present Astronomer Royal, Mr. Airey, availed himself of the then well-known properties of chilled cast-iron for the construction of one of the most delicate and important parts of the magnificent transit circle in the Royal Observatory, Greenwich, which for the last sixteen years has rendered memorable services to the arts of peace. The pivots of that noble instrument at this hour are reported to be as perfect in figure as they were when first completed, notwithstanding the wear and tear of so many years.

IRONWORKS IN STYRIA.

ATTENTION is being turned to the spathic and hæmatite iron ore deposits and coal-fields in Styria, with a view to establish steel and iron works there with English capital. The coal of certain parts of Styria, and especially that of Buchberg and Podkamnig, near Cilly, a railway centre in Styria, being free from sulphur and phosphorus, is believed to be peculiarly adapted for the manufacture of steel of the best quality. An analysis of the coal at Cilly, by Dr. Allan Miller, of King's College, London, shows that in 100 parts the sulphur is only 0·51, and the phosphorus 0·00. The quality of Styrian iron has long been famous, and the proximity of that peculiar coal to the charcoal-made iron creates most favourable conditions for the establishment and working of steel. A railway of 7½ miles will connect the proposed works with Cilly, a station on the Lombardo-Venetian line. The articles to be manufactured are steel guns, rails, axles, wheels, and tires for railways, ship and boiler plates, &c.

CASTING UNDER PRESSURE.

MR. WHITWORTH has patented a mode of making Steel Castings under Pressure, with the view of obtaining greater soundness in them. Wrought-iron and steel have a disposition to rise into vapour when not much above the melting point, and the result is that castings made from these materials are very much honeycombed, and require to be hammered to make them sound. Instead of this hammering, Mr. Whitworth proposes to apply compression to the metal when in a molten state; to which end he pours the metal into a very strong box or mould of iron coated in the inside with loam, and he employs suitable plungers, like those of a hydraulic press, but with their ends coated with loam, to press against the metal with a force of from five to twenty tons per square inch. The casting of steel and iron under pressure has often been proposed before, and the process would be useful, especially for guns, which might then be cast hollow, and be cooled from the inside on the Rodman principle, though formed of cast-iron or steel.—*Illustrated London News.*

THE LARGEST BLAST FURNACE IN THE WORLD.

THE extraordinary development of the iron manufacture in the Cleveland district has led to the building of the largest smelting furnaces in the world. One of these, and the largest hitherto built, is at the Norton Ironworks. It was put in blast, having been previously charged with upwards of 500 tons of mineral. The inside diameter is 25 ft., the height 85 ft., and the capacity 26,000 cubic feet. It was expected that it would produce about

450 tons of pig-iron weekly, and this expectation seems to be in a fair way of being realised, as the furnace has hitherto proved a complete success, both as regards quantity and quality of metal produced, and quantity of coke used to the ton of pig-iron. The fourth week after the blast was put on the make of the best foundry pig was 365 tons, or equal to 50 tons per day; and during the sixth week the make had increased to upwards of 62 tons in 24 hours, or at the rate of 434 tons per week, and the furnace has neither its full "burden" nor full blast on yet, so that its producing powers have not been fully tested.—*Builder.*

THE HIGHEST CHIMNEY IN YORKSHIRE.

Bradford has acquired considerable notoriety on account of its long chimneys, but the longest of them all must hide its diminished head in comparison with one that has been completed at the works of Messrs. Mitchell, Brothers, spinners and manufacturers, Manchester Road. This chimney, measured from the bottom of the foundation, is 110 yards long, and rises a clear 100 yards above the ground line. It is said to be the highest in Yorkshire, the next in size being a brick chimney near Huddersfield, built in 1857, the length of which from the foundation is 105 yards. The foundations, which consist of two courses, 22 ft. and 21 ft. square, and 12 in. thick each, rest upon the rock. A good bed of coal was obtained in excavating for this part of the structure. The chimney is built of stone, is octagon in form, and measures 20 ft. across at the foundation and 9 ft. at the summit. The flue is perpendicular, and 7 ft. in diameter. The "stalk" has been erected by Messrs. John Moulson and Son, Little Horton Green, contractors, from plans made by Mr. Mark Brayshaw, Old Bowling Lane, architect.—*Ibid.*

GOLD-WORKING.

A California exchange says that Mr. E. R. Chapin, of Stockton, has succeeded in inventing a very ingenious contrivance for saving gold lost from quartz. It is entirely different from any concentrator or separator that has been used by miners hitherto. It consists of a shallow pan called the separator, elevated an inch above the concentrator, which first receives the water sediment, quicksilver and gold escaping from the mill above. The bottom of the separator being deeper than the sides or mouth where the water flows over, the quicksilver and gold naturally settle down, while the light gold and sulphurets flow over with the water into the concentrator, which looks somewhat in shape like a soup tureen. Small holes are perforated in the bottom of this concentrator, through which the sulphurets pass into small pans fastened beneath, while everything else flows over the top into the conductors, which carry it away. The machine is fastened on four stout wires, each fastened at the bottom in a strong framework. Diminutive cog-wheels are attached to a cylinder, which, kept in motion by the action of the mill above, set the machine in motion.—*Mechanics' Magazine.*

RUBY SILVER.

The mineral wealth of Idaho Territory, U.S., is represented at the French Exposition by specimens of ruby silver, silver glance, and black sulphurets, of great size, beauty, and value. The *Mining Journal* states that during the past year many tons of similar ore were shipped from Ruby City to New York, *viâ* San Francisco, producing an average yield of 68 per cent. in bullion. Oro Fino Mountain, Carson District, Owyhee County, is filled with veins of silver ore, the most noted of which are Oro Fino, Morning Star, Rising Star, and Poorman, from which this ore was taken. The last-named mine, under the management of Mr. Walbridge, of New York, yielded in 1866 more than 150,000*l.* sterling in bullion, and the Oro Fino and Morning Star are stated to have produced a much greater amount. The official report of Mr. John A. Post, the United States Inspector of Internal Revenue, for the ten months of January to October, 1866, was for duties upon a declared value of 1,073,256·78 dollars from the district. Emigration has rapidly lessened the cost of labour and supplies; and many thousands of Chinese and other labourers are now employed upon the Central Pacific Railroad, by which it is expected that a direct communication with San Francisco will be effected within three years.

NEW ALLOY.

It is stated that an American has discovered a beautiful alloy, which has been most successfully applied as a substitute for gold. It is composed of pure copper, 100 parts; pure tin, 17 parts; magnesia, 6 parts; tartar of commerce, 9 parts; sal-ammoniac, 3·6 parts; and quicklime 1·6 parts. The copper is first melted, then the lime, magnesia, sal-ammoniac, and tartar are added, little at a time, and the whole is briskly stirred for about half an hour, so as to mix thoroughly, after which tin is thrown on the surface in small grains, stirring until entirely fused. The crucible is now covered, and the fusion kept up for about 35 min., when the dross is skimmed off, and the alloy found ready for use. It is quite malleable and ductile, and may be drawn, stamped, chased, beaten into powder or into leaves, like gold leaf, in all of which conditions it is not distinguishable from gold, even by good judges, except by its inferior weight. The alloy has already been largely applied in the United States, and requires only to be known in Great Britain to become a general favourite.—*Mechanics' Magazine.*

REGULATING WATCHES IN SWITZERLAND.

At Neufchatel, in Switzerland, is an observatory organised on an extensive scale, and provided with the very finest instruments.

Besides purely scientific results, the *Society of Arts Journal* says it renders immense service to chronometer-makers, by enabling them to produce watches which are every day becoming more perfect. This is important to the branch of industry in question, which can only exist by constant improvement. Prizes are given to makers whose watches or chronometers approach as nearly as possible to perfection. To give an idea of the wonderful precision that has been obtained in this branch of industry, a marine chronometer, lately tested, gave the mean variations from day to day, in two months' trial, sec. 0·164. Common watches become more perfect every year. On 67 watches tested since 1866, the mean variation was only ¾ of a second in 24 hours.

In 1862	the mean variation	was sec.	1·61
" 1863	"	"	1·28
" 1864	"	"	1·27
" 1865	"	"	0·88
" 1866	"	"	0·74

On more than three-quarters of the chronometers observed in 1866, the mean variation was less than half a second. These practical results show the importance of such observatories as that of Neufchatel.

STEEL WIRE.

Steel Wire is now chiefly used in the manufacture of needles, fish-hooks, springs, music-strings, small tools, umbrella frames, crinolines, and ropes; both for the home and foreign trades. Its application to ropes and cables is of very recent date, and is entirely owing to the success of Mr. Horsfall's invention; ordinary steel wire being manifestly useless for the purpose, and absolutely dangerous. As soon as it became known that a steel wire could be produced which combined all the advantages of lightness with hardness and extreme tenacity, it obtained a considerable share of popular favour; and, although it has been introduced within the past seven years, it has already attained a high position in the estimation of consumers, and, as prejudice is more and more overcome, must some day attract still greater attention. The steel wire rope is now used at many collieries; and is highly valued in deep pits especially, where the light weight of the rope is of such importance, both in connection with the safety and economy of the working. For railway inclines, lifts, and even ship's rigging, the same reasons are rapidly bringing it into use. Not the least important of the various mechanical inventions of the present day, which the introduction of a suitable quality of steel wire has materially assisted in perfecting, is the application of steam machinery to agriculture. The late Mr. Fowler more than once declared "that he owed the success of his plough to the introduction of Webster and Horsfall's steel wire." But the most important use to which this wire has yet been adapted, and the one which is now exciting such universal interest, is the manufacture of submarine telegraph cables. During the past five years, large quantities have been used for cables in the Mediterranean; and lately, as is well known, it has formed an important and successful portion of the Atlantic telegraph cable. The manufacture of this wire, in its various departments, kept nearly 250 hands employed for eleven months, the total quantity supplied being over 30,000 miles in No. 13, I. W. G. (=·095).—Timmins's *Birmingham and the Midland Hardware District*; quoted in the *Mechanics' Magazine*.

RIGIDITY OF GLASS, BRASS, AND STEEL.

Dr. Everett has read to the British Association a paper, in which he described the ingenious arrangements by which these experiments were carried on, and the minute deflections measured. Cylindrical rods, about one-third of an inch in diameter, of flint glass, drawn brass and steel, were alternately bent and twisted by known couples, so applied that the couple (whether of flexure or tension) was always uniform through the whole length of the rod. The amounts of bending and twisting thus produced in a given portion of the rod were measured by the aid of two mirrors clamped to the rod. In the earlier experiments, these mirrors were made to reflect a dark line placed in front of a lamp flame, and the displacements of the images were measured on a screen. In the later experiments, two telescopes were placed almost vertically over the two mirrors, so as to look down into them, and a sheet of paper (cross-ruled) was fixed in a horizontal position overhead. The displacements of the lines on this sheet as seen in the telescope were then observed. From the measurements of flexure and tension thus obtained, the co-efficients of elasticity and rigidity for the substances operated on were calculated.

BESSEMER STEEL.

Rails made by the Bessemer process are fast coming into use on all our railways; and in a few years there can be no doubt nothing else will be used, since, although their first cost is somewhat greater, their durability is greater in a much higher proportion. At the Chalk Farm station of the London and North-Western Railway, a Bessemer-steel rail is now to be seen still in use, and in good order, which has outlasted twenty-five iron rails successively placed next to it on the same line; so that, judging by this example, steel rails are at least twenty-five times as durable as iron ones. The steel rails are not, as persons might suppose, brittle, but, on the contrary, are very tough; and a late number of *Engineering* contains an account of certain experiments, made within the last ten days at the works of Sir John Brown and Co. and Messrs. Cammell and Co., of Sheffield, which conclusively illustrate this point. These experiments were made chiefly for the satisfaction of the Hon. W. J. MacAlpine, formerly engineer of the state of New York, and much connected with railways in America, who contemplates the more extended introduction of steel rails into that country. The result was to show the great toughness and powers of endurance of the steel rails. In one of the experiments, a ram of a ton weight was suffered to fall upon a rail of 68 lb. to the yard, supported on iron blocks 3 ft. apart in the clear, from a height of 20 ft.; and the only effect was to bend the rail. The rail was then turned upside down, and the blow was repeated, when the rail was bent straight, but without any cracking being visible. Finally, the rail was exposed to the test of a ton ram falling through 30 ft., when the rail was very much bent and twisted, but not a crack was visible. By the mode of manufacture now adopted perfect uniformity in the composition of every rail is ensured.—*Illustrated London News.*

Professor Winter recommends, for cooling utensils, the use of Bessemer steel. It is not acted on by the various agents which attack copper, and thus on the score of health and safety it possesses special recommendations. Over cast-iron for saucepans, &c., it will have, too, the further advantage that the vessels being so much thinner, a great saving of heating material will be effected. According to the Professor, the rolled sheets of steel may, by the aid of a lathe, be pressed into any required form, and thus the vessel is constructed of one piece, requiring no rivets or soldering. Various household utensils have, it seems, been made of this steel by Russ, of Grätz.—*Mechanics' Magazine.*

An objection made against Bessemer steel is, that the ingots on cooling are full of blow-holes. To obviate this, moulds are now used which rotate slowly on their axis after the metal is run in. The effect of the movement is to favour the escape of gas at the centre of the mass, which retains the molten condition longest, and to produce complete consolidation. Polished sections of an ingot cast under rotation exhibit but few or none of the black specks common in other specimens, supposed to result from the air-bubbles or blow-holes, as they are called in some foundries.

The art of manufacturing Steel Tubes by punching solid ingots, which are then drawn out, is likely to become an important branch of industry. Tubes of Bessemer steel, suitable for gun-barrels, and for cannon, are now made by that process, the benefit of which is that it involves no weld, and that the act of punching tests the material sufficiently to insure its soundness on all occasions. Already it has been found practicable to punch a 10-in. hole through a cylindrical ingot 30 in. diameter and 4 ft. high, and Sir John Brown and Co., of Sheffield, are erecting heavy machinery for rolling steel tubes for rifle cannon of 7 in. bore. Gun-barrels of steel are also largely made, by the same process, at a cost of 10*s.* 6*d.* each, and they are much stronger and sounder than the gun-barrels formerly made of iron.

MALLEABLE GLASS.

M. PELIGOT has called attention to a quite new fact, that he has discovered the devitrification of a piece of St. Gobain glass, prepared a long time ago by M. Pelouze; the glass had lost its transparency, but not its density. Placed in a drawer, the piece of glass, supported by one extremity, was found, after some days, by M. Peligot to be curved under its own weight, it having become a malleable glass; the surface was also covered with efflorescence. Pliny speaks of a glass that could be bent and unbent; and the story goes that Richelieu ordered an inventor to be put to death for proposing to divulge a process for making malleable glass.—*Mechanics' Magazine.*

DECAY OF STONE.

MR. SPILLER has read to the British Association a paper on the Decay of Stone. Speaking of Westminster Palace, he said that a close examination proved the fact that such of the stones as had least carving upon them, or, in other words, presented the smallest superficies, were least affected by the sulphur and magnesia which had corroded the building. With a view to arrest the progress of decay, he had submitted a plan to the Royal Commissioners, which consisted in the application to the stones of a solution of superphosphate of lime. His suggestion had been tried, along with five or six others, in April, 1864, but the government report on them had not yet appeared. Speaking in reference to the effect which his solution had on Portland stone, Mr. Spiller stated he had found by experiment that while the latter in its natural state broke under a weight of 3,725 lb., it could resist, when treated with the solution, a weight of 5,437 lb., thus proving that it had acquired an increase of strength equal to 50 per cent. Happily the necessity for adopting such means was not felt in their part of the country. Several specimens of stones treated with Mr. Spiller's solution were then handed round for inspection. Some discussion took place as to the merits of Mr. Spiller's process, several speakers approving and others expressing doubts of its suitability.

NEW CEMENT.

M. SOREL has communicated to the French Academy of Sciences a New Cement, being a basic hydrated oxychloride of magnesium. It may be obtained by slacking magnesia with a solution of chloride of magnesium in a more or less concentrated state. The denser the solution, the harder it becomes on drying. The magnesian cement is described as the whitest and hardest of all those known to this day, and it can be moulded like plaster, in which case the cast acquires the hardness of marble. It will take any colour, and has been used by the inventor for mosaics, imitations of ivory, billiard-balls, &c. The new cement possesses the agglutinative property in the highest degree, so that solid masses may be made with it at a very low cost by mixing it up on a large scale with substances of little value. One part of magnesia may be incorporated with upwards of twenty parts of sand, limestone, and other inert substances, so as to form hard blocks. By means of these artificial blocks, building may easily be carried on in places where materials for the purpose are scarce. All that is required is simply to convey a quantity of magnesia and chloride of magnesium to the spot, if there be none to be had there, and then to mix them up with sand, pebbles, or any other matter of the kind close at hand; blocks can then be made of any shape, and imitating hewn stone. This magnesian cement may be obtained at a very low cost, especially if the magnesia be extracted from the mother-ley of salt-works, either by M. Balard's process, whereby magnesia and hydrochloric acid are obtained at the same time, or else by decomposing the ley, which always contains a large proportion of chloride of magnesium, by means of quicklime, which by double decomposition yields magnesia and chloride of lime containing a certain quantity of chloride of magnesium, and which, with the addition of various other cheap substances, may be used for whitewashing.

PORCELAIN GLAZE.

A NEW Porcelain Glaze has been produced by MM. Anthoin and Gonoud, by dissolving platinum and aluminium in aqua regia, whereby a double chloride of the two metals is obtained. This is mixed with a certain proportion of Limoges glaze, and the result is a glass of a very superior quality, prepared from pigmatite, a quartz and felspar rock, very suitable for glazing porcelain of the best quality.

THE GILDING OF PORCELAIN.

A COATING of gold, which is brilliant without burnishing, may be imparted to porcelain, observes the *Scientific Review*, by means of a mixture prepared as follows:—Thirty-two parts of gold are to be dissolved in aqua regia, containing 128 parts nitric, and the same amount of hydrochloric acid, heat being applied. When the solution is complete, one and one-fifth part tin, and the same amount of butter of antimony, are to be added; and, after heat has been applied, the result is to be diluted with 500 parts water. Also sixteen parts sulphur, and the same amount of Venice turpentine, are to be gently warmed until they form a tough uniform dark-brown mass, which is to be thinned with fifty parts oil of lavender. The solution of gold is poured into this; and the mixture being kept warm, it is to be constantly and gently stirred until a uniform liquid is obtained. On cooling, the water and excess of acid separate; and the resinous mass thus obtained is to be well washed with water, and dried, then thinned with sixty-five parts oil of lavender and one hundred parts oil of turpentine; and, having been heated until it becomes of a uniform consistence, five parts basic nitrate of bismuth are to be added to it; after which, it is to be left at rest till it is quite clear. The clear portion may then be poured off, and is ready for use. It dries quickly on the porcelain, and the gilding is brought out by the application of a high heat.—Quoted in the *Builder*.

MOURNING CANDLES.

MOURNING Candles we never heard of in this country; nevertheless, some one possibly may set the fashion of using them some day, and they would not be more ridiculous than many other customs. Such candles appear to be used in Germany, and Böttger informs us how they are made. Paraffin, it seems, is heated with the shells of the anarcadium nut, which contains a black resin soluble in the paraffin. While the paraffin remains liquid it only appears of a dark-brown colour, but when it solidifies it is as black as coal. These candles are said to burn without giving off any vapour or bad smell when they have a thin wick, as paraffin candles always should have in order to burn well.—*Mechanics' Magazine*.

PRINTING WITHOUT INK.

A SPECIMEN of Printing without the inking of the types has been shown us; and from an account of the process given in the *Printer's Register* of May 6, by Mr. Küster, of Messrs. Wyman & Sons' printing establishment, it appears that the system was invented by a M. Gustave Leboyer, and was exhibited in the French Exposition. Mr. Küster states that he saw the specimen referred to (which contains 145 letters in seven different kinds of types, and two colours—red and black) composed, and 100 copies printed, all in three minutes; the printing being done in thirty-two seconds! M. Leboyer has taken out a patent in England, as well as in other countries. His machines appear to be chiefly intended for cards and bills, letter-heads, &c. The time expended in the usual inking process must, of course, be saved in the working of hand machines. The colours show no defect of intensity—they are good colours and well printed. A chemical paper or other fabric overlies the card or paper to be printed on, and the types are rapidly stamped upon this endless chemical band, which impresses the colour on the card. The band lasts for several days in constant work, and costs only about three halfpence.—*Builder*.

PICKLING APPARATUS.

To reduce the system of Pickling to an expeditious, simple, and certain operation, Messrs. Burgess and Sons, of the Strand, have adopted an apparatus shown, invented and patented by Mr. H. A. Manfield. The process consists in placing the vegetables to be pickled in an air-tight vessel, and after exhausting the air therefrom, admitting the spiced vinegar, which thus penetrates at once completely into the pores or fibres of the vegetables. As the vinegar penetrates to the centre, vegetables pickled by this process are in a better condition for eating in a few hours than they would be in three months, when pickled by the usual process. The apparatus consists mainly of a cast-iron cylindrical chamber or receiver, a perforated wooden cage for containing the vegetables to be pickled, and a globular reservoir of cast-iron, the interior of which is enamelled, for containing the spiced vinegar. The whole of this is carried in a strong cast-iron framing, on the top of which is an overhead crane for lowering and raising the cage of vegetables. The other adjuncts of the apparatus are two sets of air-pumps, one for exhausting the air from, and the other for forcing the air into the cast-iron cylinder. These pumps, which are worked independently, are driven by a Lenoir gas engine, a considerable vacuum and pressure being alternately attained. A pipe leads from the bottom of the reservoir to the cast-iron cylinder, by which the spiced vinegar is conducted to the vegetables. Another pipe communicates with the cylinder and the top of the reservoir, by which the pressure can be equalised in both vessels when required. The cylinder is fitted with the necessary cocks and safety-valve, and liquid vacuum and pressure-gauges.

The mode of procedure is as follows:—The cover of the cylindrical chamber having been removed, the wooden cage is filled with vegetables, and hoisted and carried by the travelling crane over the chamber into which it is lowered. The lid is replaced by the crane, and fastened air-tight by bolting. A cock is now opened, and the exhaust pumps are set to work, exhausting all the air from the pores of the vegetables, and any moisture or liquid from the same is drawn off by the vacuum cock. The cock mounted on the pipe connecting the chamber with the top of the receiver being open, and the vacuum equal in both vessels, the vinegar is then allowed to flow into the chamber by opening the cock on the lower connecting pipe. These cocks are now closed, and the condensing pumps are set to work to compress the air above the vinegar in the cylindrical chamber, which had been previously admitted by a cock, thus forcing the vinegar into the pores of the vegetables, and causing it to penetrate at once completely to the centre thereof. After remaining under pressure for an hour at most, the air-cock is opened, the lid unfastened and taken off, and the cage of vegetables removed. The whole of the metal parts of the machinery with which the vinegar comes in contact are made of platinum, which, being the only metal the vinegar touches, renders the pickles free from the dangerous presence of copper.

The principle of the process, it will be seen, is just that employed with so much success in preserving wood, the pickling material being made to take the place of the air and moisture present in the substance to be preserved. The soundness of the principle is so self-evident, that the successful results of its working cannot form a matter for speculation. Practice has reduced them to an absolute certainty, and has demonstrated that, in an hour or two, science can thus produce all the results of several months of immersion under the old system. And there is something more than this; advantages are afforded by the new process which were unknown before. Thus Dr. Hassall reports, that the pickles prepared by Messrs. Burgess with the new machinery are superior in several respects to those made by the old plan. The advantages are, that the pickles contain much less salt; are so speedily and completely saturated with the vinegar, that they become at once in a state fit for use; that since the only metal with which they are allowed to come into contact is platinum, they are absolutely free from copper, or any other metallic contamination; lastly, they are much more tender, and consequently more digestible, than the pickles prepared in the ordinary manner.—*Abridged from the Mechanics' Magazine.*

NEW AMERICAN MACHINES.

AMONG the articles exhibited in the American department at the French Exhibition were several worthy of special attention from their originality and excellence. One of these is Roots's Blower for blowing air into furnaces, which consists of two leaves or vanes, somewhat like a dumb-bell in the cross section set on separate axes, and revolving within a case, so that the rounded end of one leaf gets into the hollow centre of the other one during their rotation, and so presses out the air. This machine produces a strong and equable blast with small waste of power; and its employment is meditated for the propulsion of carriages in pneumatic railways, instead of the fan at present used, and by which about 80 per cent. of the power is lost. Another ingenious American contrivance is a Loom for weaving ladies' stays, with all the protuberances and indentations proper to fit the shape, and even with the pipes, or hems, necessary for the reception of the whalebones. This loom will weave forty pairs of stays in the day of ten hours, and they will be complete, with the exception of the lacing-holes. The gores are woven in by the aid of the jacquard apparatus, which lifts up only some of the threads of the warp to be incorporated with the weft, leaving the rest of the weft free, and this free weft is drawn back by an elastic finger, and is carried forward by the shuttle at the next stroke, to be incorporated in its turn with such part of the warp as the jacquard arrangement determines. Any species of garment may be woven in a loom of this character. Whitney's Gauge Lathe for the rapid and automatic production of small moulded pillars, such as are used in the railings of offices and the backs of chairs, is another very skilfully-devised machine, which will save an enormous amount of labour where many such pillars are required. There is also a good Button-hole Sewing-Machine exhibited, in which the garment is clamped to a central piece of metal in the table, which turns round, carrying the garment with it, to enable the stitching to be properly completed. But it would be better to keep the garment fixed, and to cause the arm carrying the needle to turn round; and this might be done without much difficulty.—*Illustrated London News.*

PAPER-MAKING MACHINERY.

Two of the most interesting mechanisms shown in the French Exhibition, but which have only lately been put into operation, are the machines for the production of pulp for the manufacture of paper by grinding down wood. For some time past experiments have been in progress for the preparation of such pulp from wood by a chemical process, which would dissever the lateral adhesion of the fibres without reducing their length. But the contrivances to which we now refer are purely mechanical. The first of these machines, the invention of H. Voelter, is constructed by Decker Brothers, of Wirtemberg. In this contrivance, short pieces of wood are pressed by appropriate mechanism against the rim of a large rotating stone, like a grindstone, by which attrition the wood is rapidly ground down, sufficient water being suffered to flow upon the stone to carry away the abraded particles. This water enters a tank in which there is a cylindrical sieve revolving, which excludes all the coarse particles, but allows the fine to pass through a pipe or trunnion on which the sieve turns. The particles are next carried between two horizontal millstones, where they are ground finer with the aid of water; and the effluent fluid is then subjected to two or three cylindrical strainers like the first, but each in succession finer than the preceding, and the pulp caught by the coarser of these sieves is either returned to the millstones, to be again ground, or is used for the manufacture of the coarser kinds of paper. The pulp, when brought to its finest consistency, is mixed with about an equal weight of pulp from rags for the production of printing and writing papers. Most of the papers produced in Germany have a certain proportion of wood pulp entering into their composition. But in England the invention is little known. The second machine is an American invention, introduced into France by Montgolfier and Sons; and the principle on which it acts is similar to that of the foregoing, only that a serrated disc of iron or steel rotating vertically between the serrated ends of a drum containing it is employed to abrate the wood instead of the grindstone and millstones introduced in the former case. These mechanisms are also suitable for the production of paper from straw.—*Ibid.*

ELABORATE CLOCK.

Breslau, in Silesia, was represented in the French Exhibition by an elaborate Clock, which reminds us of some of the examples of exuberant ingenuity displayed in the Middle Ages. It shows on a large dial the time at Breslau, and on a smaller dial below, the time at Berlin. On twenty-four other dial-plates are shown the time at twenty-four principal cities in the world, including Pekin, Sydney, Calcutta, Moscow, St. Petersburg, Constantinople, Rome, Paris, Marseilles, London, New York, &c. On these dials, the minute hands do not move gradually on, but each moves instantaneously forward through the division of a minute after the lapse of a minute in time. Under the dials, a globe of the earth revolves once in twenty-four hours, and a hand fixed above it shows the line of the meridian. Another globe is introduced showing the motions of the moon. Of course there is no difficulty in the production of such mechanisms, and the only reason why we so seldom see them is because they are little in demand.—*Illustrated London News.*

NEW ICE-MAKING MACHINE.

In all the Ice-making machines until now produced, the cold is produced either by the evaporation of a very volatile liquid, as in the ether machine, or by a condensed gas rapidly reassuming the gaseous form, as in the ammonia and sulphurous acid machines. A machine, however, has now been contrived which is made to freeze water by its own evaporation. It is simply an air-pump fitted to a bottle. The bottle is half filled with water, and the pump is set to work. Air is first pumped out, and then the water rapidly evaporates. To complete the vacuum and increase the evaporation, the air and aqueous vapour pumped out is made to traverse a hollow cylinder containing sulphuric acid, which of course instantly absorbs the moisture. The evaporation is so rapid that the remaining water is quickly converted into a mass of ice. Four minutes' pumping suffices to produce two pints of ice, with an apparatus which only costs about 50*s.* —*Mechanics' Magazine.*

AERIAL NAVIGATION.

The practicability of controlling the movements of Balloons has long been the subject of anxious thought and numerous experiments; but, notwithstanding the many ingenious contrivances which have been attempted, the problem still remains unsolved. During recent wars, we have seen balloons employed for reconnoitering purposes, and with great advantage, but, as in all those cases free movement at the mercy of the winds would have been hazardous, the aerial machine retained a hold upon solid earth by means of rope and grapnel. It is, however, now stated that the object long sought in vain has at last been attained by a French mechanician, M. Daniel Dulaux, of Bordeaux, who, after ten years of patient study, asserts that he has discovered a method of guiding a balloon by means of a very simple apparatus.

The first ascent with Nadar's great Balloon, the "Géant," has been made from the esplanade of the Invalides, in Paris. Besides the captain, assistant-captain, and two men, there were in the car MM. Sourel and Simonin, members of the Meteorological Society of France; and M. W. de Fonville, scientific editor of *La Liberte*. There was some difficulty in getting the great machine to rise, and one person was compelled to descend before the buoyancy was sufficient, but at last the balloon rose majestically, and was soon lost in the clouds. The trip was merely experimental, and M. Simonin records the few facts observed. The balloon entered the clouds at 650 mètres above the earth, and in five minutes after, having ascended 359 mètres more, the aeronauts were in full sunlight. The total altitude attained was 1,030 mètres; the mercurial barometer marked 674 millimètres, the thermometer 16 deg. Centigrade, the air hygrometer 88½. At the surface of the earth before starting, the pressure of the air had been 760 millimètres, the temperature 18 deg., and the humidity 82 deg. The trip only lasted one hour, and the balloon descended at Chilly, four leagues from Paris, without any further accident than the breaking of a thermometer, the uprooting of an apple-tree, and the knocking off the coping stones of a wall. The direction was due south, and the force of the wind 18 kilomètres, or more than eleven miles an hour. On the same day, M. Flammarion made a third ascent in a smaller balloon.

On the Anchored Balloon of M. Henry Giffard, the celebrated inventor of the injector for steam-engines, the *Chemical News* states that the inventor has spent more than 4,000*l.* upon the realisation of the greatest experiment of modern times. Having rented a plot of ground adjoining the extensive engine factory and machine works of M. Henry Flaud, he there erected an immense cylindrical screen of canvas fixed upon vertical poles. In this he constructed a balloon 69 ft. in diameter, holding 210,000 cubic feet of gas, formed of two webs of closely woven linen, cemented together by several layers of American black india-rubber varnish, the whole being covered with drying oil so as to prevent any of the effects of osmose or diffusion. Two series of gigantic apparatus have been constructed on the same spot, for the production of pure hydrogen. The first is composed of 100 barrels, each containing 155 lb. of dilute sulphuric acid, with a large quantity of iron turnings capable of furnishing, each, 350 to 400 cubic mètres of gas. The second apparatus is a steam generator, by aid of which the steam is decomposed, by passing over red-hot charcoal, or incandescent coke, into pure hydrogen and carbonic acid gas; the hydrogen is separated from the mixture by the aid of quick-lime, which absorbs the carbonic acid gas and leaves the hydrogen pure, dry, and cool, to be conducted by a main pipe to the upper part of balloon. With this second series of trials the hydrogen only costs two-pence per mètre cube (or about 4*s.* 9*d.* per 1,000 ft.) but the preparations were not quite completed. In a subsequent trial the balloon was inflated with hydrogen resulting from the action of sulphuric acid, and the operation was finished in 8 hours, whereas the filling of the balloon with gas procured by the decomposition of water took 48 hours. The former process gave also 3,500 cubic feet of mother water of sulphate of iron, collected in a vast subterranean basin, which can be sold to be evaporated by chemical manufactures, and which are sufficient to disinfect the cesspools of a whole quarter of Paris. In four days the total loss of hydrogen was only 2,100 cubic feet, or a hundredth part of the total volume of gas with which the balloon had been inflated. The osmose or the diffusion is really prevented. The closing of the upper and lower valves, ingenious beyond description, is absolutely hermetical. The cable, 984 ft. long, by which the balloon was attached to the earth, was coiled and uncoiled by two different steam-engines, which the mechanician can stop or set at work at will by means of cocks which serve for the distribution of the steam. The inflation being terminated, the balloon, containing 210,000 cubic feet of hydrogen gas, was retained by the ballast; at each of the 70 ropes of the group were attached ten sand-bags weighing each 33 lb.; and in spite of this weight of 22,100 lb., the car was more than 3 ft. from the ground, so great was the ascensional force. A rather strong wind, that may be estimated at 33 ft. per second, was then blowing, but it did not prevent the balloon from rising in a vertical direction.

The Aeronautical Society of Great Britain, which now numbers some of the most eminent scientific men of the day amongst its members, held its second general meeting for the reading and discussion of papers upon Aerial Navigation and the Flight of Birds, at the Society of Arts, on April 17th.

Mr. Henry Bright read a paper upon the application of a double action of a screw which would have the effect of raising or depressing a balloon, wanting a certain amount of auxiliary power, and thus save the waste of gas and the necessity of taking up ballast. He claimed as his invention the heliocoplére which has been exhibited in France, as capable not only of raising its own, but an additional weight into the air, and referred to his model which was deposited in the Museum of Patents, South Kensington, 1861. In its application to a balloon the axles of the fans are to consist of tubes. In the centre of the car must be fixed a third iron vertical tube passing through and beyond those axles and forming their axis; the upper extremity of this tube will be turned to form a crown, to which must be gathered and secured the net of the balloon. Through this central fixed tube the valve rope can be introduced into the interior of the car without encountering the rotary action of the arm of the fans; and through this same tube, divided into three longitudinal compartments, will pass two other lines or ropes, one to open, the other to close the neck of the balloon at will. With the apparatus thus suspended by its top to the net of the balloon there exists no limitation to the radius of the fans. Suppose it to be 6 ft. to 10 ft., giving a diameter of 12 ft. to 20 ft., the central portion of this if traversed by the fans would add but little to their power, and the action of the air would then more impinge upon the car. This may therefore be left entirely open, and thus give an uninterrupted view of the balloon overhead. The fans may strike off from the three-foot radius to the extremity of the arms, in which position their action would more assimilate to facing the air, and their power be effective, giving for the smallest radius named at one revolution per second a speed at the circumference a fraction over 24½ miles per hour. The ascensional and descensional power to be obtained will depend upon the area of the fans, their pitch, and their speed, and will be exceedingly varied, depending on their radius.

Mr. Hurry, C.E., of Hereford, next read a paper upon the construction of an aerial machine on the principle of an inclined plane, impelled in the direction of its surface. This was illustrated by a very beautiful model and explained by diagrams.

Papers on the principle of the flight of birds have been read to the Society. Mr. F. Brearey read a paper by the Earl of Aldborough, entitled "Some Remarks on the theory of a Flight of Birds, and its application to an aerial machine." In the machine in course of construction by his lordship, the main portion of the entire weight is sustained by a peculiar form of aerostat, stiffened by ribs, and having fine lines at the stem and stern, and of the best form for cutting through the air; the machine being somewhat heavier than its bulk of air, the power of ascending and descending, and also of propulsion, is obtained by the mechanical action of the wings alone, so that the clumsy expedient of discharging gas for a long voyage is entirely dispensed with. The author asserts that the wing of a bird is a lever which creates a fulcrum for itself, and that by the force of currents meeting at an angle under the wing, the sustaining and propelling forces are caused to act conjointly.

Mr. F. H. Wenham maintains that the only condition for the supporting effect of flight is obtained in the weight of air upon which the hinges impinge in a given time, and that all machines should be constructed specially with this condition in view. In illustration of this theory, the author alluded to a weight or spring pressing upon the rim of a gyroscope, and gradually deflecting it from the plane of rotation, on account of the enormous weight of metal rushing under the supported body in a short time; and, as a proof that the converse of this is nearly imitating the conditions of a bird passing swiftly over a stratum of air, mentions that if the weight or a spring is traversed round the edge of the deflected disc of the gyroscope, this at a slow speed will undulate under the pressure, but at a quick speed the undulation will cease: the disc will again arrange itself in a horizontal position, and the weight running thereon will be entirely supported in one plane by the momentum of the metal which has no direct support.

NEW FLYING-MACHINE.

A NEW Flying Machine has been projected in France, by M. de Louvrié, and has been reported upon, by desire of the French Academy, by M. Babinet. In this machine, as in Henson's,* projected in this country in 1843, the sustaining power is obtained from an inclined plane or kite, driven against the air; but, unlike Henson's, it has no steam-engine or boiler, but propulsion is to be effected by exploding the vapour of petroleum within a cylinder closed at one end, but with a small orifice at the other, from which the gas will issue in the manner of the gas from a rocket. The kite is formed of wire-gauze, covered with gutta-percha.

MICROSCOPES IN THE FRENCH EXHIBITION.

THE collection of Microscopes, including binocular instruments, was remarkably fine. Certainly, within the last few years the improvements that have been made in the mechanical arrangements of microscopes have been very great, and especially by English makers. The introduction of the binocular arrangement of Mr. Wenham and that of M. Nachet, of Paris, has created a new era in the history of the microscope. Mr. Wenham's contrivance, now generally adopted, consists in intercepting one half of the pencil emerging from the object-glass by a prism placed immediately above it, the transverse section of which is a trapezium of such figure that the transmitted half pencil is made to form the usual visual angle with the undisturbed half; the surface of incidence and emergence being both perpendicular to the respective directions of the rays which suffer two internal reflections in passing through the prism. The object is therefore seen stereoscopically, though in somewhat exaggerated relief. Several new and important modifications of illuminating apparatus have also been recently introduced.

The Microscopes exhibited by R. and J. Beck, J. H. Dallmeyer, and T. Ross, United Kingdom, in their mechanical arrangements, means of illumination, and powerful and clear definition, leave scarcely anything to be desired. Among other novelties introduced by Messrs. Beck is that of a binocular 1-8th, in which the prism is fitted immediately behind the back lens of the object-glass, and which, by means of a small screw, can be adjusted so as to divert any number of rays into the second tube; by this contrivance the full field of the object-glass is obtained, and the effect of monocular and binocular visions on the same object can be readily compared. Messrs. Beck also exhibited a 1-20th object-glass. But, although the English microscopes were the best in

* Described in *Year-Book of Facts*, 1844, pp. 5, 6.

the Exhibition, having come out victoriously in the trial of microscopes by the jurors, the microscopes exhibited by Continental makers may be profitably studied. The greater proportion showed a marked improvement over those exhibited in 1862, especially with regard to their mechanical arrangements. The microscopes exhibited by E. F. Hartnack, France, have peculiarities in the employment of two sets of high powers, one of which is used by immersion in water, which prevents a considerable amount of colour resulting from refraction being apparent, and causes, under some circumstances, a greater amount of light to be transmitted; but M. Hartnack's object-glasses do not approach the English glasses in angular aperture. This principle of construction has not been carried out by English microscope-makers, all their objectives being corrected for the reception of rays from air.

The microscopes exhibited by Mirand et Fils, France, combine a polariscope, and possess many ingenious mechanical arrangements.

F. A. Nobert, Prussia, exhibited a complete series of his celebrated test-lines, for which he received a medal in the Exhibition of 1851; and Messrs. Beck showed a very comprehensive and interesting set of microscopic objects.

THE MIDDLE LEVEL SIPHONS.

The great question as to whether or not these Siphons would answer their intended purpose has been solved. Since their first being used in 1862, says the *Times*, there has existed no doubt in the minds of those interested in the engineering profession, and also those in the drainage of the greater part of East Anglia, that the scheme had been most successful, with one exception, and this was, that since the above date they had never before been tested after the effects of a severe long frost, followed by a rapid thaw. It was exactly two o'clock p.m. before the tide on the sea-side had fallen sufficiently to allow of their being worked, and consequently before that time a most rapid thaw had taken place, which, with the rain that fell in the neighbourhood on the previous evening, had loosened large masses of ice. At the time mentioned, the height of the water on the sea-side was 3 ft. 3 in., that on the Fen-side being 3 ft. 2 in. This small difference in the two levels did not at first give the 16 siphons much room for play, but after a short time the difference was increased to about a foot, when they soon showed their power. Mr. George Carmichael, the resident superintendent of the siphons, had taken extra precautions in case of any accident from the ice, as might be seen by lighters being placed at St. Mary's Bridge and other places; and about half-a-dozen men were employed in breaking the ice into small pieces as it approached the iron grating protecting the entrance to the siphons, but these were only similar to those adopted near other ordinary sluices in the neighbourhood, and were hardly necessary when it is considered that whatever passes through the iron grating, or rather railing, could go through the siphons themselves. The ice in passing through became, as it were, minced into smaller pieces, being carried through at the rate of about 50 ft. per second, the diameter of the siphons being 2 ft. 6 in., and the working gauge showing 15½ in. of mercury. It should be stated that the wind at the time was southerly, thus blowing and forcing the masses of ice upon the works. But, notwithstanding this, everything passed over satisfactorily as usual, the ice causing not the slightest derangement in the working of the siphons, and there can be no longer any doubt that these siphons will, for many ages to come, remain monuments of John Hawkshaw's skill.—*Mechanics' Magazine.*

WATER-PIPES.

It is well known that Water Pipes burst during frosty weather by water freezing within them. The best way, therefore, to prevent them bursting, is not to allow water to remain in them during cold weather. There are various means by which this can be effected. A Correspondent advises householders to send for a plumber at once, that he may fix a valve at the bottom of the cistern, over the outlet pipe, with a small wire cord attached, and conveyed through a tube fixed in the cistern to the most convenient place below, so that the water becoming frozen, the action of the valve is not impeded; the danger then is at an end. For three-quarters of the year the valve will not be required, but when the frost sets in, and especially at night, let the valve drop, and the water in the cistern will not be allowed to enter the pipes. The lowest tap being opened, the pipes will soon become empty, and, therefore, quite safe; water may at any time be obtained by a slight pull at the end of the cord, and securing it to a small hook fixed in the wall. A few shillings outlay before the next frost will insure a house from damage that would cost many pounds to repair, besides the inconvenience caused to its inhabitants.

Another Correspondent says:—My method is to insert a common stop-cock in the pipe which brings the water down to our rooms and kitchens, at its nearest possible point to its outrun from the bottom of the water reservoir above. This point will be commonly found at the top of the wall of an upper water-closet, over which the reservoir is commonly placed; but the water-closet supplies of water come down other separate and distinct pipes of their own, which being only momentarily flushed as required, do not remain permanently charged with water, and, therefore, do not require any looking after.

In the topmost main stem, then, of the pipe—which, like an inverted tree, shooting downwards from its root in the reservoir above, enters the house, and, in its descent to the kitchens, sends out its branches to taps in various rooms (in some of which the mischief always occurs)—a stop-cock can be inserted with little trouble, and its future use is an equally simple matter, causing no trouble at all worth counting against the mischief which it will assuredly prevent.—*Ibid.*

THE NEW MILLWALL DOCKS.

THE total area of the land purchased by the Millwall Dock Company is 204 acres; 52 acres will be the area of the water in the docks, so that 152 will be available for wharves and warehouses. The portions of the work constructed have a water area of something more than 33 acres, and present about 2,600 yards of wharf frontage. The magnificent graving dock, which is also included in the work completed, is 413 feet long, and has an entrance 65 feet in width. In the graving dock the old and dangerous method of "propping" has been superseded by the use of "altars"—that is to say, stone buttresses, supported by brickwork. The caisson by which the entrance to the dock will be closed, instead of being dropped into grooves in the usual manner, will be kept up against the stone faces provided for it by the pressure of water on the outside.

The Millwall docks are situated to the south of the West India system, and will, when completed, be of a T form in plan, the supporting line of the letter stretching towards the West India Docks, the cross arms running at right angles with the perpendicular, and being of nearly equal length. The lock-gates are each 43 ft. wide by 31 ft. high, and differ in the details of their construction from any that have hitherto been erected in England. They are "box" gates; but instead of its being attempted to make the "box" formed by each leaf water-tight, as is usually done, the river side of each gate is perforated, so that the water flows freely into or out of the "box." Further, the gates are so constructed that, the water being in contact with both sides of their water-tight surface, the vibration caused by any blows that the surface may receive will be less than in those made under the old system, which, though water-tight at first, did not long continue so, considerable leakage being, of course, the result. The water-tight side of each gate, too, will be exposed to but little injury, as when vessels are being taken through, it will be closed against the wall of the recess into which each gate folds when opened. On each side of the river entrance is a capstan to be worked by hydraulic power, and capable of exerting on a hawser a pull of five tons at the rate of 80 ft. per second. Two smaller hydraulic capstans, each capable of exerting a pull of three tons, at the rate of 80 ft. per minute, have been erected near the end of the inner entrance lock.

The hydraulic machinery at the docks will be very elaborate and complete. The water by which it will be worked will be supplied at a pressure of 700 lb. per square inch by a pair of horizontal engines placed in an engine-house near the graving dock. These engines, which are coupled by the same crank shaft, have each a cylinder 18 in. in diameter, by 24 in. stroke, and they will work double-acting pumps, forcing the water into an accumulator, from which it will be conducted by pipes to the various hydraulic engines. The docks are admirably situated for access from the river, and when the London, Blackwall, and Millwall Extension Railway is completed, they will be placed in direct communication with all the principal railway lines in the kingdom. The engineers are Mr. John Fowler and Mr. William Wilson; the contractors, Mr. J. Kelk, M.P., and Mr. Aird. The dock-gates, swing, and drawbridges, and the hydraulic machinery, have been constructed by Sir W. Armstrong and Co., and have been erected under the direction of Mr. James Hendry.—*Times.*

STEAM ROLLERS.

A NEW Steam-roller for solidifying newly macadamised roads, constructed by Messrs. Morland and Son, from the designs of Mr. David Thomson, has been tested in Hyde Park, and subsequently in Islington, with very satisfactory results. The want of some such implement for consolidating the layer of broken stones spread over newly-made or mended roads has long been experienced; and in Paris several steam-rollers—not of the most perfect construction—have for some time been in operation. Messrs. Aveling and Porter, of Rochester, have also produced a species of steam-roller, which is identical in its mean features with the steam-roller previously constructed by Mr. Clark for Calcutta. Mr. Thomson's roller differs very materially from all these, and appears likely to become the type upon which in future such rollers will be made. The boiler is upright, with Field's tubes; and the roller is driven by pitched chains, to which motion is given by two engines, fitted with link motions. The roller, which is formed of wrought iron, is 6 ft. long and 7½ ft. diameter; and the most of the weight rests upon it. The rest of the weight is supported by two wheels, each capable of swivelling on a vertical axis, and placed near one end of the machine, and by swivelling these wheels the steering is accomplished. The total weight of the machine is about 25 tons, of which about 21 tons rest upon the roller. When a piece of new road has to be consolidated, it is first watered, and the roller is then slowly traversed over it, first in one direction and then in the reverse one. A little gravel is then thrown broadcast over the surface, which is watered again, when the roller is traversed backward and forward over it a few times, and the consolidation is then complete, and the road fit for immediate traffic. The double engines and link motions enable the roller to be moved to and fro with great facility, and without the necessity of turning at the end of the beat. Such rollers, now that they are found to be effective, must come into extended use; and the painful and destructive process of working in broken stones by carriage-wheels cannot be tolerated any longer.—*Illustrated London News.*

DRAINAGE

There has been read to the Institution of Mechanical Engineers, a description of the Pumping Engines at Crossness, for the Metropolitan Main Drainage Works, by Mr. Gilbert Hamilton, of Messrs. James Watt and Co. These engines are situated at Crossnoss Point, about four miles below Woolwich, where the southern outfall sewer for the drainage of the southern portion of London discharges into the Thames; and the sewer being below the low-water level of the river, the engines are employed for lifting the sewerage into a large covered reservoir at a higher level, whence it is allowed to flow direct into the river during the ebb tide, the average height of lift being about 26 ft. There are four independent pumping-engines, each working two sets of pumps, and each of these sets consists of four single-acting plungers, all working in one cylindrical casing. The suction and delivery valves are leather flap valves loaded with wrought-iron plates, the former being placed in a horizontal position, and the latter nearly vertical. The plungers are worked by connecting rods from the engine beam, and the motion is controlled by a heavy fly-wheel coupled to the end of the beam; the engines are double-acting, high pressure, and expansive, and the work done in the up-and-down strokes is equalised by placing one set of pumps on each side of the beam centre. The pumps discharge into a central wrought-iron trough, closed at the top, and provided with an air-vessel to ease the action of the pumps when working against a head pressure in the reservoir. The engines have now been at work more than two years, and in ordinary fair weather the usual amount of working is one engine constantly pumping, and two others for a portion of the time; but this varies greatly and suddenly with the weather, and sometimes the four engines are at full work together for some hours after a heavy rain in London, the effect of which is generally felt at the engines about six hours afterwards. The four engines together discharge 7,000,000 gallons per hour, and are capable of filling the reservoir in 3½ hours, the total content being 24,000,000 gallons. Indicator diagrams were exhibited from the engines, the duty of which is found to be 86,000,000 lbs. raised one foot with a consumption of 1 cwt. of Welsh coal.

SEWAGE IN THE THAMES.

Sewage continues to be troublesome, being deposited in the wrong place. Some correspondence has been published as a Parliamentary paper relating to the large shoals forming in the Thames in the neighbourhood of the main drainage outfalls, near Barking-creek and Crossness. The engineer of the conservators of the river reports that the character of the mud shows clearly enough whence it has come. Dr. Letheby, who analyzed a sample of it in the summer, found it fœtid, and in a state of active putrefactive decomposition. He describes it as consisting of broken-up sewage matter, with the remains of myriads of animalcules, and a large quantity of carbonate of lime in a partly crystalline state, together with the usual ferruginous clay of the lower water of the Thames. He found the very large proportion of 14·49 to 15·5 per cent. of organic matter in the well-dried mud; and he states that by "undergoing putrefactive decomposition this mud, which is accumulating in such large quantities at the sewer outfalls, may be a cause for serious alarm, especially as it there meets with sea water, the sulphates of which may, by their chymical decomposition by the putrefying mud, occasion the escape of much sulphuretted hydrogen, and set up that remarkably offensive change which is characteristic of the action of sewage upon sea water." It is not to be overlooked that near the northern outfall the greatest accumulation is 2,000 feet above the point of delivery, showing that the discharge of the sewage is not so managed as to carry it all down the stream. The survey made in June showed near the northern outfall a space of more than 40 acres, and near the southern outfall about 120 acres of the bed of the river covered by a deposit varying in depth down to seven feet; the deposit has been traced for above a mile, and might be followed further down the river, though in decreasing amount. The conservators have been in correspondence with the Metropolitan Board of Works, whose surveyor does not admit that the accumulations are due to their works. But the Board did not much urge this point, being able to give, in their letter of the 11th of November, a reply which in substance amounts to this—that Acts of Parliament require them to cast all this solid sewage into the lower part of the river, and other Acts of Parliament make it the duty of the conservators to take it out again if it is too much for Father Thames.

BORING MACHINES.

The two following papers have been read to the British Association:—"On the Application of Machinery to Boring and Tunnelling," by General Haupt. The author gave an account of the circumstances under which he had been led to consider the possibility of applying steam to tunnelling; an application which engineers had universally pronounced impracticable, but which he had demonstrated to be not only possible, but, under certain circumstances, highly advantageous. The author then explained the construction of his drilling-engine, the mode of mounting, the appliances for erecting and removing the machines, the power to actuate them, the questions of ventilation, lighting, blasting by electricity, and the application of the system to Cornish mining. The construction of the machines was explained by means of diagrams, without which it would be hopeless to attempt a description. On the subject of power, the author discussed the question of compressed air, the loss of power in compression and transmission, the possibility of using steam by the aid of a vacuum pipe, the superiority of the ventilation, &c. From experiments made by the author at the Franklin tunnel, the enormous loss of power by passage of air through pipes has been practically measured. As an instance of the advantage of using large pipes, it was stated by General Haupt that with 110 square inches of cross-section, 550 horse-power would be required to pass 3,674 cubic feet of air per minute through a pipe four miles long, whereas less than ten horse-power would suffice if the pipe had a cross-section of ten square feet. In the course of the reading of the paper, General Haupt alluded to the military railway bridges constructed during the civil war in America; and he explained the system by diagrams on the black board, and showed how a bridge had been constructed in four days and a half, chiefly by the aid of negroes, which was 600 feet long, and nearly 100 feet high—the timber being cut from the stump.

"An Account of Bergstroem's Boring Machine, used at the Perseberg Mines, Sweden," by Dr. C. Le Neve Foster. The author described a small machine for boring holes for blasting. The machine had taken the place of human labour applied to the mallet and ordinary borer or drill. It weighed only 122 lbs., cost 22*l*. 10*s*., and was worked by compressed air. The air-compresser, pipes for conveying the air, and other details, were described; and Dr. Le Neve Foster then proceeded to an account of the general results which had been arrived at by careful experiment, showing that it had been found that the driving of a level was done twice as quickly by using the machine as it could be done by hand labour, and with a saving of 20 to 25 per cent. in money.

NITRO-GLYCERINE IN SLATE AND TUNNEL-CUTTING.

Experimental blasting has been made at quarries near Slatington, in the United States. The blasting was considered entirely successful in regard to rock. Experiments in the use of the oil in "sculping" (the technical term for getting out the blocks from which slates are made) have not been concluded, but interested parties express themselves confident of its ultimate success in this branch of the business. The oil, it is said, requires one-fifth less drilling for than is necessary in the use of powder, and is more economical in many other respects. Nitro-glycerine is cutting the Pacific Railroad tunnel through the summit of the Sierra Nevada at the rate, it is said, of 50 ft. per week; and by Midsummer fifty miles of road will be added to the ninety-four already in operation at the California end.

DIAMOND-BORING MACHINE.

A substance which has hitherto, with the exception of one practical application, ministered only to the vanities of mankind, seems likely to become an object of much greater utility. A Diamond machine for perforating rocks has been constructed, and is actually at work boring a tunnel on the Bourbonnais Railway in France. We may say at once that diamonds of the first water are not necessary for this work. The black diamond of Borneo is sufficiently hard for the purpose. The machine is of very simple construction. There is an iron tube terminating with a steel ring, and into this ring the diamonds are inserted at moderately short intervals, a row on the outer and a row on the inner edge. The tube is made to rotate, and of course pressure is kept up against the rock. The hollow of the tube receives the nucleus cut out of the rock, which can be knocked off with a hammer. It is said that the machine actually in use bores a very hard rock at the rate of a mètre per hour, although driven only by water power.—*Mechanics' Magazine.*

THE AMERICAN TUBE-WELL.

Probably, no invention of the present day is causing, among scientific men, so much attention as is this exceedingly simple and yet most efficient apparatus for obtaining, in almost all situations, pure water at a small outlay. It consists of nothing more than an iron tube perforated with holes at the lower end, and shod with a steel point, which enables it readily to penetrate the hardest soil. This tube is driven into the ground vertically by means of repeated blows given by a hollow monkey working on the tube as a guide. These blows are received upon a strong clamp firmly gripping the tube near the ground, the clamp being from time to time raised as the tube descends into the earth. The process of driving is continued until it is ascertained, by means of a plumb lowered into the tube, that a water-bearing stratum has been reached. A pump is then attached to the tube, and the water obtained; at first the water pumped up comes thick and dirty, but after a while it comes clearer and clearer until it is perfectly pure which remains. It is evident that, apart from the simplicity of the tube-well system, its great advantage is in the purity of the water obtained. In no ordinary dug well is it possible to prevent surface water and land drainage from mixing with the purer water springing from the bottom; indeed, it is very questionable if, in any case, an open well is more than a cesspool in which the drainage from all the surrounding soil is collected. The unhealthy character of many localities may fairly be traced to the deleterious nature of the water supply arising from this cause, and it must always be a matter of vital importance to obtain water cut off from these impurities, and if possible drawn direct from the natural source. This the patent tube-well system most completely effects, for the tube driven into the ground seals up the well from all surface drainage; indeed, if the sinkers come to water inferior in quality or in quantity, they may drive through that into a lower and better stratum, and completely exclude the upper water; and then, as they pump, the smaller particles of soil pass through the perforations into the well and are drawn up, leaving behind a bed of gravel and small stones, which forms a natural reservoir and filter to each well, and insures the purity of the water subsequently pumped up. This invention is known and appreciated by the Americans, who, in 1860, employed it in the Northern army to supply their troops with water all through the campaign. It is of more recent introduction into this country, but is already beginning to be adopted by all those who value the purity of water. The Government, after testing it practically at Aldershot, have sent a special brigade and a number of wells with the Abyssinian Expedition. The Emperor of the French has had several wells sunk under his own personal supervision, with most decided success, both at Buchy, and near Paris, besides a number for the use of the Army and School of Agriculture.—*Ibid.*

CONSTRUCTION OF BOATS.

The following papers have been read to the British Association:—"On the Stowage of Ships' Boats," by Mr. G. Fawcus. This plan is to pack groups of boats of smaller size within groups of larger boats. Three groups of each, of three square-sterned boats, can be packed together, the heights of the inner groups not exceeding the height of the largest outside group; and thus nine boats can be placed in the space now required for a single boat. The dimensions of the group are such that the taffrail of the next smaller group meets the thwart of the stern-sheets of the next larger one, and the stem-head of the former also compactly fits into the thwart with the mast-step groove of the latter. The foremost of the after-thwarts or seats of the upper or inside boats of each outer group form stays or stretchers to support their own group, and to steady the adjoining one.

"On Covered Lifeboats," by Mr. G. Maw. The author proposes a light boat-shaped iron caisson, perfectly covered, except a man-hole for access, which would be water-tight when closed, and two openings for ventilation, with a self-acting valvular arrangement, by which water would be perfectly excluded during the occasional breaking of a wave, whilst allowing a free passage of air when not submerged.

"On the Construction of the Lifeboat," by Prof. Macdonald. Instead of the common form of the boat, with a sharp keel, the author suggests the more ample and expanded form of the head of the whale, but rising high out of the water at the bow, having bluff sides, but ending in a long clean run aft, narrowing towards the stern, where the moving paddle-wheels of Archimedean screw should be placed.

PETROLEUM FUEL.

Petroleum Oil has been used for fuel in a steam fire-engine in Boston, U.S. The occurring of an extensive conflagration afforded a practical test. In three minutes, or while the machine was being drawn to the fire, steam was raised to a pressure of 100 lb. Other fuel clogs the exhaust pipes of steam fire-engines, but petroleum does not. This was shown at the Boston fire, the engine gaining 30 per cent. of water pressure in excess of any other machine on the ground. There was little or no smoke from the funnel.

THE HYDRAULIC VESSEL NAUTILUS.

In addition to the trials made with this vessel by M. Ruthven, the patentee, experiments have been made to show the new and remarkable features of the system. For instance, it was proved that the movements of the vessel do not depend solely on communication with the engineer, whose office is simply to drive the vessel at full speed, but the control of the propelling power is left entirely with an officer on the bridge or on the deck. The nozzle works as well out of water as when immersed—a fact hitherto unintelligible to many of our most eminent engineers; consequently there is no loss of power in seaway when the ship is rolling, nor do the engines undergo the extreme strain which is involved when the screw or paddle is out of water in ships built according to the ordinary plan. Perhaps, however, the most notable experiment was that which proved that the ship could be stopped in a time which would be inconceivably short to those who consider that no improvement on the old system is possible or practicable. A piece of wood was thrown out forward and an order given to reverse the nozzles. This having been done, the vessel was brought to a standstill and was moving astern before the log had moved much more than half her length, and that though she was backed against a strong ebb tide. By the condition to which we have referred—that no difference is made in the motion of the ship by the nozzle being out of the water—a great advantage will be gained by a diminution of the weight of the stern of vessels constructed on this principle as compared with those built on the plan at present received. Besides, if any damage be done by the rudder its functions can be replaced by the actions of the nozzles.—*Mechanics' Magazine.*

SINKING SHIPS.

The model of an important invention, by Mr. F. C. Kinnear, was shown at the French Exhibition. It consists simply in the application of inflated airtight tubes, in two, three, or more compartments, to the sides of a ship when in a sinking state. These tubes, by the additional buoyancy they would give to the ship, would prevent the possibility of her sinking. They are made of waterproof canvas, and can be easily carried so as to be available in the hour of need; they have only to be inflated by a common air-pump, and are attached to the vessel by rings in her side.

SPEED OF VESSELS.

Admiral Sir E. Belcher has read to the British Association a paper "On the Methods for Testing the Speed of Vessels over the Measured Miles." The author pointed out that the trial of a vessel over one mile could not be considered any test of her real speed or capabilities; besides which, he thought the taking the speed should not be entrusted to those on board. He considered that the force and action of the tides had not been duly ascertained, inasmuch as experience had shown him that, while the surface-tide appeared by the buoys to be running a strong ebb, an undercurrent was running flood, and exercising a considerable influence on the body of the vessel immersed. This underneath current he thought would vitiate any results obtained by the course generally pursued for testing the speed of vessels. He would suggest a series of experiments to test the strength of this undercurrent. He proposed that the speed should be tested on *terra firma*, where umpires should decide, by a pair of fixed theodolites, the time of transit. Taking away from those on board any control over the starting moment, he would cause them to indicate by intersections, every ten minutes, the exact course the vessel has pursued. As regards the mode of trial, the run should be for twenty-four hours at least. She should have a supply of coals for thirty hours. At the end of the run, her remaining coal should be carefully measured, the general temperature of the engine-room should be carefully noted, the condition of the paint on her funnel examined, to ascertain whether the firing had been excessive; and a full report should be made as to how she had behaved against a head sea, her easiness ot steering, &c.

STEAM-SHIP PERFORMANCES.

The Committee of the British Association have presented their Report, which is as follows:—"The British Association possesses a large collection of records of the performance of steamships, accumulated in the course of many years, and printed in the reports of previous meetings, but in a form so bulky and cumbrous as seriously to interfere with their utility for practical and scientific purposes. At the Nottingham meeting, in 1866, it was resolved to entrust the committee, whose names are given, with the duty of condensing and re-arranging the data contained in those records in order to bring them into a more compact and useful shape. That has been done in the present Report, according to a method of which the leading principles may be summed up as follows. All results belonging to any special theory, and all quantities calculated by inference, or ascertained otherwise than by direct measurement, are excluded from the condensed tables; vessels for which certain essential data are wanting are excluded (the essential data being such as the principal dimensions, the displacement, the kind of propeller, the speed, the indicated horsepower, &c.); the vessels inserted in the condensed tables are divided into groups, according to their full speed, and very numerous groups are subdivided according to the displacement; a uniform arrangement of the data is adhered to as far as practicable, and the tables are drawn up in such a form as to be printed in octavo pages."

TO ASCERTAIN A SHIP'S COURSE.

M. Corridi, a naval engineer, has recently invented an ingenious contrivance for ascertaining a ship's course during a voyage. On the dial of the compass, instead of the star which indicates the north, a circular opening is made, furnished with a small lens. The light shining upon the compass penetrates through the lens, and traces a black mark or line on a sheet of sensitive paper underneath, which is made to move at a certain speed by means of clockwork. The sensitised paper turns with the ship, and, as the needle remains perfectly steady, every deviation or alteration of the course is photographed on the paper. —*Mechanics' Magazine.*

MARINE STEAM-BOILER.

A paper has been read to the British Association "On an Improved Marine Steam-Boiler," by Mr. W. Smith. This boiler is constructed with a series of undulating flues, instead of the ordinary arrangements of tubes employed in marine boilers. The results of a series of experiments made with marine boilers of this construction is a very considerable economy in the quantity of fuel required, and also the evaporation of a given quantity of water in a given time. This boiler occupies the same space, and is externally of the same form, as the ordinary tubular boiler.

INCRUSTATION OF STEAM-BOILERS.

A mode of preventing the Incrustation of Steam-boilers, devised by Schmitz, consists in forming an interior case for the boiler, by means of small curved plates, arranged like tiles on a roof, and thus leaving a thin layer of water between them and the boiler. This thin layer heats rapidly, and a powerful circulation of the fluid is produced, which prevents the deposit of any sediment on the boiler. The sediment is deposited on the plates, where, not being exposed to a high temperature, it remains in a pulverulent state. Heat is in this way economised, and the danger of explosion is greatly lessened. Solid particles being constantly carried to the surface of the fluid, they facilitate the disengagement of the vapour, which, therefore, is quietly given off.—*Mechanics' Magazine.*

FRENCH MARINE ENGINES.

M. Dupuy du Lôme has designed a number of Marine Screw-engines for the French navy, of which those of 950-horse power, intended for the *Ocean*, constructed at Creusot, and those of the same power, intended for the *Friedland*, constructed at Indret, are the largest. These engines have each three horizontal cylinders, of which the central cylinder operates on the principle of high pressure, and delivers its steam to the two adjacent cylinders which operate on the principle of low pressure. The high-pressure cylinder is filled two-thirds with steam at every stroke, and expands through one-third when it delivers into one of the other cylinders, the piston of which, as it is moving more rapidly at this point than the high-pressure piston, takes away the steam rapidly, and the expansion is accomplished both in the high-pressure cylinder and in the low-pressure one. This engine is on the principle of Nicholson's engine, some time since patented in England, and in which the steam from one cylinder of a pair of engines, after having completed half the stroke, is let into the other cylinder to begin the stroke and thereafter expands into both cylinders together. In M. du Lôme's arrangement the pressure of steam upon the pistons of the condensing-engines at the beginning of their stroke is the same as if there were no high-pressure cylinder at all, and it would be simpler and in every way better if two engines of the ordinary type were employed with a somewhat longer stroke. There would be no difficulty in so introducing the steam into two cylinders as to produce the same amount of expansion that is produced in these engines in three, and such an arrangement would be simpler and more compact, and the different parts of the machine would be more accessible. Universal joints are introduced into the screw shafts of these engines, and the thrust-bearing, as it is called, or that particular bearing on the shaft by which the thrust of the screw is communicated to the ship, is suspended upon cross-pins or trunnions, so that it may not be affected in its action by any bending of the ship. In all this there is needless refining, and, as a consequence, needless complication. A universal joint of the strength adequate to transmit such a strain is a vast mass of metal, and involves most difficult and expensive forgings. There is nothing in the French engines that English engineers will imitate, and the construction, though solid and strong, is not remarkable for excellence of workmanship or nicety of proportions. In France, where few good judges of such things are to be found, M. du Lôme's performances may find admirers; but in England neither his ships nor his engines will find admirers or imitators. They exhibit the inspirations of mediocrity, worked out, no doubt, by competent conventional knowledge, but quite unequal to the initiation of real improvement.

NEGATIVE SLIP OF THE SCREW.

THE paradox called the Negative Slip of the Screw, which has long perplexed engineers, has recently been explained, in the new mechanical paper *Engineering*, by Mr. Bourne. Steam-vessels propelled by the screw are drawn forward by the rotation of the screw in the water, the water answering to the nut and the vessel being drawn forward in the same manner in which a screw-nail advances when perforating a piece of wood. Owing to the recession of the water, however, the vessel is not drawn forward quite so fast as it would be if the screw worked in a solid, and the difference is termed *slip*, which slip amounts in most vessels to from 10 to 20 per cent. In some vessels, however, there is not only no slip, but the slip is the other way—or, in other words, the vessel advances faster than it would do if the screw worked in a solid nut. This is the phenomenon termed negative slip, and of which, though its existence has long been known to engineers, no adequate explanation has heretofore been given. Mr. Bourne now informs us that when a screw is rotated in water two distinct effects are produced—one to send the water backward and the other to send the vessel forward; and that, action and reaction being equal, these pressures must be equal also. As, however, the vessel is propelled forward through a much greater distance in a given time than the water is propelled backward, there must be much more mechanical power, or *vis viva*, as it is sometimes called, expended in moving the vessel than is expended in moving the water. Nine-tenths of the power, however, expended in moving the vessel is consumed in the friction of the bottom, or rather, in moving a film of water forward by friction with a velocity nearly equal to that of the ship herself; so that, as an ultimate result, we have two columns of water—one moving astern with a low velocity and little *vis viva*, and the other moving ahead with much *vis viva*. When these two forces are balanced against one another the result is a current of water in the direction of the ship, in which current the screw works. Although, therefore, there must always be positive slip, relatively with this current, there will be negative slip relatively with the ocean at large; or, in other words, there will be the same result which ensues when a steamer descends a river.—*Illustrated London News.*

SLIDE-VALVES.

A PAPER has been read to the British Association, "On the Use of Movable Seats for Slide-Valves," by Professor Rankin and Mr. J. R. Napier. The great practical convenience of the slide-valve and link-motion as means of varying the rate of expansion in steam-engines is well known. An objection to their use, however, arises from the fact that the points of admission—cut-off, release, and compression—are related to each other in such a manner that, in designing a slide-valve motion, the fixing of any three of those points for a given position of the link fixes the fourth point also. For example, suppose that, in a certain position of the link, the positions of the excentrics and the lap or cover at the induction edge of the cylinder-port are so adjusted as to give a certain rate of expansion; then the only element remaining capable of adjustment is the cover at the eduction edge of the port; and that element, when it is fixed, fixes at once the release and the compression; and it often happens that the best positions of the points of release and of compression are inconsistent with each other; so that a compromise has to be made.

That objection, in some examples of slide-valve motions, has been overcome by the use of double slides; but in all the double slide-valve motions hitherto introduced there exists the defect of complexity in construction and working; for, in addition to the ordinary handle of the link-motion, a second handle has to be used in varying the rate of expansion. The authors of this paper propose to accomplish the same result in a very simple way, by giving a small sliding motion to that part of the valve-seat which contains the induction edges of the cylinder-ports, so as alternately to contract and enlarge those ports at each stroke of the engine. The only mechanism required, in addition to the ordinary slide-valve gear, consists in the movable seat, with a rod and a third excentric to give it motion. The rate of expansion is varied when required by shifting the link in the ordinary way by the use of the ordinary handle alone; yet the effect is the same as if the admission and the exhaust of the steam were regulated by two different slide-valves, each with its own link-motion and pair of excentrics. Hence, in designing the valve-motion the points of release and compression can be adjusted to the best positions, independently of the points of admission and cut-off. The authors consider that the movable seat which they propose ought to be used together with a kind of slide-valve in which the pressure of the steam is balanced—such as that introduced by Mr. Thomas Adams, in order that the different rates of travel of the slide-valve over the fixed and movable parts of the valve-seat may not produce unequal wear.

THE SUEZ CANAL.

A PAPER has been read to the Institution of Civil Engineers, on "The Suez Canal," by Col. Sir W. Denison, K.C.B. It was stated that the scheme of the Suez Canal might be said to comprise two distinct undertakings. The first, and principal, was the construction and maintenance of a broad and deep water channel on one level, between Port Said on the Mediterranean, and Suez on the Red Sea. The second, preliminary in point of time, and indeed essential to the construction, as well as to the beneficial use of the canal, was the maintenance of a supply of fresh water sufficient for the wants of the population congregated along the line of canal, and specially at its two extremities. The arrangements for the last-named undertaking had been completed and were described. The opinion arrived at by the author, based upon what he saw and heard during a visit to the canal, and upon a consideration of the correspondence between M. de Lesseps and the late Mr. R. Stephenson, and of the report of Mr. Hawkshaw, dated February, 1863, was:—First, that (subject, of course, to the condition that the relative levels of the Red Sea and the Mediterranean were as stated by the French authorities) there would be no extraordinary difficulty in carrying an open salt-water channel from the Mediterranean to the Red Sea of the depth proposed, namely, 8 mètres. Secondly, that no special difficulty in maintaining this channel need be anticipated. Thirdly, that it would be necessary to modify the section proposed by the French engineers, making the side slopes much more gradual. And, fourthly, that the cost of maintaining the above-mentioned depth of water would be found at first to be largely in excess of the amount estimated. Eventually, it was by no means impossible that means might be found to fix or check the drift of sand, or to shut it out from the canal. But for some years it must be expected that the ordinary action of the atmosphere, which had filled up former excavations made in this dry desert, would have the same effect in the new canal. Looking at the work as an engineer, there did not appear to be any difficulty which a skilful application of capital might not overcome.

"DRYMAKINGS" IN HOLLAND.

A REPORT by Mr. Thurlow, secretary to the British Legation at the Hague, gives a description of the polders, or drained lakes, of which Haarlem-meer is the most notable example. It appears that after being pumped dry the area is cut up into parallelograms, which are frequently not much larger than an acre each, and are separated by primary canals. These drain the land in wet seasons and irrigate it in time of drought, as well as forming a highway for the small boats which take the place of the English tumbril or waggon. A certain number of parallelograms are formed into a group, and pump their superfluous drainage into transverse canals, which communicate with the main outlets to the sea. In one case there are no less than four canal systems with different levels, through all of which every drop of water must pass in order to reach the ring dyke which girdles the polder. This dyke is constructed in duplicate, with an intervening space of 15 or 20 mètres, and waterworks are erected on its banks. These dry lakes do not afterwards leak to any great extent, and the rainfall is seldom excessive, being pumped out by ordinary windmills before the 1st of May. The health of the "colonists," as the population may be called, is satisfactory, and the reclamation answers financially. Haarlem-meer took 13 years, being completed in 1852, and cost nearly a million sterling, but the outlay has been recouped by the sale of 42,000 acres. The recovery of the Zuyder Zee is seriously looked forward to, and this would throw all former undertakings into the shade. Amsterdam would then have an outlet to the German Ocean by the North Holland canal, now in process of construction, and which is of such dimensions as to allow two men-of-war to pass each other at any point. During the last 200 years 300,000,000*l.* have been expended for hydrographical purposes in the narrow tract of country, hardly as big as Wales and Yorkshire put together, lying between the Dollardt and the Scheldt, and Mr. Thurlow compares the Netherlands to a copyhold property, with Neptune as lord of the manor, whose fines amount to a million sterling per annum for repairs and superintendence.

SHODDY AND MUNGO.

Under the name of Shoddy an enormous weight of material is now used which once was waste. Shoddy was first brought into use about 1813 at Batley, near Dewsbury. Mungo was adopted in the same district, but at a later period. Shoddy is the produce of soft woollen rags, such as old worn-out carpets, flannels, guernseys, stockings, and similar fabrics. Mungo is the produce of worn-out broad or similar cloths of fine quality, and of the shreds and clippings of cloth. According to the *Times*, the Pollution of Rivers Commission, which has been visiting Yorkshire, was thus informed of the origin of the word "mungo":—A manufacturer gave some of the materials to his foreman, who, after trial in the shoddy machines, came back with the remark, "It winna go;" when the master exclaimed, "But it mun go." These old woollen rags are collected and imported from India, China, Egypt, Turkey, Russia, and, in fact, all parts of the world where woollen garments are worn. They come to Yorkshire from districts where plague, fever, smallpox, and loathsome skin diseases extensively prevail; they are sorted by human fingers when the bales are opened before being placed in machines which tear up, separate, and cleanse the fibre for manufacture; but the Rivers Commission mention that 50 years' experience has proved that these rags are not in any degree dangerous to the health of those who work among them, although in many of the countries where they are collected they are believed to be peculiarly plague-bearing materials. The lapse of time in collecting, sorting, and transmitting the rags, and the possible destruction of any special poison by friction or otherwise, must be taken into account. The dirt, dust, and fine particles blown out by the machines are collected and sold for manure at from 10*s*. to 20*s*. per ton. The shoddy trade is a remarkable instance of the utilisation of waste material. It forms nearly one-fifth in weight of the woollen and worsted manufacture of the West Riding. Mixed with wool, shoddy or mungo is largely used in the manufacture of cheap broadcloths, finer cloths for ladies' capes and mantles, pilots, witneys, friezes, petershams, pea-jackets, and blankets. A considerable quantity is used in the form of flocks for beds. Felted cloth is extensively manufactured with it, and used for table-covers, carpets, druggets, and horse-cloths. From 70 to 80 million pounds weight of shoddy and extracts are used in a year in the woollen trade of this kingdom. The trade could not be carried on to its present extent without shoddy.—*Mechanics' Magazine.*

THE WHEEL OF LIFE.

Under this not inappropriate title the London Stereoscopic Company have brought out one of the most curious optical toys that ever amused a juvenile Christmas party. The principle of the invention, which comes from America, is not new, though the manner in which it is applied in this instance certainly is, and, what is more, the principle is found to be capable of almost indefinite extension. The apparatus simply consists of a small metal cylinder which revolves horizontally on a centre pivot. In the sides of this cylinder 13 narrow slits are made, and in the centre is placed a slip of paper printed with men or animals, birds or fishes. When the cylinder is revolved these figures assume the most extraordinary semblance of vitality—fighting, dancing, leaping, and going through the most wonderful antics that ever a nightmare invented to puzzle the brain. It is quite easy to account for the peculiar optical effects which produce these illusions, but there are some things connected with "The Wheel of Life" which it will puzzle the ablest to account for. Thus more or less than 13 slits in the cylinder spoil the whole effect; again, with 13 printed figures on the inside slips, the greatest amount of animation is produced; with 12 figures the figures themselves remain stationary, and only their hands or legs move, or the balls and things they play with are turned about. But strange to say, with a double slip, that is, with 14 figures on the top and 12 below, or *vice versâ*, the figures all move in contrary directions. What is to account for this? The most curious effect of all, however, is produced by taking half of one slip and half of another, and so fixing them in the cylinder, when utterly inexplicable combinations are produced. As we have said, "The Wheel of Life" is capable of almost indefinite extension in its principle—especially to the illustration of moving photographs, growing flowers, and machinery in motion.

IMPROVED PROCESS OF BREWING.

THE ordinary way of making Beer and Ale is to steep or mash the prepared barley or malt in boiling water, and when all the sugar, starch, &c., are extracted, the liquor is run off and boiled in suitable coppers or tuns open to the air. The hops required to give the beer or ale flavour, and to assist the fermentation of the wort, are put in during this process and are boiled with the wort. When sufficiently boiled, the wort is run off into vats, also open to the air, to cool, and is there subjected to the process of fermentation in tuns, after which it is put into casks for immediate or future use. The great defect in this process, so far as the hops are concerned, is, that during the operations of boiling and cooling the wort, a very large per-centage of the flavour of the hops is lost by evaporation; yet it is absolutely necessary that the hops should be put into the beer at the particular stage of the manufacture mentioned, otherwise the liquor would not ferment properly nor undergo the chemical changes necessary for its conversion into beer or ale. To remedy this defect, Mr. John Schneider, of New York, has patented an invention which consists in placing a quantity of hops in an air-tight vessel, and extracting from the hops the flavouring principle or lupulin by means of boiling unfermented beer or ale, which he pours on to and filters through the mass of hops, and afterwards runs the liquid through a worm or refrigerator, and mixes the extract or essence of hops in due proportions with ordinary beer or ale, whereby the beer or ale is improved in strength and flavour, thus producing beer or ale of superior quality.

CHICORY IN COFFEE.

Dr. Draper gives, in the *Philosophical Magazine*, a simple means of guessing, more or less accurately, at the amount of Chicory present in mixtures of Coffee and that adulterant. Chicory, almost everybody knows in these days, sinks in water immediately, while coffee floats; and Dr. Draper therefore takes a tube and draws out the closed end to a narrower diameter than the upper part. The drawn-out end, into which the chicory sinks, he graduates into four equal divisions, and thus is able to arrive at the proportion present in different samples. This mode of testing is applicable to the estimation of other adulterants besides chicory, for nearly all the substances that have been found mixed with coffee sink in water.

SUPPLY OF LONDON WITH WATER.

Projects for supplying London with Water appear to multiply. First, we have a scheme for bringing water from the sources of the Severn, in Wales; next, we have a plan for bringing water from the lakes of Cumberland; and, finally, we have the assurance that the water obtainable from the basin of the Thames itself will supply all the wants of the metropolis. There are, moreover, conflicting claimants of the same source of supply; and another scheme has been propounded for utilising the water of the Cumberland lakes for supplying the great towns of the north of England, which, equally with London, are in want of an improved supply. About thirty-five years ago engines were erected by Boulton and Watt at Aberdeen to pump water from the Dee, to give an increased supply to that city. But these having now ceased to be adequate, the works for supplying water by gravitation, lately inaugurated by the Queen, were constructed. Liverpool, after having expended a large sum in increasing its water supply, by bringing water in pipes from a reservoir at Rivington Pike, now proposes to go for a further supply to the Bala lake at the head of the Dee; and everywhere signs of activity are manifested to increase the quantity and amend the quality of the water supplied to our great centres of population. The scheme for supplying water from Loch Katrine to Glasgow, and which has now been for a considerable time in operation, has been eminently successful in every sense; and such is the softness of this water, that it is reckoned enough money is saved in soap alone by the population in the year to pay a fair dividend upon the whole capital invested in the works. Mr. Bateman, the engineer of the Loch Katrine scheme, is also the author of the plan for bringing water from the sources of the Severn to London; and he shows that this water would be pure and abundant, and could be conducted to London on a sufficiently high level to supply all our houses by gravity. He further shows that, if all the existing water companies were to be bought up, and their existing dividends guaranteed to them, the revenue of a great scheme for supplying all London would still be adequate to pay a fair dividend on the capital invested. Certainly, London will not for ever remain satisfied with its inadequate and intermittent supply of impure and hard water, when it has the option of obtaining, on similar terms, an abundant and constant supply of water that is both pure and soft.—*Illustrated London News.*

PRESERVATION OF MILK.

GAY-LUSSAC has proved that Milk kept from the air is preserved for a long time perfectly good. Profiting from this experience, M. Mabrun warms milk in a moderate temperature in a tin vessel, furnished with a tube of lead, to expel the air; then the tube is compressed, and the orifice is closed with solder. When the milk is used at the end of several months, it will be found desirable to stir up with it the cream which is formed on the upper part of the liquid. M. Mabrun, having laid this process before the French Academy of Sciences for their examination, the committee report that milk thus preserved after six months still possesses all the properties of fresh milk. A prize of 1,500 francs has been awarded to M. Mabrun.

LONDON MILK.

IN order to gain an insight into the real quality of London Milk, the proprietors of the *British Medical Journal* obtained specimens of milk from ten first-class establishments at Notting Hill, Knightsbridge, Kensington, St. Giles, Blackfriars, the Strand, Bayswater, Paddington, Kennington, and Fulham, and submitted them to Dr. Voelker for analysation. The price at which these specimens were obtained was in every instance, save two, 4*d.* a quart. At Knightsbridge and at Kensington the charge was 5*d.* a quart, the quality being in both these cases considerably worse than where milk was being sold at 4*d.* a quart. In every instance, save one, the milk sold as whole milk was skim milk lowered with water until its real value was less than 1*d.* a quart; and the more wealthy the neighbourhood, and the more showy the shop in which the milk was sold, the worse proved the article supplied. In the Knightsbridge establishment, Dr. Voelker reports that the milk sold at 5*d.* a quart is skimmed milk, from every gallon of which, valued at 16*d.*, eight pennyworth of cream had been abstracted, and to which an amount of water had been added which gave the dairyman an illicit profit of 14½*d.* on every gallon sold over and above what would have been a fair trading profit. Of the ten samples analysed, this Knightsbridge sample was the worst save one. Only one sample stood the test of analysation triumphantly: that was supplied by the Aylesbury Dairy Company, and proved to be pure milk, with the full amount of cream in it.

SHIPS OF WAR.

An important paper upon Ships of War has been read before the Institution of Civil Engineers by Mr. Bourne, for which the Institution awarded to the author the Watt medal and Telford premium of books. In this paper Mr. Bourne states that the Iron-clad navies of France and England are a mistake, being constructed upon the broadside principle, with high sides, which is only another name for their armour; and since the paper was read it has been found by experiment that the Rodman 15-inch gun, with round shot, and our own wrought-iron guns with Palliser projectiles, are able to pierce even the *Hercules* target, which represents the strongest of our iron-clads now under construction. The author is of opinion, that vessels built on the Monitor system of Ericsson are the only ones which are capable of carrying sufficient thickness of armour to resist modern ordnance; and any Monitors now to be built, he would propose, should have side armour 18 inches thick backed by 4 feet of oak, and a turret 24 inches thick, carrying two 20-inch wrought-iron guns. Such a vessel could be constructed on a displacement but little different from that of the *Bellerophon*, and would not only be impenetrable now, but would probably remain so for some years. It is mere fatuity, however, to go on building vessels with such thin armour as 8 inches or 10 inches, which either existing guns can pierce, or guns a little more powerful—and such as will be sure to make their appearance in the next few years—will certainly be able to pierce. Thick armour, however, cannot be applied to any vessels of moderate dimensions unless they are built upon the Monitor system, with a very low side, with a turret to carry the guns, and with effective means for preventing the water which comes upon the deck from entering the vessel. At one time the impression was widely entertained, that the Monitor vessels, from being so low in the water, were not seaworthy, and could not be rendered so. This has been shown by ample experience to be a complete mistake. It is also a mistake to suppose that these vessels do not afford comfortable accommodation for the crew. By statistical returns it appears that they are the most healthful vessels in the American fleet. They are also the most popular with the sailors. Nevertheless, such is the intractability of naval prejudice in this country, that, up to the present moment, while there is an abundance of frail antediluvian arks—powerless for offence and equally powerless for resistance—there is not a single Monitor in the Royal Navy. The fact is, the art of maritime war has entered upon a phase with which naval men, as a rule, are but little qualified to deal. It is a question of a preponderance of forces; and the Monitor is the engineering solution of that problem. The common iron-clad is merely an ordinary ship covered with armour to keep the balls out; and as the armour has to be spread over a high side, it is necessarily thin and weak. In the Monitor system the area to be protected is reduced to a minimum; and, consequently, with the same displacement of vessel the armour may be made thick. In both the armour and the guns the broadside system is a system of diffusion—the Monitor system one of concentration; and in any contest between a Monitor and a broadside vessel of equal size, the broadside vessel must necessarily succumb, simply because a large force, whether of penetration or of resistance, must necessarily prevail over a small one. The Kalamazoo class of Monitors, built by the Americans, has side armour 14 inches thick backed by several feet of oak; and these vessels possess great facility of evolution, as they are fitted with balanced rudders and twin screws.

In the discussion which ensued upon this paper, and in which Mr. Scott Russell, Capt. Selwyn, Admiral Elliot, Sir E. Belcher, Mr. Bramwell, Mr. Mallet, Mr. Longridge, Capt. Scott, Capt. Hamilton, Capt. Symonds, Mr. Hemans, Mr. Barnaby, and many others took part, some of Mr. Bourne's positions were strongly contested and as strongly vindicated; on the whole, the balance of evidence was in favour of their cogency and soundness, there being little else than nautical prejudice arrayed against them. It follows from the truths evolved from this discussion, that our maritime defences are in a most imperfect state, and that our newest iron-clads are little better for resisting shot and shell than our old wooden ships, supposing the ordnance to be arrayed against us to be of the most powerful kind, whereas with such Monitors as Mr. Bourne proposes we should be unassailable by any guns either now made or projected.

NOVELTIES IN THE PARIS INTERNATIONAL EXHIBITION.*

Armstrong, Whitworth, and Palliser Guns.

Sir William Armstrong showed a 12-ton 9-inch Rifled Gun, mounted on its carriage, on the construction of which an amount of mechanical ingenuity has been brought to bear which does the inventor the highest credit. We recommend this carriage, with its simple and beautiful appliances for checking recoil, and the very nice arrangement for loading heavy guns on a broadside (a point which has as yet scarcely been sufficiently considered), to the careful examination of everyone interested in the subject. The carriage is substantially the same as that which has been adopted by the English Government. Sir William Armstrong, in addition to some projectiles, fuses, &c., showed a field-gun on

* Selected and abridged chiefly from the Reports on the Classes, prepared by order of the Committee of Council on Education; and published in the *Illustrated London News*. A few of these abstracts have, however, been derived from other sources.

an iron field carriage. The wheels of this carriage are made entirely of iron, and the spokes being removable and interchangeable, and the felloes even being in parts, spare wheels may be carried piecemeal, affording considerable facilities for transport and repair.

Mr. Whitworth exhibited a 7-inch (or 150-pounder) gun, a 70-pounder, a 32-pounder, and two field guns. All Mr. Whitworth's guns are made of "mild steel," the successive hoops being forced on by hydraulic pressure. His projectiles, of the hexagonal form with which his name has become associated, included the shrapnel shell which Col. Boxer designed for the Armstrong and Whitworth competition, Mr. Whitworth's own very formidable case shot and some steel shell. The latter are cast under compression by a new process, one which Mr. Whitworth regards as novel, but which we believe has been long applied in the casting of copper and other metals. The process applied to the casting of shells is said to give great uniformity and economy. Mr. Whitworth showed also a machine by which a 7-in. projectile, after being turned out of the mould can be planed to the exact size in six minutes, a quicker process undoubtedly than any by which a cylindrical studded shot can be prepared. The absence in Mr. Whitworth's system of any projecting soft metal studs attains a somewhat increased importance now that the enormous size and weight of projectiles render it difficult to transport or even to pile them without injury to the projections. We are surprised to find Mr. Whitworth still adhering to his flat-headed projectiles for the penetration of mailed ships, when we consider that all iron ships are backed or lined with wood, a material for the penetration of which even the great apostle of flat-heads admits this form to be unsuitable; and we wonder at it more, when we consider that seven and even eight inches of iron have been penetrated by pointed projectiles striking at an angle of thirty degrees.

The last gun in this shed was a 9-inch Palliser Gun made at Elswick. It consists of a body of cast-iron round a coiled wrought-iron barrel. The distinctive feature of this system of construction was first advocated by Major Palliser in connection with the strengthening of existing cast-iron ordnance, into which he proposed to introduce a wrought-iron barrel, instead of heaping on to the outside a quantity of so-called strengthening coils. Major Palliser thus strengthened the interior of the gun, where the strain is greatest, instead of the exterior, where the strain, if sensible at all, is felt only after it has been imposed upon the interior. The system has achieved considerable success, both in its application to existing guns and in its developed application to the building of new guns. The particular gun exhibited, for example, has stood twenty rounds with 43 lb. charges, four rounds with 55 lb. charges, and eighty-seven rounds with 45 lb. charges, 250 lb. projectiles being used in each case. We had thus in the [illegible] section of the Exhibition three distinctive types of guns

—the coiled wrought-iron gun, the steel gun, and the compound gun. To these we may perhaps add the modified coil gun proposed by Mr. Fraser. The varieties of projectiles and of systems of rifling were as numerous. There were steel shell, chilled shell and shot, and others of cast-iron.—*Mechanics' Magazine.*

Krupp's Steel Gun.

The Prussian Government exhibited nothing, but M. Fried. Krupp, the great cast-steel manufacturer of Essen, in Prussia, sent a fine collection of cast-steel forgings, among which were many ordnance and projectiles. M. Krupp's works cover about 450 acres of ground, about one-fourth of which is under cover; the number of men employed is 8,000, besides 2,000 more in the coal mines at Essen, at the blast furnaces on the Rhine, and at the iron pits on the Rhine and in Nassau; also, that during last year the produce of the works was 61,000 tons, by means of 112 smelting, reverberatory, and cementing furnaces; 195 steam-engines, from 2 to 1,000 horse power; 49 steam-hammers, from 1 to 50 tons (the blocks); 110 smith's forges, 318 lathes, 111 planing machines, 61 cutting and shaping machines. The establishment has already delivered 3,500 guns, valued at over 1,050,000*l.*, and it has received orders for the immediate delivery of 2,200 more. Most of the guns made are rifled breech-loaders, from 4 to 300 pounders.

Among the exhibits was the 1,000 pound Steel Gun presented by Krupp to the King of Prussia. It has a forged inner tube strengthened with three layers of rings over the powder-chamber, and two layers over the muzzle portion; the rings are forged from ingots without welding. The manufacture of this gun continued during night and day for sixteen months, and the cost of the piece is 15,750*l.* The breech-loading arrangement is complicated, and some time would be necessary to go through the different operations in loading. The bore is closed by a steel plug and copper ring, which are supported by two wedges—a large one in rear and a small one working on the front of the other; the large wedge is cylindrical in form behind, so that the strain may be distributed, and not received by rectangular surfaces, which are liable to fracture at the angle. The projectile and charges are inserted at the right side, the wedges having been previously loosened by a screw on the other side, the plug, removed by another screw fitted to the front of the rear wedge, and the wedges drawn out and made to rest upon a bed attached to the left side of the breech. The shot-bearer is raised by a derrick, and the projectile is forced home by a screw worked from behind the breech. When loaded, the wedges and plug are replaced, and the front wedge is worked in by a screw until it gives by pressure the requisite support to the plug. The gun is mounted on a carriage having solid steel brackets, and weighs 15 tons. This gun has never been fired.

Instruments for determining the Velocity of Projectiles.

ONE of these instruments exhibited, called the Schultz Chronoscope, is the invention of Captain Schultz, of the French artillery, and carefully protected by a glass case, in the French department. The general principle of its action may be thus stated. A tuning-fork, making an ascertained number of vibrations per second, is arranged to trace on the blackened surface of a revolving cylinder a sinuous line, showing the beginning and end of each vibration. This sinuous line will be an actual scale of time. If, then, the instant the projectile reaches each of the two given points in its trajectory be marked upon the cylinder beside the scale of time, the number of vibrations between the two marks will give the time required. The principal parts of the instrument are the cylinder, vibrating fork, electric interrupter, Ruhmkorff coil, pendulum, and micrometer; and, while experimenting, the galvanic batteries and targets. A double motion of rotation and translation can be given to the cylinder; on each side of the fork are two electro-magnets, to originate, sustain, and equalise its vibrations; and the left branch of the fork carries a quill-point, which marks the trace of the cylinder; the pendulum is used to determine the number of vibrations of the fork per second; the micrometer magnifies the trace and fixes the position of the spark; and the targets are contrived so that after the rupture of one the current is transferred to the next before the projectile reaches it. This instrument has been tried both in France and America.

The other instrument, termed Bashforth's Chronograph, is the invention of the Rev. F. Bashforth, Professor of Applied Mathematics to the advanced class of Artillery officers, Woolwich. It was in the British Marine department. The chronograph consists of a fly-wheel capable of revolving about a vertical axis, and carrying with it a cylinder which is covered with prepared paper for the reception of the clock and target records. Two markers, to trace the surface of the cylinder, are each capable of being lifted up from the cylinder by a lever acted upon by two electro-magnets, one pair of which is connected with a clock, and the other with the targets. Before the shot is fired the cylinder is made to revolve by setting the fly-wheel in motion, and also to descend; and the clock, by breaking the galvanic current at every swing of the pendulum, lifts the clock-marker, which otherwise describes a spiral line on the cylinder, and thus records the seconds and gives a scale of time. When a target is cut by the shot, the current through the electric magnets of the target-marker is interrupted, and the breaking of the second spiral line in the cylinder records the passage of the projectile through the targets. By a simple and ingenious contrivance the current is transferred from one target to another after each rupture. This instrument, when tried, both at Woolwich and Shoeburyness, gave very regular and satisfactory results, and is simpler, and probably cheaper in construction, than the Schultz chronoscope.

Portable Arms.

Among a large number of exhibitors (4641) it is reasonable to expect to find many objects of interest. The comprehensiveness of the collection was in itself a matter of the deepest interest. It included types of almost every conceivable variety of arm, from the stone and flint arrow-heads of the remotest periods of the world's history to the latest and most ingenious developments of breech-loading firearms. There were the rude clubs and maces of aboriginal tribes for hand-to-hand warfare; and there were rifles which would shoot accurately over a range of 2,000 yards. Little toy pistols, so small that the trigger must be pulled with the finger-nail; and the great duck and whale guns, which almost pass beyond the limits of portable arms. There were weapons, too, of every variety of price, from the single-barrelled Liege *armes de commerce*, at 6½f., up to the almost priceless *armes de luxe*, which are a specialité of the French gun trade. There were pistols from 2½f. to 10,000f.; there are swords from 3f. to 30,000f. Also weapons of every degree of finish, and of surprising novelty of construction, such, for example, as a gun containing in the stock a small electric apparatus by which it is discharged (exhibited by MM. Le Baron and Delmas, in the French Court); while, on the other hand, weapons of the rudest and most obsolete make were fully represented.

British Marine Models.

It must be regarded as an unequivocal sign of the times that in an Exhibition especially devoted to the arts of peace there should be found so extensive a collection of those terrible engines of war made use of by mankind for mutual destruction. As might be expected, these predominated in the British Marine department, which comprised under the general denomination of matériel of navigation and for saving life at sea, models of such purely warlike objects as armour-plated ships of war, both of wood and iron, turret-ships, and various descriptions of floating-batteries, cannons, and projectiles. The non-warlike portion of the display consisted of models of submarine boats, merchant-ships—both steam and sailing—floating-docks; fishing, pleasure, and life-boats; marine engines and models of the same, steering apparatus, ships' pumps, pontoons, light-houses, scientific instruments used in navigation; anchors, capstans, and catheads; models of plans for preventing the fouling of iron ships, works on shipbuilding, &c.

Among the objects interesting from their novelty, or general usefulness, were the following:—Mr. Lumley sent Models showing the various modes of fitting his well-known rudder, which has, we believe, been adopted in several merchant-ships and also in some few vessels belonging to the Royal Navy. Messrs. Money, Wigram, and Co., of Blackwall, exhibited Models of a very ingenious Universal Hinge, invented by Mr. Notman, for skew ports. Mr. Clifford contributed a working Model of his

Boat-lowering Apparatus, which enables the boat to be lowered by one man while the vessel is going at full speed; and Mr. May sent a Model of the apparatus invented by himself for a similar purpose. There was a small Model of a new Propeller, invented by Colonel Evelyn, which attracted a good deal of attention. It consists of a paddle inclined at any angle to the surface of the water, moving vertically up and down a revolving sternpost, with which it also revolves. The peculiarity of this propeller is that it is at the same time a most efficient rudder, and that when the vessel is going ahead, by turning the sternpost through an angle of 180 deg. it drives her astern. There is one defect about this which will, we fear, unfit the propeller for practical use, which is, that while the sternpost is revolving through the intermediate angles, the action of the paddle causes the vessel to go to starboard or port, according to the direction in which it revolves. A ship may be in many situations where this would be most dangerous.

French Marine Models.

By far the most curious, if far from the most elegant, of the French models were those of the various machines—we can hardly call them ships—constructed for coast and harbour defence. Of these the *Bélier* is probably at once the ugliest and the most formidable. Her deck is only about one-half of the length of her hull, the remainder of the space being taken up by the ram, which projects for a considerable distance, and by a turret forward, which carries two guns, firing right ahead; the sides of the ship tumble home very considerably, and the stern projects over the rudder so as to effectually protect it. The whole of the ship out of the water, and for some distance in it, is armour-plated; there are no ports in the hull, and the only guns she has are carried in the turret before-mentioned. Her propellers are twin screws, supported on brackets, driven by engines of 530 nominal horse-power, and protected by the overhanging armour-plated stern. As she is capable of being manœuvred by means of her twin-screws in a way unequalled by any known propeller or rudder, and is completely protected by her armour, she is probably, for her size, the most formidable vessel either in the French or any other navy. Her powerful ram, combined with her facility of rapid turning, would enable her to inflict incalculable injury upon an enemy. The Ministère de la Marine also exhibited a beautifully executed model of the Imperial paddle-ship *L'Aigle*, fitted with feathering paddle-wheels, and driven by engines of 1,000 nominal horse power; as well as some fine models of the various classes of transports and *avisos* belonging to the Imperial marine. A very curious model shown by the same department was that of a Submarine Boat, driven by engines worked by compressed air, and intended to be used for the purpose of attaching torpedoes to an enemy's ships. A tube projects out some distance from the bow with a torpedo at its end; a wire passes through this tube; and, after the torpedo has been attached to the ship, the boat moves off to a safe distance, and the torpedo is fired by an electric spark.

Turret Ships.

PROBABLY the collection which attracted most attention in the Exhibition was that contributed by Rear-Admiral Halsted, consisting of models of Turret-ships embodying his own views, and designed by Mr. C. E. Henwood, with plans for converting our old line-of-battle ships into Monitors. In this collection were eight complete models, showing the various classes into which Admiral Halsted proposes an iron-clad fleet should be divided, as well as models of transverse and longitudinal sections, turret machinery, gun carriages, &c. Of these eight complete models, two, carrying one and two turrets respectively, are especially designed for the protection of commerce, and are intended to steam at the rate of fifteen knots per hour; the remaining six, carrying from two to seven turrets each, are to have a speed of fourteen knots. In order to give an idea what kind of ship is required to carry the latter number, we will just quote the dimensions adopted by Mr. Henwood. These are:—Length, 455 ft., or 55 ft. longer than the longest vessel in the Royal Navy; breadth, 70 ft., or 11 ft. broader than the same vessel; and tonnage, 10,764 tons, or 4,100 tons additional. And with these dimensions she only carries fourteen 9-in. guns, four 150-pounders, and ten 32-pounders: these last may be left out of the question, as they would be useless against any modern ship of war. The whole of these ships have tripod masts, with the full sail-power of former frigates, and, by means of spar decks over the turrets, the sails can be worked without impeding the fire of the guns. To obtain good steering power under steam, they have been fitted with balanced rudders of considerably larger area than is generally allowed. The boat equipment is very complete, and steam is provided for launches, pinnaces, and cutters. All the ships have a belt of armour 6 in. thick, with 1 ft. of teak backing and 7 in. of double-rail iron (Hughes's patent metallic backing). This belt is 12 ft. broad, and extends the whole length of the ships at the water-line. It comes up as high as the maindeck, which consists of 1¼ in. of iron and 6 in. of teak, to prevent penetration by bursting shells. During action this deck is to be kept flooded with water, to prevent any woodwork in this part of the ship taking fire, and to assist in rendering any shells, &c., which may enter as harmless as possible. On this deck are the light guns already referred to, none of them being protected by armour. On the deck above are the turrets, and above these the spar-deck. The bulwarks of the upper deck let down, so as to give an uninterrupted fire from the turrets, the two end turrets in all the ships being echeloned, which enables all the turrets to direct their fire on an object situated either right ahead or astern. From the maindeck to a short distance below the upper deck extends what is called the turret-bed, plated with 9-in. armour, and with teak and patent iron backing similar to the belt; the rollers of the turret work on the upper side of this bed. The turret itself is formed of 8-in. armour, put on in rings some 3 ft. broad and 26 ft. outside diameter; the backing is similar to that used on the side of the ship, but stronger and thicker; this description of turret has been patented by Messrs. Napier, of Glasgow, who are responsible for the structural details of these ships.

The guns to be used in the ships are Whitworth's 300-pounders, the heaviest description of gun which can at present be depended upon; they are mounted upon muzzle pivoting carriages, invented by Captain Heathorne. With these carriages, and with the smallest port-hole ever proposed to be used, 20 deg. of elevation and 10 deg. of depression can be obtained. All the vessels are made with their screws to lift; this practice has long been abandoned in the Royal Navy, whereby greater strength is obtained in the stern; moreover, the after sternpost might then be done away with and the weight saved, as in the *Bellerophon* and *Hercules*. The experience of late wars shows that steam will play a most important part in future naval engagements, and that in many cases a considerable part of a ship's sailing qualities may be advantageously sacrificed to it. Admiral Halsted uses too many turrets and guns of too small a calibre, and we cannot help thinking that his vessels would be all the better if he got rid of some of his heavy rigging. The objections we have raised refer more to the details than to the principles of the design, and we think that Admiral Halsted deserves the greatest credit for the trouble and expense he has gone to in setting his ideas before the public. Much as some naval architects may shut their eyes to the fact, the turret system is gradually making its way. Turret-ships are rapidly being improved so far as sea-going qualities are concerned; and it appears to be more than doubtful if the heaviest guns can be worked on the broadside system; if they cannot, the only resource left us is in the turret.—*Scientific Results; Illustrated London News.*

Compound Ships.

Lloyd's Registry contributed to the late Exhibition a very fine series of drawings elucidating their proposed suggestions for Composite Vessels. The principle chiefly apparent in it is to secure a cage, or skeleton, of iron complete in itself in every respect but that of keeping out water. The wood planking then converts it into a ship. The principle involved in this is very important, and depends on the observation that iron and wood together are not generally to be depended upon for helping one another to meet a single strain beyond the strength of whichever of them is separately the strongest. Each material therefore must be kept to its own work. Besides this principle, there is a vast amount of minute structural detail involved in the compilation of such a set of rules as have already been adopted by Lloyd's and other registries for wood and iron vessels separately, and are now proposed for composite ships.

Torpedo Boat.

A MODEL of a very remarkable submarine Torpedo Boat was shown by the French Government. It is a very long and sharp vessel, carrying a pole with a torpedo at the end, which it is intended to deposit under the bottom or against the side of the ship which is to be attacked. The motive power is contained in three cylinders of wrought iron, containing air enormously condensed. This works a small screw-engine, and, after having done its work in that, is allowed to escape inside the vessel for the supply of the crew. There is the usual vertical rudder for giving horizontal direction, and there are also horizontal rudders for giving vertical direction. There is also a little apparatus for altering the displacement sufficiently to bring her to the surface if required, and a little life-boat, so contrived that the crew can leave the vessel by it in case of danger or accident. The vessel is in existence at La Rochelle, and it is said that it has actually remained three hours under water. But from some cause or other, it does not seem to be regarded as of practical utility.

New Compass.

A NEW Steering Compass, by John Lilly and Son, of London, entirely differs from others, as the needles only are placed in a vessel containing liquid which will not freeze at ordinary temperatures, and the indicating card is placed on the upper part of the compass bowl, thus avoiding any discolouration from the action of the spirit. It is fitted with a simple lifting apparatus, so that when not in use the needles and card can be raised from the point and thus very much preserved; and it is so constructed that it is perfectly steady in bad weather, and exceedingly sensitive in smooth water.

Trials of Steam Fire-Engines.

THE following are the particulars and dimensions of Merryweather and Son's Steam Fire-engines that competed so successfully at the Exhibition. The large steam fire-engine *L'Empereur* has two steam cylinders, each $8\frac{3}{4}$ in. diameter; two pumps—double-acting, each 7 in. diameter; suction pipe, $6\frac{1}{2}$ in. internal diameter, worked with a lift of 13 ft. to the pump, drew water from the lake round lighthouse, and projected a $1\frac{3}{4}$-in. stream steadily over the gallery of the lighthouse, and when the wind lulled twice or thrice, the stream went a mètre over the spire on the top of the vane, which is an actual height of 212 ft. from the water, so that the engine projected its stream 215 ft. high. It also played a $1\frac{7}{8}$-in. stream well over the gallery. The engine worked steadily and easily, and maintained steam well. This was varied by discharging four 1-in. streams in different dimensions. Appliances are with the engine for throwing twelve streams of water simultaneously. Merryweather's medium engine has one steam cylinder 8 in. diameter, and one double-acting pump 7 in. diameter, and suction pipe 4½ in. diameter. Their small engine, *Le Prince Imperial*, has one steam cylinder 6½ in. diameter, and one double-acting pump. 5½ in. diameter, and the diameter of the suction pipe of this engine is 4 in. It raised steam to 80 lb. in 10½ min., and commenced working, steadily rising to 140 lb. The average steam and water pressure was 120 lb. to the square inch; suction lift, 8 ft.; delivery hose 320 ft. long; nozzle, 1 in. diameter full. It played remarkably steady and well, and maintained steam easily. Average height of stream computed 120 ft., or perhaps 140 ft. All the engines have steel angle frames strongly stayed, steel tyres to wheels, and seamless drawn steel tubes in the boilers, horizontal cylinders, and pumps without cranks, flywheels, or eccentrics. The large engine *L'Empereur* is of Merryweather's Admiralty pattern, and with which Her Majesty's dockyards have already been supplied, and their smaller engine is of a similar pattern to that adopted by the Metropolitan Board of Works for their Fire Brigade. This engine is also much used by a number of provincial towns and foreign Governments.—*Mechanics' Magazine.*

Steam-Hammers.

THWAITES and CARBUTT's exhibited Steam-hammer, with its wrought-iron framing, was admired by all, and was really worthy of the occasion. A model of the horizontal steam-hammer invented by Mr. Ramsbottom was shown by this firm; it was one of the leading novelties of this Exhibition, and has given rise to much discussion, but the majority are coming round to approval of the principle. During the Crimean war horizontal hammers were used in the manufacture of the wrought-iron Lancaster shells—four hammers, worked by a steam-engine, contained the form of the shell between them; the shell, in the form of a cylinder, closed at one end, had the open end placed between the hammers; a small amount of rapid simultaneous motion was communicated to them, and the red-hot cylinder was gradually pushed downwards, and thus made to assume the bottle form of the elongated shell. In these hammers of Mr. Ramsbottom steam is applied directly to each hammer in a manner that will admit of all the variations of the ordinary steam-hammer, and deserves the special attention of all the engineers or iron and steel makers who are interested in this subject; instead of a hammer falling upon a stationary anvil, two hammers approach horizontally and expend their whole force on the mass between them, and the shock, which would otherwise have been given to the foundation is absorbed by the article under operation.

Another novelty was the steam-striker of Mr. Davis, from the Viaduct Works at Crumlin. By means of this ingenious and simple combination the ordinary form of sledge-hammer can readily be made to rise or fall to any height within certain limits, to turn round to any of a series of anvils surrounding it and in any position, and to strike out in any direction.

Hat-making Machinery.

In the French gallery was shown the whole manufacture of felt hats. The process of making the felt is interesting. The fur, after being passed between rollers, is driven out through a funnel by a rapidly revolving fan on to a revolving perforated brass cone, from under which the air is exhausted, and upon which, consequently, the felt is held down by an atmospheric pressure. It is thus sufficiently consolidated to be able to undergo the subsequent operations, all of which, up to the tying of the last ribbon on the hat, might be seen at the exhibit of M. Haas. The machine used in the manufacture of the felt was made and exhibited by M. Coq Fils. Just on the opposite side of the French machine gallery the whole operations of the manufacture of boots by machinery might be seen.

French Sewing-Machines.

Mr. Goodwin's house, whose Maison Americaine has been established in Paris eight years, exhibited a greater variety of Sewing-machines than any other establishment. The shuttle machine, the revolving-hook machine, both for forming the lock-stitch, were here. He also showed specimens of the double-chain-stitch machine, and the shoemaker's or wax-thread machine. All these machines are good of their kind. The cylinder or wax-thread machine might be seen in operation upon the soles of shoes. The price asked for an ordinary family lock-stitch machine is 350f.; but there is one specimen of a smaller foot-working machine at 250f.

M. Callebant confined himself entirely to the manufacture of the shuttle lock-stitch machine. His machines are admirable in construction and finish. Those machines with the top-motion feed leave nothing to be desired, except a reduction in price; they cost 350f. Both these houses have received several medals for their sewing-machines.

MM. Brassard Frères exhibited some very admirable cylinder machines for sewing the uppers of boots, &c.

M. Marc Klotz exhibited several machines with shuttles adapted to the reception of his thread cartouches.

Diamond-Cutting.

A very admirable and interesting exhibition of the whole process of Diamond-cutting, placed in a detached building, appeared to belong to Holland, though the diamonds exhibited were almost entirely Brazilian. Probably no such extensive and complete a collection of rough diamonds had ever been brought together. In a large series of trays was the cascalhao and other gravel from various localities amongst which the diamonds are found, and the gradual separation of this gravel leaving behind the rough diamonds. The association of the diamonds with other semi-crystalline forms of carbon, and also with the hydrous varieties of quartz (as cat's-eye), was especially noticeable. The groups of crystals of diamond, both complete and in fragments, of all colours and in all degrees of purity, must be seen to be appreciated. The series of illustrations of cleavage was hardly less remarkable. The eye easily recognised in these specimens the peculiar striation of the diamond, and even those most completely rounded by the action of water were readily recognised by this character alone. The polished gems (roses and brilliants), and the whole series of processes, were adapted to illustrate the history of the diamond.

Machine Tools.

Messmer, of Graffenstaden Works, had a grand display of Engineers' Machine Tools, some of them magnificent in design and proportions. Their chief machine, and one of the most remarkable tools in the Exhibition, is that for drilling and slotting the wrought-iron framing for locomotive engines: it is deserving of careful study, and will be found to contain many good points, as well as some defects; but no one can fail to be pleased with it as a whole, and to feel that the time has arrived when we shall have formidable rivals to compete with. Machines of the same character have been made in England by Smith, Beacock, and Tannett, of Leeds, and by others, which in some of the arrangements of gearing were even superior; for when the saddles of this machine are brought to the driving side, the overhanging portion of the shafts must be objectionable, besides the room which is wasted. A machine of this high character may well bear criticism, for, as a whole, it is probably not to be matched by any machine of the kind in the world. A slotting-machine, arranged for cutting the teeth of wheels by the slotting-tool, is rather doubtful, when considered from an economical point of view. This machine does not come up to the high standard of the grand tool, either in its proportions or disposition of the metal, especially in the back parts of the framing, where it is clumsy, which is the more surprising, as they have alongside a smaller machine of the same nature, which is almost faultless in its harmony of form and proportion.

Pocket Chronometers and Watches.

No section of horology showed greater advance since the Exhibition of 1851 than that of pocket chronometers and watches. The most striking feature was an improved proportion of all the works; but the two most essential points of improvement were the increased weights and diameters of the balances, the importance of which in the construction of a pocket watch is now fully established. Although France made a larger exhibition of watches than England, those exhibited by the latter country were decidedly the best. The pocket chronometers and watches shown by Mr. Charles Frodsham, G. Blackie, M. F. Dent and Co., F. B. Adams and Son, V. Kullberg Nicole and Capt, Parkinson and Frodsham, and J. Poole (United Kingdom), were in all respects admirable instruments.

Clock and Watch-making by Machinery.

Attempts are being made by the French to introduce clocks constructed at Dieppe by machinery. They are in all respects greatly inferior to those made in other parts of France, and, if their introduction be general, they will tend greatly to lower the character of French domestic clocks. As a rule, the result of attempting to manufacture clocks and watches by machinery in a plain way is soon to fall into a slovenly method, and thus to discourage good workmen. If the pride of highly-finished work is destroyed, first-rate hands can rarely be retained. The jurors of Class 23 were greatly disappointed by the working parts of French clocks which had been constructed by machinery. They are far inferior to the work turned out in the villages of Lancashire, where the fabrication of our horological movements is carried on.

Match-making.

Sweden being the country which produces the well-known "Tändstückers," was well represented by the "Match-making Company" of Jœnkœping, established since the year 1847, and now managed by Mr. B. Hay. The capital of this company is 22,000*l.*; it employs 620 people, and produced 45,698,241 boxes in 1866, of which about 36,000,000 were exported to England. Their produce consists of ordinary sulphur and phosphorus matches; safety-matches, with red phosphorus on the box; and, lastly, of matches without phosphorus, called by them "allumettes-kali." The process for the manufacture of this last kind of match was patented in 1866, and, if successful, is likely to do away entirely with the use of phosphorus. The price varies from 1*s.* 6*d.* to 1*s.* 9*d.* a gross. All the matches exhibited by this company ignite well and surely, and those called kali appear to be very perfect, and, it is to be hoped, will eventually take the place of all other kinds.

Ventilating Apparatus.

M. Hamelincourt, Paris (to whom was awarded a gold medal), in his design for the ventilation of the Grand Opera, provides for separate systems of ventilation in the summer and winter; in the one case admitting the external air direct, in the other heated. In both cases the fresh air is procured from an opening at the roof to insure greater purity, and enters the house between each tier of boxes. The foul air is drawn downwards through openings in the floor of the house, thence through flues which pass outwards to the walls, where they ascend, again converging to a common central shaft over the dome of the house, which has an outlet for the vitiated air under the cupola. The draught in this great central shaft is promoted by the ascent of the heated air nearest the ceiling of the house, which has access to it through perforations. Thus it will be seen that the air is renewed by entering in a horizontal direction in the sides of the house and going out at the top and bottom, the movement of the air in the pipes which draw it down through the floor being created by artificial heating. The success of such a system will depend on the complete but imperceptible changing of the air to meet fully the requirements of the largest audience; but it is imperative that the air drawn out by the floor should not contain the products of the combustion of the gas used in lighting the house.

In a paper read by General Morin at a meeting of the Society of Mechanical Engineers, held in July, 1867, at the Conservatoire, the following principles for the ventilation of public buildings are laid down; and, as a knowledge of them cannot be too widely spread, an enumeration of them cannot be superfluous:—

Ventilation consists in getting rid of all vitiated air and replacing it by fresh air.

The principal object is to get rid of it at once; it ought, therefore, to be removed from the point nearest to where the vitiation has taken place; and, *vice versâ*, fresh air should be introduced at the point furtherest removed from the occupants of the room.

The removal of the vitiated air by suction is more perfect in its results than by blowing it out.

A judicious arrangement of pipes and inlets will ensure the removal of the air by suction without the assistance of a blowing apparatus.

Ventilation by suction can be obtained by the aid of the ordinary open fireplaces, stoves, or by exhausting flues. Where possible, the air should proceed direct from the source of vitiation, by special flues, towards the bottom of these fireplaces.

Ventilation by suction is also superior to ventilation by blowing apparatus, on account of its simplicity and its easy adoption to the usual warming appliances.

Its superiority in hospitals also consists in there being no danger of a diffusion of the vitiated air of one room to another when it happens that the opening of doors and windows disturbs the movement of the air.

In the rare cases where special blowing apparatus are really necessary, as where the quantity of fresh air to be supplied is continually varying, they should be always employed in connection with suction produced in the manner described.

To sum up, the air to be supplied is collected in the space between ceiling and roof. In summer it enters this space by openings communicating with the external air; in winter the space is filled by air which has previously been warmed by an apparatus under the building, and from which it is led by an ordinary flue. The air is allowed to descend from this space into the amphitheatre by numerous openings in the ceiling, and it is induced to do so by being drawn off through similar orifices made in the risers of the steps under each row of benches, the suction being produced by a fire lighted at the foot of a shaft which communicates with the space into which the vitiated air has been drawn.

The objection which would strike most people is, that the entry of the fresh air above the heads of an assembly and its exit between their legs could hardly be effected without personal inconvenience.

The intention is to supply 1,000 cubic feet of air per hour for each person. The velocity of the current of vitiated air should not exceed 2·6 ft. per second at the openings, 3·9 ft. per second in the shaft, and 6·6 ft. per second at the outlet. The velocity of the current of fresh air should not exceed at the inlets 1·6 ft. per second. The air in the theatre in winter should be about 68 deg. Fahr., and it should therefore enter the room at a temperature of about 64 deg.

Cooking Apparatus.

THE patent Cooking Apparatus, invented by Captain Warren, and manufactured by Adams and Son, was one of the most important objects of this nature in the Exhibition. Together with Perkins's portable field oven, this object places within the reach of the British soldier the means of eating his food prepared in a way which far surpasses anything to be met with in any other army. By some unfortunate circumstance the jury (judging by their awards) failed to appreciate the peculiar excellence and originality of these apparatus. From the peculiar construction of the two boilers in Captain Warren's apparatus, the heat is communicated to them in the most economical way, and it is with the steam thus formed that the principal portion of the work is done, by making it pass through the inner and outer linings of the rectangular cooking-tins on the top. These tins simply rest on the stove, and can be put on or off at pleasure without disturbing the action of the rest. The stove is of wrought iron, containing no brick in its construction. The fire, after passing between the boilers, heats the oven (or roaster), behind and above which lies a portion of the upper boiler. The boilers are supplied from behind, the filling pipes forming also vents, and being furnished with whistles to give warning of a deficiency of water. The advantages claimed for this apparatus are that the meat is cooked in its own juices, preventing absorption of water or loss; that burning, smoking, or over-boiling from too high a temperature is avoided; with a consumption of from 4 oz. to 7 oz. of fuel per man a day; and great simplicity of construction, so that the merest tyro can use it.

Perkins's Military Portable Steam-oven, which can be used for cooking purposes as well as baking in the field, has fire only situated at one end of the long barrel-like vessel. When one recollects the great heat required for the process of baking bread, and the usual mode resorted to for heating ovens, it is difficult to understand how this small furnace thus situated, with a boiler and chimney above, can perform two operations. Mr. Perkins, by his steel tubes, has solved the difficulty. These tubes, which are filled one-tenth with water and hermetically sealed at each end, traverse the length of the oven, lying above and below, their ends protruding into the fire. The oven lies on its bearings, so that the water will remain in the ends of the tubes to be heated until it is converted into steam at a high pressure, filling the tubes and heating the oven which they surround. There appears to be a very remote chance of these tubes bursting, and an accident to one would not impair the efficiency of the rest. The very smallest quantity of fuel of any sort suffices to keep this oven at work, and being on the march will not diminish its heat. Between the outer and inner linings exists a non-conducting substance, which completely prevents loss of heat. Mr. Perkins's ovens are supplied to the British Army both for the field and barrack, and some are ordered by the Government of India to accompany the expedition to Abyssinia. Several other governments have also been in treaty with Mr. Perkins for the supply of ovens on his principle.

The following apparatus, by Messrs. Benhams, is important. Their most novel arrangement was seen in their circular apparatus, of a pattern which is in use in the new West India Mail steamers, and which consists of two roasting-ovens, two pastry-ovens, two hot closets, a broiling-gridiron, a large hotplate, a steam and hot-water boiler, four steam-kettles, two bainmain pans, a rack shelf for saucepans, &c., two furnaces, &c. all within a diameter of 7 ft., yet capable of cooking for 300 or more saloon passengers, and baking all their bread and pastry. There are, of course, guard rails to steady the stewpans, and there is also a guttered edge to the hotplate, to prevent overflows from a sudden lurch of the ship. The oven doors are curved, and slide in grooves; there are catches to secure them in their places; there is a water-gauge to show the level in the boiler, and all necessary arrangements of soot-doors and dampers for the cleansing of the flues and the complete control of the draught. The fuel consumption is said to be very moderate, and the radiation of heat surprisingly small.

The next apparatus in importance and bulk is the Troop Fire-hearth for the Navy. This is of oblong form, and has its furnaces at the front and back, the sides being protected by wood casings; so that all radiation is effectually prevented. It consists of three very large iron boilers for meat, soup, tea, cocoa, &c., capable of cooking for 1,400 men, and with large draw-off cocks for filling the soup-pails; six long iron ovens, shaped like gas retorts, and two large side ovens; the eight being capable of baking 900 lb. of bread, or, by opening a valve, of roasting the meat rations for 800 men; also a large hotplate for boiling, stewing, frying, &c., with two large ovens under it for baking or roasting; these latter being appropriated to the use of the non-commissioned officers, the married men, and the invalids. The whole apparatus is put together in three sections, so that either of them may be disused for cleaning or repairs, without interfering with the full action of the others. The management is perfectly simple, and the fuel consumption very small for the work performed.

The Automatic Kitchen.

THIS admirable invention attracted considerable attention. It may be described as a deal box constructed on the principles of a refrigerator, only that it prevents the caloric escaping instead of keeping it out. The invention belongs to Norway, and it is said to be adopted for the use of the army of that little kingdom, the army of which cannot have much more to do than consume the contents of their cooking kettles and carry their uniforms. Imagine the economy of fuel and the hundred applications of such an admirable plan of sparing and saving time and heat! All that is needed to begin with is a fire sufficiently strong to raise the water in the tin vessel which contains the meat or vegetables, or whatever is to be boiled or stewed, to a brisk ebullition. The fire may then be put out—its work is over. The pot is put into its nest of felt; lock it up, and leave it in your kitchen, or take it with you on your journey. Nurturing its store of heat, the process of cooking goes on hour after hour, just as you need soup, or ragout, or Irish stew, in your box, and ten or twelve hours after you will find it piping hot, so that you may leave London with your supper in your portmanteau, and before you have done your breakfast, and find it cooked and warm at night. Could not a trial be made of it for our troops? For campaigning what could be better? We have spent thousands on stoves and cooking ranges, and have only secured economy of fuel by accepting weighty iron machines with all sorts of tubes and stopcocks and steampipes. Anyone who has campaigned knows that meat is rarely roasted; the ration is most usually boiled or stewed with vegetables. Suppose the camp fires lighted, the kettles just singing and bubbling. There is an alarm of the enemy, or the march must be renewed at once. Nothing more common—nothing more trying to the soldier's temper and patience. With these Norwegian kettles all the men would have to do would be to pop them into their wooden cases, put them on the mules or in the cooking carts, and trudge along to death and glory, or the next halting-place, where, if they arrived in a state to gratify their appetites, they would find their meals cooked and smoking hot, which, next to glory, is probably the most valued boon which could be offered to them at the moment. In the moor—in covert sporting, where crafty lords of land like to spare their pheasants by an interlude of hot lunch; in yachting; in fact, in all places where the processes of cooking are now wasteful and troublesome; above all, in the cottages of the poor, these Norwegian boxes, which are moderate in price, promise to prove of great utility. "The Automatic Kitchen" is patented in France and abroad.—*Times report.*

Elkington's Electro-Plate.

MESSRS. ELKINGTON and Co., the well-known electro-platers, restricted themselves to metal-work, and surpassed all their English competitors in the variety and magnitude of their exhibits. Nothing is too great for them and nothing too small. They will sell you spoons that cost a few shillings (better spoons, too, than the French can make), or they will sell you a shield of rich and rare workmanship that will cost hundreds of pounds, that has exhausted two years of a fine artist's life, and that is all alive with fancy. They began the electro-plate business in Birmingham, and there was every disposition to regard it when first started as worthy of what is vulgarly called "Brummagem." Messrs. Elkington and Co. saved the new class of goods from this contempt by the genuine quality of the work they put into it, and by the taste with which they selected their forms. They produced patterns in electro-plate which completely satisfied the eye—which were far prettier, indeed, than any that could be purchased at reasonable prices in solid silver. They resolutely aimed at the very highest art; they sought out the best designs and the best designers; and they now stand before the world in the first ranks of silversmiths, carrying off the chief prize from all their English rivals. The variety of the work they produce is remarkable. They are not only silversmiths and goldsmiths, but bronze-workers, also enamellers and electro-typists. Their bronzes may be fairly judged by their reproduction in bronze of Foley's Oliver Goldsmith. But their chief claim to superiority they rest on their *repoussé* work in silver and steel. They have shields and tables, tazzas and vases, groups and trophies of beaten silver, on which they have employed artists of the highest talent to work out appropriate designs. One of their best designers is M. Willms, who has produced not a few notable works; as, for example, the Volunteer challenge trophy, and a rosewater dish and vase, bought by the Emperor of the French, the vase adorned with allegorical figures emblematic of day, the dish set off with figures that represent the four elements. But the chief of their artists is M. Morel-Ladeuil, a man of fine fancy, a most skilful draughtsman, and capable of transferring to silver with his hammer the most delicate ideas. His silver table, illustrating the dreams of a warrior, a poet, and a tiller of the soil, was one of the best things in the Exhibition of 1862. His Milton shield, illustrating subjects taken from *Paradise Lost*, is one of the very best things in the Exhibition of 1867.

Partitioned Enamel.

THE chief exhibitors in this beautiful art were Messrs. Christofle and Co., and M. F. Barbédienne, for France, and Messrs. Elkington and Co. for England. Enamelling is peculiarly a French art. We have now to regard *émaux cloisonnés* and *émaux en taille d'épargne*, or *émaux champlevés*. The characteristic of these last enamels is that they are partitioned. They represent diagrams rather than pictures, although sometimes, also, they are used pictorially. Take any geometrical ornament, and suppose it represented in outline on a field of metal. If, after the manner of wood engraving, we cut away the vacant spaces between the lines, leaving the lines raised, we shall then have a number of hollows partitioned by the raised lines one from another. Into one hollow we can put blue enamel, into the next yellow, and into the next again violet; and when these enamels are put into the fire to be fused, the partitions prevent the different colours from running into each other and preserve the pattern. When the hollows for the reception of the enamel are formed in this way—namely, by being cut out, the enamel is called either *champlevé* or *en taille d'épargne*. But suppose that, instead of scooping out the metal to obtain receptacles for enamel, we leave it flat, and obtain our hollows in a different fashion. We can do so by taking a fine thread of metal and soldering it upon the pattern we have in view. The threads of metal then become thin walls of partition, with hollows between into which the enamel can be placed as before—blue in one hollow, yellow in the next, and so on. When the hollows are produced in this fashion, the enamels are called *cloisonnés*. It is necessary to note these different methods of forming the partitions, because there is a real difference in the results. The enamel *cloisonné* admits of infinite delicacy—a delicacy and a freedom of delineation which is not within the means of the enamel *champlevé*. The only *cloisonné* in the Exhibition was to be found in the stand of Messrs. Christofle and Co., and it is most beautiful. There are two or three tea and copper services—say a teapot, a sugar-basin, a cream-jug, and a cup and saucer on a tray, the little array which is known as a *solitaire*. If there is a second cup and saucer, it is called a *tête-à-tête*. These various articles are made of copper-gilt, very nicely shaped, and on their sides are melted enamels of the *cloisonné* sort, of colour the most delicate and of the prettiest flower pattern. It is impossible in a description to give any idea of the beauty of these services, which have also about them the charm of novelty. They cost a good deal of money, about 70*l*. or 80*l*. a set; but then it must be remembered that these are the first things of the kind which have been produced, and they have on that account an extraordinary value as curiosities. The most beautiful of the sets has been bought for the South Kensington Museum.—*Times report.*

Works in Silver, by Vechte.

Antoine Vechte is on all hands admitted to be the greatest living worker in silver; and Messrs. Hunt and Roskill may well be proud to possess his services, and to exhibit his work. What they exhibited, however, had nearly all been exhibited before. There was, for example, the splendid vase executed for the late Lord Breadalbane, which serves also for a candelabra. A number of the Poniatowski gems are framed in the vase, and become translucent when it is made to contain light. There are bas reliefs and statuettes of Mars and Venus about it, beautifully wrought; from the neck of it stand forth five branches for lights, the branches are damascened with arabesques, and they sustain globes round which more intaglios are arranged in zones to obtain advantage of the light. The work (about 6 ft. high) is of silver and iron richly damascened with gold, and is worthy of the artist's great fame. There was another silver candelabrum of Vechte's in the same case, belonging to Alderman Salomon; there was a vase belonging to Lady Ellesmere; but perhaps more remarkable than aught else was the cover of a missal in beaten platinum. The subject which is beaten upon this platinum cover is the Assumption of the Virgin—a beautiful figure, surrounded with angels, two of whom hold a crown above her head. The work is very pure and graceful in feeling, full of resource, and most delicate in execution. Being in platinum it is all the more remarkable, and will hereafter be celebrated as one of the rarest works of the greatest living master of *repoussé*. —*Times' report.*

DUTCH TWIN SCREW TURRET VESSEL.

The *Prins Hendrik* has been completed by Messrs. Laird Brothers, of Birkenhead, for the Dutch Government, and is, we believe, the largest twin screw ironclad yet built. Her completion has been looked forward to with some interest, as illustrating the advantages to be derived from the application of twin screws to vessels of war, among which are supposed to be great additional power of turning and manœuvring, and greater speed where the draught of water is limited. She has been designed to carry the same weight of guns as the *Scorpion* and *Wyvern*, but, being larger in tonnage, has more roomy and complete accommodation for officers and crew, and carries her upper deck 3 ft. or 4 ft. higher out of the water, in order to make her better suited for cruising at sea than those vessels which were originally designed for coast defence. The *Prins Hendrik der Nederlanden* is a vessel of 2,100 tons, and 400-horse power, designed to have a draught of water, when all complete, of 18 ft. mean, and a speed of about 12 knots, and carrying two turrets on the system of Captain C. P. Coles, C.B., R.N., each containing two 12½-ton muzzle-loading 300-pounder guns, thus throwing a broadside of 1,200 tons from her two turrets. The dimensions are about 240 ft. extreme length, 44 ft. breadth, 28 ft. deep at side, and 2,100 tons measurement. The armour-plating is 4½ in. thick, and rests on a teak backing 10 in. thick, which in turn rests on the skin plating and framing of the ship. The turrets are cylindrical in shape, covered with armour-plates 5½ in. thick, and are placed one before and the other abaft the engine-room, and are each fitted with wrought-iron slides and carriages for two 12½-ton muzzle-loading 300-pounder guns on the system of Captain Cowper P. Coles, R.N. They are fitted with the most recent improvements in the way of turning gear, shotlifting winches, &c., and the top is formed of strong beams, and plated 1 in. thick. The rig is that of a bark, the fore and mainmast being fitted with tripods on Captain Coles' patent, to give greater range of training to the guns in the turrets, and the spread of canvas will be sufficient to make the vessel a fast cruiser under sail.

There are two separate pairs of engines, each of 200-horse power nominal, intended to work up to 2,400, having cylinders 56 in. diameter, and 2 ft. 3 in. stroke, driving two gun-metal screw propellers, each 14 ft. 6 in. diameter, on Griffith's patent, so as to offer as little obstruction as possible when under sail. The cylinders have steam jackets and improved expansion valves, and are fitted with surface condensers and other approved appliances for economising fuel, and were designed and constructed at Messrs. Laird's establishment. At a trial trip a mean speed of 12·09 miles was obtained. In testing the steering qualities the following results were arrived at:—With both engines ahead full speed and helm hard over, the half circle in 2 min. 29 sec., and full in 2 min. 43 sec.; revolutions, about 75. With one engine stopped and helm hard over, the half circle in 2 min. 8½ sec., and the full in 4 min. 39 sec.; revolutions, about 75. With one engine "full speed ahead" and the other "full speed astern," half circle in 2 min. 7½ sec., and the full in 4 min. 34½ sec. With engines as above and helm amidships, the half circle in 2 min. 33 sec, and the full in 5 min. 26 sec.; revolutions, about 60.

Natural Philosophy.

FARADAY'S CONTRIBUTIONS TO SCIENCE.

A LUMINOUS and appreciative account of Faraday's contributions to Science, from the pen of Professor de la Rive, has appeared in the *Bibliothèque Universelle*. These contributions are classed roughly under four main heads, and comprehend, first the results of his experiments on the combustion of diamond, on the sounds produced by the combustion of gases, upon the limit of vaporisation, and on regelation, or the power possessed by two pieces of ice to become welded together at temperatures above 32 deg. In 1820 Faraday described two new compounds of chlorine and carbon, and in 1825 he succeeded in effecting the liquefaction of many of the gases. He subsequently showed that a sheet of gold leaf, placed upon a plate of glass, becomes transparent when subjected to a high temperature; but, seen by transmitted light, resumes its green colour under strong pressure. His experiments upon *wootz*, or Indian steel, ended in the suggestion of alloying steel with silver or other metals, to produce good cutting tools; and his elaborate experiments upon glass suited for optical purposes led to the discovery of a kind of heavy glass that proved useful in his subsequent electrical researches.

The second head comprises the researches on electricity and magnetism, and Faraday found that there is no composite body which is rendered a conductor by being brought to the liquid state that is not simultaneously decomposed. He also showed that the theory which supposed matter to be composed of atoms possessing weight, and separated from one another by larger or smaller intervals, was in its own nature contradictory, inasmuch as some facts can only be explained by supposing that the atoms conduct and the space insulates, and others by supposing that the space conducts and the atoms insulate. He consequently concluded that we must suppose matter to be continuous, or, rather, to consist of certain centres of force in a continuous ether. The wires or other conductors which transmit electricity into a liquid, Faraday held to be merely the road by which the electricity enters, and he dismissed the term "pole," which implies the idea of electrical tension, and substituted the term "electrodes." He likewise applied the term "electrolysis" to the chemical decomposition effected by electricity, reserving that of "analysis" for ordinary chemical decompositions in which electricity is not concerned. Lastly, he termed those bodies "electrolytes" which are capable of being decomposed by the electrical current. He showed that the same current decomposes chemically equivalent quantities of all the compound bodies through which it passes, and, taking the quantity of water decomposed as the measure of the quantity of electricity transmitted, he showed that the electricity required to decompose a grain of water is greater than that manifested in 800,000 discharges of a Leyden battery charged by thirty turns of a powerful plate machine, and, consequently, equal to that constituting a strong flash of lightning. The third head comprises the discovery of induction, and also the discovery that electricity and magnetism are merely modifications of the same force, and that one is producible from the other. In the fundamental induction experiment two metal wires covered with silk were wound round a wooden cylinder, and when an electrical current was passed through one of these wires immediately a current was observed in the other wire, but in the opposite direction. He showed that the electricity developed by induction possesses all the properties of common voltaic electricity, and he also showed that terrestrial magnetism, like that of a magnet, can develop induction currents in a metallic wire rolled into a coil and vibrated in a plane perpendicular to that of the magnetic meridian. He subsequently discovered an induced current in the very wire that conducted the inductive current; and he arrived at the conclusion, subsequently confirmed by the researches of M. Matteucci, that induction is effected by the intermediation of the particles interposed between the inductor and induced body; that these particles are polarised one after the other, and that the greater or less conducting power of different substances depends on the greater or less facility with which this polarisation, necessary for the transmission of electricity, is effected. The fourth and last head of discovery embraces the researches respecting the action of electricity and magnetism upon light. Faraday found that when a polarised ray is transmitted in a direction parallel to the line which joins the magnetic poles the plane of polarisation is turned through a certain angle in consequence of the magnetic action. He also found that while magnetic bodies are attracted by the magnet all other bodies are repelled by it. A rod of iron or other magnetic substance suspended between the poles of an electro-magnet places itself parallel to the line which joins the poles; but all other bodies place themselves at right angles with this line, or in some intermediate position. Faraday consequently classed all bodies as magnetic or diamagnetic, and of the latter bismuth, antimony, and the heavy glassed prepared during the experiments on glass for optical purposes, give the most distinct manifestations. All the gases are diamagnetic except oxygen, which is magnetic. Such is a meagre outline of a memoir which professes itself to be a mere outline, but it is one drawn by a master hand.

SINGULAR TERRESTRIAL DISTURBANCES.

M. CH. SAINTE-CLAIRE-DEVILLE has communicated a curious paper, by M. A. Mauget, to the French Academy of Sciences. The author states that from the month of May, 1866, the waters of all the streams and springs of the province of Naples and the adjoining ones began to diminish until the month of June. So far there was nothing remarkable, that being about that time an annual occurrence; but on June 29, to the surprise of the inhabitants, the waters of all the wells, springs, and rivers or rivulets of the country became suddenly muddy, and diminished most rapidly. The same was the case with the Carmignano canal, which supplies Naples with water, and with another canal called Lagno di Mofito. But what caused the greatest astonishment was the fact that all the fish of these different watercourses came to the surface half dead, and were caught in that state by the people in prodigious quantities. On the 30th, the waters became clear again, but they had experienced a diminution of at least one-fifth. The wells fed by springs, which on the previous day were all dry, to find water again had to be sunk deeper, and even then the quantity obtained was but one-half the former amount. Sorrento was left entirely without water, notwithstanding it possesses eleven large reservoirs, built in Julius Cæsar's time, and considered the most remarkable monuments of that period in this part of the country. Two of the many artesian wells bored by M. Mauget in the valley of the Sebeto were filled with sand at the same period, and it was with great difficulty they were got into order again. One of them, which generally supplies 2,000 litres of water per minute, for several days ejected upwards of 200 cubic mètres of pumicestone and trachytic sand. The cause of these strange phenomena is attributed by M. Mauget to some great subterranean convulsion, such as an earthquake, whereby a quantity of carbonic acid must have also penetrated through the large fissures which diverge from Mount Vesuvius and poisoned the waters so as to stupify the fish.

MOUNTAIN ATTRACTION.

THE pendulum experiments now carried on in India in connexion with the great Trigonometrical Survey, under direction of Lieut.-Col. Walker, R.E., have led to certain new and important conclusions as regards mountain attraction. Theoretically, the nearer the observing stations are to the Himalayas, the greater should be the force of gravity; but the reverse is found to be the fact, and the difference between theory and fact diminishes with the increased distance of the stations from the hills. Commenting on this phenomenon in a communication to the President of the Royal Society, Col. Walker writes: "This seems a remarkable confirmation of the Astronomer Royal's opinion, that the strata of earth below the mountains are less dense than the strata below plains and the bed of the sea." Is there not something in this result worth consideration by geologists?

WEIGHTS AND MEASURES.

PROFESSOR LEONE LEVI has read to the British Association the report of the Committee on uniformity of Weights and Measures, which showed that the movement was gaining in decompose a grain of water is greater than that manifested in 800,000 discharges of a Leyden battery charged by thirty turns of a powerful plate machine, and, consequently, equal to that constituting a strong flash of lightning. The third head comprises the discovery of induction, and also the discovery that electricity and magnetism are merely modifications of the same force, and that one is producible from the other. In the fundamental induction experiment two metal wires covered with silk were wound round a wooden cylinder, and when an electrical current was passed through one of these wires immediately a current was observed in the other wire, but in the opposite direction. He showed that the electricity developed by induction possesses all the properties of common voltaic electricity, and he also showed that terrestrial magnetism, like that of a magnet, can develop induction currents in a metallic wire rolled into a coil and vibrated in a plane perpendicular to that of the magnetic meridian. He subsequently discovered an induced current in the very wire that conducted the inductive current; and he arrived at the conclusion, subsequently confirmed by the researches of M. Matteucci, that induction is effected by the intermediation of the particles interposed between the inductor and induced body; that these particles are polarised one after the other, and that the greater or less conducting power of different substances depends on the greater or less facility with which this polarisation, necessary for the transmission of electricity, is effected. The fourth and last head of discovery embraces the researches respecting the action of electricity and magnetism upon light. Faraday found that when a polarised ray is transmitted in a direction parallel to the line which joins the magnetic poles the plane of polarisation is turned through a certain angle in consequence of the magnetic action. He also found that while magnetic bodies are attracted by the magnet all other bodies are repelled by it. A rod of iron or other magnetic substance suspended between the poles of an electro-magnet places itself parallel to the line which joins the poles; but all other bodies place themselves at right angles with this line, or in some intermediate position. Faraday consequently classed all bodies as magnetic or diamagnetic, and of the latter bismuth, antimony, and the heavy glassed prepared during the experiments on glass for optical purposes, give the most distinct manifestations. All the gases are diamagnetic except oxygen, which is magnetic. Such is a meagre outline of a memoir which professes itself to be a mere outline, but it is one drawn by a master hand.

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WEIGHTS AND MEASURES.

PROFESSOR LEONE LEVI has read to the British Association the report of the Committee on uniformity of Weights and Measures, which showed that the movement was gaining in popular esteem. Mr. James Yates, Vice-President of the International Decimal Association, read a paper giving reasons why the office of Warden of the Standards should include standard weights and measures of the metric system, in addition to the standards of the Imperial weights and measures. He pointed out that the metric system had been adopted in France, Belgium, and Portugal, while rapid strides in the same direction had been made by America, Germany, and Russia. Some discussion followed, in which Professor Leone Levi, Mr. Manockjee Cursetjee, and others, recommended the general adoption of the metric system. Professor Rogers moved a resolution to the effect that the section should recommend the committee of recommendations to move the Legislature to introduce a knowledge of the metric system into the schools supported and inspected by the Government. The motion was adopted.

DOUBLE TIDES IN THE THAMES.

It is generally known that the tide ebbs and flows about 70 miles up the River Thames twice in 24 hours; that these tides are influenced by the increase and decrease of the moon, causing them to vary in their times, each one coming 24 minutes later than the former, which wants but 12 minutes of one hour in the 24. But accidents may interfere with this regularity, for if the wind is high at the west or south-west it is known to stop the flowing in of the tide to its usual height, as a boisterous north-east wind has a contrary effect. But it is believed that, although we may have had shifting or preternatural tides, as recorded in *Maitland's History of London*, we have never experienced anything like the phenomena which have taken place during December, 1867. On Sunday, December 2, the tide flowed at Hammersmith in the first place until 5 o'clock a.m.; it then ebbed until half-past 4 p.m ; and then became flood again until half-past 7 p.m. This unusual occurrence was, however, greatly exceeded in its remarkable character by the tide of Saturday, when two flows and one ebb occurred between midnight and 11 o'clock in the forenoon.

PHILOSOPHICAL INSTRUMENTS AT THE LATE FRENCH EXHIBITION.

Since Fraunhofer's most important discovery that the solar spectrum is not continuous but consists of luminous spaces separated from each other by numerous dark bands, researches in the spectra of various kinds of lights have been pursued with great diligence by many eminent philosophers. It has been ascertained that all simple bodies, especially those of a metallic nature, when raised to the state of incandescent vapour, emit light, which, when submitted to prismatic decomposition, does not present a continuous spectrum, but isolated bands of different colours and of different but definite degrees of refrangibility. The colours of these bright lines and their position in the spectrum are found to depend on the chemical nature of the body which emits the rays, and to be invariable for the same substance. To this method of investigation we owe the discovery of several new metals, and it has been ascertained that luminous vapours of iron, nickel, chromium, calcium, magnesium, potassium, and sodium, with some others, exist in the vicinity of the sun. In order to pursue this extremely interesting branch of physical science, which, it is confidently expected, will give us a great insight into the physical constitution of the stellar as well as of the solar photospheres, great attention has been recently paid to the construction and improvement of spectroscopes. Some remarkably fine instruments of this kind were exhibited. By far the most noteworthy was that shown by L. J. Duboscq, France, constructed after Steinheil's model. The beam is successively transmitted through six prisms of 60 deg., by which means the separation of the bands of the spectrum is greatly increased. By an ingenious contrivance these prisms can be easily moved in combination. It is to be regretted that a magnificent spectroscope with nine prisms, constructed by Messrs. Spencer, Browning, & Co., of London, was not exhibited.

Dividing-Engines.

Several of these instruments were shown. Among the best were those of L. Perreaux, France, who exhibited circular and straight line Dividing-engines of various sizes, and, as far as they could be tested, of very great accuracy. C. A. Guillemot, France, also showed a dividing-engine of a novel construction, provided with an arrangement by means of which a curve exhibiting its own error can be described. The above makers also displayed some very delicate cathetometers, by which the distance between two points in a vertical line can be determined to 1-2000th of a millimètre (0·0002 English inch). Two cathetometers, exhibited by G. Brauer, Russia, made under the direction of Professor Jacobi, also merited examination. The smaller one is exquisitely finished, and is capable of measuring distances between two points with very great precision. It is absolutely essential in the construction of these delicate instruments that the working parts should be free from tremor. This condition has been attained in the above instruments, which are decidedly the best cathetometers that have ever been exhibited.

Pantographs.

Several, embracing in some instances new constructions, were exhibited; but the only instrument of this kind which merits special notice is that exhibited by A. Gavard, France. This instrument, consisting of a series of brass rods jointed together in the form of a parallelogram, so as to have perfectly free motion in a horizontal plane, is made by very ingenious and novel contrivances to produce duplicate reductions of figures, &c., not only on plain surfaces but on cylinders. By its means patterns may be drawn and engraved on copper rollers with the greatest precision, and impressions taken from them. The invention, which is highly creditable to M. Gavard, is likely to be of great benefit to the calico-printing trade.

Under the head of pantographs may be included a microscopic writing-machine, exhibited by E. Hardy, France, but which falls far short in its performance of Mr. Peter's celebrated machine, exhibited in 1862, with which the entire bible may be written three times in the space of a square inch.

Miscellaneous.

UNDER this head the following deserve notice:—Bourbouze, France, who showed an ingenious apparatus for determining the laws of falling bodies, their friction and rigidity; L. G. Perreaux, France, an ingenious instrument for ascertaining the elasticity and strength of wires; G. A. Hirn, France, apparatus for measuring the dynamical force of torsion in working machinery; M. Chuard, France, a new safety-lamp for mines; General Arbuckle, United Kingdom, a pyrophylax, or automatic apparatus for giving notice of a fire; C. Wheatstone, United Kingdom (not in catalogue), cryptographs for secret writing, used by the War Office; F. Wedel-Jarlsberg, Sweden, a self-registering compass; S. E. Morse, United States, a bathometer for measuring the depth of water; and a very beautiful screw-cutting lathe, exhibited by R. and J. Beck, which may be considered as perfect of its kind. It is worthy of remark that, while the precise origin of the lathe is unknown, though it may be traced to the potter's wheel of the remotest times, the plan of an extremely ingenious self-acting sawmill moved by water-power may be seen in a MS. of the thirteenth century, preserved in the Bibliotheque Imperial, Paris, and is probably of much earlier date. Turning by the lathe was long a favourite pursuit in France with amateurs of all ranks, who seem to have spared no expense in the perfection and contrivance of elaborate machinery for the production of complicated figures. This taste continued at least up to the great French Revolution, and contributed in a very high degree to the excellence of philosophical instruments. Indeed, the constructive machine most perfect in its action, whether as regards the best manner of using dynamical power or the expeditious performance and the good quality of the work done, is certainly the lathe, and great credit is due to Messrs. Beck for the improvements they have made in that devoted to screw-cutting.—*C. R. Weld; Official Report.*

NEW DYNAMO-MAGNETO MACHINE.

MR. W. LADD has read to the British Association a paper "On a New Form of Dynamo-magneto Machine." The author considered that the most powerful magneto-electric machine hitherto constructed was that by Mr. Wilde,* which received its charge from sixteen permanent steel magnets. Siemens and Wheatstone have since shown that the residual magnetism left in soft iron, after being under the influence of a battery of permanent steel magnets, can be augmented from the currents generated by itself, by merely applying dynamic force to the revolving armature containing a coil of copper-wire, the terminals of which are connected with the wire surrounding the electro-magnet; and, although great effects are produced, the current itself could only be made available by its partial or total disruption—in the former case diminishing the power of the electro-magnet, and in the latter reducing it to its normal condition. But in the machine the author had constructed the power of the electro-magnet is kept up; whilst a separate current, to be applied to any useful purpose, can be drawn off by means of an independent arrangement. It consists chiefly of two plates of iron; to both ends of each is fixed a portion of a hollow cylinder, these plates are then placed at a certain distance apart, and insulated from each other in such a manner that the cylindrical pieces will form two hollow circular passages, into which spaces two Siemens armatures are placed. The plates are surrounded by a quantity of stout copper-wire and connected together; the two terminals are brought into connection with the commutator of the smaller armature, so that each change of polarity in the armature will augment its magnetism. When the machine is first made, it is only requisite to pass a current from a small cell for an instant to give the iron polarity, and after this it will retain a sufficient amount of magnetism for all future work. If the armature in connection with the electro-magnet is made to rotate, there will be a very feeble current generated in it; this passing round the electro-magnet will increase the power with every additional impulse. It will thus be seen that the only limit to the power of the machine is the rapidity with which the armature can be made to rotate, and which is entirely dependent on the amount of dynamic force employed. But the great improvement in this machine is the introduction of the second armature, which, although it takes off currents generated in its wire by the increased magnetism, does not at all interfere with the primary current. The machine now in the Paris Exhibition measures about 24 inches in length, 12 inches in width, and stands 7 inches high; but this one being imperfectly constructed as to its proportions, the results

* At a *conversazione* of the President of the Royal Society, Mr. H. Wilde, of Manchester, showed his electro-magnetic Induction Machine in full operation. Of the magnitude of this machine some notion may be formed from the fact that it weighs about 4½ tons, one-third of the weight being made up of copper wire, and that an eight-horse steam-engine is required to work it. This machine, indeed, is the most powerful generator of dynamic electricity ever yet constructed. It melts thick iron wire as easily as a flash of lightning would, and the light it produces is so intense, that when exhibited one night at Wilde & Co.'s factory at Manchester, it threw the gaslights into shadow at half a mile distance.

obtained are, no doubt, much less than they would be with a better instrument. Notwithstanding, the author had found it would keep 50 inches of platinum wire, ·01-inch diametric, incandescent; and when a small voltameter was placed in circuit with the second armature, it would give off 250 cubic centimètres of gas per minute, and, in connection with an electric regulator, would give a light equal to 35 Grove's or Bunsen's elements, the driving power expended being less than one horse. The author next described a machine of which the first example is now constructed. It is on essentially the same principle as the last; but instead of having two independent armatures running in separate grooves, they are fixed end to end, so as to appear like one continuous armature, but so placed with reference to each other that their magnetic axes shall be at right angles. By this arrangement, there is only one opening required for the armature, and full advantage of the horse-shoe form of magnet can be taken. The shoes of the electro-magnet are so proportioned to each other that there is a break in the magnetic circuit with reference to each armature alternately; but by their disposition at right angles, there never is an actual break in the complete magnetic circuit, but simply a shifting occurs of the principal portion of the magnetic force from one armature to the other at the precise moment required to produce the best effect. The mechanical advantages to be obtained by this disposition of parts must be at once obvious, as one pair of bearings and one set of driving gear required in the previous machine are here dispensed with; and from the fixing of the two armatures together, the currents are made to follow perfectly isochronously with each other. It may, however, be found of advantage to vary the angle of position of the armatures with reference to each other, according to the speed at which they are driven, so that the current given off by the exciting armature may at the precise moment exert its full effect upon the electro-magnet, so as to produce the best effect on the second armature.

Mr. Ladd also described a small magneto-electric machine he has constructed for ordinary lecture purposes.

LUMINOSITY OF PHOSPHORUS.

DR. MOFFAT has communicated to the British Association the results of several interesting experiments which he has made on the Luminosity of Phosphorus. From these experiments it is shown that phosphorus in a luminous state produces phosphorus and phosphoric acids and ozone, and that it is non-luminous in a degree of temperature below 39° Fahr., and that it is luminous in a temperature above 45° Fahr. The temperature of luminosity and non-luminosity, however, Dr. Moffat states, vary with the pressure of the atmosphere, and also with the direction of the wind. When phosphorus is kept in water, and air in a non-luminous state, the water and air become phosphorated, and they become phosphorescent on their temperature being increased, and ozone is formed during their phosphorescence. Water reduced to the freezing point also becomes phosphorated, and it becomes phosphorescent on being heated. Phosphorus in a non-luminous state does not produce ozone; phosphorated air and water are not ozonized, but they are ozonized when phosphorescent. The author observed that steel needles suspended in phosphorus vapour assume magnetic properties, and that a stream of vapour arising from phosphorus is attracted by heat and repelled by cold. From results deduced from a series of experiments made upon luminosity of phosphorus in connection with atmospheric conditions, and extending over a period of four years, it would appear, the author said, that the equatorial or sea-wind is that of phosphorescence and ozone, and that the polar or land-wind is that of non-luminosity and no ozone. From these results, Dr. Moffat is induced to ask, is it not probable, as the sea is the reservoir of ozone, that ocean phosphorescence is the chief source of its development?

The President of the Section, Sir W. Thomson, commented on the wonderful character of the results referred to by Dr. Moffat. They were new to him; but he should certainly take the earliest opportunity of endeavouring to obtain them for himself. Dr. B. Stewart said there was one point in which he did not follow Dr. Moffat; namely, with regard to the action of phosphorus vapour on metallic bodies. Wherever there was a change of temperature, currents of air were very apt to twist, and alter the position of a delicately suspended needle. Steel needles, he observed, if delicately suspended, even if not magnetic to begin with, would become magnetic from the action of the earth. The President remarked that the phenomenon of luminosity stored up in ice, and produced after the melting of the ice, was certainly one of the most startling ever met with in physical science; the luminosity having been induced by the previous presence of non-luminous phosphorus at a low temperature. It was a most beautiful and wonderful result. He was sure the publication of Dr. Moffat's paper would induce persons in all parts of the world to repeat the experiments.

ATMOSPHERIC OZONE.

MANY eminent men have felt and expressed doubts about the existence of Atmospheric Ozone. It is certain that there is at times present with atmospheric air a body that will produce the same effects on prepared test papers as Schönbein's active oxygen; therefore, it is inferred that the two bodies are identical. But it has been shown that many other bodies (and in particular oxides of nitrogen, which are often found in the atmosphere) will produce the same effect on the paper, and hence some have hastily concluded that atmospheric ozone is altogether a myth. We have referred to this subject before, and only return to it in order to make known that Dr. Andrews, of Belfast, whose researches on the nature of ozone are so well known, has satisfactorily settled the identity of the atmospheric agent with active oxygen. There are three tests by which this identity can be established. In the first place, active oxygen rapidly oxidizes mercury. Accordingly, Dr. Andrews passed a current of atmospheric air (which, by means of the ordinary test paper, he had found to contain ozone) over a bright surface of mercury, and he found that rapid oxidation took place. In the next place, active oxygen is reduced to the ordinary condition by contact with binoxide of manganese; and here again Dr. Andrews found that air which showed the presence of ozone before contact with the manganese gave no indication of its presence after having been in contact with that agent. Lastly, we know that active oxygen is destroyed when exposed to the temperature of 237 deg. Centigrade, and it was proved that air which gave indications of ozone at the ordinary temperature yielded them no longer after the air had been raised to the temperature just mentioned. Thus the doubts that have been raised as to existence of atmospheric ozone have been effectually cleared away, and our meteorologists may proceed with their observations and deductions with more confidence. One thing, however, is still required, and that is a good test paper. The ordinary iodide of potassium and starch paper gives results which are open to doubt; but a recent observation of Schönbein's goes to show that a good test paper may be attainable. Schönbein has observed that ordinary oxygen is without action on protoxide of thallium, while ozone rapidly oxidizes it to the brown peroxide. "Paper steeped in a solution of protoxide of thallium," it is said, in the *Quarterly Journal of Science*, "and exposed to free air, would be an excellent ozonometric paper if the carbonic acid in the air did not transform it into carbonate, which passes more slowly to the state of peroxide." Such paper is, however, coloured in time, and the colouration would be conclusive as to the presence of ozone. Certainty in a test is of much more consequence than delicacy. —*Mechanics' Magazine.*

Another advance has been made in the utilisation of Ozone, as demonstrated by the "ozone-generator" exhibited at the *conversazione* given by the President of the Royal Society. It is described in *Chambers's Journal* as consisting of a number of flat sheets of glass, coated with tin-foil, and piled one on the other, but slightly separated. Each plate represents a Leyden jar, and when the whole number are electrified, a stream of air forced through from one end to the other becomes so strongly ozonized that breathing it is painful and dangerous. The stream of ozonized air thus produced can be used for bleaching and other chemical purposes; and this is the form of it that is already turned to account in the decolorising of sugar on a large scale at one of the refineries in the east of London.

PRECIOUS METALS IN THE LATE FRENCH EXHIBITION.

Of these, Messrs. Johnson and Mathey were the most extensive exhibitors; and nothing in the whole Exhibition could compare with their group of objects, which was equally remarkable for variety, rarity, and (where manufactured) perfection of workmanship. The objects exhibited were—

1. A fine series of specimens of native gold.

2. Illustrations of Mr. W. Crooke's new method of obtaining gold from admixture with earthy and other minerals by the method of sodium amalgam, by which the most extraordinary results are almost instantaneously produced.

3. An educational series of equal weights and symmetrical forms of a large number of the principal metals, all chemically pure, and reduced by fusion. The weights are 1 kilo. (2 lb. 3¼ oz. nearly). These specimens illustrate the specific gravity of the metals. The series includes platinum, gold, iridium, palladium, lead, rhodium, silver, bismuth, copper, nickel, cadmium, cobalt, iron, zinc, antimony, thallium, aluminium, magnesium, potassium, and sodium.

4. Specimens of the following rare metals in various forms:—Palladium, iridium, rhodium, osmium, ruthenium, indium, magnesium, thallium, tellurium, chromium, titanium, and manganese.

5. A magnificent display of platinum apparatus used in the distillation of sulphuric acid. One still, constructed without gold soldering by a method of welding platinum, introduced by the exhibitors, is capable of concentrating eight tons of acid per day; another concentrates five tons. There is also an ingot of pure forged platinum, out of which large vessels are hammered. The value of the ingot is 1,100*l.*; the value of the larger of the two stills, 2,500*l.* There were three smaller ingots of platinum smelted by Deville's method of combined gases.

6. Sundry specimens of manufactured platinum—as tubes, wire, sheet, foil, gauze, sponge, &c., illustrating the various uses of the metal; specimens of platin-iridium, used for certain domestic purposes; platinum tubes, in nests, used for boiling vinegar for pickles.

7. An obelisk of pure magnesium, weighing 5 kilo. (176 oz.), and illustrations of the various forms in which magnesium is brought into the market.

The value of this most remarkable and interesting group of objects is stated by the exhibitors to be about 20,000*l.* It is not easy to say whether the admirable skill and ingenuity shown in the manipulation of platinum or the scientific value and interest of the groups of the other and rarer metals is more to be admired.

PRINCE RUPERT'S DROPS.

Most of our readers will have seen or heard of Faraday's experiment illustrating the incompressibility of water. That able experimenter was in the habit of showing that when one of the toys known as Prince Rupert's drops was placed in a phial of water, and the end broken off, the force of the concussion from the disruption of the drop shattered the glass phial. Reusch now gives another interesting experiment with the same toy. In place of water, he fills the bottle with melted resin, and when this has solidified he nips off the end of the glass drop. The bottle is smashed, as in the case of water, and the mass of resin is seen to be deeply fissured throughout its length. The drop will be found as a kernel, loosely aggregated together, but is easily detached from the resin entire. When broken to pieces the fragments will be seen to have the form of a cone on an hemispherical base, like some forms of hail.—*Mechanics' Magazine.*

NEW SOURCE OF HEAT.

MESSRS. STEWART and TAIT have made a number of interesting experiments upon disks of aluminium and ebonite rotated *in vacuo* at a high velocity, and by which operation they find the temperature of the disks to be raised, or, in other words, heat to be produced. They find that this heating is not at all caused by the communication of external heat from the bearings or elsewhere, nor from vibrations communicated to the disks themselves, nor from the operation of the magnetic force of the earth; and the question consequently arises in what way it can have been generated? It is not impossible that, by pursuing this investigation, some unknown form of force may be discovered, or perhaps some new manifestation of the odylic force of Reichenbach may be detected. When we remember how short the time is since we became acquainted even with such a familiar force as galvanism, we may fairly expect that we shall find out many other forms of force now unknown; just as we have discovered many new metals in the present century of which no knowledge existed in the last.—*Illustrated London News.*

THE TUNING-FORK AS A REGULATOR OF MOTIVE POWER.

THE Tuning-fork has frequently been employed to measure minute intervals of time. M. Duhamel and many philosophers after him adopted the instrument for this purpose. With this object, M. Breguet now proposes to prolong indefinitely the vibration of a tuning-fork by means of clockwork. He has constructed some apparatus for this purpose, which is described in the *Comptes Rendus* as being arranged similarly to an ordinary clock of two parts—a train of wheels and an apparatus with isochronous oscillations yielding to a reciprocating action through the medium of an escapement. The tuning-fork regulates the running of the train; the train gives to the tuning-fork at each vibration a slight impulse necessary to prolong its oscillating movement. The train, by means of indices carried upon the axles and turning in front of the dial, enables the vibrations of the tuning-fork to be counted. The more precise method of controlling the regularity of the movement of an instrument of this kind consists in the comparison of a regulating tuning-fork with a free one by the optical process of M. Zenagous. By this process M. Breguet was enabled to ascertain the persistence of harmony once established between these two tuning-forks, the free instrument being put in vibration by the hand each time it is desired to renew the comparison. The harmony is still maintained when the moving weight of the apparatus is doubled or trebled.

The instrument first employed by M. Breguet made about one hundred vibrations (fifty double) per second. He, however, subsequently tried another making about two hundred simple vibrations per second, and the apparatus has worked without any change having to be made. M. Breguet regards it as certain that we shall be able to apply to the instrument some much higher-pitched tuning-forks by conveniently diminishing the dimensions of the escapement. It will be readily understood that in placing upon the two branches of the key two equal and symmetrical masses we can diminish the rapidity of the vibrations, and it is easy to conceive dispositions which would permit the passing through all speeds between two extreme limits. The results of his researches on this subject lead M. Breguet to believe that the principle of this instrument can be utilised for chronoscopic experiments, such as are required to measure or appreciate very small fractions of time. It will also serve to give an uniform movement to different apparatus for registration or observation which are employed in the sciences. And lastly, it will enable us to obtain the synchronism of two rapid clock-work movements, which has not yet been realised, and which is frequently sought after in electro-telegraphy, and in other applications.—*Mechanics' Magazine.*

SOUNDING AND SENSITIVE FLAMES.

PROFESSOR TYNDALL has given, at the Royal Institution, a lecture on Sounding and Sensitive Flames. In beginning, the Professor stated that the sounding of a hydrogen flame within a glass tube had been noticed by Dr. Higgins, and the subject had been investigated by Chladni, Faraday, Wheatstone, and other philosophers; and the jumping of a naked fish-tail gas flame, when near flaring, in response to musical sounds, was first noticed by Lecomte. We can only refer to some of the more striking of the numerous experiments. Friction, it was said, is always rhythmic, and musical sounds are produced by it; even when a candle-flame is passed rapidly through the air an almost musical tone is obtained. When a fluttering of the air is produced at the embouchure of an organ-pipe, the resonance of the pipe raises it to a musical sound. So, also, when a flame was introduced into tubes of various lengths, other rich notes were obtained, varying in pitch according to the length of the tube; and by changing the size of the flame, the tubes were made to produce their harmonic sounds. By means of a mirror and the screen, the vibrations of these flames were shown to consist of a series of partial extinctions and revivals of the flame. It was also shown that as one tuning-fork may be excited by another, so one flame may be made to sound by another; as a silent flame may be made to sing by the human voice. In regard to the sensitiveness of flames, it was shown that the bright flames of a candle or of a fish-tail gas-burner is quite unaffected by a variety of loud noises; but when the flame is reduced by a stream of air from a blow-pipe it then becomes very sensitive, jumping at the sound of a whistle, tapping on the table, &c. A broad, steady flame from a bat's-wing burner was quite apathetic to sounds till the pressure of the gas was increased, when it became exceedingly sensitive, jumping and dividing into tongues at the sound of a distant anvil, bell, &c. By the sound of a whistle also, a long flame became short, forked, and brilliant; and a forked flame became long and smoky. The one was the complement of the other. Sensitive flames were shown to be affected by very slight noises, such as the creaking of boots, rustling of a dress, &c.; and Dr. Tyndall, by repeating some lines of Spenser, showed that a flame, by jumping at intervals, picked out certain sounds and was unaffected by others. These flames also behave differently at the utterance of the various vowel sounds, and are especially sensitive to the letter S. The rapidity with which sound travels through the air was well illustrated by these experiments. The lecture was concluded by the exhibition of a gas-flame dancing to the playing of a musical-box.

SOLAR PHYSICS.

Messrs. De la Rue, Stewart, and Loewy have published the second series of their researches on Solar Physics, in which they express the opinion that the existence of sun spots is imputable to the action of planets revolving near the sun; and especially to Venus, which, from her magnitude and nearness, might be supposed to exercise particular influence. They say that "the average size of a spot would appear to attain its maximum on that side of the sun which is turned away from Venus, and to have its minimum in the neighbourhood of this planet." They add that they do not imagine that they have yet determined the nature of the influence which the planet exerts in producing the spot. But they call attention to Professor Tait's opinion "that the properties of a body, especially those with respect to heat and light, may be influenced by the neighbourhood of a large body," and that an influence of this kind will be more powerful in the proportion of the intensity of the heat; just as a cold poker will more disturb the temperature of a fire than it will that of a warm room. If we suppose the planets near the sun to intercept the hail of meteors falling into the sun which produces light and heat by combustion, there must necessarily be spots or black places opposite to the planets, where no fuel will be fed in; though these spots will not be immediately opposite to the intercepting planets, but at some distance therefrom, owing to the conjoint motions of the planets and the sun.

ON THE RADIANT SPECTRUM.

Sir David Brewster has read to the British Association the subsequent paper:—In the spring of 1814 I described to the Royal Society of Edinburgh the following experiment. When we look at a minute image of the sun, produced by reflexion or refraction or otherwise, it is surrounded with a brilliant radiation. If we now form a spectrum of this radiant image, it will appear as the centre of the radiation, occupying nearly the place where the intensity of the actinic rays is a maximum. In a rude experiment with a prism of flint glass, whose mean index of refraction was 1·596, the index of the extreme violet was 1·610, and that of the centre of the radiant image 1·640; the distance of this centre from the extreme violet increasing or diminishing with the dispersive power of the prism. If we now refract this spectrum laterally, as in Newton's famous experiment, we obtain the oblique spectrum, from which it follows that the centre of the radiant image has a higher index of the refraction than any of the rays of the visible spectrum. In these experiments the radiant image is produced by the action on the retina of the minute and bright image of the sun; but the same results are obtained, and more distinctly exhibited, by placing a surface of finely-ground glass in front of the prism, or even behind it and near the eye. Having obtained no explanation of the Radiant Spectrum from Professor Playfair and my other scientific friends in Edinburgh, I described the experiment to the Marquis Laplace and M. Biot in the autumn of 1814, but without obtaining any decided opinion upon it. At a later period I described the phenomenon to Dr. Wollaston, who wrote me that he observed it when his prism was soiled—an observation perfectly correct, because the soiled surface, or a cold surface breathed upon, is equivalent to one of ground glass. In 1839 I read a paper on the subject to this Section, when the Association met at Glasgow. At that meeting several eminent natural philosophers were present—Professor Stokes, Dr. Whewell, and our distinguished President, Sir William Thomson. Professor Stokes gave it as his opinion, that the phenomena was produced by parallax: an explanation, if it can be called one, which seemed to be accepted by the meeting. A quarter of a century has elapsed since this opinion was given, but no attempt has been made to show that parallax, or a geometrical cause, could produce a phenomenon which is in so many aspects purely a physical one. My eminent colleague, Professor Tait, has lately printed a note in the *Proceedings* of the Royal Society of Edinburgh, in which he states that the phenomena of the Radiant Spectrum are produced by parallax: I think he cannot prove it; and I formed this opinion upon several observations to which I have made no reference in this brief notice, but especially upon one crucial experiment which indicates, if it does not establish, a very different cause. In certain experiments the radiation beyond the violet is not seen. If in this case we exclude the luminous spectrum, and look at the place where the radiant image should have appeared through a surface of ground glass, it is immediately and distinctly produced. There must, therefore, have been at that place a bright source of visible or invisible light, by which alone a radiant image can be produced. Hence a better theory than that of parallax, and one of great interest, if true, may be sought in the phenomena of fluorescence, discovered in sulphate of quinine, by Sir John Herschel; and in fluor spar and other substances by myself, and in the fine explanation of them by Professor Stokes. In this theory of the Radiant Spectrum, the invisible radiation of the chemical rays is rendered visible in being scattered by granular surfaces, just as the invisible chemical rays in the ordinary spectrum are rendered visible from being reflected and scattered by the particles of fluorescent bodies.

BINOCULAR VISION.

M. Claudet has exhibited to the British Association a curious phenomenon in Binocular Vision, produced by the twirling of a card having the letters of a word alternately placed on the front and on the back; the appearance produced by the rotation being that the letters of one-half the word appeared very considerably darker and in advance of those of the other half, which appeared fainter, and some considerable distance to the rear.

COLOURS OF THE STARS.

An instrument has been contrived for determining the Colours of the Stars. A disk capable of revolution, and filled with glasses or solutions of different colours, is set before a small telescope through which a platinum wire, made incandescent by a battery, is viewed; and the particular colour is brought round before this artificial star, which will make its tint identical with that of the real star under observation.

CLIMATOLOGY.

The alteration of the earth's axis of rotation by tidal friction has, by some physicists, been assumed as a sufficient explanation of changes in the earth's climate. Mr. Stone, of the Greenwich Observatory, has investigated the question; and, in the *Monthly Notices* of the Royal Astronomical Society, has demonstrated the failure of that theory to account for the phenomena. Geologists who have built up elaborate arguments on that assumption will have to reconsider their conclusions.

MUSCULAR FORCE.

The force generated within the body by the food is partly expended in internal work, or in keeping up the processes of circulation and respiration, and partly in external work or muscular effort. Professor Frankland has computed that one gramme of muscle gives by its disintegration 1,848 metre-kilogrammes of force; and in a recent number of the *Philosophical Magazine*, Mr. John Douglas, of Madras, taking the weight of muscle-producing food consumed by certain classes of the natives in India, and reckoning that this food produces its own weight of muscle, concludes that the total amount of potential force thus entering the system daily amounts to from 143,000 to 146,000 metre-kilogrammes. But Helmholtz and Fick reckon that about 160,000 metre-kilogrammes of force are expended daily on the internal work of the body alone; whence Mr. Douglas concludes that the force expended in external work must be looked for elsewhere than in the disintegration of the muscular tissues. The only exception that can be raised to this conclusion is that there is no evidence to show that the force spent on internal work is wholly wasted. On the contrary, much of it is known to be expended in friction, which is not, properly speaking, a waste, but only a transformation of force, and of that which disappears a part may consequently reappear in other forms. Besides, there is no reason to believe that the whole force developed in the body is generated by that part of the food which produces muscle, a large part of it being, no doubt, generated by that which produces heat.—*Illustrated London News.*

MOLECULAR VORTICES.

Several years ago a paper was read before the Royal Society of Edinburgh, by Mr. Rankine, explaining certain new principles of the constitution of matter, which he called the hypothesis of Molecular Vortices. Mr. Rankine held that each atom of matter consists of a nucleus, or central physical point, enveloped by an elastic atmosphere; and that the changes of elasticity produced by heat arise from the centrifugal force of the revolving particles, which revolve quicker with every increase of temperature. Similar doctrines had previously been held by other philosophers, and within a month Sir W. Thomson explained Helmholtz's discovery of the law of fluid motion in a perfect liquid, and suggested that Helmholtz's rings—or *vortex atoms*, as he calls them—are the only real atoms in nature. Helmholtz has proved an absolutely unalterable quality in the motion of any portion of a perfect liquid in which the peculiar motion which he calls "wirbel-bewegung" has once been created; and holds that either to produce or to destroy this peculiar motion can only be an act of creative power. The new doctrine has been illustrated by experiments showing the action of smoke-rings upon one another, and two smoke-rings were frequently seen to bound obliquely from one another, shaking violently from the effects of the shock. Sir W. Thomson says that the investigations of D. Bernouilli, Herapath, Joule, Krönig, Clausius, and Maxwell on the various thermo-dynamic properties of gases may have all their assumptions satisfied by the laws of vortex motion without requiring to suppose any other property in the vortex atoms of which the matter is composed than inertia and the occupation of space. For the case of cubically-packed vortices, he has succeeded in finding the solution which expresses the motion of every particle of the fluid, and has also found the modulus of rigidity thus constituted; while it is quite certain that closely-packed vortex atoms, even of different dimensions and configurations, must produce in the aggregate an elasticity agreeing with the elasticity of real solids. These investigations open up to us new views of the constitution of matter more profound and more consistent with observed phenomena than the infinitely strong and infinitely rigid pieces of matter which constitute the atoms of Lucretius and Newton, and by which none of the properties of matter are explained without attributing those properties to the atoms themselves.—*Ibid.*

AIR CARRIED ALONG BY FALLING BODIES.

A curious discovery made by M. Melsens has been reported to the French Academy of Sciences. This *savant* has noticed that when a ball is allowed to fall into water from some height it carries with it into the water a volume of air twenty times the size of the ball. This air, it seems, accompanies the ball in its descent, no matter to what depth, and is only set free when the ball strikes the bottom. Marriotte, it would appear, has made the same observation, and has remarked that every drop of rain as it falls, draws along with it a volume of air two or three times its own size, a fact which he thought would account for the light wind felt near where a shower is falling. Melsens, however, has carried his experiments further. He fired a pistol ball into water, and found that the volume of air then carried into the water was a hundred times that of the projectile. In other experiments he fired a pistol bullet into blocks of porcelain paste. With an ordinary charge of powder, the hole made in the paste was exactly the diameter of the ball; but when a very strong charge of powder was fired, the hole made was large enough for the experimenter to pass his arm through. These results led Melsens to make some experiments on panes of glass, and the conclusions arrived at upset a commonly accepted notion. Many of us, probably, have seen it happen that when a smooth pebble or a marble is thrown against a pane of glass, a clean circular hole is cut, and not a crack produced. This, it has always been supposed, was owing to the high velocity of the projectile, but M. Melsens' experiments contradict the opinion. He found that when he fired a ball with a strong charge against a pane, the glass was always smashed up into a great number of pieces. A ball with a very low velocity generally cut a hole more or less clean, but with a medium velocity a hole without any cracks might be produced.—*Mechanics' Magazine.*

ATOMIC MOTION.

Chemical and even vital phenomena are now brought under the dominion of mechanical laws; or, if this has not yet been wholly done, the tendency of further research is more and more effectually to accomplish it. Dr. Alexander Naumann, of Giessen, has lately contributed to a German periodical a paper "On the Velocity of Atomic Motion," in which he points out that the specific heat of gases under constant pressure may be resolved into three parts—the heat of expansion, the heat of molecular motion, and the heat of atomic motion. The heat of expansion expends itself in external work, and the total thermal content of a gas is consequently represented by the *vis viva* of the progressive motion of the molecules, together with the *vis viva* of the atoms inside the molecules. The motion of the atoms, it is concluded, is an oscillatory motion to and from each other; and the position of equilibrium is the distance at which attraction and repulsion mutually neutralise one another. As the temperature rises, the velocity of an atom in passing its position of equilibrium increases in proportion to the square root of the absolute temperature, and the amplitude of vibration increases at the same time. It follows that every compound body must be capable of being decomposed by heat; for as the *vis viva* of the atomic motion continues to increase, and therefore, also, the amplitude of the vibrations of the atoms, the attracting forces will, after a certain limit, no longer be able to hold back the atoms within the limits of the molecules.—*Illustrated London News.*

THE ROYAL SOCIETY.

At the anniversary meeting, Lieutenant-General Sabine was re-elected president. His address was principally occupied with the labours of the Meteorological Department of the Board of Trade, and the researches of the Meteorological Committee of the Royal Society. A considerable mass of information has been collected, the discussion and arrangement of which have been undertaken by the Committee, and the quality of the intelligence from the coast stations is to be improved; the stations in the British Islands have been inspected; and the committee are to convey, free of cost, telegraphic intelligence of any serious atmospherical disturbance, to such parts as is desirable. The second topic of general interest was that of certain arrangements made in respect to the observation of the total solar eclipse of

1868. The eclipse will be of the greatest possible duration, affording, therefore, more leisure than usual for such observations as can only be made during the brief interval of the totality. The total phase will be visible in India, but elsewhere only in countries practically unavailable. Recent observations on the spectra of the heavenly bodies render spectroscopic observations of the red protuberances and of the corona a matter of peculiar interest at the present time. The President and Council therefore considered how far they might contribute to a full use of so rare an opportunity in regard to these more especially physical phenomena. The Copley medal was awarded to Dr. Von Baer, for his eminent researches in comparative anatomy, philosophy, and embryology; the Royal medal to Messrs. John Bennet Lawes and Joseph Henry Gilbert, for their researches in agricultural chymistry; a medal was awarded to Sir William Logan for his able labours on the geological survey of Canada.

NEWTON OR PASCAL.

Although the cognateness of this controversy to our *Year-Book* may lead the reader to look for some record in its pages, we shall not be expected to report here the entire evidence of the case. It has lately agitated the whole scientific world, but has been virtually settled; and our account must be confined to the report as we found it in a leading article in the *Times* journal, whence the following outline is abridged:—"The question in dispute was, whether Sir Isaac Newton was the original discoverer of the Law of Gravitation. This question was raised for the first time, two centuries after the discovery itself, and nearly a century and a-half after Newton's death, by M. Michel Chasles, a French mathematician of the highest eminence. It was raised on the authority of a series of documents in the possession of M. Chasles, who did not, however, feel at liberty to state how they came into his hands. They purport to be letters written by Newton and some of his most famous contemporaries; and include, in particular, a correspondence which is supposed to have passed between him and Pascal. Their effect is to show that Newton was indebted to that illustrious man, and other French philosophers, for many of the ideas on which his fame depends. It is not denied, as we understand, that Newton was the first to publish, as well as to develop, that marvellous induction which is the foundation of half our knowledge about the universe. What is asserted is that he was led to it under the inspiration of Pascal, whose mathematical genius, as is well known, was equal to his theological learning. It is this assertion which crumbles to pieces on the first touch of the facts adduced in a letter of Professor Hirst, to be given hereafter.

"In order to appreciate these facts, we must bear in mind that no explanation had been given of the source whence the papers were derived. It is, perhaps, needless to remark that such a circumstance would alone have been fatal to their value as evidence in a court of law. It is a familiar rule of legal procedure that ancient documents must in general be shown to have come from proper custody. A witness in a lawsuit, producing a number of deeds, but declining to say how he came by them, would certainly be ordered to stand down, if he were not committed for contempt of Court. M. Chasles, however, had an undoubted right to prescribe his own conditions in the domestic forum of science, subject only to the suspicion naturally attaching to his reticence on a point so essential. To do him justice, he displayed a laudable anxiety to promote a searching investigation of the case, not only by forwarding to Sir David Brewster and Mr. Hirst copies of the disputed letters, but also by intrusting to M. de Khanikoff specimens of the originals, with Newton's signature appended, for comparison with genuine specimens of his handwriting. Sir David Brewster, as Newton's biographer, lost no time in invoking the aid of Lord Portsmouth and Lord Macclesfield, who possess large collections of Newton's letters; and these gentlemen, after a careful scrutiny, avowed their conviction that M.Chasles' manuscripts were not penned by Newton. Sir David Brewster went further, and declared that they bear no resemblance to Newton's handwriting, and must have been fabricated by a person who had never even seen a genuine signature of the pretended author. Still, opinion is but opinion, after all, and it is notorious that experts constantly differ on matters of this kind. The authority of Sir David Brewster and his English coadjutors, though met by no counter evidence whatever, might perhaps have been challenged on the ground of national bias, had not chance supplied a proof not less cogent than the immortal arguments by which the Law of Gravitation was established. It appears that M. de Khanikoff accompanied Mr. Hirst to Burlington-house with a view of comparing the spurious documents, as we may now call them, with Newton's letters in the possession of the Royal Society. The result, according to Mr. Hirst, was 'perfectly conclusive,' but it was presently corroborated by a disclosure which must put to shame all the believers in this daring forgery. On turning over a volume of extracts, compiled by a certain Pierre Desmaiseaux (admitted F.R.S. by Newton himself) 'Mr. W. White, Assistant Secretary to the Royal Society, had the good fortune to discover that three out of the five alleged specimens of Newton's handwriting were *verbatim* copies of isolated passages occurring in the French translation of three letters originally written by Newton in English.' In other words, Newton, who could not even read French without a dictionary, had been made by the fabricator to repeat in French to one correspondent, word for word, the identical expressions which he really used elsewhere in writing to another correspondent in English. This supposition is as preposterous as the alternative supposition is inevitable. The fabricator, not aware that Newton always wrote in English or Latin, copied out of M. Desmaiseaux's compilation a French version of these English letters, adding, we presume, dates and addresses suitable to his design. But this, although quite 'annihilating,' as Mr. Hirst says, is not all. The fourth document, alleged to be in Newton's handwriting, is neither more nor less than a slightly garbled transcript from a French translation of two sentences in Dr. Samuel Clarke's works. This passage, in French alone, happens to be contained in the very same book of M. Desmaiseaux, which, for all we know, may prove to be the fountainhead of the whole imposture. The only difference is the substitution of '*que j'ai rapportez*' for '*rapportez ci-dessus*,' and of '*on*' for '*l'auteur*;' in all other respects the identity of the passage is verbally complete, while its substance is far too recondite to have been clothed in the same form by two separate minds.

"After this crushing refutation of a theory which never had in it an element of probability, it would be idle to dwell on collateral indications of forgery. It may, however, be worth mentioning, on the testimony of Sir David Brewster, that it involves the increditable assumption that Newton had written on the Infinitesimal Calculus and the Equilibrium of Liquids at the age of eleven, besides minor absurdities. It is surely not a little discreditable to the credulity of scientific jealousy that *in the absence of any direct evidence to that effect*, the genuineness of these pseudo-Newtonian letters should have been accepted in France. If, as M. de Khanikoff states, there is a certain similarity between the letters attributed to Pascal and the manuscripts of Pascal in the Imperial Library, the presumption is good so far as it goes. But it only goes so far as to suggest that, in Pascal's case, the fabricator took the obvious precaution of studying the handwriting which he mean to counterfeit. With this part of the problem, if problem it be, we leave our neighbours to deal, well assured that no deception which diminishes the glory of a French *savant* will escape their vigilance. We are concerned with Newton alone, and can only express our amazement that so groundless a charge of plagiarism against him should have found ready credence in the present day. It is among the remarkable features of Newton's career that he outlived the publication of all his greatest discoveries by forty years, maintaining an unique supremacy in science before the eyes of all Europe, and constantly engaged in correspondence and controversy with the leading mathematicians of his age. It is wellnigh incredible that his obligations to Pascal should have remained undetected and unsuspected for 140 years, while his obligations to Descartes and Kepler were perfectly well known and acknowledged. There is a sense, indeed, in which no idea is or can be original—in which Newton's reasoning must be regarded, with all other great works of imagination and intellect, as a link in the chain of human thought. In no other sense can the originality of Newton be impugned, and we may safely predict that each fresh attempt to disparage his mighty labours will end by confirming his title to the gratitude of mankind."

At the late meeting of the British Association, Sir David Brewster said he had received from Professor Chasles several of Newton's letters, or extracts from them; and he read one or two observations tending to show that this was a gigantic fraud—the greatest ever attempted in the world as connected with science and literature. Sir David read the following notes:—1. The correspondence was founded on the assumption that Newton was a precocious genius, having written on the infinitesimal calculus, &c., at the age of eleven, whereas he was then at school, and knew nothing of mathematics, occupying himself only with water-wheels and other boyish amusements. 2. There is no evidence that Pascal and Newton had any correspondence. Having examined the whole of Newton's papers in the possession of the Earl of Portsmouth, he never found any letter or paper in which Pascal was mentioned. 3. The letters from Hannah Ayscough, Newton's mother, bear his signature, although she was a married woman and could have signed Hannah Smith. 4. The letters of Pascal have been found by M. Fauqere to be another hand, and the signature not that of Pascal. 5. The letters of Newton are not in his hand, and some of them bear a signature which he never used. One of them is signed "Newton," as if he had been a member of the peerage, and many of them "J. Newton," a sign which he never used. 6. An experiment with coffee is mentioned in one of the letters of Pascal, whereas coffee was at that time unknown in France. 7. All Newton's letters are in French, a language in which he never wrote. All his letters to the celebrated French mathematician, Vangnon, are in Latin, and Newton himself has stated that he could not read French without a dictionary. 8. The style and sentiments in Newton's letters are such as he never could have used. He expresses "eternal" gratitude to Pascal, a word which no Englishman ever uses. 9. According to the correspondence, M. Desmaeseaur got access to Newton's papers after his death, and carried off a great many papers. Now, it is certain that Mr. Conduitt, Newton's nephew, arranged and examined all Newton's papers, in order to obtain materials for a life of him, and, having failed to find a competent person to write, he undertook it himself, and obtained by persons then alive all the information that existed respecting Newton's early life and studies. All this information, which he (Sir David Brewster) had used in his *Life of Newton*, stood in direct contradiction to the assumption of Newton's precocity and early connection with Pascal, which was the basis of the correspondence now exciting so general an interest. There could be no doubt, therefore, that the letters of Newton and Pascal were forgeries calculated and intended to transfer to Pascal the glory of the discovery of the law of gravitation which was due to Newton.

Electrical Science.

TWO DISCOVERIES IN ELECTRICITY.

These discoveries, reported to the Royal Society, deserve especial notice as additional illustrations of the Conversion of Mechanical into Electrical Force. Those of our readers who are acquainted with the extraordinary machine of Mr. Wilde will know that in that case a relatively small permanent magnet is, by the exertion of great mechanical force, made to produce the most intense effects. In a paper by Mr. C. W. Siemens, however, "On the Conversion of Dynamical into Electrical Force without the aid of Permanent Magnetism," it is proved that permanent magnetism is not necessary for the conversion of *mechanical* into *electrical force*, and that it is possible to produce the most powerful electrical or calorific effects without the aid of steel magnets. The apparatus employed to show this is an electro-magnetic machine, consisting of one or more horse-shoes of soft iron surrounded with insulated wire, of a rotating keeper of soft iron surrounded also with an insulated wire, and of a commutator connecting the coils in the manner of a magneto-electrical machine. The keeper is cylindrical and is hollowed at two sides for the reception of insulated wire, which is coiled longitudinally. If a galvanic battery were connected with this arrangement the keeper would rotate in a given direction. If the battery were excluded from the circuit, and the keeper made to rotate in an opposite direction to that resulting from the galvanic current, no electrical effect could be produced, supposing the electro-magnets absolutely free from magnetism; but by inserting the battery of a single cell in the circuit, a certain magnetic action would be set up, causing similar poles to be forcibly approached to each other, and dissimilar poles to be forcibly separated, alternately, the rotation being contrary to that which would be produced by the existing current. The co-operation of the battery is only necessary for a moment of time after the rotation has commenced, in order to introduce the magnetic action which then continues to accumulate without its aid. Indeed, the battery is not necessary at all, for the author states that it suffices to touch the soft iron bars employed with a permanent magnet, or even to dip the former into a position parallel to the magnetic axis of the earth, in order to produce the phenomenon. Practically, it is not even necessary to give any external impulse on re-starting the machine, the residual magnetism being quite sufficient for the purpose. Now, it is found that on imparting rotation to the armature arranged as above, the mechanical resistance rapidly increases, and to such an extent that either the driving strap commences to slip, or the insulated wires constituting the coils become so hot that their silk covering is ignited.

Professor Wheatstone had independently made the discovery that an electro-magnet, if it possesses the slightest polarity, may become a powerful magnet by the gradually augmented currents originated by itself. His instrument is not unlike the one described above. The core of the electro-magnet is a plate of soft iron 15 in. long and ½ in. broad, bent into a horse-shoe form. Round it, in the direction of its breadth, is coiled 640 ft. of insulated copper wire 1-12 in. in diameter. The keeper is made on the plan of that of Mr. Siemens, and has 80 ft. of insulated wire coiled longitudinally. If now the wires of the two circuits are joined, so as to form a single circuit in which the currents generated by the armature, after being changed to the same direction, act so as to increase the existing polarity of the electro-magnet, very powerful effects are produced. The force required to move the machine is great, showing a great increase of magnetic power in the horse-shoe; 4 in. of platinum wire may be made red-hot, and water may be decomposed by the current. Professor Wheatstone thus explains these effects. The electro-magnet always retains a slight residual magnetism, so is always in the condition of a weak permanent magnet; the motion of the armature occasions feeble currents in its coils in alternate directions, which brought into the same direction pass into the coil of the electro-magnet in such a manner as to increase the magnetism of the iron core; the strength of the magnet being thus increased, it produces in its turn stronger currents in the coil of the armature; and this alternate increase goes on until it reaches a maximum dependent on the rapidity of the motion and the capacity of the magnet. The Professor mentions that the strongest effects are produced at the first moment of completing the combined circuit, but a remarkable increase of all the effects is observed when a cross wire is placed so as to divert a great portion of the current from the electro-magnet. The resistance of the machine is very much less, but the four inches of platinum wire will remain permanently ignited. The force of two men was employed in these experiments. Mr. Siemens does not mention what force he employed.—*Mechanics' Magazine.*

ELECTRICAL CURRENTS.

DR. GERLACH has contributed to Poggendorff's *Annalen* a paper on "The Mechanical Theory of the Electrical Current," in which he points out the agreements which subsist between the laws of electro-dynamics and those of the motion of solid substances. The *vis viva* of a galvanic battery he shows to be proportioned to the consumption of zinc, though in batteries of many cells it takes the shape of a small quantity of great intensity, and in batteries of few cells of a large quantity of a low intensity. So the power generated by a pound of coal may be employed to raise a small weight to a great height or a large weight to a small height, or may give a great velocity to a small body or a small velocity to a large one, the *vis viva* remaining unchanged in all he modifications. The increase of the cells of a battery produces more powerful impacts, while an increase of the plates increases the quickness of their succession, but not the intensity of the individual impulses.—*Illustrated London News.*

LIGHT AND ELECTRICAL CURRENTS.

An important paper on the identity of the vibrations of Light with Electrical Currents has been contributed to Poggendorff's *Annalen* by M. Lorenz. In this disquisition it is shown that, in accordance with the laws for the propagation of electricity, under the action of free electricity and of the electrical currents of the surrounding media, which we can deduce from experiment, periodical electrical currents are possible, which in every respect behave like the vibrations of light; whence it is concluded that the vibrations of light are themselves electrical currents. In the first place, it is shown that periodical electrical currents are possible which will travel with a wavelike motion, and, like light, make vibrations which are at right angles with the line of propagation; and, in the second place, it is shown that the laws of electrical currents can be deduced from the known laws of light. On the whole, it is concluded to be probable that light consists of *rotating* vibrations in the interior of bodies; that the electrical current is no translatory motion, but a rotation in one direction, the axis of rotation being the direction of the current; and that this rotation is continuous in good conductors and periodical in bad.

ELECTRO-MAGNETISM IN IRON-SMELTING.

The use of an Electro-magnetic current in the Smelting of Iron has been tried at one of the leading ironworks in Sheffield, it is said, with complete success. A fixed electro-magnet is placed opposite an opening in the side of the furnace; the magnet is excited by means of a Smee's battery, and the current of magnetism is directed into the molten metal. The effect is described as being surprising. The metal appears to bubble and boil; the metal is expedited, which economises fuel; and the quality of the iron is so much improved that for toughness and hardness it can hardly be equalled.

NEW EARTH BATTERY.

Mr. Ballantyne has described to the Franklin Institute a form of Earth Battery, consisting of a tub of zinc without a bottom sunk deep in the ground, with a layer of coke inclosing it within and without, but not in contact. The contact must be made by copper wires carefully insulated, which, when continued, will convey the current in any direction. Such a battery will long maintain its power, and is specially suitable for medical purposes.

NEW SAND BATTERY.

Father Secchi, of Rome, in the *Laboratory*, describes a very useful form of Galvanic Battery of novel and simple construction. He takes a piece of thin sheet copper, of about 8 in. square, and on one side cuts six notches about 1½ in. deep, so that six points are left. The points are alternately bent in horizontally, and the sheet is rolled and soldered so as to form a hollow cylinder resting on three points. This is set in a glass cylinder of the same height, at the bottom of which is placed some broken crystals of sulphate of copper, through which the three vertical points are forced, the three bent horizontally resting upon the sulphate. Well-fitting disks of bibulous paper are now passed over the cylinder of copper down to the sulphate, and on these is placed a thin layer of sand. A cylinder of zinc, about 6 in. high, is now passed over the copper to rest upon the sand, and then all the space between the copper and the zinc and the zinc and the glass is filled up with sand nearly to the top. The copper cylinder may now be filled up with powdered sulphate, and the battery is set in action by pouring water upon the sand. According to the learned author, a battery of this description and these dimensions —which is specially applicable to electric clocks and bells—will keep in constant action for more than two years.—*Mechanics'*

SUGAR-REFINING BY ELECTRICITY.

Electricity is likely to receive many important applications in the arts, one of which is to the refining of sugar. In Wilde's electro-magnetic machine electricity is produced by the rotation of a magnetic apparatus by a steam-engine; and just as by means of an electro-magnetic engine a current of electricity may be made to produce its equivalent of mechanical power, so by a reverse process mechanical power may be made to produce electricity. One of Wilde's machines is driven by a 15-horse power engine. The armature rotates 15,000 times in a minute, and the stream of electricity produced generated light of such intensity that it can only be looked at through coloured glass, and the rays collected by a burning-glass set fire to paper. The heat generated is such as to melt refractory platinum like so much lead. In sugar-refining the action of the animal charcoal by which the dissolved sugar is whitened is imperfectly understood. But, the brown colour being imputable to the existence of uncombined carbon, bleaching will be effected by any expedient which uses up this carbon in the formation of a colourless compound, and nascent hydrogen appears to constitute such an agent, and is no doubt produced by the action of the animal charcoal on the liquid. Now a stream of electricity directed through the solution will produce not merely nascent hydrogen but nascent oxygen also, and electricity may thus be made to perform the function of the charcoal, at least to some extent. We are informed that one of Wilde's machines is fitted in a sugar refinery in Whitechapel.—*Illustrated London News.*

ELECTRICAL COUNTRIES.

In a paper addressed to the French Academy of Sciences, M. J. Fournet treats of a new and curious subject, viz., the electric state of certain regions. From the report of this paper in *Galignani*, we gather that in the mountains of the basin of the Rhone and their offshoots there are some spots distinguished for their evolution of electricity, which is sometimes very remarkable; while others, though apparently identical in surface, are in a state of absolute electric neutrality. Some very striking instances of this are quoted by M. Fournet. On the night of August 11, 1854, when Mr. Blackwell was on the Grands-Mulets at an altitude of 3,455 mètres, the guide, F. Couttet, on leaving the hut, perceived the surrounding ridges apparently on fire. He immediately called to his companion to witness the scene, which was owing to a tempest. Their clothes were literally covered with electric sparks, and their fingers, when held up, were phosphorescent. At that very time Lyons was visited with a deluge of rain, and the whole day had previously been exceedingly stormy. In 1841, as the same guide was accompanying M. Chenal up Mont Blanc, they were overtaken by a violent storm, and found themselves enveloped, as it were, in thunder and lightning. All the stones and rocks around them emitted electric flames, yet the summit of Mont Blânc and the sky around it were perfectly clear. In 1867 Saussure, Jalabert, and Pichet were on the Breven, at an altitude of 2,520 mètres. They soon experienced a strange pricking sensation at their fingers' ends, and on stretching them out, this sensation became stronger and stronger; and at length electric sparks could be drawn from Jalabert's hat-band, which was of gold lace, and even from the knob of his cane. As the storm was raging above their heads, they had to descend 25 or 30 mètres, where the influence of this electricity was no longer felt. Another instance of this occurred on July 10, 1863, when Mr. Watson and several other tourists ascended the Jungfrau, and there the snow itself, which fell during the storm which overtook them, proved to be electric.—*Mechanics' Magazine.*

EFFECTS OF ELECTRICITY ON SEEDS.

Everyone feels a personal interest in the success of agricultural operations, and all facts tending to promote that success deserve the widest circulation. We quote, therefore, although with many misgivings as to their entire reliability, the experiments of M. Blondeau on the action of an induction current on Fruits and Seeds. The author states that the electrization of apples, pears, and peaches hastens their ripening. He has also experimented on beans, peas, and cereal grains, submitting them to the action of the current before they were planted. The seeds were made to conduct electricity by soaking them in water for some time, and they were then submitted to the action of a current for several minutes. After this they were planted in pots filled with good garden earth;

nd other unelectrified seeds were planted at the same time, and kept under the same conditions for the purpose of comparison. M. Blondeau states that the electrified seeds always came up first, grew more rapidly, and gave much more vigorous and fruitful plants than the unelectrified. But now comes a statement which we cannot help regarding with suspicion, and which must, at all events, make us hesitate before we electrify beans. Many of those which had been submitted to the action of the current obstinately persisted in growing upside down, that is to say, the root came up into the air, and the plumule was directed downwards into the soil. This, if true, is a most extraordinary fact. —*Ibid.*

ELECTRICAL RESISTANCE.

Mr. C. W. SIEMENS has invented a simple and excellent contrivance by which the measurement of resistances can be made by persons wholly unaccustomed to electrical experiments. They have only, after the necessary connections are made, to turn a screw till a needle stands opposite a fiducial mark, when the resistance required may be read directly on a scale with considerable accuracy. Mr. Siemens proposes to apply this invention to thermometers, when the resistance read will indicate the temperature; and the only electrical connections required will be the joining of the battery-wires to two terminals. Other applications of this apparatus will doubtless arise, and extend the practical application of electrical measurements. Mr. Siemens reports that in accuracy and range his instrument fully equals the Wheatstone bridge, whilst it possesses considerable advantages in cheapness and portability. Mr. Hockin has tested the constancy of the standard resistance units with satisfactory results, except in the case of one mercury tube, in which case he suggests that lead-glass may have been used, and injury have consequently taken place from the nitric acid used to clean it. Mr. Hockin has also made interesting experiments on the construction of large resistances by the use of silenium. He finds that coils can be made of this material having resistances of one million units and upwards, and that these artificial resistances will maintain their constant at high temperatures up to 100°. These will be found useful in practice, and much superior to those hitherto constructed of gutta-percha, or other insulators, and which were of comparatively slight use in accurate work, owing to absorption, change of resistance with temperature, and inconstancy when kept for any considerable time.—*Proc. British Association.*

THE ELECTRIC LIGHT IN FRANCE.

THIS new light has been adapted in France, to a ship for the first time, and also for use at sea. In the Bois de Boulogne, at a grand skating *fête*, fifteen electric lights erected for the purpose lit up, *a giorno*, the whole scene of lake, island, ice skaters, and spectators. The effect was splendid. This lighting up was executed by M. Serrin, and was remarkable for its steady brilliancy, while, at the same time, it was simple, economical, clean, and very powerful. For each of the fifteen batteries, there were collected forty Bunsen elements placed in a subterranean chamber, which concealed the battery from sight, as well as prevented the odour of nitrous gases from annoying the spectators. By the side of this pit there was fixed a pillar, hollow within, through which the wires passed to the platform, solidly, and at the same time slightly constructed. On this platform was fixed the electric light established by M. Serrin. It was arranged catoptrically, as in the lighthouses of Havre and Odessa, furnished by the Alliance Company of Paris, and was placed on rails; thus, as soon as the carbon ends were burnt away, and the light diminished, the man in charge had nothing to do to renew the splendid light but to push, by the hand, a newly-lighted lamp, which instantly supplied the place of the faded one. When this was burned out, another lamp was rolled into its place, capable of burning again several hours. By this arrangement, a single additional lamp was sufficient (or a sixteenth one) to conduct the service rigorously carried on, and the interruptions of which were quite imperceptible.

ILLUMINATING BEACONS AND BUOYS BY ELECTRICITY.

MR. T. STEVENSON has read to the British Association a paper explaining his proposed method of Illuminating Beacons and Buoys at sea by electricity conveyed from the shore by submarine wires, with description of the induction spark apparatus used in the first experiments. and of that recently designed by Mr. Siemens, of London. He said that the object of his proposal, which was first made in January, 1854, to the Royal Scottish Society of Arts, was to render beacons and floating buoys visible at night, like lighthouses, by "submarine electric wires." In the then state of electrical science he devised, however, the "apparent light," as preferable from its being more certain. In a report on the magnetic-electric light to the Northern Light Board in 1865, he reverted to his former proposal, and after consulting his friend Professor Swan, who proposed the combination of the Leyden jar with the induction coil, he instituted experiments, and communicated to the same society, in January, 1866, that he had produced a good light in the focus of lighthouse apparatus by means of four Bunsen cells, an induction coil, and Leyden jar. The Northern Lights Board, on the recommendation of Messrs. Stevenson, in February, 1866, produced, with the sanction of the Board of Trade, a submarine cable from Messrs. Siemens of London, but it was not adapted for the apparatus employed, and the current could not be passed under the water. Messrs. Stevenson then reported that as Mr. Siemens had thought of a different arrangement he should be employed to furnish an apparatus of the kind suggested. While Mr. Siemens was engaged with this instrument, improvements in the arrangements of the induction spark were suggested by Dr. Strethil Wright, Mr. Brebner, C.E., and lastly by Mr. Hart, who conducted all these experiments, and to whose zeal is mainly due whatever amount of efficiency the induction spark may possess. By means of these improvements the light, which was quite efficient as viewed at sea by Dr. Ferguson, Dr. Wright, and others, was kept in action during a week at the cost of 2s. for 16 hours, with the current passing through a wire 800 feet long. Mr. Siemens' apparatus, which consists of a lever on the beacon, worked by the primary current acting on an electro-magnet, by breaking contact, produces its effects by the deflagration of mercury, and is described by Mr. Stevenson as a beautiful application of electricity to a case of great importance. The author suggested that both systems should be subjected to continued experiment, in order that the best method should be adopted for carrying out his proposal, which is expected to form a new era in maritime illumination. Mr. Stevenson looks forward to the time as not far distant when such a navigation as Liverpool will be as clearly defined at night as in the day by the illumination of its beacons and buoys. Mr. Siemens' apparatus was worked by 20 cells, while the induction spark had only 6; but when fully equipped, it will be worked by 18 cells. Both apparatus were shown in the foci of Holophotes.

ENGRAVING BY ELECTRICITY.

An apparatus, for Engraving by Electricity, exhibited in the machinery department of the French Exhibition, is ingenious, and illustrates the activity of mind now devoted to the improvement of the engraver's art by the introduction of new scientific methods. A metal plate, with some object drawn upon it with a special ink, is slowly rotated, with its face vertical; and several other similar plates, but of decreasing smallnes, and with correspondingly diminished speed, are also slowly rotated by appropriate mechanism. On these plates it is intended the object delineated on the first plate shall been graved upon different scales of magnitude; and this is accomplished by applying a diamond cutting-point to the face of each plate, which is pressed against it through the agency of an electrical current whenever a blunt point presented to the first plate encounters the ink, but is withdrawn at other times. The point presented to the first plate is a feeler, which determines by electrical agency whether there is ink beneath it or not, and, if there is, the diamond points opposite to all the other plates are pressed in, and if there is not, they are withdrawn, and prevented from cutting. The feeler and the diamond burins must, it is clear, all follow a spiral track.

ELECTRO-MAGNETIC ENGINES.

It has long been known that electricity or galvanism is capable of generating mechanical power; and, conversely, mechanical power is capable of generating electricity, as is done in Wilde's magneto-electric machines, where light or heat is generated by the expenditure of its equivalent in power. Electro-magnetic engines have not superseded the steam-engine simply because the zinc used in the one is more expensive than the coal used in the other. But the reverse process of using power for the production of electricity is an expedient which has already come into use in the arts, and which promises one day to find many still more important applications than it has already received. One important feature of electricity as a prime mover is that its equivalent power can be produced with little waste; whereas in thermo-dynamic or heat engines, of whatever class, the waste is very great; and this distinction points to electricity as an important *carrier of power*, which will be in many cases more economical and much less cumbrous than shafts, belts, or hydraulic apparatus. Thus, for instance, in working railway trains in tunnels, an engine situated at a distance may be made to transform its whole power into electricity, which may be easily transmitted to an electro-motive engine attached to the train, whereby the propulsion may be effected with little waste. Indeed, it is not impossible that such a system may come into use for propelling all trains upon railways, whereby the motive force will be furnished by stationary engines set along the line, and the locomotive be discarded. The only use to which this method of generating electricity is at present applied is the production of electric lights for lighthouses, and, if necessary, the electricity may be led through a cable to a lightship or lighthouse in the middle of the sea, while the mechanism itself is situated on the mainland.—*Illustrated London News.*

Mr. Wilde has received a letter on the subject of his recent experiments in magnetism from Mr. Moses G. Farmer, of Salem, Mass., United States, dated November 9, 1866, in which he says that he had obtained an increase of 31 per cent. in the power of a magneto-electro-machine, by transmitting the current from the armature through coils of wire surrounding pieces of soft iron forming the prolonged extremities of the permanent magnets of the machine. Mr. Farmer, in the same letter, adds:—"I have built a small machine in which the current from the thermo-battery excites the electro-magnet of your machine to start it, and after the machine is in action, a branch from the current of the magnets passes through its own electro-magnet, and this supplies the magnetism required. It is not exactly like a person standing in a basket and trying to lift himself—because the electricity proceeds from the conversion of the mechanical energy, which must be continually supplied. Neither can it in anywise be likened to the various schemes for producing perpetual motion; but depends on the principle, that the actual energy of the mechanical force, conjointly with the potential energy of the magnet, can develop a greater amount of potential energy than is originally resident in the magnet; or, in other words, it is a method of converting part of the actual energy of the prime mover into the potential energy of magnetism."

ELECTRICAL MACHINES IN THE LATE FRENCH EXHIBITION.

The most important philosophical instruments connected with electricity are those by which the various measurements of electrical quantities are effected. These are divided into strength of currents, quantity of electricity, electro-motive force and resistance of conductors. The most interesting electrical machine in the Exhibition was that exhibited by M. Wesselhoft, Russia. It is the invention of Professor Töpler, of Riga, and acts on the principle of multiplying induction resulting from a series of glass plates rotating with great rapidity. This instrument is a great improvement on Holtz's apparatus of a similar nature.

P. Dumoulin-Froment exhibited a machine of this kind, but it is more in the nature of a toy than a machine of practical utility. But Oersted's discovery of these electro-magnetic laws have been turned to signal advantage for astronomical es. The Americans were among the first to apply these determination of the difference of longitude, and W. & Son, United States, exhibited an astronomical clock and chronograph which was used for ascertaining, in connection with the Atlantic cable, the difference of longitude between Newfoundland and Valentia. France exhibits some grand magneto-electrical apparatus. That of Nollett's, exhibited by Ruhmkorff, France, constructed for the École Polytechnique, and his inductive apparatus for converting dynamic into static electricity, were especially worthy of being attentively examined.

General Morin exhibited a very ingenious apparatus for registering minute variations of temperature by means of a thermo-electric pile. The apparatus is composed of fifteen brass rods and the same number of iron ones, so disposed as to constitute a thermo-electric pile of fifteen couples. If we suppose one of the soldered points of junction of the two metals to be kept at a constant temperature—the freezing point, for instance—then, another junction being situated in a given medium at another temperature, a current will be excited in proportion to the difference. The existence of this current is made apparent by the deviation of a magnetic needle, the electric fluid previously passing through the bobbins of a common multiplicator. The needle itself is suspended by a silken thread. Let us now suppose the needle to be situated in the plane of the magnetic meridian, and to be provided with a vertical shaft proceeding from its centre and supporting a copper needle at its lower end. As copper is non-magnetic it cannot exercise any influence on the desired result, and being parallel to the iron needle, and consequently in the same vertical plane with it, it will strictly indicate the same deviations. A horizontal disk of white paper situated under this copper needle, and supported by a vertical shaft made to revolve by clock-work, completes its entire revolution in the course of one hour, being, in fact, neither more nor less than a dial-plate, which, instead of being fixed and provided with movable hands, as in a common watch, or rather chronometer, is itself movable round a fixed hand which is represented by the copper needle. The latter has a sharp vertical needle-point fixed at its lower surface. At the expiration of every quarter of an hour the paper disk suddenly springs upwards, meets the sharp point, and is pricked by it. This mark will show what was the position of the needle at a given hour; and as this position marks the degree of the intensity of the current, which is itself but an exponent of the temperature of the medium under consideration, it follows that by this contrivance the variation of temperature which has taken place in the course of one quarter of an hour is registered. It will, of course, be understood that the paper disk returns to its ordinary level as soon as it has received the mark of the needle. The performance of this novel and ingenious apparatus is stated to be highly satisfactory.

W. Ladd, United Kingdom, showed a very ingenious electro-magnetic machine, with a new application of the principle of augmenting indefinitely the power of an electro-magnet by currents produced by itself. The apparatus can be used for lighthouse and other purposes, and is driven by a one-horse power steam-engine, by which force effects are produced equal to a fifty Grove's battery.

Elliott Brothers, United Kingdom, exhibited Sir W. Thomson's astatic reflecting galvanometer used in laying the Atlantic telegraph cable; and P. H. Desvignes, United Kingdom, a gyroscope which revolves by electro-magnetism.

G. Trouvé, France, exhibited various ingenious automatic toys, such as humming-birds, small gyroscopes, heads of animals, &c., set as pins, which move by magneto-electricity.

Under the head of electricity may be included Chronoscopes and Chronographs. These instruments are chiefly applied to the measurement of the velocity of projectiles by electricity, and for registering the exact moment at which an astronomical or other observation is made. The chronoscopes shown by E. Hardy, France, constructed for the French Government, were the best instruments of the kind in the Exhibition.

The instruments used for the automatic regulation of the carbon electrodes of electric lamps were extremely interesting. England was not represented in this department as she was in 1862; but France, in the exhibition of V. Serrin's extremely beautiful and ingenious apparatus, now used in many of the French lighthouses, was admirably represented. The apparatus has been greatly improved since 1862, and the automatic regulation of the charcoal points is now under the most perfect control. The intense nature of this light is such that it has been used with great success in obtaining photographs of the catacombs under Paris, and of the sewers, specimens of which were shown adjoining M. Serrin's exhibition.—*Official Report.*

ELECTRIC CLOCKS.

ELECTRIC Clocks were not so numerous in the late French Exhibition as might be expected from the excellence to which they have attained. The application of electricity to time had, however, several representatives. The clock exhibited by Paul Garnier, France, is one of the best, combining various improvements. They may be thus enumerated:—The oscillations of the pendulum are independent of, and free of any influence from, the moving power (whether electricity or gravity). The pendulum is compensated. The rod, of white deal, is baked and soaked in a mixture of beeswax, oil of turpentine, and linseed oil, and then French polished, to prevent absorption of moisture. The compensation consists of a zinc tube (sheet zinc), resting on the adjusting-nut at the bottom of the wood rod; the cast-iron bob rests on the top of the zinc tube by means of a plate screwed to the latter. The proportions are as follow:—The acting weight suspended from the curved lever, for the purpose of uplifting the impulse arms, is 2½ drachms, exerting a pulling pressure (longitudinally) of about ½ drachm at the point where the arms hold the curved lever, so that the actual force required to disengage the arms is a high fraction of a drachm, the hooks of the curved lever and the pin in the impulse arms being hardened and polished cast steel. Hence the pendulum becomes a correct timekeeper, equal frequently, when due care is taken, to a first-rate astronomical clock. In the best form of electric clock the pendulum makes a contact at each oscillation by bending a spring, which in itself, as the temperature varies, will influence the rate of the clock. The manner in which the impulse is imparted to the pendulum is not entirely free from friction, and tends to produce "wobbling," as the impulse, although parallel, is not in the same plane as that in which the pendulum oscillates. The contact-makers are generally formed of iron cups, containing mercury, into which dip pieces of copper with iron extremities. One enters the mercury at the moment the other leaves it, so that no spark from the direct current can oxydise the surfaces of the contact-makers, as both transmit the same current alternately —the left one to the magnet of the pendulum, the right one to the clock.—*Ibid.*

NEW TELEGRAPH INSTRUMENT.

At the chief office of the London District Telegraph Company, in Cannon Street, is a telegraph instrument which, in point of detail and result, appears to be the nearest approach to simplicity and perfection hitherto available for public or private use. It is a printing instrument, producing letters printed in ordinary type by means of pressing small keys bearing the respective letters. It is worked, says the *Star*, by a combination of clockwork and electricity, and has now been in use for some weeks without a single derangement. Other somewhat similar results have been arrived at by other instruments, but with the exception of that invented by Professor Hughes, none have been brought into successful use. This instrument has, however, many advantages over that of Professor Hughes. It does not exceed 15 square inches in size. It is extremely simple in all its arrangements, is portable, and costs less than a third of that invented by Professor Hughes. These many advantages render it particularly suitable for private telegraphs, as any one can work it. A printed record is kept of the message, and should no one be in attendance to receive a message when transmitted, the printed slip will remain for attention as soon as any one is present to attend to it.—*Mechanics' Magazine.*

NEW TELEGRAPHIC THERMOMETER.

Professor Wheatstone has described to the British Association a new Telegraphic Thermometer, and the application of the principle to other meteorological indicators. He exhibited the instrument and explained its construction; and concluded by stating the purposes to which it might be applied, among others the following:—The responder may be placed at the top of a high mountain and left there for any length of time, while its indications may be read at any station below. Thus, if there should be no insuperable difficulties in placing the wires, the indications of a thermometer placed at the summit of Mont Blanc may be read as often as required at Chamouni. A year's hourly observations under such circumstances would no doubt be of great value. If it be required to ascertain during a long-continued period the temperature of the earth at different depths below its surface, several responders may be permanently buried at the required depths. It will not be requisite to have separate questioners for each, as the same may be applied successively to all the different wires. The responder, made perfectly water-tight, in which there would be no difficulty, might be lowered to the bottom of the sea, and its indications read at intervals during its descent. In the present mode of making marine thermometric observations, it is necessary that the thermometer should be raised whenever a fresh observation is required to be made.

ELECTRIC TELEGRAPHS.

The telegraph apparatus shown in the French Exhibition contained few novelties, but indicated satisfactorily the quiet progress which had been made in this art-science in the five years which have elapsed since the last London Exhibition.

In the French Exhibition of 1867 there was a significant inclination on the part of the French inventors to bring forward type-printing telegraphs. This is the result of the great success which has been attained by Mr. David Hughes's telegraph—the only instrument of similar importance which has not figured in previous exhibitions. This system, introduced from America, promises ere long to rival the Morse in the extent of its employment.

Every day we are advancing towards the possession of standards of merit. Telegraphy is growing, from stage to stage, more practical, because those inventions which do not come up to the established standard find their level sooner than they did before these standards existed. Thus the single needle telegraphs, which, during long years, held their own in England, have almost entirely died out. The host of fantastical schemes of submarine cables and methods which we heard of in 1862 have been frightened out of existence by the great reality of the Atlantic cable. And with such a standard as the Hughes type-printer, the numerous inferior schemes which emulation has called or recalled into being in this Exhibition, will, infallibly, in a short time retire into oblivion.

W. T. Henley, North Woolwich, showed a case of cable samples with sections. In addition to the cables shown in the London Exhibition of 1862, we have the following :—

Cables.	Laid.	Conductors.	Length in Miles.	Weight in Tons.
Denmark	1863	4	12	134
Norway	1863-6	1	50	177
Persian Gulf	1863-6	1	1615	690
Ramsgate	1864	6	23	207
Italy and Turkey	1864	1	61	186
England and Ireland ..	1865	7	26½	307
Prussia and Sweden ..	1865	3	55	405
Wrexford	1865	4	17½	321
River Plate	1866	3	30	473
Cooke's Strait	1866	3	53	440
Behring Sea	1866	1	601	784
Norway	1866	1	7	10
England and Hanover ..	1866	4	240	2465

LONGITUDE BY THE CABLE.

In ascertaining the exact longitude by means of the Atlantic telegraph cable, a distance of about 1,900 miles has been measured, and the measure is not probably more than 40 ft. from the truth. The time required for a signal to pass through the cable has been discovered with still greater precision to be 31-100ths of a second, which is probably not in error by 100th of a second. This is equivalent to a velocity of 6,020 miles a second, and is notably less than the velocity of the electric fluid upon land lines, which numerous observations have shown to average 16,000 miles a second.

PROGRESS OF TELEGRAPHY IN 1867.

The events connected with the extension of telegraphic communication in 1866 were the most memorable ever recorded in its history; for in that year not only was a complete cable, uniting the Old World and the New, successfully submerged, but another, which was considered irretrievably lost by the general public, was recovered from the depths of the Atlantic.

Some of the facts connected with its history and progress during the year 1867 are peculiar and interesting. The first prominent occurrence was the repairing of the Atlantic cable of 1866, which had been broken some two miles from the Bay of Heart's Content. It appears that when the shore end of the cable referred to was being laid the Great Eastern, from which it was paid out, was in a fog, and it was laid in a shallower part of the ocean than was originally intended by the engineers. It was found that an iceberg, which had grounded in 27 fathoms, was the cause of the accident, and the cable was repaired in the marvellously short space of 48 hours, under the supervision of Mr. Henry Clifford, C.E. The same rope broke again in July, about 87 miles from Newfoundland. Thirteen miles of it were picked up by the ship *Chilton*, under the direction of Sir Samuel Canning, and laid in a deeper channel than that in which it had formerly been deposited. This was the first case of what may be called ordinary repair to the Atlantic lines, as contradistinguished from picking up and splicing, and the promptitude with which it was effected afforded another proof of Sir Samuel Canning's ability and skill.

It may be here remarked that not the slightest interruption has yet occurred in the cable of 1865. A cable has been laid between Havannah and Key West, Florida, and a second line between Key West and Punta Rossa. The first is sheathed in iron and weighs 2·15 tons to the nautical mile. The route of it is across strong and variable currents and over about 1,000 fathoms. A curious miscalculation took place while this line was being constructed. Owing to the phenomenon of under-currents the cable assumed a direction over the stern as if the current was continuing to go west (as it actually did during the first 20 miles), when it was really going east. The result of this miscalculation was that the supply of materials ran short, and the line had to be completed with part of the Key West and Punta Rossa wire, and the latter finished with a portion of what was intended for a Red Sea cable. The whole length of the section is 120 miles, and on the Havannah coast the shore end runs into 450, and on the Key West into 136 fathoms. The shallowness of the bed on which a great portion of the Key West and Punta Rossa line lies exposes the gutta-percha covering to a severe test in the tropics. Some of it is laid on mud banks where the normal temperature is between 80 deg. and 90 deg., and it has no outer "serving" to preserve it from rust. We may here add that during the progress of the expeditions in which these lines were established considerable loss of life took place among the staff which superintended its construction.

A line has been laid from Placentia to Lloyd's Cove, Sydney, and touches at the French island of St. Pierre. Unlike the Atlantic cable, this is sheathed in iron wires and weighs 2·25 tons per nautical mile generally, and 11 tons per nautical mile at the shore end. The whole length of the section is 301 nautical miles, and every indication has been given that its general insulation is perfect. The South Foreland and La Panne, in Belgium, have been also united by a line of telegraph which contains four conductors, two of them consisting of recovered portions of the Cromer and Emden cable. The La Panne line is 47 miles in length, and the wire is covered with asphalte and an outer "serving." In Persia a special loop line from Khanakeen to Teheran and another from Teheran to Bushire have been erected. These are, however, of no very great importance as alternative lines, for which they are intended, between Bagdad and Bushire, for the line between Bagdad and Bassorah is working well, and that between Bassorah and Bushire has never been interrupted. Considering, however, the Russian position, the line between Teheran and Bushire is not without its value.

For the purposes of the Abyssinian Expedition Major Champain, R.E., has taken out materials and a staff for the construction of a semi-permanent line from Annesley Bay to the final headquarters. This will consist of copper wire, and the insulators will be attached to bamboo supports. For flying telegraphs 40 miles of Hooper's wires, without iron covering, have been supplied. This peculiar species of wire resists the power of the sun better, it is said, than any other, and by experiments performed in England it was proved that artillery might pass over it without doing it any material injury. Thirty miles of wire have been sent out to Turkey, which are to form a line across the Bosphorus, and a similar quantity has been transmitted to Brazil. At home little has been done, owing to the suspense created by the proposed scheme of the government to take the telegraphs under their own control. Considerable advance has, however, been made in the construction of telegraphic instruments. The details regarding these are, as may be expected, almost entirely technical, but we may observe that during the past year some very successful essays have been made to convert mechanical power into electricity.

Chemical Science.

PROGRESS OF CHEMISTRY.

At the late Meeting of the British Association, Professor L. Anderson, President of the Chemical Section, observed:—The discoveries of the last thirty years had not only enlarged her bounds, but had unsettled certain fundamental views without substituting others in their stead. Even so far back as the beginning of the present century, the Atomic Theory of Dalton, which had served its purpose once, had been found to be no longer adequate to the requirements originating in the advanced state of the science. Then, chemistry might have been described as the chemistry of oxygen; now, it might be called the chemistry of carbon. Various attempts had been made to substitute another theory in the place of the Atomic, but most of these had resulted in nothing better than the burdening of the science with a cumbersome nomenclature. Reverting to Sir Benjamin Brodie's views on the matter, the learned President explained them as having for their object the total abandonment of the Daltonian Theory, and the substitution of a system by which he compares with one another the weights of different substances in a gaseous state, in which they are capable at a standard temperature of filling one unit of space. But this system dealt largely in hypothesis, for it required that many substances which had hitherto been regarded as simple elements be dealt with as compounds. The Daltonian Theory must be abandoned, but some kind of molecular hypothesis would require to be adopted. Dr. Anderson suggested the formation of a committee to consider how far a uniform system of chemical symbols might be brought into use.

ACTINIC POWER OF LIGHT.

Mr. Louis Bing, of Bishop Stortford, an artist, proposes the following improved mode of an apparatus for determining the Actinic Power of Light. His object is to measure the actinic power of light numerically in the same manner that temperature is measured for the purposes of photography and other purposes connected with scientific investigation. To this end he produces a graduated transparent medium varying in transparency from the unit to any required degree of opacity, and to this medium he applies a sensitised strip or sheet of paper, placing it under the transparent medium for the purpose of exposing it to the action of the light, and thereby obtaining an indication of the power of the actinic rays. By this means the photographer is enabled to decide with precision the length of exposure required for his plate or printing paper to obtain certain determined results. The transparent medium may be constructed by the use of overlaying plates of talc, glass, or gelatine, the unit of transparency being one thickness of the plate, and the transparency gradually decreasing by super-imposing a gradually increasing number of plates until any required degree of opacity is reached. Mr. Bing prefers, however, to use for the transparent medium a glass vessel, having two flat sides, and filled with any suitable coloured solution not affected by light. The upper plate will have an inclination from the lower plate both in the direction of its length and breadth, that is, from (say) the left-hand corner upwards, and also upwards to the right. Thus the vessel will be wedged-shaped, tapering in two directions to the corner which he terms the unit corner. The whole of the lower transparent surface of the vessel he proposes to divide into squares of equal size, and to number them from left to right with increasing numbers, and also from the lower and thinner end or edge of the wedge-shaped vessel to the thicker end. The numbers will commence from the unit corner of the lowest series of squares, and continue to increase throughout the whole surface of the instrument, according as the sectional thickness of the light-transmitting medium increases, or as its transparency diminishes.—*Mechanics' Magazine.*

NITRO-GLYCERINE.

EXPERIMENTS have been made in the canton of Neufchatel with Nitro-glycerine, in order to detach some large blocks of rock on the right bank of the Areuse, for the purpose of constructing a dam across the river, to prevent the materials occasioned by land-slips being carried down by the floods. The first hole was drilled halfway up the side of the mass of rocks facing the river, 21 ft. in depth and 2 in. in diameter, and was charged with only 6 lb. of nitro-glycerine. The block of rock that was detached was about 300 cubic métres. A great part of the *débris* fell into the river.

A terrific explosion of this blasting oil has taken place at Newcastle-upon-Tyne, the cause of which is thus explained:—Nitro-glycerine crystallises from solution in wood-spirit, as sugar from syrup; nitro-glycerine explodes by percussion. The shovel which was used to knock off the ends of the canisters containing the solid nitro-glycerine doubtless afterwards came in contact with some of the solid nitro-glycerine placed in the soil.

A Civil Engineer writes to the *Times*: "Having used this most dangerous oil in considerable quantities for blasting purposes in Prussia, I was not at all surprised to hear of the recent accident occurring, when this unfamiliar material had to be dealt with by inexperienced hands, for the greatest care is required both in the carriage and use of this oil. In the first place, a sharp blow or jolt given to the canister will, in some cases, cause the compound to explode; and, secondly, it freezes or congeals at a comparatively high temperature, and when in this state may be exploded even by the scratch of a needle. Hence it is advisable to store it in glass bottles, its state being the more easily ascertained, and, glass is outside the gauze, while there are some slight improvements in the top. On being tested the first lamp exploded, but it was understood that it had not been rightly fixed. A second one, however, after being subjected to an atmosphere of gas and a strong current of air, kept in for a considerable time, and exhibited a faint green light at the top of the lamp for upwards of 14 minutes. The ordinary Clanny and Davy lamps as usual exploded, showing that for all purposes of safety they are not to be depended upon, so that their use in all mines of a fiery character ought not to be tolerated. The old Stephenson or "Geordie" appears to be one of the most reliable, and did not explode. With certain improvements suggested by the colliery viewers, and also by Mr. Mills, there is now every probability that the Stephenson can be made all that is required of a safety lamp. Similar experiments, it appears, have recently been made at Helton Colliery, in Durham, as well as at other places.

NEW ANÆSTHETIC.

SOME interesting particulars of this valuable agent in altogether banishing pain in surgical operations have been published by the distinguished discoverer in the *Medical Times and Gazette.* Dr. Richardson states that in carrying out his researches on the bichloride of methyline he had been led into a new inquiry—as to the condensing power of the pulmonary surface for gases and vapours. He believes that all gases and vapours which enter the blood by the lungs are condensed by the pulmonary surface into a liquid state previous to absorption, and this physiological result he finds in curious accordance with the facts brought to light by Professor Graham on the condensation of gases by platinum and colloidal substances. If the condensing power of the lung be proved it will afford an explanation of some interesting and difficult physiological problems.

CREOSOTE.

A LARGE proportion of ordinary Creosote is nothing more than carbolic acid, but the true creosote is a very different substance. Rust gives a method by which these two bodies may be distinguished from each other, by their behaviour with collodion. When carbolic acid is mixed with collodion, a gelatinous precipitate is formed, whilst the collodion remains clear on the addition of true creosote. Dr. Hager gives another test. A few drops of ammonia are added to a weak solution of chloride of iron until the precipitate which originally forms is dissolved. Carbolic acid communicates a blue or violet tinge to the solution, whilst creosote gives a green colour, which afterwards turns brown.—*Mechanics' Magazine.*

GASES IN MINES.

A METHOD of getting rid of inflammable gases from mines has been suggested to the French Academy of Sciences by M. Sommer. He proposes, by means of electricity carried by suitable wires into the mine, to explode the inflammable gases before the miners enter. But, even if this were done, an atmosphere of chokedamp would be left behind, which, however, would not be so dangerous. Ansell's fire-damp indicator acts on the principle that firedamp will flow more rapidly into a vessel formed with a porous septum than air will flow out; and the increase in the volume of the contained gas thus resulting will raise the level of a column of mercury and ring an alarum-bell by electricity. It has long been proposed to light mines by an electric light contained in an hermetically-sealed glass-globe, the electric light requiring no air for combustion. But the best precaution against explosions is afforded by the introduction of a better system of ventilation. A very small diminution in the pressure of the atmosphere, as shown by the barometer, will often suffice to evolve large quantities of inflammable gas from the coal; and it may one day become advisable to work coal-mines under artificial pressure.—*Illustrated London News.*

CARBOLIC ACID.

THE manufacture of Carbolic Acid in Germany does not appear to pay well, and L. Rumdohr, the manager of some mineral oil and paraffin works, has turned his attention to other uses for his material. He has found that the raw compound of creosote and soda may be employed for the manufacture of gas of a highly illuminating power. We need not dwell upon his money figures, since they could not apply to the manufacture in this country, but will simply give the results of his experiments. The carbolate of soda is burned in a close furnace, the sole of which is a cast-iron pan, 8 ft. long, 4 ft. wide, and 9 in. deep. The grate is 2½ ft. square. The other arrangements will be obvious to our readers. In the first step of the proceeding the water is driven from the material; the creosote and soda compound is then decomposed, a porous coke with which the soda is mixed being left. One result of the decomposition is the formation of a quantity of carbonic acid, the greater part of which unites with the caustic soda employed to produce the carbolate. The carbonate of soda is easily extracted from the coke, and may be used again and again. As regards the yield of gas, the author states that 100 lb. of creosotate of soda will give 550 cubic feet of gas. If, however, these 100 lb. of the compound contain 50 lb. of creosote the yield will be 1,100 cubic feet of gas. The gas is represented to have a very high illuminating power. Burned from an ordinary bat's-wing burner consuming 3 ft. per hour, the light was equal to nineteen wax candles, six to the pound and 10 in. long. The rate at which the candles burned is not given. It is not necessary to say more of this process, which is not likely to be followed on a large scale, but it might, perhaps, be made available for lighting up particular works.—

CARBONIC OXIDE AND FORMIC ACID.

Dr. Crace Calvert, in a lecture before the Society of Arts, has described M. Berthelot's remarkable process for converting Carbonic Oxide into Formic Acid. A strong solution of caustic lye of potash or soda is poured into the lower part of a large glass vessel, which is then filled up with carbonic oxide. After giving a rotatory motion to the vessel, the carbonic oxide is absorbed by the potash or soda, producing formiate of potash or soda, from which the free acid is easily obtained. On March 7 a paper was read before the Chemical Society, by Mr. Chapman, showing that, by digesting formic acid with a solution of chromic acid, the formic acid was oxydised and carbonic acid and water were produced. This may afford a hint for an antidote to the poison of snakes, which consists mainly of formic acid.—*Illustrated London News.*

GUN-COTTON.

Many modifications of Gun-cotton have been proposed; the most recent, says the *Scientific Review*, being granulation; which, it is asserted, removes the inconvenience and danger that has hitherto attended the use of this explosive compound. It is first prepared as ordinary gun-cotton; it is then subjected, in a vat, to manipulations similar to those used for the production of paper-pulp; after which it is formed into solid masses, to which any desired density is given by subjecting the material, while still moist, to pressure. The solid masses are cut into grains, that are sorted if necessary; or the pulp, containing a small quantity of collodion, gum, or some other substance of a binding nature, is introduced into a vessel to which is imparted a vibrating motion, which gives rise to granulation.

Whilst the application of gun-cotton as an explosive agent has been steadily advancing, Messrs. Prentice and Co., of Stowmarket, the manufacturers of this material, have carefully watched the results of its mechanical work, as well as the chemical investigation to which it has been subjected. Applying the system of Professor Abel, chemist to the War Department, Messrs. Prentice are enabled to carry out a plan of compression which their experience has led them to see is of value in the use of this material. The principle thus introduced insures the most perfect attainment of the points essential for the safety and stability of the material, and, it is stated, renders it non-explosive in the open air, at the same time securing the highest effective power. In preparing this material the cotton is first made explosive in the usual manner, then taken to the pulping mill under Professor Abel's system. After thorough separation of the fibre and admixture of the pulp, it is compressed by hydraulic machinery until 1 in. of the cotton of any given diameter is equal to 6 in. of powder. It is in a most portable and convenient form, and the advantages to the miner of having the whole of his explosive force confined at the bottom of the hole cannot be over estimated. This new process of manufacture will no doubt give results which will materially lessen the work of miners, quarrymen, and contractors.—*Mechanics' Magazine.*

APPLICATIONS OF GLYCERINE.

The greater solubility of many substances in Glycerine than in water is a well-known fact that has been extensively applied in pharmacy. One substance much more soluble in glycerine than water is arsenious acid, which, as is well known to bird-stuffers and others, has the property of preserving animal matters from putrefaction. Calico-printers have long employed an aqueous solution of arsenic or arseniate of soda to preserve their thickening materials, albumen, &c. We see with some surprise that M. Paraf has taken out a patent in France for the use of a solution of arsenic in glycerine for this purpose.

Glycerine is found to be an excellent material for smearing plaster of Paris moulds before taking a cast. It is easily applied with a brush, and, after the cast has set, it readily separates without the least danger of splintering or cracking. It is said to possess many recommendations over the soap and water usually employed for the same purpose.

MANUFACTURE OF OIL OF VITRIOL.

A new process for the Manufacture of Oil of Vitriol has been patented in France. The only novelty, however, is in the apparatus, the chemistry of the new process being the same as the old. The huge leaden chambers are dispensed with, and the whole plant occupies forty times less space than that required by the old plan. We may say briefly that the sulphur or pyrites is burned in compressed air. The sulphurous acid gas is first washed and then brought in contact with the nitric vapours in a comparatively small leaden chamber, contrived to bring the gases into intimate association, and lead away the sulphuric acid as soon as formed. By the washing of the sulphurous acid, the sulphuric acid is obtained free from some of the impurities usually found in it.

NEW COLOUR.

Professor Church has described to the Chemical Society a very interesting Colouring Matter, derived from the red wing feathers of the Touraco. Ornithologists and bird-stuffers had remarked that the red matter is washed out by water when the feathers are not protected by the greasy matter which nature has provided to keep them dry. The experiments of Professor Church proved that this is really the fact. The colouring matter is readily soluble in water, and still more so in water rendered alkaline. From an alkaline solution the colour is precipitated when the alkali is neutralised with an acid. Another still more remarkable fact established by Professor Church is that a considerable amount of copper enters into the composition of this most singular colouring matter. Chemists and naturalists will wait with impatience for the more complete account of the colour promised by the Professor.

INVERSE FILTRATION.

MR. CAREY LEA, in an account of some new manipulations, gives a method of what he calls "Inverse Filtration," which is very simple, and will be found useful in many cases. When, for example, the mother-liquor is to be separated from crystals, or caustic potash is to be filtered, or generally when solid and liquid matters have to be rapidly separated on a large scale, Mr. Lea makes use of a small funnel, over the mouth of which he stretches a piece of stout muslin, and ties it securely round the neck. Then on the stem of the funnel he passes a piece of india-rubber tubing, which may be several feet in length, or it may be short, and the difference made up by inserting a piece of glass tubing. The funnel and tube are then filled with water, the open end of the tube being closed with the finger, and the funnel is quickly inverted in the vessel containing the mixture to be filtered. We have here a combination of filter and siphon, and the pressure of the column of water in the longer leg of the siphon greatly expedites the operation. Our chemical readers will see at once in how many cases this simple method will be applicable. It is sometimes necessary to place filtering-paper inside the muslin, and in doing this some precautions must be taken which will suggest themselves to every practical man.—*Mechanics' Magazine.*

MAGNESIAN SALTS AND ROCKS.

MR. STERRY HUNT has read before the French Academy of Sciences the summary of his researches upon certain reactions of Magnesian Salts and Magnesian Rocks. The author attacks the theory of MM. Haidinger and Suckow, who explain the efflorescence of sulphate of magnesia by the reaction of sulphate of lime and carbonate of magnesia. He believes that the magnesian silicates which form portion of the dolomites in the environs of Paris are the representatives of the unaltered formation of steatites; that the talcs and serpentines are formed aqueously; that the greensands of the Paris basin are of the same composition as serpentines, &c.

NICOTINE.

The *Journal of the Society of Arts* states that a Belgian chemist, M. Melsens, who has made numerous communications to the Academy of Sciences, has found that the proportion of Nicotine contained in different species of tobacco varies much according to where it is produced. The tobacco grown in France, especially that from the department of Lot, contains about 7·96, or near 8 per cent. of nicotine, whilst from Havannah tobacco only 2 per cent. is found. M. Melsens proposes to smokers, to preserve them from the baneful effects of this alkaloid, to put in the barrel of their pipe or in the cigar-holder a little plug of cotton, impregnated with a mixture of tannic and citric acids. The smoke passing through cotton leaves the nicotine, which combines with the two acids to form tannate and citrate.

NAPHTHALINE.

The Naphthaline, which clogs our gas-pipes at times, and gives great trouble, but has brought but little profit to gas makers, is now receiving some practical applications. It is not, however, easy to separate it from the tarry matter which always accompanies it without repeated sublimation. We notice in *Dingler's Journal* a mode of effecting the sublimation which is said to give the naphthaline at once in very fine transparent crystals which are nearly odourless. The crude naphthaline, consisting of small brown crystals with tarry matter, is intimately mixed with twice its volume of fine quartz sand. A layer of this mixture, 4 in. deep, is placed on a water-bath, and the powder is covered with a cloth. Over this a light wooden or paper box is placed for the vapour to condense in. Naphthaline volatilises, although slowly, under the temperature of boiling water; and the product thus obtained is of great purity. The solid hard residue which remains after the sublimation is said to be applicable to many technical purposes, but we are not told what they are.—*Mechanics' Magazine.*

NEW MAGNESIUM LAMP.

The American Magnesium Company, of Boston, are manufacturing a new and improved Magnesium Lamp. In the *Journal of the Franklin Institute* it is thus described:—" The clockwork, by which the motion is produced, is inclosed in the square-shaped portion below, and at the back. In the rounded front are the part for feeding the ribbons, &c. These consist of two little rollers, between which the ribbon is passed, and regularly delivered by their motion. They are placed immediately over the front opening, at which the ribbon is ignited and burned. Below this opening work eccentric cutters, which nip off the ash thread from time to time. The ribbon is supplied from flat bobbins, from which it passes into the chimney and to the rollers. The whole structure is exceedingly compact, so as to fit easily a common magic-lantern box. The most important novelty in this instrument is the arrangement of the chimney and draught. The draught blows directly into the face of the light, thus sweeping off the smoke, and making the intensest light exactly where it ought to be."

INDIGO FROM RAGS.

A METHOD of extracting Indigo from cotton or woollen Rags, dyed with that substance, has been patented in France. The inventor places the rags in a boiler, provided with a double bottom, and saturates them thoroughly with a solution of caustic soda of 1 deg. Baume. He then keeps them under the action of steam at 45 lbs. pressure for five hours. By this treatment the indigo is reduced and dissolved, and may afterwards be precipitated from the soda solution and collected. The indigo so recovered is said to be as pure as the best sorts in commerce. The process, it is said, will be particularly useful to paper-makers. It necessitates a careful sorting of the rags, but this is usual in paper mills.

BLEACHING AND WASHING.

BOLLEY, one of the best technological chemists of the day, has made an examination of the relative Bleaching powers of the hypochlorites of lime and magnesia. The latter he finds to bleach much quicker than the former. Hypochlorite of magnesia has another special advantage in the case of straw. Chloride (hypochlorite) of lime, the author states, first colours the straw brown, and then bleaches it, but slowly. The magnesia compound, on the contrary, does not give the brown colour, and bleaches straw very quickly. He explains the difference in the action by showing that magnesia is a much weaker base than lime, and consequently parts with the chlorine much quicker. He proved this by exposing solutions of the two to the air, by which he found that in a given time the magnesia lost much more chlorine than the lime.

From Bleaching we may naturally pass to Washing. We read in *Cosmos* that the Dutch laundresses, so celebrated for the whiteness of their linen, soften the water they use with borax instead of soda. They employ, it is said, a good-sized pinch, perhaps a tea-spoonful, to six gallons of boiling water, and by this quantity save half their soap. The writer goes on to say, that borax and water make a very good drink for hot weather, and that it may be employed to soften the water used in making tea; we recommend our readers not to try the experiment.

A strange way of whitening linen is given us by the *Hamburg Gewerbeblatt*. Ozone is a powerful bleaching agent, and is rapidly formed when turpentine is exposed to the air. The writer, accordingly, and apparently as the result of experiment, recommends that a little turpentine should be added to the last rinsing water, which, when the clothes are dried, effects a tolerably energetic bleaching. To get the turpentine to mix with the water, he mixes one part of the oil of turpentine with three parts of strong spirit, and adds a tablespoonful of this mixture to a pail of water. No trace of smell of the turpentine is left, it is said, when the clothes are dried in the open air, if recently rectified oil is employed. Turpentine, however, will not dissolve in spirit on simple admixture; the two require to be distilled together, when perhaps they may be used as stated above. If this method of bleaching linen is really successful, the many disadvantages which result from the frequent application of the chlorides of lime and soda to linen would be avoided.—*Mechanics' Magazine.*

CHEMICAL COMPOSITION OF THE MUD FROM THE STREETS OF THE CITY OF LONDON. BY DR. LETHEBY.*

DURING the last twelve months many analyses have been made in my laboratory of the Mud from the City thoroughfares, with the view of ascertaining the relative proportions of horsedung to the matter from the abraded stones and iron of wheels and horseshoes; and the results show that the former material averages about 57 per cent. of the dried mud. It was first ascertained that the amount of moisture in the street mud varies to a considerable extent, according to the state of the weather, but it is rarely less than 35·3 per cent. of the weight of the mud in the driest weather, the average of ordinary weather being 48·5 per cent., and in wet weather it ranges from 70 to 90 per cent. After all moisture has been driven off from the mud, by exposing it for many hours to a temperature of from 266 deg. to 300 deg. of Fahr., the relative proportions of organic and mineral matters were as follows; and for comparison the composition of well-dried fresh horsedung and common farmyard dung has also been determined:—

Composition of Mud from the stone-paved streets of the City, compared with fresh horsedung and farmyard dung dried at 300 deg. Fahr.:—

Constituents.	Fresh horse-dung.	Farm-yard dung.	Mud from stone-paved sts. Max. Organic.	Min. Organic.	Average.
Organic matter	82 7	69·9	58·2	20·5	47·2
Mineral matter	17·3	30·1	41·8	70·5	52·8
	100·0	100·0	100·0	100·0	100·0

The largest amount of mineral matter is always found in the mud in wet weather, when the abrasion of the stone and iron is greatest. At that time it may amount to 79 per cent. of the weight of the dry mud, whereas in dry weather it does not exceed 42 per cent. Taking the average of all weathers, the amount of

* Communicated by the author to the *Chemical News.*

tion of the mercury is carried on in a close furnace, there need be no danger to the workman.—*Mechanics' Magazine.*

LEAD-POISONING.

M. Marmise points out a novel source of Lead-poisoning, viz. —the painted woodwork obtained from the demolition of old houses, and which being used for fuel gives off smoke charged with lead, that may be disseminated and taken in with the breath. According to the *Lancet*, five out of ten dealers in old panellings in the city of Bordeaux have suffered more or less from lead colic, and in some instances the metal has been found deposited in the chimneys of those fireplaces in which old woodwork has been burnt. It is also said that the handling of freshly-printed journals, inasmuch as the ink contains litharge, may also account for the existence of symptoms clearly referable to the injurious influence of lead.

METEORITES.

M. Daubree, who has been investigating the specimens of Meteorites in the Paris collection, divides all Meteorites into two primary groups—Siderites and Asiderites—the former being characterised by the presence of metallic iron, and the latter by its absence. The Asiderites contains one group only, which is termed Asideres. The Siderites are divided into two sections: in the first the specimens do not enclose stony particles, and in this we find the group of Holosideres; in the second both iron and stony matters are present This, then, induces two groups: Sysideres, in which the iron is seen as a continuous mass; and Sporadosideres, in which the iron is present in the form of scattered grains.

INTERSTELLAR IRON.

A paper has been read to the Royal Society, by Thomas Graham, F.R.S., Master of the Mint, on the amount of hydrogen given off by a sample of the Lenarto Meteoric Iron when in a state of ignition. He found that it gave off three times its volume. Now, ordinary malleable iron will hardly absorb more than one-half its volume. From this difference the author infers that the iron must have passed through a very dense atmosphere of hydrogen when in a state of ignition. We cannot see the force of this inference, much less can we agree with one of our contemporaries, who in writing of it says that we must look for this atmosphere far beyond our solar system—in fact, that we must look upon it as proved that this iron has *come from some of the fixed stars*,* because it is proved by spectrum analysis that some of them contain hydrogen. Suppose now that this iron has passed through a very dense atmosphere of hydrogen, so much denser than our hydrogen as

* Hence this phenomenon has been heralded empirically as "a Message from the Stars."

the amount absorbed by the meteoric iron is greater than the amount we can cause ordinary soft iron to absorb; for this seems to be the grounds on which the inference is drawn. But what kind of hydrogen would that be which is six times denser than the hydrogen we know of? What kind of water, acids, &c., would it form? Is it not rather something other than hydrogen, if such a gas does exist, that it is like hydrogen in everything except that it is six times denser?

This of course is on the supposition that it is an essential property of this quasi-hydrogen to be of that density; but it is not an essential property of it; for on being excluded from the iron it became like other hydrogen. How, then, can there be an atmosphere of ordinary hydrogen, but six times denser than ordinary hydrogen? Why, by no other means than that of external pressure. But how are we to get that external pressure? Hydrogen being the lightest thing we know of, it will naturally arrange itself external to all other matters in any atmosphere. If we assume other matter to exist which is lighter than hydrogen to press externally upon it—and doubtless there is such matter, for example, nebulous matter—still that will not help us much; our atmosphere is surrounded with such matter, which is seen, as the zodiacal light. Though we do not reckon it as part of our earth it certainly is a part of it, and with it we take the density of our hydrogen. But is there not an easier way of accounting for it than by such an assumption, which even will not account for it without other assumptions? First, has it been ascertained that ordinary soft iron can be made to absorb six times its natural quantity by being heated in an atmosphere of hydrogen compressed sixfold? Secondly, has it been ascertained that this meteoric iron, after the hydrogen has been expelled, will re-absorb three times its bulk on the same conditions that ordinary soft iron absorbs only one-half its bulk. Till these are done an assumption is hardly admissible.

Assuming these experiments to have been made, and that ordinary soft iron will not absorb three times its own bulk even under pressure, nor will meteoric iron re-absorb the same quantity which was previously driven out of it, we will venture just one assumption, which we think will not involve so many difficulties as the assumption of a dense atmosphere of hydrogen. Suppose now that the meteoric iron was expanded into a state of vapour even till it was of the density of ordinary hydrogen, which is not too much to suppose in the case of a shooting star. Then suppose it to enter an atmosphere of ordinary hydrogen in that state. In passing through such an atmosphere it would be cooled and would condense, and in so condensing would enclose much hydrogen and imprison it, and in gradually shrinking and cooling, it would compress the hydrogen, and it might easily be to the extent of that in the Lenarto iron. Moreover, this absorption and condensation might all take place in our own atmosphere. It is a very interesting phenomenon, and we should like to see it investigated by some competent head and hand, whether Mr. Graham's or some other equally competent experimentalists. The inferences that have been drawn and the explanations that have hitherto been given, do not appear to us to be satisfactory—*Mechanics' Magazine.*

ENAMELLING IRON.

ENAMELLING Iron is almost a new art. No metal is capable of receiving a coating of vitrified porcelain or enamel unless it is capable of withstanding a red heat in a furnace. Articles of cast iron, as a preparation for enamelling, are first heated to a low red heat in a furnace, with sand placed between them, and they are kept at this temperature for half an hour, after which they must be allowed to cool very slowly, so as to anneal them. They are then subjected to a scouring operation with sand in warm dilute sulphuric or muriatic acid, then washed and dried, when they are ready for the first coat of enamel. This is made with 6 parts by weight of flint glass broken in small pieces, 3 parts of borax, 1 of red lead, and 1 of the oxide of tin. These substances are first reduced to powder in a mortar, then subjected to a deep red heat for four hours, in a crucible placed in a furnace, during which period they are frequently stirred, to mix them thoroughly; then toward the end of the heating operation the temperature is raised, so as to fuse them partially, when they are removed in a pasty condition and plunged into cold water. The sudden cooling renders the mixture very brittle and easily reduced to powder, in which condition it is called frit. One part of this frit by weight is mixed with two parts of calcined bone-dust, and ground together with water until it becomes so comminuted that no grit will be sensible to the touch when rubbed between the thumb and finger. It is then strained through a fine cloth, and should be about the consistency of cream. A suitable quantity of this semi-liquid is then poured with a spoon over the iron article, which should be warmed to be enamelled, or, if there is a sufficient quantity, the iron may be dipped into it and slightly stirred, to remove all air-bubbles and permit the composition to adhere smoothly to the entire surface. The iron article thus treated is then allowed to stand until its coating is so dry that it will not drip off, when it is placed in a suitable oven, to be heated to 180 deg. Fahr., where it is kept until all the moisture is driven off. This is the first coat; it must be carefully put on, and no bare spots must be left on it. When perfectly dry the articles so coated are placed on a tray separate from one another, and when the muffle in the furnace is raised to a red heat, they are placed within it and subjected to a vitrifying temperature. The furnace used is similar to that used for baking porcelain. This furnace is open for inspection, and when the enamel coat is partially fused, the articles are withdrawn and laid down upon a flat iron plate to cool, and thus they have obtained their first coat of dull, white enamel, called biscuit. When perfectly cool they are wet with clean soft water, and a second coat applied like the first, but the composition is different, as it consists of 32 parts by weight of calcined bone, 16 parts of China clay, and 14 parts of feldspar. These are ground together, then made into a paste, with 8 parts of carbonate of potash dissolved in water, and the whole fired together for three hours in a reverberatory furnace, after which the compound thus obtained is reduced to frit, and mixed with 16 parts flint glass, 5½ of calcined bone, and 3 of calcined flint, and all ground to a creamy consistency with water, like the preparation for the first coat. The articles are treated and fired again, as has been described in the preparation coat, and after they come out of the furnace they resemble white earthenware. Having been twice coated, they now receive another coat and firing, to make them resemble porcelain. The composition for this purpose consists of 4 parts by weight of feldspar, 4 of clear sand, 4 of carbonate of potash, 6 of borax, and 1 each of oxide of tin, nitre, arsenic, and fine chalk. These are roasted and fritted as before described, and then 16 parts of it are mixed with the second enamel composition described, excepting the 16 parts of flint glass, which is left out. The application and firing are performed as in the other two operations, but the heat of vitrification is elevated so as to fuse the third and second coats into one, which leaves a glazed surface, forming a beautiful white enamel. A fourth coat, similar to the third, may be put on if the enamel is not sufficiently thick. The articles may be ornamented like china ware, by painting coloured enamels on the last of the coats, and fusing them on in the furnace. A blue is formed by mixing the oxide of cobalt with the last-named composition; the oxide of chromium forms a green, the peroxide of manganese makes a violet, a mixture of the protoxide of copper and red oxide of lead a red, the chloride of silver forms a yellow, and equal parts of the oxide of cobalt, manganese, and copper form a black enamel when fused. The oxide of copper for red enamel is prepared by boiling equal weights of sugar and acetate of copper in four parts of water. The precipitate which is formed after two hours moderate boiling is a brilliant red. The addition of calcined borax renders all enamels more fusible. —*Mechanics' Magazine.*

JAPANESE ALLOYS.

A WRITER in an American scientific journal gives some interesting facts with especial reference to the alloys in use in Japan. The first alloy given may be regarded as a weak Japanese imitation of jewellers' gold. This *Shakdo* is an interesting alloy of copper and gold, the latter metal in proportions varying between 1 per cent. and 10 per cent. Objects made from this composition, after being polished, are boiled in a solution of sulphate of copper, alum, and verdigris, by which they receive a beautiful bluish-black colour. *Gin shi bu ichi* ("quarter silver") is an alloy of copper and silver, in which the amount of silver varies between 30 per cent. and 50 per cent. Ornamental objects made from this composition take, when subjected to the action of the above solution, a rich grey colour, much liked by the Japanese. *Mokume* is a mixture of several alloys and metals of different colours associated in such manner as to produce an ornamental effect. Beautiful damask work is produced by soldering together, one over the other in alternate order, thirty or forty sheets of gold, *shakdo* silver, rose copper, and *gin shi bu ichi*, and then cutting deep into the thick plate thus formed with conical reamers, to produce concentric circles, and making troughs of triangular section to produce parallel, straight, or contorted lines. The plate is then hammered out until the holes disappear, manufactured into the desired shape, scoured with ashes, polished, and boiled in the solution already mentioned. The boiling brings out the colours of the *shakdo*, *gin shi bu ichi*, and rose copper. Of brasses (*sin chu*) the finest quality of brass is formed of 10 parts of copper and 5 parts of zinc. A lower quality, of 10 parts copper and 27 parts zinc. *Kara kane* (bell metal) varies from first quality—copper 10, tin 4, iron $\frac{1}{2}$, zinc $1\frac{1}{5}$th, to 4th quality—copper 10, tin 2, lead 2. The best small bells are made from the former quality, and large bells from the latter.

IRIDIUM IN CANADA.

Mr. Meves, of Madoc, states that Iridium exists along with the other materials with which gold has been found in the Richardson mine. The presence of iridium, says the *Keystone News*, is not mentioned in the reports of Dr. Hunt and Mr. Michel; but as Mr. Meves has obtained his specimens quite recently, they may have been taken from different parts of the vein or "pocket," as this deposit has been called. Iridium is one of the rare metals, and is of extreme hardness. It was found in Californian gold, and its presence in the gold coined at the United States mint caused the destruction of several valuable dies, and from this led to its detection and removal. The same substance is found in the gold of the Chaudière, as also platinum, and an alloy of osmium and iridium, named iridosmine. The latter is very hard and durable, and is put to a practical use in pointing gold pens and in jewelling. Platinum, it need scarcely be remarked, is a most valuable metal, and if found in the gold region here, as is quite likely, would constitute of itself a valuable discovery. We mention this to encourage explorers to have their eyes open to other things besides gold. Such a tract of country might also be expected to supply precious stones, as chalcedony, amethysts, and other varieties of coloured quartz, jaspers, and even diamonds.—*Mechanics' Magazine.*

UTILISATION OF GASES.

The *Mining Journal* says that probably the first attempt to utilise the gases given off in the process of coking has been made at the works of Messrs. Carver and Co., of St. Etienne. The gases are collected and drawn off through pipes and cooled, when the tar, ammoniacal liquids, &c., are condensed. From these condensed liquids, benzine, naphthaline, sulphate of ammonia, artificial manures, and a number of dyestuffs, are made. The gas remaining after condensation of the liquids, which is, of course, ordinary illuminating gas, can be used in the usual manner. It is estimated that in France alone no less than 4,000,000 tons of coal are annually coked, and it has been proved that Messrs. Carver's process is capable of giving a profit of nearly 2*s*. upon every ton of coal treated. A more conclusive evidence of the advantage resulting from that sound technical education so readily obtainable on the continent could scarcely be desired.

PHOSPHATE OF LIME.

Mr. C. Norrington, of Sussex House, Plymouth, renders available for the purposes of manure-manufacturers, phosphorus-manufacturers, and others, those mineral and fossil substances containing phosphate of lime, which, although well known, yet on account of their containing too large a percentage of carbonate of lime, iron, silica, and other valueless substances, are generally considered of no value in the economical manufacture of superphosphate of lime. He does this by using hydrochloric acid, which has also usually been considered unfit for the same manufacture, although it possesses valuable solvent properties, and is of little cost, being a superabundant waste product of the soda manufacture. Mr. Norrington also treats in like manner coprolitic phosphates, apatite, bone ash, phosphatic guanos, and other mineral phosphates, such as are already in use for the manufacture of superphosphate of lime. He further treats phosphatic substances with hydrochloric acid, using only sufficient for the solution and removal thereby of the carbonate of lime present without rendering the phosphates soluble.

A WINTER LANDSCAPE.

The materials for making a chemical experiment which affords some entertainment are sold in Germany with directions for obtaining "a Winter Landscape" in a bottle. These materials consist of a colourless liquid in a bottle, which is really a solution of nitrate of lead, one part to three of water; and a box of fragments of sal-ammoniac of about the size of small beans. About 2 in. of a bottle or glass are to be filled with the solution, and then pieces of the sal-ammoniac are to be dropped in to cover the bottom. The double decomposition which ensues with the two ingredients causes the deposition of a white crust, upon which is seen projections which seem to be miniature representations of trees, bushes, grasses, and rocks all covered with snow. Readers who think of amusing themselves by repeating this experiment must remember that nitrate of lead is a poisonous salt.—*Mechanics' Magazine.*

PROGRESS OF PHOTOGRAPHY.

New Processes.—Mr. J. Spiller has read to the British Association the following paper:—The author said: "I have the pleasure of submitting to the notice of the Section several interesting results and improvements in photography, based, it may be said, on the chemistry of gelatine. The processes to which I refer are the various modifications of the Woodbury type, including the new method of micro-photo-sculpture, the art of photo-lithography, as practised in the Royal Arsenal at Woolwich, and some illustrations of the use of gelatine or albumen, on a foundation of silk, satin or cambric, the work of Mr. H. B. Pritchard, of the War Department. The Hon. H. Fox Talbot was one of the first to describe and make a practical use of the action of light upon a mixture of gelatine and a soluble bichromate, and after him Col. Sir H. James, Mr. Swan, of Newcastle, and Mr. Woodbury, of Manchester, have applied the same chemical principle in new directions. It is known that the chemical rays of light have the effect of rendering insoluble gelatine to which a bichromate has been added. It would appear that this oxidizing salt hardens the animal substance by forming with it a combination of chromic oxide. In proof of this view, it may be stated that Mr. Swan has lately devised a mode of working, in which a minute quantity of chrome alum or sulphate of chromium is used instead of the red chromate, and it is found that when dried this mixture is not again affected by water. The carbon prints of Mr. Swan, which were exhibited and so much admired in 1866 at Nottingham, are illustrations of the use of a chromate in conjunction with gelatine and pigments. Mr. Woodbury's process is also based on the insolubility of the chromo-gelatine after exposure to light, and upon the subsequent action of water upon a sensitive film, which has been in different degrees influenced by insulation under an ordinary photographic negative. The depths of tint in the original are represented by variations in the thickness of the film of gelatine left unacted upon by water, and thus dried may then be used as a matrix to produce a corresponding series of depressions upon a surface of lead or type-metal by the aid of a powerful hydraulic press. The blocks so produced serve for printing off a great number of proofs when they are liberally 'inked' with warm gelatine, highly charged with Frankfort black or other suitable pigment, and pressed down upon a smooth sheet of paper until the excess of ink is forced out on all four sides of the block and so removed from the space constituting the area of the picture, which, when set, is, lastly, protected with a varnish of collodion. A glass plate may be used instead of paper to receive the ink, and this, backed with another (opal) glass, gives an excellent result, suitable for a variety of ornamental purposes.

"Mr. Woodbury has lately perfected a modification of his process, which is applicable to the representation in high relief of microscopic objects. The method consists in spreading a warm solution of gelatine, containing a little sugar and bromate of potash, over a glass plate previously coated with collodion. The film sets on cooling, and is then placed in contact with an ordinary photographic negative of the microscopic objects to be delineated, exposed to light, submitted as before to the action of water, and the soluble portions washed away. When the surface moisture has evaporated, a mixture of plaster of Paris, containing a small proportion of alum, is poured over the relief to the thickness of half-an-inch, and left to set. When dry it will be found, owing to the alum in the plaster hardening the surface of the gelatine directly on coming in contact therewith, to leave the gelatine easily, without any fear of adhesion. To give a finished appearance to the resulting casts, this intaglio, when dry, may be placed in a lathe, and a suitable border twined on it, which will be represented in the resulting proofs by a raised border, similar to what is seen on medallions or plaster casts. The name of the object may also be neatly engraved on the intaglio, to appear in raised characters on the reliefs. This intaglio should then be well waxed to fill up the pores, and is ready for taking any number of impressions in plaster; or a better plan is to take one in plaster, and having smoothed away any defects, to mould a reverse in sulphur, which will give a greater number of fine impressions. Great progress has been made during the last year in perfecting the details of photo-lithography, and the results which I now exhibit are illustrations of the practical use of this art as a means of procuring on a reduced scale printed reproductions of the large series of lithographs issued for the use of the British army by the Royal Carriage Department. Negatives of the required size are taken in the first instance by the collodion process, this service being performed in the Photographic Establishment of the War Department at Woolwich under my supervision. The pictures are then copied upon a sensitive surface, prepared by floating a sheet of bank post paper upon warm chromo-gelatine solution, made as follows:—I. Gelatine, 3 oz.; hot water, 40 oz.; II. Bichromate of potash, 2 oz.; hot water, 10 oz. The two solutions are mixed together, and should then be kept from the light. The prepared side of the paper is, when dry, laid against the negative, and for a short time is exposed to light. It is then greased all over by spreading a thin layer of 'litho-retransfer ink' upon stone, and passing it through a lithographic press, and the whole surface is in the next place submitted to the action of warm water thickened with gum. The ink resting upon the unexposed portions of the print is thus removed, the gelatine in these parts still remaining perfectly soluble, and the paper is washed with dilute gum-water, using a sponge to assist in detaching the loosened layer of ink, and finally washed with warm water alone. This sheet of paper is an accurate transcript in lithographic ink of the original photograph. All the lines should be clear and sharp, and there will be no difficulty in transferring to stone and printing off any required number of impressions by following the details of the ordinary lithographic process."

Enamels.—There has been read to the British Association the following "Notice respecting the Enamel Photographs executed by Mr. M'Raw, of Edinburgh," by Sir David Brewster. In order to give permanence to photographs, various attempts have been made to burn them into glass or porcelain. M. Joubert and M. Lafon-Camersac have some time ago produced very fine pictures by this process; and more recently, M. Obermetter and M. Grune, of Berlin, have been equally successful. Our countryman, Mr. William M'Raw, has also succeeded in obtaining very excellent pictures, which will bear comparison with those produced by the best foreign artists, and he has requested me to show the accompanying specimens to the Section. Mr. M'Raw believes that his process is similar to that of Camersac, which is kept secret, and he claims no other merit than that of being the first British artist who has succeeded in this branch of photography. His pictures are produced in any enamel colour, and although, before they are fired, they can be rubbed off like daguerrotype, yet the burning fixes them immovably, while the fusion of the picture gives it its characteristic transparency. From some experiments which he has already made, Mr. M'Raw is sanguine that the pictures may not only be produced in monochrome, but that they may be simply tinted and finished with the various colours burned in. Although the specimens are chiefly on glass, yet they can be transferred to any surface or substance that will stand the firing, such as enamelled copper articles of porcelain.

Focal Light.—Mr. Claudet has contrived an apparatus for varying the focal plane during the act of taking a photographic portrait, so as to soften the hard lines, and lessen the area of blurred surface, in a picture. Something has been done before, we are told, by other ingenious photographers to remove these evils; but Mr. Claudet would appear to have treated the defects scientifically, and to have overcome them at least in part, by certain and legitimate means. His invention lends to the portrait a softness and uniformity of texture hitherto supposed to be unattainable by this process of transcription.—*Athenæum.*

Photography at the French Exhibition.—Judging by the manner in which the prizes have been distributed, the jurors attached less importance to the successful practice of Photography according to known methods than to the discovery of new developments and applications of the art. They have not given their chief prizes to the men who can produce the best portraits or the best landscapes, but to those who can render such portraits and landscapes permanent. M. Lafon de Camersac, of the Rue de la Paix, received one of the three gold medals which the jury have awarded; but the business which he pursues is not that of taking photographs, it is that of transferring photographs to enamel. An ordinary photograph is apt to fade, and being upon paper it is easily destroyed; but send this photograph to M. Lafon de Camersac, and by a process which is not quite clear, for he keeps it a secret, he will transfer it with the most perfect accuracy to enamel; he will pass it through the fire, and he will return the picture to you vitrified. He has been working at this process of vitrification since 1851, and year by year since then has made such steady progress and met with such success that now he boasts of having furnished the public with no less than 15,000 enamels. These indestructible enamels can be made of any size. You may have them small enough to be set in a ring, and you may have them large enough to hang in a picture-frame on your walls. They do not cost much, and they are executed with rare taste and fidelity. The result is most valuable, for there is no other method of rendering photographic pictures indestructible that approaches this in the fidelity with which it reproduces all the attributes of the photograph to be preserved, and in the assurance of safety which it affords.

The French had great success in the production of their Carbon prints, M. Garnier and M. Jessiè du Motay being deemed worthy of gold medals. Most of the French carbon prints are described as produced by the process of Poitevin, who in 1855 succeeded in turning to account the discovery of Mr. Mungo Ponten. He combined carbon or any other pigment in a fine state of division with gelatine, starch, or gum, applied it over the surface of his paper, dried it, submitted it to the action of light under a photographic negative, and so first produced what is now usually called a carbon print. Many specimens were exhibited of this form of picture; some of great beauty, and all pretending to the permanence which belongs to ordinary engraving. The chief English exhibitors of carbon printing were Mr. Woodbury, of London, Mr. Swan, of Newcastle, and Mr. Pouncey, of Dorchester. Among these, as a discoverer, Mr. Pouncey stands first in point of time. His first announcements belong to the year 1858—that is, three years after Poitevin's first success. He is evidently on the right path, and he deserves some credit as one of the earliest to understand the importance of carbon printing. But a comparison of his results with those of other exhibitors in the same line was not satisfactory. His prints are rather coarse in appearance: in the production of them a solvent is used which is expensive enough to interfere seriously with the commercial value of the process, and the specimens which were exhibited in Paris seemed to be varnished to secure protection. Mr. Swan, of Newcastle, comes after Mr. Pouncey in point of time—his discovery dates from 1864; but he appears to have carried his process of carbon printing to a high degree of perfection, and he showed some excellent results of it in landscapes and portraits. Mr. Swan's process has been admirably worked by Mr. Nelson Cherrill, who exhibited some very fine work in landscape, printed after this manner. The latest process of carbon printing which has been invented in England is that of Mr. Walter Woodbury. It is wonderfully simple, and the results are full of promise. A picture is transferred to a thin sheet of gelatine; water washes away those parts of the gelatine on which the light has not acted; and we have a relieved surface which perfectly represents the light and shadow of the picture. By hydraulic pressure the gradations of relief on the gelatine are transferred to soft metal, and the subsequent results —the impressions, which are of much softness and beauty—are produced by mechanical means so simple that hundreds and thousands of them can be obtained in a few hours.

The chief prize for Photography proper was awarded to an Englishman living in Paris, Mr. Bingham. He obtained the first of the silver medals and was very near obtaining a gold one. His portraits are certainly of the highest order, but it is not for his portraiture that he has been rewarded. In fact, he did not think it worth his while to exhibit a single portrait. He obtained his honours for a species of photograph which has a deserved reputation in Paris, but which is systematically repressed in London—for the reproductions of pictures—a most difficult art. Certain colours are rather unmanageable in the photograph —dark ones coming out bright, and bright ones coming out dark. The photographer has to humour these, and all his skill is tasked to produce a result fairly representing the original.

Nothing can surpass the beauty of some of the photographic Landscapes which the English school produced. Thus, the views of Mr. Bedford (the same who went with the Prince of Wales to the East) were very fine. In some small landscapes exhibited by Mr. Russell Manners Gordon, and taken with Dallmeyer's new wide angle lens, the distance is in perfect detail, while the atmospheric effect is truly rendered. The views presented by Mr. Macfarlane were quite wonderful for their accuracy and softness. Taken in Bengal, the photographer had to contend with the disadvantage of too dry a climate and too clear an atmosphere. Nevertheless, the results were remarkable, and had all the softness of English scenery. Colonel Wortley's instantaneous pictures of seas and skies are also admirable. The clouds are especially good, and are much sought after by artists as studies. Then Mr. Thurston Thompson sent an extensive series of architectural views. The reproduction of old architecture in this way with so much definition of detail is most important, and Mr. Thompson has succeeded in giving full pictorial effect to his records. All the views as thus far mentioned are taken in the ordinary way, on wet collodion. Of late years, therefore, a method has been perfected of taking impressions in dry collodion, which need not instantly be developed. The picture may remain latent on the surface of the dry collodion for several months before it is developed for use. Mr. Mudd, of Manchester, has carried this method of taking pictures to a high pitch of excellence, and exhibited some beautiful pictures.

If in landscape the English photographers were before all the world, in portraiture it must be repeated that they were behind the French. In this department of the art the English photographers were fully represented; but even if they were not they must cede the palm to the French. M. Claudet, one of the best of the London photographers who exhibited here, a Frenchman, exhibited likewise among the French. Mr. Mayall produced some interesting studies—enlarged portraits full of vigour—and his work may be taken as a fair example of good Regent-street photography. Some of the most artistic-looking heads exhibited in the English department were the work of an amateur, Mrs. Cameron. This lady has produced a number of fine studies. Her process is stated to be the result of an accident. She happened to use a small lens to produce large work. The result was that the hardness of outline for which most of our photographs are remarkable was effectually avoided. The lens could not do what the lady wanted it to do, and produced an image with a blurred delineation; so she strives for this blurred effect, and in many cases succeeds in turning out a head with a good deal of power in it, and with a softness of outline which is in singular contrast to the ordinary style of photographs.

In Photo-lithography there were a good many specimens, but none of them came up to those already produced in this country by Pouncey of Dorchester. Some years ago the Duc de Luynes at Paris founded a prize of 8000f., to be given to the artist who should discover a process by which pictures could be produced containing all the gradation of light and shade found in a good photograph combined with the permanency of a printed book. He also gave 2000f to be divided among those who, up to a certain time, had approached nearest to the desired end; and out of this fund a medal of 400f. was awarded to Pouncey for his carbon process. Not satisfied with the success thus attained, Pouncey proceeded to mature his present process in photo-lithography, the results from which certainly greatly excel all the examples of similar processes exhibited. The heliographic engravings of H. Garnier, Grenelle, are printed in a common copper-plate press, and it is difficult to tell them from the photographs from which they have been in the first place produced. Garnier is the author of the process for facing copper plates with steel, and his photographic plates are thus faced, and in printing long numbers this facing is several times renewed. Finally, the process is not an expensive one.—We select and abridge these details from the excellent report in the *Times*.

A New Light for photographic purposes has been proposed by Mr. Sayers. It is composed as follows:—Nitrate of potash in powder, and well dried, 24 grammes; flower of sulphur, 7 grammes; red sulphuret of arsenic, 7 grammes. These three ingredients, being well ground together, the mixture, on being ignited, will yield a most powerful photogenic light; but 200 grammes of the compound are necessary to make the light last half a minute. The cost of the mixture is not more than 80 centimes per kilogramme, which would last 2½ minutes, while light from magnesium wire costs about one shilling per minute.

Action of Light.—M. Saint-Victor has been for many years engaged in experiments upon the action of light in photography, and as the result of his most recent researches he announces the extraordinary fact that porous or rugose surfaces, which have been exposed to light, have a definite decomposing action on salts of silver when placed in contact with them in the dark. It has been considered probable by many natural philosophers that phenomena-like phosphorescence are due to the emission of light previously absorbed. Till M. Saint-Victor's discovery, this hypothesis had little beyond vague speculation to support it, but now it becomes an established theory. The French *savant* has proved by various photographic experiments that pieces of pasteboard, which have been exposed to the light, give out actinic force in the dark, and may be employed in producing decomposition of silver-salts.

Permanent Photographs.—Mr. Pouncey, of Dorchester, has read, at the Inventor's Institute, a paper entitled, "Sun-painting in Oil Colours," illustrated with specimens of the applicability of his process to pictorial and decorative art. The photographic prints exhibited were on paper, canvas, panels, copper, &c. The gradation of tone was considered to be quite as perfect as the finest silver photographs, while possessing over the latter the immense advantage of absolute permanence. Mr. Pouncey explains the processes as follows:—

"The sensitive medium used is bitumen of Judæa, dissolved in turpentine, benzole, or other hydrocarbon, with which is ground up oil colour of any desired tint. The pasty mass is then brushed over a thin sheet of translucent paper, and dried in the dark. When dry, the sheet is exposed under a photographic negative to daylight, or a strongly actinic artificial light, which hardens, or renders insoluble, those parts of the sensitised pigments to which the transparent parts of the negative have permitted access of light. After some minutes' exposure to light, the embryo picture is washed in turpentine, benzole, or any other solvent of bitumen. This dissolves those portions which have not been effected by the actinic rays, leaving the remainder of the pigment firmly attached to the paper, in quantity proportional to the amount of light which permeated the different parts of the negative. The picture is now complete, and may be transferred, as in the lithographic process, to cardboard, canvas, wood, stone, &c.; or, if ceramic colours are used, it may be transferred to potters' "biscuit," and burnt in as usual.

Snow Scenes.—Mr. Coote has exhibited some Snow Scenes, the negatives of which were taken on collodio-albumen plates. Some of these beautiful views were slightly defective in the high lights, a number of vein-like markings appearing in the sky and foreground. Mr. Wardley states that these defects were entirely caused in the development, and had no connection with the character of the collodion used, or with the preparation of the plate. He considered that the imperfections were produced entirely by the repellent or nonmiscible nature of the solutions, containing acids and salts, used in development, acetic acid being one of the chief causes of the defects. Another source of the evil may be a low temperature, and the developing solution being allowed to rest, even for a moment, on the plate. Such defects may be produced in abundance on any kind of dry plate if the developing solution is allowed to rest.

Black Tints.—M. Niepce de Saint-Victor states that the obtaining of the black tints in héliochromie is certainly more extraordinary than obtaining colours. There are four processes by which these results can be produced. The first offers most interest, because it allows pure black tints to be obtained either in the camera or by contact. These results are accomplished by the reaction of a highly alkaline liquid upon chloride of silver.

Magnesium Light.—M. Silvy has sent to the Photographic Society of France some photographs, obtained by the aid of the magnesium light, of the vaults of the Chapel Royal of Dreux. These vaults, without being subterranean, are excessively dark, and only receive the daylight through painted windows placed at a considerable height, and very intense in colour; so that, without artificial illumination, it was impossible to take photographs of them. The lamp he used is so arranged as to burn at the same time four ribbons of magnesium passing through two parallel tubes, and the light produced by it is exceedingly beautiful. A great portion, however, of it is lost, or rather intercepted by the part of the ribbon which, having been burned, does not detach itself fast enough, and so obstructs the brilliancy of the flame, exactly as a candle which wants snuffing. It would be very easy, however, to obviate this inconvenience if, while waiting for some better contrivance, these primitive lamps were a little improved.

Rapid Production.—Hitherto there has been one great desideratum in photography—the production, promptly, of a large number of photographs. This difficulty has been overcome by Mr. Helsby, of Church-street, Liverpool, who has invented a machine by which he can simultaneously take fifty photographs of a person or object. Mr. Helsby first applied his discovery to the production of miniature *cartes*, about the size of postage stamps, and which—gummed at the back—are very useful for placing on cards, letters, &c. The likenesses taken by the process are admirable.

Printing Frame.—At a meeting of the Manchester Literary and Philosophical Society, Mr. Coote has exhibited a Frame for printing transparencies on glass, of which the following is a description:—As frames for printing transparencies for the lantern and stereoscope have occupied some little attention of late, I thought it might be useful to submit to the inspection of the meeting tonight one that I had made last winter for printing stereo-transparencies from negatives, on plates 7¼ in. by 4½ in., the size I always use on account of being able to take single pictures in the same camera. The frame is the same in principle as the usual frame for printing transparencies by superposition, and without having to cut either negative or prins by simply moving the prepared plate and negative to the right and left in opposite directions alternately; but it is a little longer, and 4½ in. broad inside. The opening for exposure is in the centre, but is made longer than is required for a stereo-print. Over this opening I place a mat made of thin brass, the desired size and shape of the picture required. This mat is sunk into the bed of the frame until it is quite level with it. A negative is then put in, and by moving the mat up or down in its recessed bed, you can get more sky or foreground at will, and the movement right and left gives you any other portion of the picture you may desire. Having settled that point, I then place on the negative a straight strip of soft cardboard, wide enough to reach within about ⅛ in., the bottom of the opening in the mat; and then place on the prepared plate, which is kept in a horizontal position by resting on the strip of cardboard; and it also enables you to get the two sides of the picture exactly on a level with each other after reversing, to close the frame. A loose back, with a brass spring on, is put in, and a small lever bar brought down over the spring and held in its position by a small catch. It is necessary to have several strips of cardboard varying in width, and it will be obvious to any one that they must not exceed in thickness the glass of the prepared plates, otherwise the pressure of the back is kept off the glass and the plates are not in close contact. By use of this frame I can easily take out for the lantern portions of pictures taken the full size of the plate, say 7¼ in. by 4½ in., whether the subjects be horizontal or upright.—*Mechanics' Magazine.*

Action of the Heart.—Photography has now been employed to produce a diagram that will show the manner of Action of the Heart and arteries, and there cannot be a doubt that the graphic representation of internal action obtained by arrangements similar to those employed in the steam-engine indicator may be rendered a valuable aid to medical diagnosis. In the instrument now invented a trumpet-tube, with a thin membrane of india-rubber stretched over its larger orifice, is placed, with the membrane, over the heart. Mercury is poured into the tube, and the surface of the mercury carries an eye, through which a ray of light may enter to act on a sensitive plate behind, which is moved on by clockwork. It is plain that the same indications could be obtained by mechanical means alone, and without photography at all. But however obtained, such indications are most valuable, and they should be extended so as to embrace the electrical conditions of the body as well as the mechanical motions.

Apparatus for Burning.—Mr. Skaife has patented the construction of an apparatus for igniting and burning any powder or other composition either in a solid or liquid state, the flame or flash of which being sufficiently actinic is applied for the production of photographic pictures. For this purpose the apparatus consists of a platform of metal perforated with touch-holes, supported by springs in such a manner as to permit of its being easily vibrated or thrown into a tremulous motion by the touch of the finger. Connected with the platform is a parabolic reflector pierced with a groove, through which communication is made with one end of the platform by which it may be touched, so that by means of the springs it may suddenly vibrate. The deflagrating powder or other explosive actinic substance being strewn upon the perforated platform is suddenly brought into contact with a light from an ordinary spirit lamp placed underneath it, at the same instant the platform being thrown into vibration communicates this motion to the particles of the powder or other substance to be ignited. The result of this is that every particle explodes or is ignited simultaneously, and produces a flash of light which, acting upon a sensitised plate in an ordinary camera, produces the picture of any object placed before it. When the picture of a near object is required, the powder may be placed over a touch-hole of the picture; when a distant object is to be taken, the powder may be distributed over the platform and over several touch-holes, to all of which the light may be applied.

Copper and Steel.—M. A. Durand has produced some curious Photographs printed on Copper and on Steel. He does not describe his method, but states that all depends upon the proper degree of polish to be given to the surface of the metal, and upon a peculiar way of coating it with bitumen. The specimens produced are remarkable for their delicacy and finish. Another operator, M. Jeuffrein, states that he has found iodide of aluminium, a substance hitherto unknown to photographers, very serviceable in preventing the collodionised surface from blistering.

Natural History.

ZOOLOGY.

ANIMAL TISSUES.

A PAPER on the formation of cells in animal tissues, by Dr. Montgomery, has been read before the Royal Society, in which the doctrine is advanced that the formation of such cells is a purely physical process. When to myeline, in its dry, amorphous state, water is added, slender tubes are seen to shoot forth from all the margins, whence it is inferred that a crystallising force is at work. When white of egg was added globules were formed, deposited layer after layer, as in organic formations.—*Illustrated London News.*

THE AZTECS.

THE curious children who about fourteen years ago* so much excited the curiosity not only of the multitude but also of some members of the scientific world, who, by the way, laboured rather to show what they were not than to demonstrate what they were, have returned to London, children no longer, but rejoicing in a state of maturity that has endowed them with seemly stature, so that they measure some four feet or so from the ground. This height is not great, but the young persons repel the appellation of dwarf, since, although they retain that bird-like expression of face which is more marked in the gentleman than in the lady, and which, after a lapse of fourteen years, still renders them perfectly recognisable, they are otherwise perfectly formed, without anything squat in their appearance, while they are protected by the well-turned throat from the application of the word "*Crétin*," unless, indeed, that be loosely extended so as to comprehend all persons of intelligence below the average. The odd dresses which the Aztecs wore in their childhood are now cast aside, and the strange pair are dressed in the adult costume proper to modern European civilisation, the gentleman, who is altogether of a grave, sedate appearance, wearing an intensely respectable suit of black that would do great credit to a missionary tea party. The lady is far the livelier of the two, and is most demonstrative in her joy if anything like a cake is presented to her, but her manners are much more child-like than idiotic. The only way in which the Aztecs seek externally to distinguish themselves from ordinary folks is a strange method of dressing their hair. This is very long, and instead of hanging down stands upright like an enormous brush, approaching the dimensions of a grenadier's cap, and what is singular enough, instead of being of a wiry texture, it is extremely

* See *Year-Book of Facts*, 1854, pp. 234, 235.

soft to the touch. Our readers need scarcely be told that these odd specimens of humanity travel about accompanied by the hypothesis that they are relics of the ancient inhabitants of Mexico, and that this hypothesis is indicated by the name "Aztec," habitually bestowed upon them. But at this point a debate begins into which we have no wish to enter. Whether the so-called "Aztecs" are degenerate types of an ancient race, or whether they are the result of some *lusus naturæ* that is without ethnological importance, they form a curious spectacle likely to produce discussion.—*Times.*

CANNIBALISM.

MR. CRAWFURD has, in the fourth volume of the *Transactions of the Ethnological Society*, treated this ghastly but attractive subject with much point. He begins by pointing out that the only European nation against whom a charge of this revolting nature has been brought are the Caledonians, and more especially the ancient Scots. The accusation is made by St. Jerome and adopted by Gibbon, whose racy remarks on the subject, though doubtless well-known to most of our readers, are worth reprinting:—"When they (the Attacotti or Scoti) hunted the woods for prey, it is said that they attacked the shepherd rather than his flock, and that they curiously selected the most delicate and brawny parts both of males and females, which they prepared for their horrible repasts. If in the neighbourhood of the commercial and literary city of Glasgow a race of cannibals has really existed, we may contemplate in the period of the Scottish history the opposite extremes of savage and civilised life. Such reflections tend to enlarge the circle of our ideas, and to encourage the pleasing hope that New Zealand may produce in some future age the Hume of the Southern Hemisphere." Mr. Crawfurd repudiates this charge with indignation, remarking, with justice, that the Scots of whom Jerome speaks were soldiers in the Imperial pay, living in the civilised country of Gaul, and that, therefore, he could not have seen them devouring human flesh, but had merely heard some vague scandal to that effect. Mr. Crawfurd proceeds to say, with some *naïveté*, "Let me add that the Scoti, if they were cannibals, were Irish invaders and conquerors. . . It may reconcile Irishmen to the imputation of cannibalism, thus made against their forefathers, that the Roman historian describes them as *bellicosa hominum natio* —a valiant race of men."

The cannibalism of modern savages does not appear to be due to dire necessity, for some of the most wretched tribes are free from it, but rather to a spirit of combined sensuality and revenge. Among the Fijians, for example, human flesh is regarded as a choice delicacy; but, besides this, a man has a fiendish pleasure in devouring the body of his enemy, because he believes that by so doing he has condemned his spirit to perpetual torture. Cannibalism is occasionally practised among the people of the Tonga islands, but public opinion regards it as a rather disreputable indulgence. Fast young men do it in imitation of the Fiji islanders, and for the sake of being thought terrible fellows, but on their return home they are apt to be shunned by the ladies of their acquaintance, who cry out "Away! you are a man-eater." The Batak nation of Sumatra have long laboured under a terrible stigma. More than forty years ago Sir Stamford Raffles wrote home a letter containing the following passage, which we have seen reproduced over and over again:—"I was informed that formerly it was usual for the people to eat their parents when too old to work. The old people selected the horizontal branch of a tree, and quietly suspended themselves by their hands, while their children and neighbours, forming a circle, danced round them crying 'When the fruit is ripe, then it will fall.' The practice took place during the season of limes, when salt and pepper were plenty; and as soon as the victims became fatigued, and could hold on no longer, they fell down, and all hands cut them up and made a hearty meal of them. The practice, however, of eating the old people has been abandoned, and thus a step in civilisation has been attained; and, therefore, there are hopes of future improvements." Mr. Crawfurd doubts the accuracy of this statement, says that Sir Stamford was fond of writing sensational letters, and points out that, as revenge is the cardinal motive of cannibalism, children could gain no satisfaction in devouring the withered bodies of their parents.

THE GORILLA COUNTRY.

Mr. Walker, of Fernand Vas, has written a letter to Dr. Gray, under date of August 29, 1867, from which the following is an extract:—

"It may interest you, as well as the Zoological Society, to know that I have a fine, healthy, young male gorilla, which, I hope, may eventually reach the Zoological Gardens. I have heard of a young chimpanzee at some distance, and I have to-day sent to endeavour to procure it as a companion for my little Njina. I shall do my utmost to send the pair safely to England; but as the winter will be coming on before I can ship them, I may have to keep them until next spring, and it will be a hard matter to keep them alive all that time. The gorilla was captured on the 13th inst., and brought to me the next day by its captor, one of the natives trading for me, who, whilst taking a walk, unarmed, except with a spear, suddenly came on a family of gorillas—father, mother, and young one. The mother, contrary to what might have been expected, abandoned her 'baby,' and ran off; the father showed fight, rushing at the native open-mouthed, and receiving a stab in the side from a spear, which caused him to retreat a little; when my man, not waiting to receive a second attack, snatched up the young one, and made for his home as fast as possible, and the next day brought the little fellow to me, made fast with a forked stick about his neck, as if he was a most ferocious animal. I soon made him more comfortable, by placing a belt round him, to which I attached a small cord; and though somewhat snappish for a day or two, and very shy, he soon became quite familiar and tame, and now his greatest delight is to be in my arms, where he would stop altogether if I would let him, and had nothing to do but to nurse him. He is, I should think, between one and two years old, hearty, vigorous, and healthy, with a tremendous appetite, and contrives to get through several pounds of berries a day, besides nearly a pint of goat's milk, with which I mix up two raw eggs, to prevent diarrhœa, to which these animals are very subject, and which has occasioned the death of four others which I have had at different times; but I think this one stands a better chance of living than any of the previous ones—at any rate, there seems little fear of his dying of starvation.

"I have always been puzzled by M. Du Chaillu's account of the unconquerable savageness of young gorillas, which is so diametrically opposed to my own experience of them. I certainly never saw any of those in his possession whose untameableness he mentions, but he saw one perfectly tame at my factory in, I think, 1860; and of the five I have had, only one, and that about four years old, was at all savage; the others soon became tame, familiar, and playful, and the present subject is no exception to the rule, having made great progress in a very short time, and being certainly quite as devoid of spitefulness as a chimpanzee of the same age, and only so short a time from the 'bush' would be. The grief of the little fellow when first caught was quite touching to witness; he could scarcely bear to be looked at, and, if at all annoyed by the presence of many people round him, would lie on the ground, with his face buried in his hands, and sway his head from side to side, as if in an agony of sorrow at losing his parents; and even now, when left alone for any length of time, he has relapses of the same kind, and appears to be in great tribulation."

ETHNOGRAPHY OF THE FRENCH EXHIBITION.

MRS. LYNN LINTON has communicated to the British Association an able and interesting paper on "The Ethnography of the French Exhibition, as represented by National Arts." The author considered that, apart from all question of commercial value or social gain, the Exhibition had, at least, one feature of undoubted importance, namely, its ethnological material, which is singularly rich both in amount and suggestiveness. Every variety of art is to be seen, from the rude works of the savage, whose finest ideas are embodied in a necklace of shells, a mask of tattoo, or a temple of skulls, through the intermediate grades of the semi-civilised making their first efforts, up to the latest productions of European skill. The archæological gallery of the Exhibition leads us by successive stages from the primitive conditions of the lake-dwellers to the complex life of modern times. The work of each nation, even in the department of jewellery, has a distinctive character of its own, evidencing the peculiar habit of thought and intellectual status of the race. The European, with all his science, cannot come near the exquisite grace of the unlearned Hindú or the wandering Kurd. There is a strongly marked dissimilarity of intention in Eastern and Western work. There is no national life, no public meaning in anything that comes from the East. It is all small and individual work, for a few grand men and their harems; nothing for the mass of the people. The West, on the contrary, shows its mechanical improvements and grand scientific discoveries, planned to lessen the toil of labour and multiply its products, so that the poor shall profit as well as the rich. We learn the truth of this view in a very small and quite unimportant matter, valuable only as an indication. Both West and East send models of their fruits, costumes, trades, &c.; but the East sends them as toys—mere playthings, which are made to amuse, and not to instruct; while the models of the West are in aid of horticultural or ethnographical science, the final cause of which is public good, not private pleasure.

SHELL OF THE BIRD'S EGG.

Dr. Ogilvie has read to the British Association a paper "On the Adaptation of the Structure of the Shell of the Bird's Egg to the Function of Respiration." The principal object of this paper was to call attention to the constant occurrence of a cavernous stratum on the interior of the shell of the egg, formed by a series of watery excrescences from the calcareous crust, and covered in by the lining membrane of the shell, which adheres so intimately to the points of the tubercles that a fleecy film is always left when the membrane is torn off from the inside of the shell, and in many cases can be removed only by burning it off by calcination, though the nature of the structure may be shown in other ways, as by sections and the use of aniline, which tinge the fibrous tissue, with little or no effect on the shell proper. The penetration of the external air into the cavernous structure, through the overlying stratum of the calcareous crust, is facilitated by the pore-like pits on the outside of the shell, which, though in many cases they do not go directly much below the surface, yet may be shown by the permeation of coloured liquids to furnish an indirect communication with the vacuities of the deep layer, either by fissures or cracks passing between them, or by the more pervious nature of the intervening tract. This general arrangement of an upper compact and a lower cavernous stratum has a certain analogy with the structure of the internal tissue of leaves—amounting, indeed, in some cases to so close a resemblance that one might readily compare the shell of some chelonian reptiles to the parenchyma of a leaf which had undergone calcification; and, as in the egg-shell we have the pore-like pits on the outer surface to facilitate the permeation of the air to the subjacent stratum, so in floating leaves, which have their stomata on the upper epidermis, we generally have some arrangement to lessen the obstructive influence of the layer of compact tissue between them and the spongy parenchyma below. Of this perhaps we have the most striking example in the large tapering bells in the leaf of the white water lily, which, when exposed to the action of aniline dye, become very conspicuous objects from the readiness with which they take in the colour. They somewhat resemble a series of nails driven through the compact tissue, with their flattened heads immediately under the stomata and their points projecting into the air spaces below. As another example of such an arrangement, reference was made to the vacuity under each stomatic opening in the upper layer of parenchyma, in the leaf of the common pond weed.

ARTIFICIAL BIRDS' NESTS.

The Societies formed for the protection of insectivorous birds in Switzerland are manufacturing artificial Birds' Nests, which are set up in appropriate situations, and which are found to be speedily tenanted. A member of one of these Societies had observed that some birds of this kind selected holes in rotten trees to build their nests in, and he set up a number of rotten trunks in an orchard. The birds multiplied so fast that he was no longer troubled with caterpillars, whereas his neighbours, who had not adopted the device, were much annoyed by them. The artificial nests which were placed in the public walks and communal forests when this movement was begun are now inhabited by hedge-sparrows, redstarts, tomtits, and other small birds.

EIDER DOWN.

A Consular Report on Iceland gives this account of the way in which Down is exacted from the Eider duck. Early in June the bird, always repairing to the same spot, comes to some small holme or islet in a bay or fjord, and lays its eggs, after lining its nest with the down plucked from its own body. As soon as the eggs are laid, the owner of the hatching-ground robs the nest of the down and a part of the eggs, both of which the poor bird replaces a second and a third time, when she is left in peace to complete the process of incubation, but with her body completely denuded of down. This method is adopted because the down of the dead bird loses its elasticity, and is of comparatively little value. The hen bird gives 8 oz. or 9 oz. of down to a nest, but when cleansed the weight is diminished by half. The value of the cleansed down is about 19*s.* per lb. The annual produce in Iceland is valued at about 5,000*l.* In some instances, one small holme will give its owner an annual income of 150*l.* Such is the care taken of these birds, that during the hatching season no guns are allowed to be fired in their vicinity; foreign vessels arriving are forbidden to fire salutes.

SONG BIRDS FOR NEW ZEALAND.

The *Otago Times* states that Mrs. Bunbury, a lady who arrived from Great Britain in the *William Davie*, has landed with quite a collection of Song-birds—only a portion of those which she had when the ship sailed, but enough, and of kinds, to constitute a most valuable present to the Acclimatization Society, to which body Mrs. Bunbury has presented them. There are in the collection skylarks, thrushes, blackbirds, starlings, goldfinches, and linnets, and all of them were landed in such excellent condition as to prove that throughout the voyage they had been tended constantly and with skill. Captain Logan also successfully brought out some song-birds, although he lost proportionately many more than Mrs. Bunbury. Indeed, of some 70 shipped by the captain, only 10 or 12 have survived.

THE EPIORNIS.

This is the name given by Isidore Geoffroy St. Hilaire to a gigantic bird, the existence of which is only revealed by a few enormous eggs and some fragments of bones found in the southern part of Madagascar. St. Hilaire was of opinion that this bird might perhaps still be discovered alive in the unexplored regions of that portion of the island, and most naturalists entertained the same belief. In a paper addressed to the Academy of Sciences, M. A. Grandidier states that this hope can no longer be fostered now. The immense extent comprised between the sea on one side, the 20th degree of south latitude, and the 44th degree 30 m. east longitude on the other, which until lately had remained unexplored, is a vast barren table-land at an altitude of 142 mètres, here and there interspersed with a few clumps of ricketty trees, arborescent euphorbiaceæ, and nopals. This region, though very thinly peopled, is not quite uninhabited, a few miserable huts being occasionally met with. The poor wretches who vegetate here, called Antandroois, have never either seen or heard of the gigantic bird in question, and they have no tradition or fable regarding it. Nor can the vast central forests, intersected with paths in every direction, and frequented by the Hovas, admit of a hope of this bird's being ever found alive on the island. Evidence of its former existence, Mr. Grandidier informs us, is far more abundant than has hitherto been believed, for although its eggs in an entire state are rare, fragments of them are very common, he himself having picked up many on the southern coast between Cape St. Mary and Machikora; bones he has been unable to find. The soil around Cape St. Mary is calcareous, covered with downs accumulated along the sea-coast, and rising sometimes to the height of 140 mètres. The rains, in washing down the sands of these downs, bring to light the fragments of these eggs, together with a quantity of sea

WALRUS IN THE ZOOLOGICAL SOCIETY'S GARDENS

A YOUNG Walrus has, during the past year, been one of the most attractive additions to the Zoological Society's Menagerie in the Regent's Park. It was placed there in the middle of January, having been brought from Dundee. The animal, a cub half-grown, was captured on August 28, 1866, by Captain Richard Wells, of the whaling steam-ship *Arctic*, between Cumberland Island and Disco Island, in the middle of Davis's Strait, on the west coast of Greenland.. A herd of two or three hundred walruses being found basking on the ice, Captain Wells sent his boats to attack them. One very large female, which was amongst those killed, was fastened by a rope to the stern of the boat, to be towed to the ship. This cub would not quit the body of its mother, but clung fast to it, until the female was hauled up, after which he allowed himself also to be caught with a rope about his neck. When the ship returned to Dundee, after a perilous and unsuccessful whaling voyage, Mr. Bartlett went to that port and bought the Walrus for the Zoological Society. He at once brought the animal to London, by one of the regular line of steamers, when the large box in which it had been confined on board the *Arctic* was conveyed into the Regent's Park Gardens, and set down close to the iron railing on the western side-path, behind the seal's pond, and just outside the inclosure round the smaller pond. This inclosed grass-plot, with the small pond or basin in the midst of it, which was filled with brackish water, formed the playground of the walrus by day; and he spent the night in his box, a plank of which was removed, as well as a piece of the iron railing, to allow him to pass in and out. It was necessary, however, to close the box at night, and to keep watch over his movements in the daytime, or he would soon climb over the railing and escape. "Jemmy" was extremely wilful, and appeared playful, scrambling after the men who entered the inclosure, and butting at them rather testily with his great hairy muzzle, which had a pair of incipient tusks, scarcely two inches long. The age of this walrus is supposed to have been then seven or eight months, and he was above 7 ft. in length. When full-grown he might have attained a length of 16 ft., with 10 ft. girth, weighing about 3,000 lbs. His tusks, as shown by the skull and tusks of another, suspended on a tree in the inclosure, would then be 14 in., or perhaps 10 in., in length, curving downwards from the upper jaw, and pointing towards the ground, unlike the tusks of the elephant. Some interesting remarks on the structure and uses both of the tusks and of the long, bristly whiskers, or rather moustachios, of this singular animal, will be found in Mr. Frank Buckland's description of him in a number of *Land and Water*. In the opinion of that naturalist, and of Mr. Bartlett, the bristles of the whiskers, which communicate with the brain by large and highly sensitive nerves—each bristle, in fact, being hollow and filled with nerve-substance—are employed by the walrus to grope in the sea-sand for shrimps and prawns, or soft mollusks, which supply a great part of his natural food. The tusks are probably serviceable in raking up the sand and weeds to assist his search; the whiskers are used as brushes, to draw to his mouth whatever small articles he likes, and to push away what he dislikes. By these and other observations, Mr. Bartlett discovered how to feed the newly-arrived guest. While on board the *Arctic*, the diet of the walrus was pork fat, which did not seem to agree with him, and he could not swallow herrings. He was then supplied every day with two quarts of whelks and four quarts of mussels, divested of their shells and mixed together, which was the best food he could eat. The young walrus in the Regent's Park, we regret to add, died towards the close of the year. He was figured in the *Illustrated London News*, Jan. 27, 1867.—The only other living specimen which has appeared in the Gardens was brought there in 1853, but died two or three days after its arrival.

SCALES OF FISHES.

Mr. Couch has contributed to the *Intellectual Observer* a paper on "The Scales of Fishes," in which he points out that whereas in the case of reptiles the scales do not grow, but the animal periodically casts its skin, in the case of fishes each scale grows so as to accommodate itself to the increase in size of the individual. Near the middle of each scale there is an organised disk from which the growth proceeds in much the same way as the nail of the finger. A lubricating mucus, not easily miscible with water, is secreted by the skin to enable the fish to pass more readily through the water, and this fluid passes through a channel in the middle of each scale, with its opening directed towards the tail of the fish. A similar expedient of lubrication might be introduced in the case of ships.—*Illustrated London News.*

FISH IN THE AMAZON.

Prof. Agassiz, who has lately been engaged in examining the Fish of the river Amazon, states that he has not found one fish in common with those in any other fresh-water basin; that different parts of the Amazon have fishes peculiar to themselves; and as an instance of the teeming variety of the Amazon, he adds, that a pool of only a few hundred square yards showed 200 different kinds of fish, which is as many as the entire Mississippi can boast. In the Amazon itself 2,000 different kinds exist, a great proportion of which are most excellent eating. Several are extremely curious, one especially, which has the power of walking or creeping on dry land, and of worming its way up the trunks of trees.

ENORMOUS PIKE AT CLAREMONT.

In the ornamental water at Claremont an enormous Pike has been found dead. It measured 3 ft. 9 in. long, girth at the back of the head, 1 ft. 8 in. Its weight was over 30 lb. It is said to have been the largest fish ever seen in the locality, and must have been in the water over twenty years. It appeared to have died from old age, and had been dead for some days, but when weighed it was in good condition. The mouth had a most formidable appearance, some of the teeth being nearly an inch long.

SALMON POACHING.

At the sitting of the Special Fishery Commissioners at Workington, Cumberland, on Sept. 14, 1867, a remarkable collection of trophies taken from poachers by the river watchers employed by Mr. A. Dalzell, of Salmon-hall, on the Derwent, was shown in the public court. This consisted of six ponderous iron leisters, mostly eight-pronged, of great weight and rude construction, and which are used to spear salmon on the spawning beds; some 20 click hooks—barbarous triangles of large hooks, which are thrown into the salmon as they swarm at the foot of mill-dams and other places when obstructed in their progress up the river; a strokehall—a large guff used for hooking salmon in a somewhat similar manner, and two or three "shuckle" nets, which are of a similar description to the trammel net recently declared illegal by a decision of the Court of Queen's Bench. These nets consist of a wall of fine netting, having on each side of it netting of a large mesh, which, when extended in the water, a salmon can pass through, and the fish then pressing against the small meshed net, thrusts it through a large mesh on the other side, and thus encloses itself in a purse. Mr. Dalzell's watchers were accompanied by some grand specimens of the bloodhound, English mastiff, and bulldog, the men themselves being fine specimens of 6 ft. 2 in. Cumberland wrestlers. All these trophies were taken from fish poachers on the Derwent by Mr. Dalzell's watchers, who had in the last season been the means of convicting fish poachers in fines to the amount of between 400*l.* and 500*l.* The Derwent swarms at this time (September) with salmon and salmon trout, which have wonderfully increased through the operation of the new Salmon Fishery Act and the means of protection afforded thereby. The Special Commissioners on Fisheries were occupied two days in inquiries at Workington into fixed engines on the Derwent up to Cockermouth, and on the Marron, a tributary of that river. All the "fixed engines" inquired into consisted of dams originally constructed for the purpose of supplying water-power to corn and other mills; but which, it is alleged, have been taken advantage of for fishing, in consequence of the facilities which they afford for that purpose, and for the practices of poachers.

OYSTER CULTURE IN ENGLAND.

(*From the Times, October* 15, 1867).

In the *Times* of September 6, 1866, was a notice of what had been recently doing on the south coast of England and the north coast of France, but more particularly referring to attempts just commenced on the former, in the establishment of Oyster Farms for the breeding, growth, and fattening of Oysters for the market. The oyster farms on the coast of France continue their work successfully, and supply a vast number of oysters to the Paris and other markets; but their success is understood to have been more marked in the growth and fattening of purchased oysters laid down in their *parcs* than in the raising of spat from old fish. Tbe same may be said of most of the oyster farms on the English coast, although there are exceptions here to which we shall presently refer. In the establishment of any oyster farm, where the operations are mainly intended for the breeding of oysters that are to be afterwards preserved for growth and fattened for the market on the same grounds, there is necessarily a large outlay of capital made in the first instance, and three or four years must then elapse—presuming that a rise of spat has been obtained from the first batch of oysters laid down in the prepared beds—before any return can be obtained from this original expenditure. With this important fact ever present for the consideration of the oyster producer, it is not surprising that a far greater amount of attention has been paid by them to the growth and fattening of oysters purchased from coast dredgers, than to the raising of spat from old fish. The acknowledged result of this course has, however, been to denude natural breeding grounds on both coasts of fish, old and young, and it has only been the almost insurmountable difficulty met with for several years now past in procuring oysters of any kind suitable for the fattening beds, that has turned the attention of people in the direction of breeding as well as fattening oysters for the table. Mr. Lowe, one of the secretaries of the Acclimatization Society, has stated that, in answer to his inquiries concerning the French natural oyster beds, he was informed that the number of oysters dredged from the Cancale deep sea beds in 1863 was under four millions, while twelve years previously the take averaged sixty millions. He also refers to the well-known fact of the discovery of a bed of oysters lying off in the Channel between the two coasts, which was three miles in length. In a very short time the oyster dredgers cleared the bank, and destroyed all life for reproduction by their rapacity.

Mr. Ffennel, inspector of Fisheries, reported a few years since that on one part of the Irish coast one bed of oysters gave employment to 2,000 fishermen, but so recklessly were the beds dredged for the unfortunate bivalves that the freight, which once reached 1,000*l.* per week in the season, had fallen down to 300*l.* per annum. The French were the first to appreciate the full weight of the suicidal policy pursued for the supply of oysters by this overdredging of the natural deep-sea breeding grounds. MM. Coste and Kemmerer may be considered to have been the pioneers of the new state of things on the French coast, where the main supply of the future for the markets is looked for from the breeding beds established at St. Brieuc and other places. Referring to what the French have done in this respect, Dr. Henry Lawson, the late editor of the *Popular Science Review*, says—"The most convincing evidence of all is that afforded by the Isle of Ré. Five years since the shores of this island were barren and uncultivated; now they give employment to 3,000 men, and the crop of oysters produced in 1861 was valued at 320,000*l.* sterling." The oyster farms on the Isle of Ré are, however, much more valuable and productive now than at the time Dr. Lawson wrote of them.

The most successful instance of the rise of oyster spat and its preservation up to this time on the English coast for the present year has occurred on the same part of the coast as it did the previous summer—at Hayling Island, a few miles east of the Isle of Wight, where an enclosed area of water of eighteen acres, and of from five to six feet in depth, may be almost said to be crowded with young oysterlings. To show, however, clearly what has been done and is now doing with oysters at Hayling, we must leave the baby mollusks, and travel backwards for a short time. We may refer to the *Domesday Book*, and find there the Hayling and Emsworth oyster beds referred to, and marked with a certain annual value, those of Emsworth being valued at 6*s.* 8*d.* Looking back through the haze of centuries, in fact, there is no apparent limit to be found to the time of the laying down of the oyster in the waters of the harbours now called "Langston," "Emsworth," and "Chichester." In making excavations for the formation of new beds a few weeks back at Hayling, through a morass that must have been a morass for ever, the remains of a skeleton were found which had been interred in the ancient manner, with the knees drawn up to the chin, and with the remnants of oyster and other shells with it. A few moments after exposure to the atmosphere the bones fell into indistinguishable form in dust. The natives of the island, so it has been said, aver this to have been the remains of the man who first tasted an oyster!

The natural capabilities of the coast line and indented creeks of Hayling Island for artificial aids in the culture of the oyster, which for unknown centuries had bred there, first led, in 1865, to a private and successful attempt at raising spat, and afterwards to the formation of a company to enable the work to be carried out on a requisite scale. This Company have so far been most fortunate, although no returns will be seen for the outlay of capital in the raising of spat alone for two years to come, and its experience even thus far in the somewhat uncertain business of oyster raising is worth some attention from all who may have a weakness for the "inhabitant of the shell," or may take an interest, business or otherwise, in pisciculture.

The first great experiment made by the Hayling Oyster Fishery was made on the site of some old salterns at the south-east extremity of the island, the entire water area experimented in being about 3½ acres. The results of the experiment were of a most unaccountable, although perfectly satisfactory, character; and when we state that precisely similarly puzzling results have been obtained this year at the opposite side of the island, and on a very much larger area of water, we may possibly have said enough to fully rouse the interest of the reader. In the spring of 1866 two *parcs* were prepared for the old oysters to throw off their spat in—one on the plan pursued on Lake Fusaro, in Italy, and the other on the French plan pursued on the Ile de Ré. The Fusaro bed, as we may term it for plainness of description, was of about 3 ft. depth of water, which, as a general rule, might be considered as still water, fresh water only being admitted at spring tides through a sluice gate from the harbour outside the banks of the oyster farm. The bed of this *parc* was partly covered with shingle, and on this shingle were laid early in April 50,000 oysters from deep sea beds; light and flat hurdles formed of hazel sticks and brushwood were laid over the oysters, and held by stakes in the bed of the pond a certain distance above them. The other bed, on the plan of the French at Ile de Ré, was entirely laid with shingle (over the saltern beds), and had a constantly yet gentle running stream of water passing over it. In lieu of using hazel stick hurdles for collecting the spat, tiles were laid down. Both ponds, or *parcs*, were connected by a narrow waterway, through which the water flowed from the Fusaro into the Ile de Ré beds. There was no material difference in the time of laying down the oysters in either bed, nor was there any difference in the quality of either. The result of this experiment was that while the pond on the Lake Fusaro plan was filled with spat at spawning time, the other pond held no spat, nor was any thrown off by its oysters subsequently. The spat was first discovered in the first week in June in the Fusaro pond, and there was no second display. Unfortunately for this supply of young oysterlings, really magnificent by reason of their number and the manner in which they had thriven by the beginning of the following September, it was determined, contrary to the advice of the company's manager, to allow the young oysters to remain attached to the hurdles in their first position for a certain time, and until they had obtained a larger size. The consequence was that the shell of the growing babies grew round the sticks of the hurdles, and in subsequently removing them the under shell was broken in three cases out of four, and 75 per cent. of the fish destroyed. The oysters that did not suffer from this barbarous detaching process at a wrong period of life are now flourishing amazingly in *parcs* specially prepared for their comfort and growth on the site of the Ile de

Ré beds of last year's experiment, and which has now undergone an entire remodelling and arrangement. In their new home the oyster spat gathered and saved from off the hurdles laid over the oysters in the Fusaro *parc* now measure from a *minimum* size of one inch to a *maximum* of two inches in diameter. In September, 1869, these oysters will be in the market for consumption on our tables. The successful experiment of 1866 in the Fusaro water was, of course, repeated last year with, as nearly as possible, the same preliminary attendant conditions. Strangely enough, however, and curiously illustrative, as it proves, of the uncertainty of oyster hatching, no spat rose last year from the depths of what promised last year to be the richest oyster mine in England. No known and reliable theory can account for this striking difference by the marked success of one year and the failure of the next.

This part of the company's grounds has been re-arranged. They now comprise one breeding pond (the old Fusaro water) empty, and cleaning out in readiness for future operations, with six acres of water space, divided into nine *parcs*, lying parallel with each other. Each *parc* is enclosed by puddled clay walls, lined with chalk blocks, and has its water sluice at the head and foot. The floor, or bed, is made of shingle sand, and has a fall of about 20 in. from head to foot. A reservoir trench, running across the head of the *parcs*, and having communication with the harbour waters, gives a means of water supply to the *parcs* through the head sluices, and a cleansing of their bed by rushing the water through them and out through the foot sluices into the drain trench. The latter also acts as a canal for the flat-boat in any visit to the *parcs* and their contents. It is a very important fact that in the shallowest of these *parcs* during last winter not one of the young oysterlings of the previous summer's spat was known to have been killed by the cold weather or frost.

It is now time to return to the three-months old oysterlings left imprisoned in the 18-acre *parc* at the opposite extremity of the island.

In September, 1866, the company's engineer had just commenced operations for the formation of *parcs* and other inclosed spaces on the north-west shore of the island, the walls of No. 1 *parc* being at no great distance from the bridge across the narrow channel which separates Havant from the island of Hayling. All then was in an embryo state; now there is one *parc* of 18 acres area, and one of seven acres, both in working order. There are also ten acres laying out in parallel beds, with puddled clay and chalk-lined walls, trench and reservoir, as on the old Ile de Ré site, and a feeding reservoir of five acres. In addition, low walls have been commenced over a large area of shoals between two points of the coast, communicating channels are being cut for boat service between the shoals and "rythés" deepened, and 800 other and adjoining acres remain for any further extension of the present range of *parcs* which may be found requisite. Our present purpose is to deal more with what has been done, however, than with what may be done here. The 18-acre *parc* and the adjoining one of seven acres were both stocked with oysters during the spring of the present year, the conditions in both cases being as nearly as possible alike; the oysters themselves, it is necessary to observe, being taken indiscriminately from one lot and deposited at the same time in both *parcs*. The water in both ranged from 5 ft. to 6 ft. in depth, and wattle-work hurdles of hazel sticks and fine twigs were staked down over the oysters, and at a certain height above them. Two thousand tubs of oysters were laid down. On the 1st of June the presence of spat was first discovered in the 18-acre *parc*, and by the 6th the births of the oyster baby hosts were evidently brought to a close for the season. Sixteen thousand hurdles were staked over the old oysters. These hurdles were next taken up, and the oysterlings then removed, with the bark, from the larger sticks by a number of men and lads employed for the purpose, and the smaller twigs cut into short lengths of four or five inches. These strips of bark and cut lengths of twigs, with the oysterlings attached in sizes varying from a pea to that of a large horse-bean, are then sent away to the *parcs* prepared for their reception and growth for market. Taking the lowest estimate of the numbers of oysterlings on each of these hurdles taken up from the 18-acre *parc* as the spat there of the season, they cannot average less than 5,000, giving a grand total of 80,000,000 young oysters as stock for market in 1870–1.

It was estimated in 1864 that seven hundred millions of oysters were consumed annually in London, and considerably more than that number in the provinces. With our growing population annually increasing the number of oyster-eaters, what a grand future appears to be looming upon the future for oyster producers!

The following are the registered average temperatures of the water in the 18-acre *parc* at Hayling during the months of May, June, July, and August, taken 3 ft. under water, and in the shade by day:—

1867.	Maximum.	Minimum.
May.—By day	61°	55°
„ By night	60°	53°
June.—By day	67°	63°
„ By night	65°	62°
July.—By day	70°	65°
„ By night	70°	64°
Aug.—By day	70°	66°
„ By night	70°	65°

At the close of September last the *minimum* temperature of the air was found to be 48 deg.; the temperature of the water in the 18-acre *parc* at the same time was tested and found to be 58 deg.

At a meeting of the Food Committee, on Dec. 11, 1867, Mr. Robert Atkin proposed to build a class of vessels of about 150 tons, fitted with wells, to keep the fish alive, with steam-power adequate both for working side-screw propellers and for lifting the trawl net. The trawl itself would be much larger than any now in use worked by manual labour, and by that means larger quantities of fish would be taken from deeper water than was now fished, and from which the best fish were obtained. He thought the great object would be to ensure certainty of a large supply of fish. The class of fishing vessels he proposed would be able to keep at sea in all weathers, and the fish would be kept alive till they were landed. He had fished with a trawl in 100 fathoms of water. He considered the fishing vessels at present used were too small, as well as the trawls which they used. He was well acquainted with the fisheries of the North Sea and the Baltic, as well as on the coasts of India and China, and he considered the Chinese left us in the shade entirely in their fisheries, both in the rivers and in the sea. The present small fishing vessels had not power to drag such a trawl as would ensure much larger catches of fish from deeper waters. The nets he proposed would be stronger as well as larger than those ordinarily employed. Mr. Atkin expressed his opinion that, by means of this enlarged scale of operations, great additions might be made to the supply of oysters from *beds at present inaccessible*. The English and French oyster fishermen dredged only to a depth of about 30 fathoms, but no doubt much *larger supplies might be obtained from beds which would be found in deeper water*. He proposed that dredging should be carried on upon a larger scale, and employing larger dredges to be worked by steam power, which could also be applied to the working of a side screw as auxiliary propulsion of the vessel. He believed that *large oyster beds existed on* the Dogger Bank. As oysters were now selling in London at 2*d*. *each*, it would be worth while to increase the supply and reduce the price. He proposed to adopt the plan which was carried out in America—viz., when any large supply of oysters was obtained, to take the fish out of the shells and pack them in cases. In New York, oysters treated in that way were sold at 4*d*. per lb., which was remarkably cheap compared with the price charged in this country.—*Journal of the Society of Arts.*

We add some incidental details of the progress of the French Fisheries. In a paper addressed to the Société d'Acclimatation M. Delidon makes some interesting remarks on the state of Ostreiculture in the commune of Marennes, Charente-Inférieure, and especially on the artificial oyster-beds of the rock of Der. M. Delidon considers the current as the natural vehicle by which the spat of the oyster is carried to those places where it finds suitable materials to fix itself upon. But if no obstacles be put in the way of the current, an immense quantity of the spat will be taken out to the open sea and utterly lost, and it is to avoid this that collectors are formed. The ancient Romans used to make them of timber, and this material is used to this day with perfect success, with the single drawback that timber is not very durable. Stone, sea-shells, and tiles, therefore, answer much better; but even these are not unattended by annoyance, for as the oyster only travels once in its life—that is, in the state of spat, it becomes necessary, after a certain time, in order not to be at the expense of multiplying the collectors, to detach the young oyster from the stone or tile, and transfer it to the definitive oyster-bed. Now, in this preliminary operation at least 25 per cent. of the young oysters are destroyed, because of the thinness of their shells, which break in the attempt of separating them from the tile or stone. This serious loss is partly owing, according to M. Delidon, to the clumsy shape of the knife with which the operation is performed; but, in a great measure, also to the circumstance that the oyster is fixed to the naked tile or stone, whereas, if the latter were coated with some substance that would resist the action of the water, but could be removed without much difficulty by mechanical means, all this loss might be obviated. M. Delidon recommends for this purpose a composition he has tried successfully for the space of two years, and consisting of plaster of Paris made up into a paste with oil.

The Calais oyster would be in great request did not its weight and size prevent its transport. It is described as white and of a very delicate flavour, and is taken from a bed remarkably clean and free from mud, about 2½ kilomètres to the north of the harbour. The average weight of these oysters is about 71 English pounds per 100 oysters. Their sale is, therefore, limited in a great measure to the immediate neighbourhood; some are sent to St. Omer, and even to Lille and Arras, but beyond that point the cost of carriage becomes too great, and consequently not more than five boats from the port of Calais engage in the trade. These five boats, however, take from 558,000 to 620,000 oysters annually, which fetch from 35f. to 40f. per grand mille, or 1,240 oysters, and in dear seasons are sold at 50f. and even 60f. per grand mille.

BORING ANNELIDS.

A PAPER has been read to the British Association "On the Boring of Limestones by certain Annelids," by Mr. E. Ray Lankester. The author stated that, in the discussion relating to the boring of mollusks, no reference had been made to the boring of annelids—indeed, they seemed to be quite unknown; and he now brought forward two cases, one by a worm called *Leucodore*, the other by a Sabella. Leucodore is very abundant on some shores, where boulders and pebbles may be found worm-eaten and riddled by them. Only stones composed of carbonate of lime are bored by them. On coasts where such stones are rare they are selected, and all others are left. The worms are quite soft, and armed only with horny bristles. How, then, do they bore? Mr. Lankester maintained that it was by the carbonic acid and other acid excretions of their bodies, *aided* by the mechanical action of their bristles. The selection of a material soluble in these acids is most noticeable, since the softest chalk and the hardest limestone are bored with the same facility. This can only be by chemical action. If, then, we have a case of chemical boring in these worms, is it not probable that many mollusks are similarly assisted in their excavations? Mr. Lankester did not deny the mechanical action in the pholas and other shells, but maintained that in many cases the co-operation of acid excreta was probable. The truth was to be found in a theory which combined the chemical and the mechanical view.

THE SHIP BARNACLE.

At a meeting of the Microscopical and Natural History Section of the Literary and Philosophical Society, Mr. Sidebotham has read the following Note on the Ship Barnacle:—On September 28, I was at Lytham with my family. The day was very stormy, and the previous night there had been a strong south-west wind, and evidences of a very stormy sea outside the banks. Two of my children came running to tell me of a very strange creature that had been washed up on the shore. They had seen it from the pier and pointed it out to a sailor, thinking it was a large dog with long hair. On reaching the shore I found a fine mass of barnacles, *Pentalasinus anatifera,* attached to some staves of a cask, the whole being between four and five feet long. Several sailors had secured the prize, and were getting it on a truck to carry it away. The appearance was most remarkable, the hundreds of long tubes with their curious shells looking like what one could fancy the fabled Gorgon's head with its snaky locks. The curiosity was carried to a yard where it was to be exhibited, and the bellman went round to announce it under the name of the sea lioness, or the great sea serpent. I arranged with the proprietor for a private view, took my camera and a collodio-albumen plate, and obtained the photograph I now exhibit. The afternoon was very dull, and the plate would have done with a little longer exposure, but this, along with specimens I show, will give some idea of the strange appearance of this mass of creatures. This barnacle is of interest, as being the one figured by Gerard as the young of the barnacle goose. As some of our members may not have seen the book and read the quaint description, I have brought my copy of Gerard's *Herbal* for their amusement. I may just mention that another mass of barnacles was washed up at Lytham, and also one at Blackpool, the same day or the day following. I did not see either, but, from description, neither was so fine as the one I have described. This mass of barnacles was evidently just such a one as that seen by Gerard at the Pile of Foulders. It is rare to have such a specimen on our coasts. The sailors at Lytham had never seen anything like it, although some of them were old men who had spent all their lives on the coast.—*Mechanics' Magazine.*

THE POISON OF THE COBRA.

Some interesting experiments have lately been made in India, relative to the action of the Poison of the Cobra, by Dr. Shortt. This gentleman, having regard to the numerous lives that were lost annually in India from the bite of this snake, was mainly anxious to discover some antidote for its poison, and set about testing its various remedies in repute for that object. After much expense, and no little risk to himself, he has found that all are valueless. Still thinking that some effective agent might be known to the natives, he offered a reward of 500 rupees for its production, stipulating that he (Dr. Shortt) should find the cobras and conduct the experiments, which were to be three in number. The prize still remains unawarded. Recently Dr. Shortt has received a communication from Sir T. Madava Row, the Dewan of Travancore, intimating that his Serene Highness the Maharajah has taken much interest in the question, and begs to offer a reward of 1,000 rupees, under such conditions as Dr. Shortt may think desirable, to the person who can produce a remedy, and satisfy him that it is effectual against snake-bite. The prize, therefore, now amounts to 150*l.* The discoverer, whoever he may be, will serve the cause of humanity greatly; and this announcement, we hope, will awaken an interest in the question that may lead to some satisfactory result. Dr. Shortt has been good enough to say, that he will be glad to facilitate the conduction of experiments (or to receive any suggestions thereon), and that he will consign to us, for the use of any gentleman disposed to investigate the question, heads of cobras, uninjured, preserved in spirits or simply dried, or in any other way that may be desirable; and, should we advise it—the idea is exceedingly unpleasant, but if science demand we must obey—he will send one or more cobras themselves for experiment, on our being satisfied that every precaution will be taken to prevent the likelihood of any accident occurring. Certainly never were conditions more favourable for experiment, ugly though it may be. We therefore hope the result will be the discovery of an antidote to a poison which kills so many human beings every year.—*Lancet.*

PLAGUE OF MOTHS.

In several parts of New South Wales great annoyance was caused last autumn by immense quantities of Moths. The Rev. W. B. Clarke, in a letter to the *Sydney Morning Herald*, gives an account of the annoyance occasioned to the congregation at St. Thomas's Church, North Shore, in 1866, and again in 1867:—"The moths appeared in church this year on the 14th of September, and from that date to this have gone on increasing in numbers, until several bushels have been destroyed, though apparently without much diminishing the army. The state of the church was such on Sunday, October 6th, from the accumulated dust (moth-feathers) and the incessant swarms that were continually flying through the building, that Divine service could not be held therein. More than seven days' hard labour in endeavouring to subdue them had been then spent in vain, and since then applications of the strongest ammonia, sulphur, smoke, and other contrivances, used for hours, have failed to drive them away, for as fast as one swarm is partly destroyed another succeeds. There are so many openings in the building that cannot be closed, and so many lodgments outside, that no smothering contrivance has succeeded, and as the trees and ground are full of them, the moths, if driven away for a time, muster again and return. This morning I made an attempt to reckon up the numbers grouped together upon the windows, and I counted more than 80,000. In the tower and below the floor, and hidden behind the skirting, there are probably many millions. An opinion has been published that these moths came in from the sea. I am told that a vessel yesterday twenty miles from land was covered with them. Their first appearance this year was with a west wind. Previous visitations have probably left eggs enough to account for the present multitudes without going a great distance."

INSECTS FABRICATING IRON.

It is well known that some Insects are skilful spinners, but it is not known that some of them fabricate Iron. A Swedish naturalist, Sjogreen, has published a curious memoir on this subject. The insects in question are almost microscopic; they live beneath certain trees, especially in the province of Smaland, and they spin (like silk-worms) a kind of ferruginous cocoons, which constitute the mineral known under the name of "lake ore;" and which is composed of from twenty to sixty per cent. of oxide of iron, mixed with manganese, ten per cent. of chloric, and some centimètres of phosphoric acid. The deposits of this mineral may be two hundred and fifteen yards long and from eighteen to thirty inches thick.

AUSTRALIAN LEECHES.

A very remunerative business has lately grown to pretty extensive proportions in Melbourne in the exportation of Leeches. The trade is principally carried on in connection with the operations of the Murray River Fishing Company, the fishermen there employed turning their attention at seasons unfavourable to the fishery to the collection of leeches. From 150,000 to 250,000 leeches are sometimes collected in one of the trips of the Company's steamers. They are then packed and conveyed to Melbourne, where a large proportion of them are put up for transmission abroad, great numbers being sent to London and Paris, where it is stated they are preferred to leeches brought from any other place. The principal outlet for the export is America, where the demand is always great from the absence or rarity of the proper kind of leech throughout that great continent.

SNAILS AS A CURE FOR CONSUMPTION.

THE peasantry of Ireland have great faith in the efficacy of Snails as a cure for persons in a Decline, or Consumption, writes a Correspondent of *Land and Water*, but they do not in all places use them in the same way. A lady in Tipperary, who has as large a practice as the regular doctor, tells me that the way to administer snails is to "boil them in veal broth," and says that she herself knew a lady who was taking cod liver oil with no result, grow strong by trying this remedy. But a daughter of a clergyman in Galway writes thus:—"The snails used for the broth, as you designate my very fine syrup, are the common large things that creep about the garden with their houses on their backs. They are collected and placed on a large dish, and plentifully sprinkled with dark sugar, then another dish is placed over to prevent them from running away, and next morning the syrup which has been made in the night is to be drained off, and a table-spoonful taken three times a day; a little lemon peel may be added to flavour the broth. The same snails should not be sugared twice. It is a really good thing, but of course will not cure in a day, but I know a lady who attributes her own cure to it."*

THE THYSANURA.

A PAPER has been read to the British Association "On some Points in the Anatomy of Thysanura," by Sir J. Lubbock, Bart. The author remarked that the thysanura, though extremely numerous, and in many cases very pretty little creatures, had attracted but little attention, owing, perhaps, to their great delicacy and the consequent difficulty of preserving them in a satisfactory condition. Under any decaying log of wood, under damp leaves, in long grass, in short, in almost any damp situation, the thysanura form no small proportion of the population. Like other insects, they have six legs, but they never acquire wings. The tail is provided with two long appendages which are bent forward under the body, and thus form a spring, by means of which the animal is enabled to jump with great activity. A smynthurus, for instance, measuring one-tenth of an inch in diameter, will easily jump up twelve inches in the air. This, however, is due mainly, not to muscular power, but to the elasticity of the spring. The muscles draw the spring forward and bring it under a small latch or catch. Directly this is relaxed, the elasticity of the organ jerks the spring back, and throws the creature upwards and forwards. The author

* See the account of snails on Box Hill, l
the Earls of Arundel, in *A Picturesque Pro*
Editor of the present volume, 1828.

described in detail the muscles by which the spring is moved. Another remarkable peculiarity in the thysanura is the presence, on the first abdominal ring, of a process which acts as a sucker in the Poduridæ, and in smynthurus gives rise to two long filaments which serve the same purpose. The author described the arrangements of the muscles by which this curious apparatus is moved. He then described the digestive and respiratory organs; and after pointing out that smynthurus and papirius, though very nearly allied in external character, differ entirely in their method of respiration, the latter genus being almost or entirely deficient in tracheæ, he proposed, therefore, to form for it a new family, which he proposed to call *Papiridæ*.

A WONDERFUL FISH.

The *Courrier de Sagon* brings, as a contribution to Natural History, the not very credible-sounding description of a fish called "Ca-oug" in the Anamite tongue, which is said to have saved the lives already of several Anamites; for which reason the King of Anam has invested it with the name of "Nam hai dui bnong gnan" (Great General of the South Sea). This fish is said to swim round ships near the coast, and, when it sees a man in the water, to seize him with his mouth and to carry him ashore. A skeleton of this singular inhabitant of the deep is to be seen at Wung-tau, near Cape St. James. It is reported to be 35 feet in length, to have tusks "almost like an elephant," very large eyes, a black and smooth skin, a tail like a lobster, and two "wings" on its back.—*Athenæum.*

DOMESTICATION OF ANIMALS IN ENGLAND.

Mr. J. Thrupp has communicated to the Ethnological Society a very interesting paper upon the Domestication of certain Animals in England between the seventh and eleventh centuries. The customs and regulations contained in ancient laws and charters afford assistance in fixing the dates of the domestication of certain animals, and of this the author availed himself.

1. A man had an absolute right of property in tame animals, a limited one in semi-domesticated, and none in wild. 2. He was responsible for damage done by the first, partly for the second, but not for the third. 3. There was a fixed price to be paid as compensation for stealing domesticated animals, a smaller fixed price for the semi-domesticated, but none for the wild. 4. Rent payable generally in produce, and also fines to the king; damages and compensations might be paid in the first, generally were in the second, but never in the third class. 5. When a species was wild, the clergy did not tithe it, but as soon as it became domesticated they did so. 6. Wild animals were left to take care of themselves. The semi-domesticated were under the care of the general body of slaves; but the domesticated had special officers appointed to attend them, such as swine-herds,

ox-herds, &c. 7. When they were completely domesticated, they were let out to tenants as a part of their farm, much as farm-buildings are now, and at the end of the tenure reverted to the landlord. 8. They were also specially bequeathed or granted in wills or charters, as were the inclosures, cattle-yards, hog-pens, or castra, in which they were kept.

The custom of petting animals has been suggested as the origin of Domestication, but the author believes that it was adopted mainly from economic motives, was practised so soon as it was found to pay, and was carried to the extent, and was persevered in so long as it was found to be profitable, *and neither further nor longer.* The animals on whose produce our Anglo-Saxon forefathers at first mainly lived, and which they most earnestly desired to domesticate, were hogs, bees, and eels. The hog was the first with which they were successful. The domestication of the horse was probably of a later date, and its history exhibits a difference in the habits of the Cymric and Teutonic races. The Welsh loved, bred, and trained horses when the Anglo-Saxon cared little for them. In the tenth century, a large proportion of the Welsh horses were kept at home, fed and trained; but their brood mares, when in foal, were turned loose in the forest, for the express economic reason that when they could "not draw a cart up and down hill," they were not worth home keep. Horses turned out in the boundary forests were as much an object of systematic forays as hogs; and in a treaty between the Welsh and the Western English of the tenth century, it is stipulated that home-bred horses carried off from the woods shall be paid for with 30*s.*, and forest-borns with 12*s.* From the time of Athelstan, the tribute of the Welsh, which had previously been paid in valueless wolves, was demanded in horses, hawks, and greyhounds; the exportation of these was forbidden by law, and they were eagerly accepted in payment of compensations; the clergy induced Edward the Confessor to tithe them; hunting on horseback became suddenly the fashion; and every man of rank adopted the custom, which the early Anglo-Saxon abhorred, of fighting on horseback.

At the earliest period, the Anglo-Saxon was probably more anxious to domesticate bees than horses. Their produce was an article of food, necessary to brewing mead, and extensively used, externally and internally, in medicine. In the sixth and seventh centuries, bees were altogether wild; they swarmed in the woods, and formed their honeycombs in hollow trees, and were at first classed by law with foxes and otters, as incapable of private ownership, "*because they were always on the move.*"

From the bee, which has continued semi-domesticated, the author passed to the hawk, whose domestication was superior in degree, though inferior in proportionate number; was probably a foreign taste, and has altogether ceased. There is no evidence that the earlier Anglo-Saxons trained these birds. With the introduction of fire-arms the breeding of hawks ceased, for they were no longer the most profitable or exciting means of taking wild fowl. Of all the animals which the Anglo-Saxons vainly attempted to domesticate, the eel probably cost them most labour and money. Enormous ovaria were attached to nearly every monastery, and supplied the monks with many thousands of eels to alleviate the severity of their fasts. The list of the animals which the Anglo-Saxons kept as pets, and probably attempted to domesticate, is a very long one. We have wolves, foxes, otters, bears, roebucks, hares, weasels, cats, ravens, rooks, dogs, cranes, peacocks. The weasel and the cat were both domesticated at the same time and for the same purpose, yet the animal which proved effective is no longer home-nourished, while the worthless one—thanks to an affectionate and domestic disposition—is petted and pampered in every family.

BIOLOGY.

PROFESSOR SHARPEY opened the business of the Section Biology, at the British Association Meeting, with the following address:—I need scarcely remind you that Biology, or the science of the living economy, in its widest sense comprehends whatever relates to the organisation, functions and mode of life of living beings, whether plants or animals, as well as their natural history, that is, their distinctive characters, mutual affinities, systematic classification and distribution. Our special science has fully shared in the general advance of human knowledge, which goes onward from year to year with steady progress. In adverting, for a few moments, to the present state of anatomy and physiology, we cannot fail to be impressed by the general prevalence of improved methods of investigation, and the general use of instrumental and other appliances of greater power or greater precision in scrutinising the intimate structure of the body, and in observing, estimating, and recording physiological phenomena. We see further marks of advance in the increasing application of the other sciences, especially chemistry and physics, to the elucidation of the living economy, and in the readiness with which new discoveries in these sciences are taken advantage of for the prosecution of anatomical and physiological research. Through these means more extended and more precise data are obtained for the discovery or recognition of prevailing laws and the construction of rational theory; and physiology is acquiring more and more the character of an exact study. It is now two centuries since the microscope was first used in anatomical and physiological inquiries, and yet I can remember the time when its use might have been considered exceptional—when, at any rate, it was confined to a very few hands; but now it might almost be said that no physiologist or naturalist is without one. Great improvements are continually being made in the potency, precision, and convenient application of the instrument; and signal advantage has been gained from the use of appropriate re-agents for facilitating microscopical investigation. We need not look abroad for examples.

Some of the most important fruits of recent microscopical inquiry are due to the zeal and sagacity of our own countrymen. I need refer only to the discoveries concerning the intimate structure of the nervous system; and without invidious selection, I may more especially signalise the well-known researches of Mr. Lockhart Clarke on the nervous centres, which, I am happy to say, he continues successfully to prosecute—the discoveries of Prof. Beale on the structure of ganglions and of nerve-fibres, and their ultimate distribution in the tissues and organs—and the interesting observations of Mr. Hulke on the retina. By using high microscopic powers, with the greatest address and skill, Dr. Beale found out exquisitely minute fibrils in the peripheral branches of the nerves, and traced their distribution in various tissues. These inquiries have been followed up by the German histologists, and now it is maintained that nerve-fibres may be traced even into the particles of epithelium. Be this as it may, it is satisfactory to know that, as the functional influence of the nerves has been found to govern in a higher degree and more direct manner than formerly suspected the circulating, secreting, and other nutritive processes, so our knowledge of the anatomical domain of the nervous system is being correspondingly extended. As a marked instance, I may refer to the recent observations on the termination of nerves in the secreting epithelium of glands.

In proceeding to say a word on other instrumental applications, I may pass over the continued investigations into the electricity of nerves and muscles, and new determinations, by new methods, of the velocity of nervous excitation, as well as new observations with the ophthalmometer, ophthalmoscope, laryngoscope, and the newly-invented cardiograph, and shall content myself with specialising the investigations made in this country into the phenomena of the pulse, in health and disease, by means of the sphygmograph, and the important experimental inquiries of Dr. Sanderson on the influence of the thoracic movements on the circulation of the blood, carried on by means of the hemadynamometer and additional ingenious apparatus contrived by himself. The account of his observations is contained in the Croonian Lecture for 1866, delivered by him before the Royal Society, which has been published in the *Philosophical Transactions.*

An important contribution to the physiology of respiration was, not long since, derived from a combined chemical and optical investigation, by Prof. Stokes, into the oxidation and deoxidation of the colouring matter of the blood. Spectrum analysis promises much aid in physiological inquiry. It has been already employed by Dr. Bence Jones and Mr. Dupré, in a most remarkable and extensive series of experiments on the time required for the absorption and elimination of foreign matters by the living tissues. The substance used was a salt of lithia; and it was traced into and out of the non-vascular as well as the vascular tissues. The continued employment of chemical means in physiological inquiries scarcely requires any comment. I must, nevertheless, make an exception in regard to some recent experimental results, which led to an important modification of the views heretofore generally entertained as to the generation of muscular force. From an experiment, now well known, by Fick and Wislicenus, in an ascent of the Faulhorn, these observers concluded that the mechanical force and heat developed in muscular exertion cannot be derived solely or principally from oxidation of the proper muscular tissue. Dr. Frankland has subjected their data and conclusions to a careful chemical criticism, in which he determined experimentally the heat, and consequently the mechanical force, produced by the oxidation of albuminoid substances; and, on comparing this with the results of the Alpine experiment, he has fully confirmed the conclusions drawn from it. It would, therefore, seem as if a muscle ordinarily uses other materials, probably hydro-carbonous, to be oxidated in the production of force, as a steam-engine uses fuel, and not its own substance. More lately, Prof. Parkes has made, at the Netley Hospital, two series of very careful experiments, in which the whole of the discharged nitrogen was exactly determined; and his experiments, which are related in two recent numbers of the *Proceedings of the Royal Society*, lead to the same general inference as those of the Swiss inquirers; but Dr. Parkes has further found that nitrogen is retained during the actual performance of work, perhaps even taken up in some form by the muscle and assimilated, and that the discharge of it mainly takes place in the period of rest which succeeds exertion.

Without unduly protracting these rather desultory remarks, I may be permitted to speak of a new and curious method of research quite recently introduced by a foreign experimenter, which has as yet been especially employed for tracing the more intimate distribution of the ducts in the liver and kidney, but is possibly applicable to the solution of other anatomical and physiological questions. It consists in injecting into a vein or introducing into the stomach of a living animal a colouring matter, which may, after a certain lapse of time, be found filling, and so rendering conspicuous, the gland ducts through which it is being eliminated from the system.

It is needless to pursue these considerations further, and it is not my purpose to attempt anything in the nature of a general survey of the recent work done in our science. The number of active workers has so greatly multiplied, and the published results of their labours have become so immense in extent and variety, that, to me at least, it would be a hopeless task to present within reasonable compass any consistent and intelligible summary. In one of the lately published annual Reports on the progress of anatomy and physiology, I find that the writers referred to as having contributed to these sciences within the year are between five and six hundred, and a good many of them are cited for two or more contributions. One fruitful source of this increased production has been the institution in recent years of physiological laboratories in various continental seats of learning, in which practical instruction is given in histological and physiological studies, and where many able and well-trained young men, ambitious of scientific distinction, are engaged in prosecuting original inquiries. No one, of course, can doubt the gain to science thus immensely accruing; at the same time, it must be admitted that the eager publication of immature results and hasty conclusions to which some are tempted, and the corrective, or, at least, diverging statements of others, equally confident, which speedily follow, present in not a few cases an amount of contradiction and confusion most bewildering to any one who desires to master the existing state of knowledge of the subject. But although this is undoubtedly a drawback, it is trifling in comparison with the advantage of manifold activity and accelerated progress. Anatomical and physiological journals, and other channels for the publication of physiological papers, have of late years been on the increase abroad, and augmented facilities are thus afforded for disseminating new matter; and we admire, I might almost say envy, the number and excellence of the graphic illustrations with which they are furnished. Such advantages are not so freely offered to the anatomists and physiologists of this country. Anatomical and physiological memoirs, for the most part, require elaborately executed figures for their illustration, and the expense of a journal illustrated fully and fitly is found to be a serious obstacle to its maintenance, with the limited circulation which a purely scientific periodical has heretofore obtained in Britain. It has sometimes occurred to me that a publication fund might be established, which, under unimpeachable management and control, might be applied especially to defray part of the expense incurred in illustrating scientific memoirs. Such a purpose, I venture to think, is not unworthy of consideration by those who desire to promote knowledge by pecuniary foundations.

Let me say a word on the influence of the British Association in the promotion of our science. It carries on its work in various ways. One most important line of action is the appointment of committees, or individual members, to draw up reports on the progress and existing state of particular branches of science, or to investigate particular scientific questions by actual observation or experiment, and report thereon; and every year sums of money are voted to meet the expenses of such investigations. These reports are published *in extenso* in the annual volume, and are, for the most part, of great and acknowledged value. Biological science has fairly participated in these advantages, and has further profited through the example set by the British As-which has led other influential bodies to set on foot investigations by similar means. Doubtless, it might be held that the same or like advantages might be obtained through a stationary scientific institution, and without such local gatherings and annual visitations as that which we are now attending; but it has been justly said that the periodic meetings of the British Association in different places serve not only to freshen the interest and stimulate the activity of the habitual cultivators of science, but also to render the study more widely attractive, and enlist fresh energies in the pursuit; and then it must be remembered that the subjects for reports and particular lines of inquiry are for the most part suggested or determined by the discussions that take place at these meetings. It must be confessed, indeed, that the published proceedings (as distinguished from special reports) of the Section of Physiology make no great show in the series of volumes issued by the Association; but, without undervaluing the reports of these proceedings, I would venture to say that they are not, and cannot well be, a just measure of the useful work done. Much of the good effected by the sectional meetings can never be recorded. I remember being present at an assembly of the German Association of Naturalists at Berlin in 1828, and of hearing Oken, one of the most distinguished members and original founders of that institution, declare that the great purpose of the Association was, not to listen to long and elaborate communications, but rather to bring men of kindred pursuits from different parts into friendly relation with each other, affording them the opportunity of freely exchanging information, exhibiting new and interesting specimens and experiments, offering mutual suggestions, and establishing useful correspondence. All, I feel sure, will admit that this promotion of friendly intercourse among men engaged in the pursuit of science and those interested in its advancement is—and let us hope it will long continue to be—one of the great benefits conferred by the British Association.

BOTANY.

NEW PLANTS.

Among the Plants that are gradually making their way into our hot-houses there is the *myrmecodia tuberosa*, one of the strangest subjects of the vegetable kingdom ever known, and first sent over from Malacca by Dr. Collingwood. Its stem is tuberous, and everywhere covered with thorns; it is constantly inhabited by thousands of ants, that have pierced galleries through it in every direction. These galleries are coated with an animal cement of such tenacity that, when a tubercle dies and wastes away, the galleries remain, presenting the appearance of certain ramified *algæ*.

Dr. Hooker has read to the Linnean Society a paper on the *Fuchsia coccinea*, of Aiton, showing it to have been a totally different species from the plant now so extensively cultivated in all regions of the globe under that name. The true *F. coccinea*, introduced in 1788, and published in the first edition of the *Hortus Kewensis*, vol. 1, is only known in the Oxford Botanic Garden; and from specimens dried in 1788, in the Banksian and Smithian Herbaria, from the plant then cultivated at Kew. The true plant is figured by Salisbury and others; but these, and indeed all authors, have confounded Aiton's plant with the *F. Magellanica*, Lamarck. The latter is the plant figured in the *Botanical Magazine* as *F. coccinea*, Ait., and now cultivated under that name. It is a common Chilian and Fuegian plant, whereas the native country of *F. coccinea*, Aiton, is still unknown. The President afterwards read the continuation of his "Notes on the Structure of the Myrtaceæ" and a "Note on the Stigmatic Apparatus of the Goodenovieæ," with especial reference to the manner in which impregnation is impeded or facilitated in the different genera belonging to that family. Dr. Hooker exhibited an extensive series of Japanese Coniferæ, and made some observations upon them, pointing out their affinity with Indian and North American forms. Mr. G. Maw exhibited a living specimen, in flower, of the *Porana racemosa*, which he had succeeded in raising from seeds communicated to him by Dr. Wight, by whom the plant was originally described in his *Icones Plantarum Indiæ Orientalis*, from the eastern slopes of the Neilgherries. The living plant was accompanied by a fossil from the Tertiary beds, which was stated by Mr. Maw to have been identified by Dr. Heer with the genus Porana, but which, in the number, form, and venation of its sepals, accords far better with *Kydia calycina*, another Indian plant figured by Dr. Wight in his *Icones*, and of which, as in Porana, the Sepals become greatly enlarged after flowering.

SENSITIVE PLANTS.

Some experiments have been made in France upon the Sensibility of Plants, by which it appears that they are affected by cholroform, ether, electricity, and other agents, in much the same way in which animals would be affected. A sensitive plant, which shut up its leaves on the slightest contact of a fly's wing, lost its sensibility in the same way in which an animal would on being exposed to the vapour of ether. Three other sensitive plants were then exposed to a direct current of electricity from a single Bunsen's cell, but they were unaffected by it. On exposing them to the action of an induced current, however, obtained by the aid of a very small Ruhmkorff's coil, they immediately began to shut up their leaves. The first plant was exposed to the current for five minutes, and in about a quarter of an hour it began to reopen its leaflets; the second plant, which was exposed to the current for ten minutes, did not recover before two hours and a half; and the third plant, which was exposed to the current for twenty-five minutes, was killed. The plant which had been exposed to the action of the ether vapour did not feel the induction current which acted so instantaneously upon the other plants.

CULTIVATION OF CINCHONA IN INDIA.

The cultivation of the Cinchona in British Sikkim is progressing very satisfactorily. Specimens of red bark two years old have been analysed and found to contain 3½ per cent. of febrifuge alkaloids. In Madras, in 1865-6, notwithstanding the unfavourable character of the season, unprecedented progress was made in the cinchona plantations. Millions of excellent seeds have been produced. The yield of crystallised sulphates of the red bark species (C. succirubra) has been 10 per cent.; the bark of the C. officinalis has yielded nearly 8 per cent. of quinine. It has been proved that strips of bark may be removed from the trees without injuring them, if moss be immediately applied, and that by mossing them before it is stripped off the bark may be immensely improved. Moreover, the second growth of bark, treated in this way, is richer in quinine than the first, and the third than the second. In order to make the benefits of the cinchona as accessible as possible to the poorer inhabitants, Government officers have been instructed to promote the cultivation of the tree by villagers and small holders of land. A commission of medical officers has been appointed to conduct inquiries with a view to test the efficacy, as febrifuges, of the cinchona alkaloids other than quinine. Fourteen surgeons holding appointments in localities where fever is prevalent have been directed to conduct experiments, and submit monthly tables of the results of their investigations. One medical officer has been specially selected to visit the hilly districts of the northern division, where fever of every variety prevails, and to remain at the different stations a sufficient length of time to test the effects of the alkaloids, both relatively and positively. An analytical chymist has also been appointed, for a term of three years, to investigate on the spot various points connected with the cultivation of the tree, and the extraction and use of its alkaloids.

AUSTRALIAN WINE.

On the importance of Geelong as a grape-growing district, remarks the *Register*, some idea may be formed from the fact that nearly one quarter of the area under vine culture within the colony is within the immediate vicinity of our town; and of the superiority of the Geelong grapes for wine-making purposes some notion may be conceived from the fact that of 110,000 gallons of wine made during one year within Victoria, nearly 50,000 gallons were made in this district.

PROPAGATION OF MISTLETOE.

A Correspondent of the *Nottingham Journal* writes:—"The correspondence which appeared in the *Times* some three years ago, relative to the propagation of mistletoe led me to attempt its cultivation, in which I have most satisfactorily succeeded. The process of culture is simple and easy. Select the ripest berries, viz., those of a pale yellow tint, rub them on the under side of a branch of a moderately young apple or poplar tree. The glutinous juice will make the seed firmly adhere to the bark, and being placed on the underside of the branch, it is less likely to be taken by birds. The branch selected for the operation should be young, vigorous, and free from dry epidermis. During the following summer each seed will throw out two claws like members, which attach it firmly to the bark. In this state it remains until the next April, when the first pair of leaves commence development. I have two plants raised on the same tree from seeds placed on it in the Christmas of 1865."

FOREIGN VEGETABLES AT THE FRENCH EXHIBITION.

From the Official Report we quote the following, by Dr. Robert Hogg:—The only vegetables exhibited in a fresh state were a numerous collection of potatoes, consisting of no less than 158 sorts, in the Prussian department, and a number of esculent roots in the Algerian department. The latter furnished excellent examples of some of the esculent roots of tropical and subtropical regions, which are not frequently to be met with. Among these were large rhizomes of *Colocasia odora*, *C. antiquorum*, *C. violacea*, *C. sagittifolia*, and *C. esculenta*. Of these, the latter is the one most extensively used. It is known by the names of Egyptian ginger, cocoa-root, eddoes, and yams; but the last name is more properly applied to a very different root. The rhizomes or large fleshy roots of this plant abound in starch, and form an important article of food to the inhabitants of the countries where they are grown. A peculiarity of the flowers of this plant is that they have such a cadaverous smell that flies deposit their eggs in them as they would in a dead carcass. Several roots of *Canna edulis* and *Canna discolor* were also exhibited, the roots of which are used as food; and numerous varieties of *Dioscorea alata*, a species of yam, which appears to assume every form of round, long, and palmate in the shape of its tubers. There were also numerous varieties of the tubers Batatas or sweet potato—the potato of Shakspeare, which was largely imported every year from Spain and Portugal, under the name of "Spanish potatoes," during the sixteenth century. They are extensively grown in the south of Europe, but are too tender for outdoor cultivation in Great Britain.

Of dry farinaceous vegetables there were some very extensive collections in the Portuguese, the Italian, and the Russian departments. In the Portuguese were found a large collection of many varieties of haricots. Here might also be seen many samples of "Gesse," or, as it is called in England, chickling vetch. It is the *Lathyrus sativus* of botanists, and its seed is used in Italy, Spain, and Portugal for making bread; but so remarkable an effect does it produce on the animal system that it is necessary to mix it in half the quantity with wheat or other flour. If used alone for any length of time it produces extreme rigidity of the limbs; and swine fed upon it entirely lose the use of these members and become exceedingly fat, lying on the ground. In all the departments already named were numerous examples of the ram's-head or chick pea. It will be found marked "*Pois Chiche.*" It has been called by botanists *Cicer arietinum*, from the great similarity the seed bears to a ram's head; and its English name of chick pea is in allusion to a fancied resemblance it has to a young bird coiled up in the shell. The seed is used in the south of Europe in the same way as we do garden peas, in soups and other dishes; and about Naples the children and common people eat them raw when they are yet tender. By the Spaniards, who call them "*carvancos*" or "*garavanzos*," and the Neapolitans, who call them "*cece caliato*," they are roasted, ground, and formed into an agreeable infusion resembling coffee. A remarkable peculiarity of the plant is that during the excessive heat of summer the leaves and stems sparkle with minute drops of an extremely acid, thin, viscous liquid, which has been found to be oxalic acid in a state of purity.

In the Italian collection of haricots there was one that might be introduced with advantage into English gardens; it is called *Fagioli del Giappone*, and has been cultivated successfully by the Acclimatisation Society of Paris. It is a small round seed of the shape and colour of a green pea, and its colour would doubtless prove a high recommendation.

In most of the departments preserved vegetables might be found, but particularly in Holland and Russia. The Dutch are remarkable for the brilliancy of their colour and their fine condition. They consist of carrots, peas, cauliflower, red cabbage, Brussels sprouts, cabbage, chick peas, and turnip-rooted celery. Besides these, in the Russian department there was a large collection of preserved mushrooms.

THE QUEKETT MICROSCOPICAL CLUB.

From the Second Report of the Committee, dated July, 1867, we gather that during the past year the following Papers were read, many of them having been illustrated by means of living or mounted specimens. The President, on "The Minute Structure of the Iris and Ciliary Muscle;" Mr. Bockett, on "A new form of Lamp carrying its own Reflector;" Dr. R. Braithwaite, on "The Organization of Mosses;" Mr. Burgess, on "Mounting Botanical Objects;" on "Cuticles of plants;" Mr. Cooke, on "Transmission of Specimens by Post;" on "The Progress of Microscopical Science in 1866;" on "Nachet's principle of Binocular construction;" Dr. Tilbury Fox, on "Human Vegetable Parasites;" Mr. N. S. Green, on "Melicerta;" Dr. Hallifax, on "Making Sections of Insects;" Mr. Higgins, on "Otoliths of

Fishes;" Mr. Highley, on "Shore Collecting;" Mr. F. Kitton, on "The Publication of New Genera on insufficient material;" Mr. R. T. Lewis, on "Some of the Microscopical Effects of the Electric Spark;" Mr. S. J. McIntire, on "The different kinds of Podure;" Mr. C. A. Watkins, on "Yeast and other Ferments." The field excursions had been numerous; the library of books of reference had been extended; and 140 slides of interesting objects have been added to the cabinet, making the total number 263.

AN ABYSSINIAN TREE.

ONE of Bruce's most unlikely stories was, that the Abyssinians subsisted to a great extent upon the stem of a kind of plantain. Everybody knew that in all parts of the world the fruit only of these plants was eaten, and the stem a mere mass of fibres. Bruce was evidently wrong, and was trying to palm off a traveller's tale. Years rolled on; one who had made an expedition into that dangerous district brought away some seeds with him of plants which seemed to him to be unlike those which grow in the adjoining countries. He forwarded these to the Royal Botanic Garden at Kew; about the year 1858 they were carefully sown, and the queer little black triangular seeds, as they rose above the surface proved themselves to be a kind of *Musa Ensete*, as it afterwards came to be called. The plant, which was intended to be a representative specimen, seemed to want potting continually—it was always attempting to get pot-bound. In about two years it became necessary to grow it in a tub 5½ feet square, and nearly 5 feet deep. The size of the plant at that time was as follows:—Circumference of the stem 6 inches from the ground, 7 feet 3 inches; height from the surface of the soil, 26 feet; leaves each about 15 feet long and 3 feet broad. The plant did not increase much after that time, for its flower-spike was in course of formation; there were fifteen magnificent leaves upon it, the midrib of each being of a rosy-red colour. In a few months its flowers opened, its seed was fertilised, its fruit proved to be perfectly useless in an edible point of view. Here, then, we had found Bruce's Plantain! The seed ripened, the stem was cut down, and we were all so anxious to get a bit of its core, that we might try the flavour of this new vegetable. Carefully we cooked it, trying over and over again to see when it should become tender, and each time nauseated by the stench from the pot. At last our patience could stand it no longer, we turned the mess out, and of all the horrible things we ever saw that was decidedly the nastiest; the water in which it was boiled was purple, and the "cabbage" was indescribable. Not one of us tasted a mouthful of that feast we had looked forward to for so many months. Without a doubt, the Abyssinians cut down the *Musa* stem just before the plant begins to form its fructification; probably the stem would then be succulent, and it may be even with a sweetish taste.—*The Gardener.*

Geology and Mineralogy.

IGNEOUS ROCKS OF SCOTLAND.

Mr. Geikie, President of the Section of Geology, has addressed the British Association on the Igneous Rocks of Scotland, in illustration of the progress of volcanic action in these islands. We have not space for the details of this paper, and must restrict ourselves to the closing observations of Mr. Geikie's paper. He said:—"He had brought the subject under the notice of the Section with the view of indicating a field of research in British geology where much remains to be discovered, and where the labourers are but few. As a result of this neglect, the nomenclature of this portion of British geology has been virtually at a stand for about half a century. While so much has been done in this respect by chemists and geologists abroad, we are but little further forward than when the great outlines of the subject were sketched long ago by the early leaders in the science. The same vague names, the same confused and defective arrangement, the same absence of careful chemical and mineralogical analysis, so excusable in the infancy of the science, still disfigure our geological writings and even the best of our geological collections. Field-geologists must be content to bear their share of the blame, yet it is not from their hands that the needed reform is mainly to be looked for. They can do but little till chemistry comes to their aid with information regarding the composition of the rocks which they investigate, and the extent to which the nomenclature adopted in other countries can be applied in their own. Surely the time must come ere long when it will be deemed a task worthy of years of long and patient research to work out the nature and history of the volcanic rocks of this country. Such a task will not be the work of a single observer. It will require the labour of the geologist, skilled to glean the data that can only be gathered in the field, and of the chemist who, aided and guided by these observations, shall seek to determine the composition of the different igneous rocks, and the relation which, in this respect, they bear to the rocks of other regions, and to the products of modern volcanoes. But whether distant or near, the day will doubtless arrive when we shall be able to connect into one story, as far, at least, as our fragmentary records will permit, the narrative of the varied volcanic eruptions which from early geological times have taken place in the British Islands, and to link that chronicle with the long history of volcanic action over the globe."

INTERNAL TEMPERATURE OF THE EARTH.

Mr. Higginbottom, jun., has illustrated this question to the Manchester Geological Society, by a description of the Astley Deep Pit, near Ashton-under-Lyne, sunk to the Black Mine, on the Dukinfield estate, near Manchester. Its total depth, from the surface of the ground to the bottom, is 686½ yards. The general diameter is 12 ft., with the exception of a length in the middle, where it has been widened to 12½ ft. to facilitate the passing of the chairs, excepting also a few yards of the pit bottom, where it gradually increases to 19 ft. 2 in. In sinking the pit itself 320,931 cube feet of material have been excavated, and 10,584 more have been cut out for mouthings. Of the total depth of the pit 211 yards have been sunk through rock; 443½ through shale; and the remaining 32 through seams of coals. Of these seams there are 26 of more than a foot in thickness, of which 15, with an aggregate thickness of 58½ ft., have been worked at different places in the neighbourhood, and may, therefore, be considered to have a present commercial value. The shaft, with the exception of 42 yards, where it is tubbed with cast-iron segments, is walled with a 9-inch wall of arched bricks, stiffened at intervals by stone rings, 18 in. on the bed and 12 in. thick, of which there are 80. Altogether, 7,308 cube feet of stone and 750,000 bricks have been used in the shaft, exclusive of those employed in the mouthings, &c. In sinking, water was met with at the following depths:—At 181 yards from the surface, 40 gallons per minute; at 240 yards, 35 gallons; at 358 yards, 52 gallons; at 413 yards, 33 gallons; and at 590 yards, 5 gallons; making a total of 165 gallons per minute. This water is raised to the surface by means of seven lifts of plunger pumps, of these the four upper are 12 in. diameter, and the three lower 9 in., 7 in., and 6 in. diameter; they have all a stroke of 8 ft. The four heavy lifts average above 90 yards in length each, and are arranged alternately on opposite sides of pump-rods; each stroke of the pump raises 39 gallons, and consequently the engine has to run at an average speed of 4¼ strokes per minute for the 24 hours. At full speed the engine would make from eight to nine strokes per minute. The pump trees are 13 in. internal diameter, and are for the most part of wrought iron; the plates of which they are made increase somewhat in strength towards the bottom of the lifts. The total weight of the pumping-rods, joint-plates, clumps, bolts, plunger-poles, &c., is 85 tons; of this weight 40 tons are balanced at the pit top by a loaded balance-beam, the remaining 45 tons being sufficient to overcome the weight of the column of water and the friction of the plunger-poles, &c. The pumping apparatus occupies in the pit an area of 29 square feet, having 84 square feet for winding.

The conducting rods are of pitch pine, attached to bearers of the same wood, which are supported on cast-iron boxes let into the walling of the pit. The horse-trees are also for the most part of pitch pine, as are the pump-rods, which are 18 in. square at the top, and diminish gradually downward to 10 in. The total amount of timber used in the pit is 5,882 ft. The pumps are worked by a side lever Cornish engine, with a 70-in. cylinder, 8 ft. stroke. The steam is supplied by three boilers, 34 ft. long, 6 ft. 6 in. diameter, with an ordinary working pressure of steam of 12 lbs. to the square inch. The winding-engine cylinder is 60 in. diameter, with a stroke of 7 ft. The winding-drums are 24 ft. $2\frac{1}{2}$ in. in diameter, and the whole weight of crank, crank-axle, and drums is 53 tons. To one of the winding-drums a brake-drum is attached, which is acted on by a steam-brake of great power. Besides the winding-drums there is on the main shaft a balance-weight drum of 6 ft. 8 in. in diameter, to which is attached a balance weight of 5 tons. The engine is capable of running 25 strokes in the minute, and consequently of raising the load in the pit at the rate of about 21 miles an hour. Allowing for the time lost in hooking on and taking off, the engine is able to raise 600 tons of coal in 10 hours. The winding ropes are of wire, $4\frac{1}{2}$ in. broad by $1\frac{1}{8}$ in. thick at the top, tapering downwards to $3\frac{1}{4}$ broad by $\frac{3}{4}$ in. thick. They weigh $4\frac{1}{2}$ tons each, and the breaking strain at the thin end is 30 tons; the actual working load is $3\frac{1}{4}$ tons, which is made up as follows:—The chair, which is constructed to carry four double load tubs, and weighs 16 cwt., four tubs which weigh 17 cwt., and the coal weighing 32 cwt. making in all 65 cwt. The winding ropes pass over pulleys 15 ft. in diameter, which are supported by the head gear at a height of 50 ft. above the landing-stage.

Besides the engines described, which were erected by Messrs. Fairbairn, of Manchester, there is on the ground a high pressure capstan-engine of 30-horse power, by Messrs. Garforth, of Dukinfield. There are now 11 boilers actually in use, and room in the boiler house for two more boilers. There are seven lifts in the pit, all being rams, the longest lift being 150 yards. There is also a small low-pressure engine, which drives a circular saw and drilling and punching machines, and supplies generally the power required in the workshops. The workings are aired by the assistance of the dumb-drift, which is driven up from a counter level to No. 2 shaft, rising 2 ft. to the yard. The dumb-drift is 10 ft. diameter, which forms an area of $78\frac{1}{4}$ ft. and enters the up-cast shaft at 600 yards from surface; the furnace-drift is 25 yards from the pit bottom, being $61\frac{1}{2}$ yards below dumb-drift. Careful observations, made during the sinking of the pit, have shown that the temperature of the strata increases with tolerable regularity from 51 deg. at a depth of 6 yards, to $75\frac{1}{2}$ deg. at a depth of $686\frac{1}{2}$ yards. The temperature on the pit top, this day, May 28, 1867, at 11 o'clock a.m., was 58 deg. at the pit bottom, 64 deg. variation, 6 deg.; in the return air roads, when the air has passed round the workings, and done all its work previous to making its exit into dumb-drift, is 71 deg.; variation from pit bottom, 7 deg. The remaining 205 yards have been sunk by the Dunkirk Coal Company. There was also an incline at work at the bottom of Astley Pit, which is 250 yards down, lying at an angle of 1 foot to the yard, making the total perpendicular depth from the surface to the lowest point 770 yards.

A vote of thanks was unanimously passed to the writer of the paper, and in the discussion which followed, Mr. Greenwell said:—I have observed at Monkwearmouth, at a depth of 580 or 590 yards, the temperature has been as high as 86 deg.; but it appears that the temperature at Dukinfield, where the depth is more by 100 yards, it is only 71 deg. I think if you take the temperature at the surface (58 deg.) and if that is deducted from the 71 deg. at the bottom, and that distributed over the depth, it will be found that they will make 1 deg. for a greater length than is usually accepted. It rather agrees with an idea upon the point which has occurred to me, and that is this—that if you take pits of moderate depth—say, 40 fms., 50 fms., 60 fms. or 70 fms., you will find an increase of temperature of 1 deg. for every 45 ft. to 50 ft. But, if you go deeper, say 200 fms., you will find an increased average of a great many more feet for the increment of 1 degree. I think this is fully corroborated, as far as one example may corroborate anything, by Dukinfield.

The President: A great deal has been said about the Temperature of the Earth, and both on the Continent and in this country there have been a great many observations upon it, and each particular observer adheres to the results of his own observations, and wants to make the earth hotter by a degree for so many feet. These observations are very different, and are likely to be very different, because many of them are not made with the care they ought to be. At any rate, they do not point to any general conclusion. We find that in Cornwall and Devonshire there is one scale of increase of temperature; in Durham another; and in Cheshire another. This is probably due to the way in which the observations have been made. Observations of temperature, with a delicate thermometer, require a great deal of care. When there are a great many men in a pit, and a current of cold air, and when as suggested by Mr. Livesey, the decomposition of pyrites liberates heat, the conditions must be very different. Then, we all know that in deep mines gas is pent up in the coal, and exercises considerable force in liberating itself. The force is so great that it has forced the face of the coal right off. An instance occurred at Ebbw Vale lately, where 30 tons of coal were said to have been forced off by the pressure of the gas to get out. When the gas thus diffuses itself through the works it lowers the temperature of the mine. On looking at all the observations, and the different results, we must come to the conclusion that we have not an absolutely correct rule as to the increased ratio of the temperature of the earth.

Mr. Higson: Pits of the same depth differ in different parts. The upper part of the middle coal or greater field is never at the same heat as at the lower. You will find a greater increase of heat down the Astley Mine, at 300 yards, than you find at 300 yards where there is the beginning of the middle coal field.—Mr. Greenwell: It is clear from that that you cannot take an increased ratio of heat from an increase of depth, if you have a greater amount of heat from one description of strata than from another. It is due to other causes than the depth of the earth. Mr.

Evans: At five successive dates I took the temperature at the top and the bottom of our pit, and I found that it differed from 70½ deg. at the bottom to 59½ deg. at the top. This varied every day from 5 deg. to 10½ deg. Mr. Dickinson: That is quite what I should have expected—that the increase of the temperature at the bottom of the pit would vary with the height of the barometer at the top.

APPLICATION OF FIREDAMP TO ILLUMINATION.

At a recent meeting at Nottingham, of the Association of Gas Managers, an elaborate paper "On the Explosive Properties of Firedamp and Coal Gas, with Particulars of Experiments made in Lighting portions of the Oaks Colliery with Pit Gas," was read by Mr. John Hutchinson, of the Barnsley Gas Works. Mr. Hutchinson remarks that it is certain that the coal cannot be worked without at the same time liberating the gas; it is equally certain that we cannot carry on the numerous and important manufacturing and domestic operations to which coal is now applied (and deemed indispensable) without its aid. It becomes, therefore, a matter of importance to investigate whether this dangerous gas cannot (in some cases, at least), be collected and utilised, for the purpose of lighting the main thoroughfares and other safe parts of the mine, instead of being allowed to circulate, and become mixed with air; thus forming the explosive compound which has at various times committed such fearful ravages. If, therefore, this gas can possibly be so utilised, the subject must be one of great interest to an association of gas managers, although the gas is manufactured by nature, without the aid of either stokers or retorts, on a grand scale, of which we have really very little conception; all the apparatus and appliances which we ordinarily think necessary to the carrying on of a modern gasworks are dispensed with. We appear to have no definite idea of the magnitude of the operations, or the time taken to conduct the process, yet it is evident to our senses that coal gas is, or has been, made and stored up on a scale so immense as to totally eclipse the idea of even our modern gas engineers. The author then proceeded to give an account of experiments he made at the Oaks Colliery some five years since. It appears that in July, 1862, Mr. George Minto, then underground viewer, suggested that the large blower of gas then existing in the pit, which had been going on for some time, and which appeared strong and pure, might be turned to some account, such as lighting the mine, and Mr. Hutchinson was consulted to devise the mode of carrying out the suggestion. He and Mr. Minto descended the pit, which was about 300 yards deep, and having been provided with lamps at the cabin, went to examine the place. They proceeded down the engine plane, about 800 yards, which dips about 6 inches to the yard, and then some 500 or 600 yards on the level; all was life and activity; there was a sufficiency of fresh air, and the seam of coal was about 9 ft. thick. They next proceeded to the gas-pit; this is a branch road from the level on the right hand, at the entrance to which was a gate, so that the air could freely circulate through it; this was kept constantly locked, no one but the underground viewer being allowed to have a key.

At length they arrived at the place where the gas is actually issuing, which is a small pit or well about 4 ft. in diameter and 25 ft. deep, and had been sunk three or four years ago to prove the throw or fault, the vein of coal having been suddenly lost at this point. The engineers had been compelled to abandon this search for the coal, in consequence of so much gas and water being given off as to render it unsafe to proceed further, and had filled up the little pit with any sort of débris. Through this rubbish and water the gas boiled up incessantly from the seam of coal below, with a very violent agitation. They made a careful examination of the place, and this caused a number of questions to suggest themselves, such as—What kind of gas is it? Is it inflammable? Is it given off at a uniform rate of pressure? What illuminating power has it? What is the quantity given off per hour? Can it be conducted to, and consumed in, a safe part of the mine, &c.? To answer these and other questions, it was absolutely necessary that some practical experiments should be made at the source from whence the gas issues, in order to learn something of its nature and properties; so the next day they paid a second visit to the dreary cavern, if such a mild term may be applied to such a place. On this occasion the gas or firedamp escaped plentifully, with a loud bubbling, roaring, hissing noise, at the surface of the water, which was 63 deg. Fahr. It might also be heard issuing out of the coal, or crevices of the rocks, in various situations round about them. It had no smell, or at least, so slight, that there is a difficulty to find words to describe it; yet it could be recognised by persons accustomed to it. With a large funnel inverted over one of the blowers in the water, and a 6 ft. length of india-rubber tubing, the pressure-gauge gave 7 in. He caught abundance of gas, filling a number of test tubes, bottles, and bladders. At the end of this tube the thermometer, held in a stream of gas, indicated 63 deg. Fahr., the same temperature as the water in the pit. He then applied the red and blue litmus, lead and turmeric papers, and limewater tests, but no reaction was shown on any of them.

On their third visit, Mr. Dymond, one of the proprietors of the mine, accompanied them, and was certainly anxious to have everything done towards freeing the mine of the gas that could be done with safety, and was desirous of witnessing the experiments. They now collected the gas in larger quantities, filled a Pepys's gasholder, and removed it to the cabin before mentioned, and tried the gas with an Argand union jet and bat's-wing burners, and found the gas to burn, to all appearances, equal to the manufactured coal gas. It sparkled a little with the particles of coaldust that were flying about, but otherwise it burnt very well. He was fully convinced of the practicability of the plan suggested of utilising the gas for lighting a portion of the mine, which would not only be a considerable saving in oil, &c., but, so far as it could be collected and burnt, render the mine so much safer, by destroying the explosibility of the gas so consumed, instead of the said gas escaping into and circulating in an explosible form through the colliery workings, until it escapes from the upcast shaft. But, before any steps could be taken towards so desirable an object, it was necessary to obtain the consent of Mr. Woodhouse, the mining engineer, who has the sole control of all matters connected with the ventilation of the Oaks Colliery; so two bladders full of the gas were at once forwarded to that gentleman, who happened to be at a neighbouring colliery, and he compared the gas contained in the bladders with the coal gas manufactured on the pit premises, and declared it to be equal to the artificial gas so made, so that he at once gave full authority to proceed with the experiments, and to have everything done that was needful, with a view of lighting a portion of the mine.

Mr. Dymond then gave instructions for the road to the gas-pit to be cleared of rubbish and fallen rocks, so that free access could be obtained thereto, and no expense to be spared in order to render all as safe as possible. A staff of men were now set to work, and the stones and rubbish removed; the well was cleared out some 10 ft. or 12 ft. deep and walled up; plates of sheet lead were laid down and covered with clay puddle, to force as much of the gas as possible through the water. A small gas-holder 4 ft. deep and 6 ft. in diameter, with a 6-inch T-pipe on the top, was then procured and fixed over the gas pit; at one end of this T-pipe was a slide valve, which could be opened or shut as required; at the other end was a bend connected to the pipes, which connected the gas to the engine plane, &c., where it could be consumed with safety; 4-inch pipes were laid from the gas pit to the bottom of the engine plane, from which point 3-inch and 2-inch pipes were continued to the bottom of the shaft. Into the 6-inch T-pipe on the top of the holder was inserted a short piece of ½-inch tubing, and a 12-inch pressure-gauge attached thereto; but the water was instantly blown out; indeed, when the valve and all other outlets were closed, the force of gas was so strong, that the weight of two men was not sufficient to keep the gas-holder down; it also forced the water from under the holder, although it dipped 12 in. To keep the holder in its position, they found it necessary to place pieces of timber between the roof of the mine and top of the gas-holder. He could now collect gas in a greater quantity with comparative ease. He made various trials of the quantity of gas given per hour with a 30-light gas-meter. He obtained from 295 to 300 per hour, or 7,200 ft. per day. They were fully aware that a great deal more was given off, but the difficulty was, how to collect it under the gas-holder. The small pit being partially filled up, the gas was forced laterally into the crevices of the rocks around, so that the puddle was often thrown up. The pressure in the gas-holder could be regulated by opening or closing the valve more or less, and allowing the surplus gas to escape; and being anxious to prove if the gas was given off at a uniform rate, he set the valve so as to maintain 1 in. head of water, and attached a registering pressure-gauge to the ½-in. pipe; the pressure remained constant —1 inch during the whole 24 hours. He tried various pressures with like results, thus proving beyond doubt that this simple and inexpensive apparatus might be depended upon for collecting and furnishing a regular and constant supply of gas to the mine. He then tested the illuminating power, which he found equal to 10 sperm candles; in one instance he obtained 12 candles, but was somewhat surprised, after repeated trials with Cooper's tube, to find he could get no condensation by the bromine test, although the ordinary coal gas gave 4½ per cent.; neither could he obtain any indication of carbonic oxide or carbonic acid. The specific gravity was ·517. The chemical test papers were again applied, as before mentioned, with like results. He found the loudest explosion to occur when the gas was mixed with nine times its volume of air.

At length the pipes were laid, the burners attached, and ready for lighting. Then came a very critical point. They were anxious to be satisfied that the gas contained in the pipe to which the light is applied was in such a condition at the moment that the light could not by any possible means travel backwards to the gas pit, and thereby cause an explosion. He felt quite certain upon this point, from observing the pressure and other indications, but in a matter of such importance there should be no room to doubt. For the first light he used an Argand burner, the gas passing through a glass tube filled with shot; after that a ½-in. pipe about 1 ft. in length, filled with wire, driven in lengthwise, previously proving by direct experiment that it was impossible for a light to run back under such circumstances. The first light was now applied with perfect success, and continued to burn quite satisfactorily; others were now lighted without fear; by degrees, some 60 lights were put on, which have continued to burn day and night without intermission ever since that time until December 12, 1866, on which date a terrific explosion occurred, with the particulars of which most of our readers will be familiar. This caused the death of near 400 unfortunate individuals, 285 of whom remain emtombed in the pit, which it was found necessary to close in order to put out the fire. Before finally closing up the pit, a 10-inch pipe was placed up the side of the shaft, so as to give vent to the pent-up gases which are given off in large quantities at the present time. Indeed the mine now appears to be one huge gasometer. On Friday, June 7, the quantity of gas driven off was near 50,000 cubic feet per hour. However, the quantity varies considerably with atmospheric changes. An account of the changes which occur in barometer, thermometer, and pressure-gauge, is taken every hour, and faithfully recorded in the colliery offices. The gas now given off appears identical with that which he found to issue from the gas pit before named, with the exception that it contains about 3 per cent. of carbonic acid, no trace of which could be discovered in the latter.—*Mining Journal.*

SILURIAN GEOLOGY.

In a review of the fourth edition of Sir Roderick Murchison's *Siluria*, we find the following:—The present edition of *Siluria* is fitly inscribed to Sir William Logan, the director of the geological survey of Canada, and among its new materials the account of Sir William's recent discoveries finds a foremost place. He has found that underneath the oldest of our fossiliferous formations there lies another still more ancient system of vast thickness, to which he has given the name of Laurentian, and in which he and his colleagues have found in Canada remains of humble grade. To Sir Roderick himself we owe the discovery of rocks of this age in Britain; a discovery which, with its accompanying deductions, whereby the geology of more than half of Scotland was at once revolutionised, is certainly his greatest achievement in science—the Silurian system always excepted. He gives us in the present edition of his book a succinct account of the steps which led to that important result, and brings his narrative up to the present time, embracing in it all that has been done by himself and his associates since the publication of the last edition of *Siluria*. Much valuable information has been added from the work of Professor Ramsay upon North Wales. The wonderfully complicated geology of that region has been more thoroughly investigated than that of any other mountain tract in this island, and the results are shown in the publications of the Geological Survey. Of these Sir Roderick has fully availed himself, and they form not the least important additions to his volume. Further details are given regarding other palæozoic districts in Britain, which have recently been examined with greater precision. One of the distinguishing features of *Siluria* has always been the abundance of its palæontological information. In this respect the present edition does not fall behind its predecessors. Aided by the co-operation of such men as Davidson, Salter, and Rupert Jones, and availing himself of the materials published in foreign countries, Sir Roderick has rendered his work as necessary as ever to the library of the palæontologist.

In the final chapter the author quits his ancient formations, and battles stoutly for the views he has long maintained regarding the former potency of the causes of change upon the surface of the earth. Our readers are probably aware that there are at this moment two schools of geology—one teaching that the vicissitudes the earth's surface has undergone were once of a much more violent and sudden kind than anything with which history has made us acquainted; the other holding that we have no reason to believe the order of nature since the introduction of life upon the earth to have ever been greatly different from that which obtains at the present time. Geologists of the former class are known as convulsionists or cataclysmists; those of the latter as uniformitarians. Sir Roderick is a champion of the former and earlier school. In his concluding pages, which, whether accepted or not, are worth reading, he strikes out lustily against the uniformitarians, of whom Sir Charles Lyell is acknowledged to be the leader.—*Times.*

KENT'S CAVERN, DEVONSHIRE.

MR. W. PENGELLY has read to the British Association the Third Report on Kent's Cavern, Devonshire. The great chamber, the gallery, the passage of urns, the vestibule, and the north-east gallery have been completely explored to the depth of four feet below the base of the stalagmite floor, to which from the beginning, and as a first exploration, the excavation has been restricted. The débris left by the earlier explorers has been removed and carefully examined; but the committee have carefully kept the remains found in this apart from the specimens yielded by the ground which was unquestionably intact. The succession of deposits—with the exception of a part of the vestibule, where a layer of black soil, apparently identical with that found almost everywhere above the stalagmite floor, occurred beneath the floor—has been uniformly the same as that described in the previous reports. The band of black soil referred to was of irregular outline, and covered an area of 100 square feet, varying in thickness from two to six inches throughout about half its area. It immediately underlay the stalagmite, but elsewhere it was separated from the nether surface of the floor by a layer of the ordinary red cave-earth, varying from three to six inches in thickness. No trace of such material beneath the stalagmite has been encountered by the committee elsewhere. The floor immediately overlying the black band was loaded with fallen blocks of limestone cemented by stalagmite matter rising to the roof of the cavern, and originally extending from its eastern almost to its western wall, thereby dividing the vestibule into two separate chambers. The black mould overlying the stalagmite has, during the past year, yielded a large number of objects, such as were described in previous reports, as well as several of which no example has been previously found. Marine shells occur everywhere in this accumulation, but in the vestibule are found very abundantly common oyster-shells, sometimes forming considerable heaps. In all cases it does not appear these are to be regarded as evidence of molluscous diet; many of them were certainly "dead valves," small shells being frequently attached to the inner surface. Portions of potsherds are also numerous. In most cases these are composed of a coarse clay, having an admixture of small stones. Three spindle-whorls have been added to the collection during the year—one of them composed of coarse grit, the upper and lower surfaces of which are curved, and give it an oblate spheroidal form; the other whorls are of slate, and have numerous ornamental lines. Flakes of black and white flint, chiefly the former, have occurred in large numbers in this overlying black mould. Amongst the metal articles found are a small bronze hook, an almost perfect bronze socketed celt, a halfpenny of 1806, and a sixpence of 1846. The bone implements include an awl; a portion of some prismatic tool, with rounded edges, having on its surface a series of equi-distant grooves, such as to suggest that it may be part of a measuring-rod; two bone combs, and fragments of two others. The combs have the form of shoe-lifters, with teeth at the broad end. One of the combs is small and rude, the other larger and better finished, with a hole at the end as if for suspending it. The large comb and other interesting articles were found in the south-eastern portion of the great chamber, where the black mould was itself overlaid by a cake of stalagmite, which was attached to the wall of the cavern. This was the first and at present the only example of such a cake formed immediately on the black deposit itself. The interest attaching to it lies in the fact that the lodgment of the black mould had closed before the formation of the stalagmite lying on it had begun, hence the geological and archæological evidence are concurrent. The overlying mould has continued to yield a large number of bones of various mammals and birds, some of them belonging to extinct species.

The most interesting objects found during the year are several portions of the human skeleton—including vertebræ, parts of the lower jaws containing teeth, several loose teeth, and a skull. The skull was found about six inches below the surface, adjacent to the limestone rock, and immediately within the northern external entrance of the cavern. The other human remains were found in different parts of the vestibule. The committee report that the stalagmite floor has presented its usual character, and comparatively few objects have been found in it. Amongst these are stones of various kinds, charcoal, flint flakes and cores, and remains of various animals, including the bear, fox, horse, and man. Since the second report was sent in, a total of ten flakes and chips of probably artificial origin have been found in the stalagmite. The human remains are a tooth and a portion of an upper jaw containing four teeth. These, the most interesting remains of man's osseous system which the cavern has yet yielded, were found on the 3rd of January, 1867. The black band below the stalagmite floor has yielded bones and teeth of various animals, and traces of the presence of man. The animals represented are the ox, deer (more than one species), horse, badger, bear, fox, *rhinoceros tichorhinus*, and *hyæna spelæa*. The indications of human existence are chips, flakes, cores and implements of flint, bone tools, and bones partially burnt. A total of 810 specimens of flints have been found. No inconsiderable number of these are more or less perfect lanceolate implements. It appears utterly impossible to suppose that they were introduced into the cavern by other than human agency, or that they had been moved from the spot where they were primarily lodged. The bone tools found were three in number, one of them an awl 3¾ inches long, and cut at one end to a sharp point. The second tool is a portion of a so-called harpoon, barbed on one side only, and about 3¾ inches long. With the exception of the black band, the deposit below the stalagmitic floor is everywhere tolerably uniform in character—red cave-earth, with angular fragments of limestone.

The Report next enters into details in regard to the conformation of this portion of the cave, and goes on to state that no other branch of the cavern has proved to be quite so rich in bones as the great chamber. Nevertheless, a large number of teeth and other remains have been exhumed from the red loam during the year. The mammals represented by the collection now made may still be said to be the cave bear, cave lion, cave hyæna, fox, horse (probably more than one species), and several species of deer, the tichorhine rhinoceros, mammoth and badger. The condition of the bones is the same as those described in previous reports, and it is stated that, so far as known, no bone or tooth of machairodus, hippopotamus, or man, has yet been found in the cave-earth. The red earth has yielded a considerable number of chips and flakes of flint; during the last twelve months the aggregate from the four-foot level amounts to 238 specimens. There are not amongst these any ovate implements, nor can the series, as a whole, be regarded as quite equal in extent to those described in previous reports. The report then goes on to call special attention to the bone instruments found, as a proof that man occupied Devonshire when it was also the home of the extinct lion, hyæna, bear, rhinoceros, mammoth, and other contemporaries. The instruments alluded to are the bone awl and the harpoon already described. The pin is described as being well made, and it is thought probable it may have been an article of the toilet, and it is inferred the polish on it may have been the result of the constant use to which it was put. It may probably be said of its original possessor that—

> The shaggy wolfish skin he wore,
> Pinned by a polished bone before.

The Report then shortly recapitulates the more prominent features of the cavern, and the conclusion is drawn that Kent's Cavern has not only been identified as the home of one of our early ancestors, but the vestibule as the particular apartment in which he enjoyed the pleasures of his own fireside, where he cooked and ate his meals, and where he chipped flint nodules and split and scraped bones into implements for war, for the chase, and for domestic use. The Committee then refer at some length to the light thrown by the explorations on the Antiquity of Man. The successive discoveries made in the cavern, the Committee think, ought to be a warning not to place implicit confidence in merely negative evidence; and go far to encourage the hope that the bones of man may yet be exhumed, though probably in sparing numbers only, and fortifying even the most cautious in holding and avowing the belief that man was in Devonshire the contemporary of animals that had become extinct before the time of history or of tradition. After tracing back the proofs leading to this conclusion, the Report concludes by stating that the facts already ascertained are calculated to stimulate research, and to encourage the hope that whilst a spadeful of deposit remains dislodged, a discovery may remain to be made.

Sir C. Lyell congratulated the Section on the success which had attended past explorations in the cavern, and on the fact that in every new part of the cavern there were discoveries of a new class. He believed it would be of the greatest importance to continue the researches in the cavern, and that it would take a great many years before the contents were properly exhausted. In the gravel-beds of the cavern there had now been found the remains of the mammoth, by which they found that man had co-existed with that animal; and they had obtained proof of the co-existence of man with the co-existence of no less than three different species of elephants in Europe. They had most unquestionable proof that three different species of elephants existed when it was inhabited by that race of men who made those flint hatchets and those bone instruments which had been found in such large numbers in the cavern. Whatever scepticism might exist in the minds of those who are not skilled in archæology, no one could look at these flint and bone instruments that have been discovered in Kent's Cavern without being convinced that there had been human agency employed in their formation.

Mr. Pengelly said that the three Reports of the Committee ought to be studied in connection, in order that the full force of the evidence bearing on the antiquity of man might be appreciated. He had only further to say that if man was found contemporaneous with extinct mammals in Devonshire, that did not fix the antiquity of the human race, for it could not be supposed that this ungenial climate was the cradle of man.

BONE CAVES IN NAMUR.

The Bulletin of the Royal Academy of Belgium contains an account of the exploration of seven caverns at Furfooz, in the province of Namur, in which beds of clay and gravel, mixed with bones of animals—some being of species now extinct—were discovered. The most remarkable bed is one of yellow clay, which contains angular blocks of limestone, mingled with bones of man and animals, and remains of implements and articles of domestic use. No date is assigned for these relics, but they are said "to carry us back to a very remote period." Mr.

Dupont, who explored the caves in company with Mr. Van Beneden, is of opinion that the former occupants were contemporaries of certain species of animals which are now found in the polar regions only, or on the summits of high mountains, and that the traces of handiwork indicate a state of civilisation less advanced than that of the stone age, as exhibited by the specimens discovered in Denmark and Switzerland. Traces of a parallel state of civilisation exist in the caves in the south of France, of which Mr. Lartet and the late Henry Christy have given an interesting account, now in course of publication, with copious illustrations.

ANTIQUITY OF MAN—ICHNITES.

A Correspondent of the *Athenæum* writes to that journal :—"In a quarry near Brewood, Staffordshire, I found, a few days ago, the casts of fossil footprints, evidently reptilian, on a slab of red sandstone; and on another large slab I detected the moulds of what are unmistakably the imprints of two large human feet. The mould of the left foot is very perfect, and measures exactly fifteen inches in length; the distance from the toe of the left to the heel of the right foot is eleven and a half inches. The mould of the right foot is less perfect. These imprints of human feet are, perhaps, deserving the attention of geologists."

To this Mr. W. Hellier Baily replies, that "impressions, believed on good evidence to be the footprints of reptilian animals, on the mud of an ancient sea-beach, since submerged and consolidated, are not uncommon in the New Red Sandstone formation of Warwickshire, Shropshire, Lancashire, and Cheshire, accompanied in some instances by the bones and teeth of several extinct reptiles, as recorded by Sir Charles Lyell in his *Manual of Elementary Geology*. The largest of these impressions hitherto noticed in England have been met with at Storeton and Tarporley, in Cheshire, and identified with similar footprints found in Saxony, named Cheirotherium, by Prof. Kaup, from their resemblance to a human hand. These remarkable footprints are generally arranged in pairs of large and small impressions, following each other at intervals of about 14 in., and believed to be those of the fore and hind foot. The large impressions are usually 8 in. in length by 5 in. broad (one is mentioned as having measured 12 in. long); the smaller, or those of the forefeet, being only 4 in. by 3 in. Prof. Owen, who afterwards made a comparison between some teeth from sandstone of a contemporaneous formation in Germany, which had been referred to saurians, with teeth which had been found in the sandstone of Warwick and Leamington, discovered an identity of internal structure of such singular complexity as suggested to him the name which he applied to them of Labyrinthodon. This peculiar character of the teeth, in connection with his examination of other bones, convinced that profound observer that these remains could not be referred to true saurians, but belonged to batrachian reptiles, of which he described several species; proving the former existence of a group of sauroid-batrachians, gigantic frog-like animals, allied to saurians, characterising the period of the New Red Sandstone formation. He also found that the cheirotherian impressions, of which there were several kinds, corresponded with the bones of the extremities described by him, in exhibiting the same inequality of size between the fore and hind foot—a fact which he considered might well justify the opinion he advanced as to the extreme probability of these impressions having been footprints caused by such animals as were included in the genus Labyrinthodon. The Dumfries-shire sandstone has also afforded numerous impressions, which are, however, principally ascribed to terrestrial reptiles or Chelonians; they are beautifully figured by Sir Wm. Jardine, Bart., in his Ichnology of Annandale. The New Red Sandstone of the valley of the Connecticut river, United States, exhibits impressions of rain-drops, with numerous footprints of reptiles and birds; the reptiles consisting of lizards, chelonians, and batrachians. Some of these footprints are mentioned as being 22 in. long by 12 wide, showing that these fossil-birds had feet four times as large as the ostrich. Footprints of no higher animals than those of reptiles and birds have hitherto been recorded from rocks, of contemporaneous age with the New Red Sandstone, in any part of the world. The large size of the impressions observed by your Correspondent at Brewood merits attention; but his too-confident assumption that they are the imprints of human feet is quite unwarranted by the evidence we possess, which, although negative, is conclusive as to the total absence of any vestige of the human species throughout the entire series of geological formations, or, at least, up to the time of the existence of the mammoth and cave animals, with which he is said to be contemporaneous; although I think the extreme antiquity which some would assign to the human race is not yet satisfactorily proved. Any one who has seen the cheirotherian impressions cannot fail to be struck with their resemblance to the human hand; and, therefore, it is very probable that these large markings alluded to were, like them, the footprints of a reptile of the labyrinthodont character."

Colonel Greenwood next writes to the *Athenæum*:—"Mr. Baily proves theoretically that the first Correspondent must be mistaken as to the fact. He gives us the usual list of the tracks which have hitherto been found in the sandstones of England, Saxony, and America; and he lays it down that as nothing more has hitherto been discovered, nothing more can hereafter be discovered. Of this, according to him, 'the evidence we possess, although negative, is conclusive.' Such is his argument. It is only to be equalled by a certain other negative argument which says that as no remains of land life are found in sea strata, no life existed on land when these sea strata were in deposit. Here the place is confounded with the period. Because in the place where sea strata are no fossil land life is, therefore no land life existed on the land at the period when these strata were deposited in the sea. Land animals neither live nor die in the sea? This accounts for the absence of their remains in sea strata. Fossils of land animals are only found in land drifts and caverns. No fossil fish are found there. Suppose we were to apply the negative argument, and to assert that in the period when drifts were formed on land, there were no fish in the sea? But the tracks of some land animals may be found on ancient sea-shores which are now turned into sandstone. For this, however, there must happen an almost miraculous succession of chances. The tracks are first gently overlaid with sand; the shore sinks hundreds, perhaps thousands, of feet below the sea; strata are deposited over it. The whole is turned into stone, again raised *sub dio*, the strata denuded, and the very slab on which the markings are engraved happens to be exposed to the eye of a scientific observer. Under these marvellous circumstances, the tracks most likely to be found are those of amphibious reptiles, 'gigantic frog-like animals,' turtles, and birds of the wader tribe. And tracks of all these are found in sandstones, not because they are of higher or lower organisation, as Mr. Baily supposes, but because they are by nature and habit denizens of the shore. In all the strata between the red sandstone and the chalk we have not a vestige of birds. Did birds become extinct for millions of years? and were they created afresh? or is it that though they thronged the air and land during these countless years, we have not happened to find their tracks delineated in sea-sand turned into stone? According to the negative argument, birds never existed at any time or place except when and where moist sands existed. Nay, rain never fell, except then and there. The marks of rain-drops are found in the Connecticut sandstone, but not before, and nowhere else; and 'the assumption' that rain ever fell before or in any other place 'is quite unwarranted by the evidence we possess, which, although negative, is conclusive as to the total absence of any vestige of rain." This is Mr. Baily's argument.

GEOLOGICAL EXCURSIONS.

Two of the most popular Excursions made by the Members of the British Association from Dundee were the following, devoted to Geological Exploration. The first excursion was to St. Andrew's. The geological party proceeded three or four miles along the coast, and here and there Mr. Geikie pointed out and explained the peculiar features and combinations of the rocks. The most interesting portion of the route, was at the "Rock and Spindle," where there are some curious illustrations of marine denudation. At one point Professor Heddle, who was one of the party, showed that in twelve years the sea had either fallen or the earth had risen to the extent of a foot and a half. In some places it was interesting to observe the old line of the sea-beach, which is thickly set with shells, &c., now ten or twelve feet above the present level of the sea. Mr. Geikie pointed out several instances where the volcanic agglomeration and sandstone were in curious proximity; and the peculiar formations assumed by the rock and the geological features of the district generally were described in a lucid manner. A number of beautiful fossil plants exhibited on some of the rocks were examined with much interest. Many of the geologists made good use of their hammers, and carried away specimens of the various kinds of rock, particularly those of a volcanic nature. Professor Heddle particularly requested that the party should not touch the fine column of the wheel-like formation on the "Rock and Spindle," which he said had already been destroyed to some extent.

The other trip, which had a special geological interest, was to Dura Den, Fifeshire. The party, after a visit to Dairsie Castle, where a Scots Parliament was held in 1335, reached the famous fossiliferous Den about midday. By the kindness of Mr. Watson, of Dura Den Works, a pit was dug near the margin of the stream, and several slabs of the yellow sandstone were lifted in presence of the company. One of them, the turning of which evoked a hearty cheer, exhibited no fewer than 17 specimens of the *Holoptichii Andersoni* all distinct and vivid. The party spent a considerable time in the inspection of the fossil trout so singularly exposed to light after an imprisonment of ages. Nearly every individual of the group was perfect in outline and form, and the intensely black impression on the slab showed every scale and feature of the little armour-plated fish, which seems to be fossilized in great shoals in this remarkable bed. With the exception of a large flat fish about the size of the common flounder, the fish were all of the river trout form, about five to seven inches long. The party, having left the Den, were conveyed to the seat of Mr. Dalgleish, of Dura, in whose absence Mr. Harsbrugh did the honours of the house, by exhibiting a large geological collection there, gathered mainly from the Den, and by presenting wine and cake.

OIL REGIONS OF AMERICA.

The American papers, referring to the statistics of the productions of the Oil Regions during the past year, express a hope that science may soon do something to bring Petroleum into use for purposes in addition to those of illumination. The yield of 1866 was so far in excess of the demand that it is calculated the present year commenced with a surplus on hand in the various markets of the world of 733,000 barrels of refined, "which will have to be consumed before the production of 1867 can be brought forward."

A NEW OIL SOURCE.

At Büren, a Swiss village which tourists will remember who have walked up the valley of the Suhr, the inhabitants have begun to manufacture oil from chafers. The process was initiated by two men, who, having noticed that a chafer looked greasy when squeezed, thought the grease might be useful for the wheels of their cars. They caught a number of chafers, subjected them to pressure, and obtained a quantity of greasy liquid, which after a few days became clear and yellow, and on trial was found to burn brilliantly and with an agreeable odour. Forthwith, there was a general chase after chafers by the villagers, of which the results are said to be very remarkable; which means, we suppose, that the yield of oil exceeded their expectations.—*Athenæum.*

BITUMINOUS GNEISS.

AT the annual meeting of the Swedish Academy of Science M. Nordenskiod has announced that a discovery of great importance to geological science had been made in the hill of Nullaberg, in Sweden. A large deposit of Bituminous Gneiss, 33 mètres in thickness, has been found embedded in layers of gneiss and mica schist. It is composed, in addition to felspar, quartz, and mica, of a black substance like coal, containing carbonated hydrogen—in fact, a real organic substance, formed of the remains of plants or animals coeval with the deposit. He added that there could be no doubt as to the antiquity and geological situation of the strata of Nullaberg; infiltration was impossible. The inference to be deduced was that the crystalline stratified rocks of Scandinavia were formed when there existed animated creatures, but at a time long anterior to the period when life is supposed to have first existed on the earth.

ALTITUDE OF MINES.

A REPORT of the American Government gives the following interesting figures relative to the elevations of some of the principal Mines and Mining regions of the Pacific slope:—The Sierra Nevada rises in many places to a height of 9,000 ft. or even more, and from the comb of the ridge to the level of the valley the distance, in a direct line, is from 40 to 50 miles; and the descent of the streams, with all their bends, is more than 100 ft. to the mile. With the rapidity of current consequent on such a descent, they have worn very deep channels, leaving steep and high intermediate hills. It is on the side of the mountains, thus cut into great canons, that most of the mining in California is done. The average elevation of the placers of the Sacramento basin may be estimated at 2,000 ft. The mines in the valley of Klamath river are at an elevation of about 2,500 ft. The silver mines of Kearsarge, in California, are 10,000 ft. above the level of the sea. The silver mines of Alpine County are from 5,000 ft. to 6,000 ft. above the sea. The new Almaden quicksilver mines are 1,000 ft. above the sea. The mines of the Comstock are from 5,000 ft. to 6,000 ft. above the level of the sea. Reese river and Emeralda mines are about

7,000 ft. above the sea. The Idaho mines vary from 3,000 ft. to 6,000 ft. above the sea. The mines of Arizona are at various elevations, from 300 ft. to 3,000 ft. above the sea. Those on the banks of the Colorado are perhaps as near the level of the sea as any known.—*Mechanics' Magazine.*

GOLD MINING IN VICTORIA.

Some interesting statistics relating to the Gold mining in Victoria show that the exports of gold, the produce of this colony in 1865, amounted to 1,543,149 oz. This quantity was about 2,249 oz. short of that in 1864. The total quantity of Victorian gold which passed through the Customs of this and the adjacent colonies since the first opening of the gold-fields amounted to 32,272,793 oz., representing at 4*l.* per ounce, a value of 129,091,172*l.* In addition to this it is estimated that 2,863,247 oz. have been taken out of the colony by private hands, without passing through the Customs, bringing up the total produce of the Victorian goldfields at the end of 1865 to 35,286,040 oz., which, at 4*l.* per ounce, would represent a value of 141,144,160*l.* Since 1853, when the export of gold was 3,150,020 oz., the quantity has declined; 2,985,695 oz. were exported in 1856, 2,280,678 oz. in 1859, and 1,658,241 oz. in 1862. The estimated number of gold miners at the end of 1865 was 79,457, of whom 62,131 were engaged in alluvial, and 17,326 in quartz mining. This estimate shows a reduction of 2,290 miners upon the numbers enumerated in 1861. The machines used in gold mining in 1865 numbered 6,337, representing an approximate value of 1,773,271*l.* The number of steam-engines working was 964, of which 473 were employed in alluvial and 491 in quartz mining. The following machines were used in alluvial mining:—3,228 puddling machines, 427 whims and pulleys, 115 whips, 78 horse pumps, 648 sluices and toms (having 4,428 sluice boxes), 196 water-wheels, 33 hydraulic hoses, 102 pumps, 8 derricks, 25 crushing machines (having 461 stamp-heads), and 4 boring machines. The machines used in quartz mining were—99 crushing machines (having 5,119 stamp-heads), 231 whims and pulleys, 56 water-wheels, 15 derricks, 98 whips, and 10 quicksilver cradles.—*Ibid.*

COPPER IN NATAL.

We are indebted to Mr. Crowder for a description of the interesting discoveries at the Ifumi of ancient native smelting-places and appliances. Short galleries or tunnels had been made into the lode at various points, and at the nearest point where water was available are certain singular basins and channels cut out in the surface of a huge flat rock. This rock is about two feet under the surface of the ground. The first basin examined was small and shallow, and had probably been used to pound the ore in, for near it was found a round stone, such as might be used as a pestle. Close to this basin is a larger and deeper one, such as might used for washing the pounded ore, and this was probably its use, for a channel, afterwards dividing into two, leads from it to the edge of the rock. In another part of the rock is a deep cavity, about 1 ft. in diameter at its mouth, 18 in. at its widest part, and 2 ft. 9 in. deep, narrowing from its middle downwards, and having very much the shape of a huge soda-water bottle. This cavity had probably been used by these ancient Caffre miners as the crucible in which to smelt the pounded ore, which by washing had previously been freed from valueless earths. That it had been used as a crucible is likely, for it has two cracks in it, possibly caused by the application of heat; indeed, it is difficult to understand how otherwise they could have been caused. Now that this rock has been exposed, the Caffres of the neighbourhood —being perfectly satisfied that it was where the ore was smelted —state that they know where holes exist in rocks which must formerly have been used as moulds in casting those copper balls worn round the waist by natives within the memory of the first white people who came to Natal. Mr. Kirkman is of opinion that some of the lesser holes may have been used for casting copper beads such as the girls in the Zulu country now fasten their petticoats with. At the bottom of one or two of these rude cupolas there are holes through which the blast has been applied. The surrounding rock is similar to what has been brought to Durban, and contains in small quantity the green carbonate of copper. That richer ore than this had been obtained is evident, for Mr. Cato picked up some fragments of a different character—heavier and richer—containing several of the salts of copper. These fragments of richer ore show signs of ancient fracture, and that they have not been recently broken out of the matrix. In Zululand, not far from the great fork of the Tugela, a tribe of aboriginal smelters still abide—people who were spared by Chaka on account of their knowledge of mining processes. Probably the art, so far as Natal is concerned, died with the old race of natives swept away by the pitiless invaders from the northward.

We have already referred more than once to the quaint but entertaining logs or diaries kept in connection with the voyage from the Cape to Natal of the Dutch vessels *Centaur* and *Noord*. The first of these ships was sent in search of the crew of the wrecked bark *Stavenisse*, cast ashore close to Durban in the year 1867. The expedition started in January, 1688, and lasted nearly a year. It succeeded in rescuing 19 of the shipwrecked mariners, to whom we are indebted for the first description given of this colony. From this source we learn that the natives then residing here were numerous, but that they differed in many respects from the present race. But the only point of difference we now have to deal with is the fact that copper was then in general use —that it was an article of barter and a medium of exchange amongst them. So valuable was the metal considered, and so plentiful were cattle in those days, that an arm-ring would purchase one or two oxen. Clearly, however, it was worked, and as the travels and observations of the sailors did not extend beyond the coast districts, it is more than probable that these traces at the Ifumi are vestiges of works carried on in those early times. And thus, after a lapse of nearly two centuries, these buried evidences of savage industry have turned up in verification of a discovery which bids fair to be of great value and significance. For it is obvious that if these savages could with their simple tools find ore rich enough to smelt in their rude fashion, there must be far richer deposits obtainable by civilised resources at a greater depth.—*Natal Mercury.*

VOLCANIC ERUPTION IN ICELAND.

A Volcanic eruption has taken place in Iceland, of which an account has been sent to Mr. Buchan, Secretary of the Meteorological Society, by two of the Society's observers at Reykjavik—viz., the Rev. S. O. Pälssen, Knight of the Dannebrog, and Dr. Hjaltalin, a member of the Althing. The Rev. S. O. Pälssen writes:—"On Thursday, the 29th of August, it blew a stiff breeze from the east, and the sky was rather cloudy. At 9 a.m. the air became suddenly impregnated with a strong smell of sulphur, which lasted the whole day, and was felt even in the rooms if doors and windows were not carefully closed. In the afternoon reports were heard as of artillery discharged at a great distance. On the following day the same reports were heard at intervals, but no smell was observed. In the evening, at half-past seven, there was seen in the direction of E.N.E. sheets of flame ascending into the air like lightning. The same appearance was observed in the west part of Iceland for several nights following and in the same direction. It has been ascertained that this eruption took place somewhere in the desert vicinity of Vatnajökul. It has fortunately not been attended with any serious consequences. Sulphurous ashes were seen on the grass in the nearest inhabited tracts; and for some days, until rain fell, the pasture was not very wholesome for the cattle, which were unquiet, and gave less milk than they used to do. This eruption must have been somewhat violent, as the flames were seen at great distances over the mountains; and a column of smoke was also visible. Since the middle of September no further symptoms of this eruption have been observed." Dr. Hjaltalin writes:—"On the 29th of August, a disagreeable, sulphurous odour was felt over all our little town (Reykjavik), and became very oppressive, and occasioned a good deal of coughing. The weather at the time was somewhat misty and warm, the temperature being 46 deg.; and the wind was from S.E. to E., and not strong. In the evening, heavy shots, like a continuous cannonade, were heard from the east, and a rolling, as of thunder, underground. Next day, at 7 p.m., apearances of a great fire were seen in a direction S.E. by E. from Reykjavik. The colour of the flame was bluish-white, resembling the flame of burning sulphur. It was half a mile broad at the base. It continued all night, and was clearly seen more than a hundred miles out at sea. Lightning and rolling peals of thunder were heard, but, as far as known, no earthquake was felt either here or in any other part of the island. Grayish white ashes were found on the grass in some places, which I found on examination to consist of a black pumice dust and pure sulphur. From a comparison of the different reports, it is all but certain that the eruption took place on the north side of the Skaptarjökul, or a little to the north of this great glacier. The centre of the eruption was thus about 125 English miles from Reykjavik, and in a desert 60 or 70 miles from any inhabited place. The sudden appearance of the eruption, the absence of any accompanying earthquake, the enormous breadth and height of the column of flame, which seemed to overtop the hills between it and the sea, the strange and disagreeable odour which it spread over the whole of the island, and its short duration, make it one of the most extraordinary volcanic eruptions that have ever appeared in Iceland."—*Scotsman.*

NEW VOLCANO IN NICARAGUA.

MR. A. B. DICKINSON, of the Legation of the United States, Leon, Nicaragua, writes to the *Times*, Dec. 4, 1867:—"On the 14th of November last, a New Volcano broke out in Nicaragua, about eight leagues to the east of the city of Leon, on a crowded line of volcanoes running through the State parallel with the Pacific coast. It commenced about one o'clock in the morning, with a succession of explosions which were very distinctly felt and heard at Leon. These explosions opened a fissure through the earth's crust about half a mile in length, running from the old fissure in a south-west direction, and about midway between the extinct volcanoes of Las Pilas and Orota, they being two of the numerous cones which stud the ancient fissure. Before daylight on the morning of the 14th, fire was seen issuing from the new volcano in various places. The explosions continued irregularly during the whole time that the volcano was in a state of eruption, sometimes in rapid succession, and at other times at intervals of half an hour. Low rumbling sounds were heard almost incessantly. In the course of a few days, two craters were opened on the new fissure, about a thousand feet apart, the one on the south-western extremity discharging perpendicularly, and the other shooting out towards the north-east at an angle of 45 degrees from the perpendicular. The flame from these two craters steadily increased in size and height, while jets of flame and slighter discharges were emitted from two or three other side fissures.

"On the morning of November 22, I rode out to the new volcano for the purpose of observing it more closely, though I had seen and heard it, and felt the concussions very plainly each day and night from Leon. The best view which I obtained of it on this occasion was before daylight from a mountain-summit about one mile to the north-west of the fissure and at right angles with it. The main crater at the right hand was actively at work, throwing out flames and half-melted cinders through a circular orifice about 60 ft. in diameter, which was constantly filled to its utmost capacity with the mingled contents of the fiery realms below. A regular cone, built up entirely by the falling cinders, to the height of about 200 ft., had already formed around the crater. The rim and throat of the cone were white with heat, while the outside was red-hot halfway down, and the remainder black, but still glistening down to its base with innumerable glowing sparks. It was puffing quite regularly about once a second, with a strong constant blast, which kept up a column of flame filled with flying cinders to the height of about 500 ft. above the mouth of the crater. Irregular explosions occurred at intervals varying from ten to 30 minutes, increasing the force and volume of the discharges, and sending their contents far up into the black rolling clouds above. The cinders went up in blazing, half-fused masses from one to three feet through, and after ascending an immense height came rattling down upon the cone, hardened, striking with a clinking metallic sound. After daylight, the red appearance of the cone changed to a bluish black.

"The left-hand crater was shooting out oblique discharges of flame and cinders of a similar character, at an angle of 45 deg. from the other, and evidently communicated with it about 1,000 ft. below the surface, the two orifices being that distance apart, and both discharging simultaneously. This half-horizontal crater appeared to be about 20 feet in diameter.

"The afternoon of the 27th, after a series of explosions which seemed to shake the earth to its centre, the volcano commenced discharging vast quantities of black sand in connection with the heavier rocks. The column of flame at night was considerably increased in height, and bright meteor-like spots were seen from Leon, ascending in the flames, to the height of not less than 3,000 ft. These were large spherical rocks, from four to five feet in diameter. The next morning the streets and housetops of Leon were covered with a thick coating of fine black sand from the volcano, and a vast luminous cloud of raining sand overspread the whole surrounding country. This rain of sand continued until the morning of the 30th, when the volcano gradually died away, apparently smothered by its accumulated eruptions. The sand now covers the whole surrounding country, from the volcano to the Pacific, a distance of more than fifty miles from it. At Leon, it lies from an eighth to a quarter of an inch in depth. As we approach the vicinity of the volcano, it gradually grows deeper and coarser. For a mile around the crater it lies in particles from three-eighths to half an inch thick, and is about a foot in depth. Still nearer to the cone, the sand increases to several feet in depth, and the particles gradually increase in size till they become small broken rocks. Around the base of the cone, round heavy rocks, from 4 ft. to 5 ft. in diameter, they lie thickly scattered, but much the larger portion of them are broken into fragments. The cone itself is now 200 ft. high, with a crater in the top the same number of feet in diameter, and about the same in depth. The inside of the crater is covered, the same as the outside, with hard broken rocks, generally less than a foot in diameter. The throat of the crater is entirely filled up. A long ridge of black scoria leads out from the smaller crater, in a north-easterly direction. The slaggy, lava-like scoria which first issued from the main crater is now principally covered up by the hard, plutonic rocks which came out with the later discharges from a greater depth. The forest for leagues around is scarred and maimed by the swift-falling showers of keen-edged sand, and for half a mile from the cone the trees are levelled with the ground, and their scattered fragments lie buried under the broken rocks.

"The volcano was an active and interesting sight for sixteen days, and now, in its repose, affords an ample and instructive field for the geologist. Indeed, no country in the world presents a more interesting study than the plain of Leon. Twenty volcanic cones are seen bristling from it at a single view. Its soil is inexhaustible in fertility, and as finely pulverised and as evenly distributed as the soil of the Nile or the Mississippi.

"This wonderful soil, however, has not been pulverised or distributed by water, but by fire. It has literally rained down from the volcanoes richness freighted with fertilising materials. Humboldt regretted before his death that men of science had not more fully investigated this remarkable region of country, and I hope it may not much longer be neglected by them.

"The recent fall of sand has been followed by a shower of rain, and corn, cotton, and grass have grown more rapidly under its fertilising influence than I have ever known plants to grow before. Some weeds and plants it kills; to others it imparts new life and vigour.

"I send herewith a specimen of the sand gathered at Leon before the rain, hoping it may be analysed.

"It is proper, in connection with this occurrence, to call attention to the recent destructive storms, earthquakes, and eruptions, on and around the islands of St. Thomas and Jamaica, during the same period of time which I have been describing, and which undoubtedly sprung from the same general cause, as those earthquakes were distinctly felt at Leon."

EOZOON.

Sir William Logan has brought to this country a specimen of Eozoon, recently discovered in Canada, which is more perfect in its configuration than any previously found; and which, occurring in a homogeneous limestone, cannot have been *manufactured* by the processes which are supposed by Profs. King and Rowney to have been at work in the production of the serpentinous Eozoon. This specimen would undoubtedly have been supposed to be a coral allied to Stromatopora, but for the evidence afforded by the microscopic structure of the serpentinous specimens, which unmistakably demonstrates its foraminiferal affinities in the opinion of every naturalist who has established his claim to authority upon such a question; and it will come to be considered hereafter whether Stromatopora itself will not have to be transferred to the same group.

"If any should now persist in regarding *Eozoon Canadense* as the product of 'a plastic virtue latent in the earth,' they must for consistency's sake adopt Dr. Plot's ætiology as good for *all* fossils."—*W. B. Carpenter.* See the *Quarterly Journal of the Geological Society*, No. 91, for illustrations of the *Eozoon Canadense.*

GREAT ERUPTION OF VESUVIUS.

After an almost perfect repose of six years, Vesuvius recommenced its demonstrations on the night of Wednesday, November 22. The Report of Giovanni Cozzolino, the Vesuvius guide *par excellence*, amounts to this:—"At half an hour after midnight a new crater was opened on Vesuvius, on the right of the two cones formed in 1866. About the middle of the grand cone, in the direction of Bosco Reale, another was opened, which is sending forth lava. In the same direction, and precisely on the plane of lava of 1866, two other small craters have been formed, which throw many stones into the air. The cone, in fact, is much split and divided by the shock which it has received." "On the night of the 16th and 17th," says another report, "the eruption made considerable progress. The crater is full of lava; there are five cones which throw large quantities of stones into the air. One of the currents of lava is flowing in the direction of 1855, and which running behind the Hermitage, precipitated itself into a valley about ninety feet beneath, forming one of the most magnificent spectacles I ever gazed upon. Other two currents of lava have forced passages, one by the road by which one ascends the mountain, and which, after running about fifty paces, has stopped; the other near the path by which one descends, and this continues running."

The Naples Correspondent of the *Athenæum* says: "Beginning then, from the very summit, the large crater is about 220 mètres in circumference, according to measurements taken last June, and the walls of it are of an irregular height, here and there having fallen in. As to its depth, it would be impossible to speak with precision now; but it must be considerable, as on Wednesday last, the lava was said to be within twenty or thirty feet of the top. In former times, when there was nothing but a hole in the centre, sending out sulphureous exhalations with the puff as it were of a bellows, I have descended many feet; but all that is changed now. In the very centre has shot up another cone, the summit of which from a distance can be just seen topping the main cone; and this it is which has been shattered, and is throwing out lava—every opening, every hole in which being called a crater. Thus the number may vary every hour, for the explosive efforts of the mountain open continually new crevices, emitting matter of some kind or another. For some days everything that was emitted from this central cone and its young family of craters or flowed into the large crater, the contents of which have thus been rising higher and higher hourly, until they have filled up the basin, except where the wall rises abruptly higher, and now forms a lake of fire. In some directions the lava has broken bounds, as towards Ottajano on the south-east, which may be seen from Pompeii with the slight use of an Irishman's glass. This, perhaps, is about twenty or thirty paces long. The stream which runs down towards the north in the direction of Massa di Somma, from which in 1855 we witnessed the magnificent spectacle described above, is about ten mètres wide, and has traversed one-fourth of the mountain—that which was coming down by the road by which one ascends the mountain has stopped, so that only two streams are visible; one from Pompeii, by twisting one's neck round the corner—the other from Naples. As to any damage to be apprehended from this eruption, I believe there is none. Scarcely any harm ever happens, or can happen, from one which commences at the summit; the distance to be covered before the habitable and cultivated part of the country can be reached is too long, and the obstacles raised by the rugged beds of lava are too great to admit of a rapid or a distant course. It is when the thicker crust of the mountain at the foot of the cone is broken up by its intense efforts to relieve itself, that we hear of vineyards being burnt and houses overwhelmed, and see those wondrous scenes which I have on several occasions described. A lava eruption from the summit, like the present, is simply an easy effort of the mountain, full to overflowing, to disgorge itself. All the inflammable materials within have risen to the edge of the basin, and are flowing over when the height of the walls permits. Besides lava, light stones, here called '*schiuma*,' are thrown into the air, perhaps about 100 mètres when there is no wind; they are red hot as they come out, but soon become black with exposure to the air. The flames, so far as one can judge, rise about twenty mètres. There were but few indications of the approaching eruption in Rosina, as it was not of a violent character. Cozzolino tells me that there has been a failure of water for two years, and that to get even a jug of water he has to rise betimes in the morning. A night or so before the mountain spoke, the fowls in Resina hopped off their perches, and were much agitated—a sure sign of something coming, says my guide. In Naples several persons were sensible of their chairs rocking.

"During the whole of last week the attractions of the eruption were irresistible, and it was scarcely possible to remove one's flattened nose from the window as midnight drew near. Last Saturday night it was particularly fine, when the lava was overflowing its boundaries, and coming down on the left as one looks from Naples in the direction of Massa di Somma. Last night the mountain was shrouded in impenetrable clouds—a heavy storm of thunder and lightning played around its head—but in the intervals of flashes one could see the tips of the black clouds and sky above, glazing with the deep red hues of the volcanic fires."

A party of friends went up, whose description of the ascent is worth giving :—"As we commenced our ascent of the grand cone, we felt the mountain quiver and shake with every effort, and then a sound as of a discharge of a volley of musketry ensued, followed by showers of stones and lava. Some of the stones were certainly half a ton in weight, and these, after a short ascent, fell and rolled down the sides. Other and smaller stones, with lava, ashes and fire, were shot up 1,000 feet in height, and fell around us in dangerous proximity. It was a sea of fire on the top, which might not be approached; and pouring over its boundaries towards Ottajano, it had arrived at the bottom of the mountain. Only fancy this bubbling, roaring mass, full seventy feet, some say many more, in diameter, rising with a tide which has no ebb, and ever breaking over some fresh point!"

With a cold north-east wind and a clear sky, volumes of smoke rose up, and curling and tumbling one over the other, stretched across in the direction of Capri. As if a steamer of I know not how many horse-power had traversed the Bay, you see that long column stretching its great length along, and announcing to every village and hamlet on the coast that the mountain is in eruption. Many parties go up every night, and from a distance one can see the torches glittering like glowworms; but hundreds and thousands are kept away by groundless fears of disturbances which those on the spot never dream of. Last night, another party of friends made the ascent, notwithstanding a pelting rain, and under a regular wet blanket of cloud arrived, not at the summit, but next evening the great stream of lava pouring down towards Ottajano had swollen to gigantic proportions of about 40 or 50 feet in breadth, and about 15 to 20 feet in height. From this diverged five or six what might be called tributary streams but that they ran the wrong way, stretching down like the fingers of a man's hand. At intervals of from one to five seconds, the mountain trembled and roared, and then ejected a mass of living fire, upwards of 1,000 feet in height. From Naples it had the appearance of what is called in pyrotechnics a fountain, yet such a fountain as no human hand has ever composed. Myriads of stars appeared to be falling; but on approaching nearer, some of those infinitesimally small stars are discovered to be stones or rocks of half a ton in weight. Next night the display in the direction of Naples was increasingly beautiful; for, as was predicted, the lava had broken over the crater towards the Hermitage, and its glowing and serpent-like course could be plainly watched.

Prof. Luigi Palmieri, Director of the Observatory, published the following article :—"After the memorable eruption of 1861, which was the occasion of so much damage to Torre del Greco," says the professor, "Vesuvius was reduced to so calm a state that, on ascending the summit of the mountain, nothing more was to be seen than a large and deep crater with a very few smoke-holes (*fumarole*), of moderate temperature, and often sending forth only pure carbonic acid gas. In February, 1864, from the bottom of that great crater fire was seen to reappear with frequent detonations, after which the heated matter was ejected with an impetus so violent that it fell on the sides of the mountain, thus rendering it impossible for some days for the scientific and the curious to approach. This, its first vigour, having subsided, the lava appeared, which remained inclosed within the crater, which was nearly filled, and the volcano again became calm; but in October, 1867, the *fumarole* became more active, and the apparatus in the Vesuvian Observatory showed such a degree of agitation that the fire, urging on impetuously the masses of lava with which the old crater had been filled, opened a new road, forming a mouth for the eruption, and cutting away entirely the upper part of the cone. On the fissures in the neighbourhood of the principal mouth there appeared other smaller openings, which, with the matter ejected, formed as many cones. That which corresponded to the principal mouth rapidly increased, and the others remained very small, ceasing after a few days to be active. The detonations were frequent, and were heard in all the towns lying at the foot of the mountain. The fragments of burning lava were shot to a maximum height of 240 mètres. On the second day of the eruption the lava showed itself at the base of the larger cone, but did not rise above the edge of the old crater. On the night of the 17th of November it began to transgress its bounds, and descend the declivity of the mountain between north and west, often changing its direction. This lava is minute in its character; and almost from the beginning has been covered copiously with *scoriæ* in small fragments, of the kind known by the natives under the name of *ferrosine*, of which some arrive in twelve hours at the base of the great cone, where they stop, and others are arrested in an indurated state on the rapid declivity. The small cones have now almost disappeared under the matter ejected from the larger cone, which has an opening towards the north, from which issue various streamlets. On the morning of the 29th of November, together with black smoke, there was ejected a quantity of ashes, which indicated that point where the eruption is on the decline. The detonations were not heard in the Observatory, and the fragments of lava shot forth from the new cone were very rare. The electro-magnetic seismograph, also, for two days was less agitated, and 30th of November things remained as they were yesterday."

Prof. Palmieri was premature in speaking of its decline, as some of the most brilliant spectacles were witnessed subsequent to that date; and on the 2nd December he himself writes as follows:—"Since yesterday the lava in the Atrio del Cavallo, running in two directions, in a much larger mass, has been impelled slowly towards the plain. The ashes still continued, and those which were collected present a different tint from those which exist in the collection of the Observatory. On the top of the mountain, where one cannot go without great danger, are now found phenomena of the highest importance to science. The cone of eruption, which has hitherto been black, begins to be coloured. Almost all the higher points of the mountain are powdered over with sublimates of chlorine and sulphates: the sulphate of lime forms the white zone which crowns those products, ready to disappear with the first rainfall. The lava can be seen in the form of a lake of fire, such as it exists within the cone before it boils over, there being an opening through which the lava issues, and this opening is above the ordinary level of the lava."

The *Athenæum* Correspondent, Jan. 1, 1868, says:—"Vesuvius has fired up again with great vigour. In the early part of last month it ejected large quantities of ashes, stones, and lava, uttering at the same time thunders that were heard full twenty miles off. These detonations were, of course, preceded by very sensible shocks of earthquake, so violent, indeed, as to occasion great apprehension in the inhabitants of the towns at the foot of the mountain, who, many of them, fled, or prepared for flight. On several occasions the lava burst out from the summit of the mountain just above them; and so continued were the shocks, that the ground heaved beneath their feet, and their doors and windows shook as if under the pressure of a violent wind. During this interval, which continued till the 14th of the month, there were at times thirteen streams of lava issuing from various points, and pouring down the sides of the mountain. Sometimes they arrived at the bottom of the cone; at others they stopped capriciously and other mouths were formed. The currents swept on through the snow, interlining the brilliant white mantle of Vesuvius with black, and at some points falling over precipices, so many cascades of fire. The scientific instruments renewed their activity in the Observatory, the very walls of which shook so much as to render it necessary to take down the seismograph and other scientific apparatus, and lay them on the ground; then came the thunders of which I have spoken, and finally out gushed the lava, to the relief of the overburdened mountain. These are not so much scientific as practical observations, and we may gather from them that heavy smoke, accompanied by severe shocks, is followed by copious lava; this by stones and ashes, and then comes an interval of comparative repose. Such has been the mode of action since the 20th of November; and when or how it will terminate no one would venture to say. From the 14th of December to January 1st, the phenomena were similar to those already described."

LAGOONS OF CORSICA.

PROF. ANSTED has read to the British Association the following paper:—"The eastern coast of Corsica is the most malarious district in the Mediterranean; but this has only been the case within the historic period. 2,000 years ago there was a defensible town on the coast called Aleria, and 120 years later a Roman colony was established there, the seat of a large trade. This and the coast was inhabited till the Middle Ages, when the pirates of the Mediterranean forced the inhabitants back into the hills. In the early part of the sixteenth century the plains ceased to be habitable, and they have never since been without deadly malaria in the summer. Mariana, another ancient and mediæval colony near the lagoon of Biguglia, had also been deserted. To the north of the sites of both these ancient towns extends a lagoon, formerly, in all probability, an open bay. The fine sand and mud of the rivers and watercourses are carried towards the north, and form a bar or wall of sand in advance of the coast. Behind this bar, wherever there are torrents between the rivers, a pool or lagoon is formed—these torrents not being able to keep open a channel to the sea. But a communication must be kept up, partly to enable the surplus waters to escape to the ocean during winter, and partly to admit the sea to the pool when, during summer, the contents are evaporated. Meanwhile, all the organic matter brought down by the torrents is retained in the lagoons, decomposes there, and is converted into miasmatic vapour. So long as there is free communication to the sea there is no malaria; but when the lagoon is formed malaria sets in. The lagoon of Biguglia extends 8 miles towards the north; its greatest width is about 1½ mile. The wall or bank separating the lagoon from the sea is from 900 to 400 yards wide, and its height is about 9 feet above the level of the Mediterranean. There are two cuts, which are now filled up. The deepest part of the lagoon is 10 feet, and much of it is not more than 3 feet. The water is nearly fresh in winter, and everywhere brackish in summer. The lagoon receives the drainage of 45,000 acres, and contains itself 4,800 acres. The quantity of rain averages 24 inches per annum, of which 6 inches fall in November and 4 inches in October. More than 2 inches has fallen in 24 hours, nearly 4 inches in a week, and about 12 inches in 4 weeks.

"From these measurements, it is evident that the lagoon might rise 6 inches in 24 hours, and 3 feet in a month, if it were not for the outlet to the sea: a channel will thus always be kept open. 2,000 years ago the mud and sand of the Golo had not formed a bar in front of the bay—the shore of which was within the inner shore of the lagoon. There was no effectual barrier preventing the waters of the torrents reaching the sea until three centuries ago. Thus, within 1,700 years there has been commenced and completed a bank of sand 7 miles in length, a quarter of a mile wide, and about 15 feet high—the result of two rivers, the Golo and the Bevinco. The deposit is equivalent to about 75 grains of solid matter deposited on an average by each gallon of water. There is no evidence of any elevation of land within the recent or historic period that can explain the change that has taken place. It is evident that the lagoon has been formed by the accumulated sands and mud, and that the malaria is due to the closing of the lagoon. It is in the highest degree desirable that these lagoons should be got rid of or rendered innocuous. This can be done in the lagoon of Biguglia by separating the area into two unequal parts. The larger area might be drained by pumping, at a moderate cost, and kept dry by the same machinery occasionally used. Part of the smaller area might be converted into the channel of the Bevinco, and the rest drained by inexpensive machinery. The redeemed lands would be of great value, but the principal result would be felt in the improvement of the sanitary state of the adjoining districts. The experience of Mr. Bateman in Minorca seems to prove that malaria may be removed by the drainage of lagoons."

SUBTERRANEAN WATER SUPPLY.

Mr. J. W. Barnes has read to the British Association a paper on "The Exploration of Beloochistan and Western Scinde, with a View to examining the Subterranean Supply of Water." The author commenced his operations at a place about eight miles north-east of Kurrachee, where, after some weeks' labour, he succeeded in piercing the first water-bearing strata, where the water rushed up and overflowed the surface, continuing, without intermission, to the present time. Water was obtained at other places in the arid country, and springs were visited which are from sixty to three hundred feet above the valleys. With this evidence of subterranean water, we are bound to inquire where is the source. Originally, of course, it is derived from rain or snow. The desert country of Scinde is often spoken of as destitute of rain. The rainfall averages, indeed, only 4 inches per annum; but, if we glance at a map of Asia, we observe, between the eastern borders of Persia and the western boundary of the Scinde and Punjab valleys, a tract of country 330,000 square miles in extent, with a mountainous and humid area, from 3,000 to 12,000 feet above the sea-level, from which a considerable subterraneous supply of water must be derived. Granting an average annual rainfall of 3·75 inches over this area, and as we know that in every country a portion of the rainfall, estimated from one-third to one-twelfth, percolates and is absorbed by the permeable strata, there is room for a strong inference that a vast body of water is available over the whole of the region, between the thirtieth parallel of latitude and the Indian Ocean. It is recorded by navigators that large springs of fresh water burst up through the sea in the neighbourhood of Cape Ormuz. The formation of this part is, undoubtedly, tertiary; and the stratification of the hills, where not horizontal, generally inclines either to the eastward or southward.

A NEW THEORY.

A Correspondent writes to the *Athenæum* as follows:—"The opinion of the Astronomer Royal that the strata below the mountains are less dense than those below plains and seas, as well as some of the experiments of Prof. Tyndall on heat, induce me to offer the following *theory* for investigation. Is it not possible that water, which at 40° begins to expand for every degree of *cold*, may at some high degree of temperature contract for every increase of *heat*, and thus explain why the particles of water projected on to a plate of heated metal 'globulize,' plainly indicating a *contractile* force imparted to the water by the intense heat? 1. Whence comes all the water *in*, *on* and about this earth? 2. How is it that the moon, which we would expect to be of similar component parts to the earth, has apparently no water? 3. Why do we find water so far *below* matter of greater specific gravity than itself? Once allow that water does contract by heat, and then query No. 1 is answered. The earth when thrown off in an incandescent state was composed of various matters in a state of fusion, which matters arranged themselves according to their specific gravity. Water, being on account of the intense heat the heaviest, took the lowest or more central place, and the other matters arranged themselves around the water-mass according to their specific gravity. The outer mass cools and *contracts*, but when the cooling reaches the *water*-mass it *expands* by cooling, breaks through the cooling strata above, making *slight* elevations in so doing, overflows the surface as boiling water, speedily giving forth its *heat*, evaporising, parting with some of *itself*, oxygen to help to form the air, hydrogen to help in forming other compounds, but cooling down very rapidly, dissolving some of the solid components of the earth, and hastening the second cooling of the crust below. The second time the outer coating is thicker and when the cooling again reaches the water-mass within, the disruptions and upheavals consequent on its expansion by cooling are greater, and greater inequalities are caused upon the surface of the earth. More boiling water is poured forth from within, and at each successive cooling greater inequalities are caused, while by the solvent power of the waters on the surface, disintegration and re-arrangements of the solid constituents of the earth progress. The bases of the mountains will probably extend to a considerable depth below them, and will be composed of materials similar to those of the mountains themselves, displacing thus a portion of the central water-mass and thereby lessening the specific gravity of the mass below them. May not the moon have within her now the water-mass ready to be poured forth as required when the outside crust shall have sufficiently contracted? May not the present appearance of the lunar craters be caused by the pouring forth of a part of the central water treasury?

"Query No. 3 can hardly be answered by the gravitation of water through fissures. Fissures do not penetrate far into the interior of the earth, and the fact of water existing at enormous depths would seem to indicate that the normal place of water is near the centre of the earth. Besides, the average density of the earth is greater than the average of its outermost coating, *i.e.* of that portion of the shell the density of which we know by being able to *examine* it. Now we must suppose either that some of the denser elements occupy the central portion of the earth, remaining, except for this purpose, useless, or a[illegible] theory as that here suggested. Whence came the mountains if the earth was, like a huge metal casting, slowly cooling? What was the disturbing force within if all its parts obeyed the usual law of contracting by cooling?"

FLEXIBLE STONE.

A Geological curiosity has been deposited in the Museum of the Hartley Institution at Southampton: it consists of a piece of Flexible Stone about two feet long, seven inches wide, and more than one inch in thickness, having the appearance of rough sand-stone, which bends with slight pressure like a piece of india-rubber or gutta-percha of the same size. This interesting specimen has been placed in a glass case constructed for it, fitted with a lever, by touching the key of which on the outside of the case the flexibility of the stone is shown. It was presented to the Hartley Institution by Mr. Edward Cushen, from his relative Mr. R. S. Munden, who obtained it from Delhi, in the East Indies. In its natural position the stone is said to run in thin layers in the soil in which it is found, but is so rare in India that it finds a place in the museums at Calcutta. We are informed that there is a similar stone, but not so wide as the one under notice, in the British Museum, and another in the Museum of the School of Mines, but specimens are very rarely to be met with. The Rev. F. Trench, of Islip, Oxford, has a piece, which he sent to the Exhibition of 1851. Although the stone has a gritty appearance, no grit or dust is thrown off by the motion given to it when under pressure.—*Churchman.*

EARTHQUAKE AT ST. THOMAS, WEST INDIES.

On the 18th of November, the Island of St. Thomas, which, twenty days previously, was the scene of a terrific hurricane, was visited by an Earthquake. About three o'clock in the afternoon of a fiery hot day, when, literally "the heavens were brass," the awful roar of an approching earthquake was heard—a sound, once heard, never afterwards to be forgotten. In a moment the houses shook from doorstep to roof; they cracked and groaned; the earth heaved and danced again, and much of the damage which the hurricane had commenced was now completed. The whole population, some 15,000 to 20,000 souls, rushed into the streets, shrieking, praying, and imploring the Divine mercy. All that night one shock succeeded another in rapid succession. The shocks continued for several days.

About twenty minutes after the great shock on the 18th, a confused cry was heard from the sailors and workmen on board the shipping in the harbour, while numbers of them were seen pouring over the sides of the ships and pulling for life to the shore. In a few seconds the cause of the panic was apparent. A monstrous breaker, or rather a sea-wall, variously estimated at from 30 ft. to 60 ft. high, was seen racing in towards the harbour, at a pace of fifty miles an hour. It seemed as if the town at least, if not the island, would be swept away. As, however, it approached, the narrowness of the entrance and the rocky headlands it encountered checked its force and reduced its elevation; and though it tore large ships from their anchorage, turned small ones bottom upwards, and submerged numberless boats and their crews, it finally broke with comparative harmlessness on the beach, not running inland more than 100 yards above the usual high-water mark.

The Royal mail steamer La Plata had a narrow escape. She was lying at Water Island, three miles from St. Thomas. She had commenced coaling and taking cargo on board from three large hulks alongside, 100 or 200 negroes being employed upon the work. When the earthquake occurred, it was felt quite as strongly in the ship as ashore. Some thought the boiler had burst; some that the ship was struck by whales. The alarm had scarcely subsided when there was a cry of "It's coming; it's coming!" The negroes swarmed on deck, the sailors rushed up the rigging, and the great wave was seen sweeping along in unchecked fury and stretching the whole width of the horizon. There was a roar like thunder. Captain Revet seized the wheel, and endeavoured to present the stem of the ship to the advancing wall; but it struck her on the starboard quarter. Though she reeled, groaned, and staggered with the blow, the wave passed her with no more serious injury than a shattered bulwark and a few tons of salt water on her decks. The passengers were landed, for safety, at Water Island and sent round to St. Thomas, where La Plata subsequently had to proceed for repairs and to coal.

The disaster was not confined to St. Thomas, having extended, in a lesser degree, to Porto Rico, Vieque, St. Croix, Tortola, and other adjacent islands.

PRE-HISTORIC ART.

A Correspondent of the *Athenæum* remarks that "with respect to the forms of animals said to be delineated on flakes of bone by the cave men, it is difficult to accredit such a sign of mental power to savages so rude as these are represented to be." Mr. Oldfield, in the *Transactions of the Ethnological Society*, informs us that the aborigines of Australia were "quite unable to realise the most vivid artistic representations. On being shown a large coloured engraving of an aboriginal New Hollander, one declared it to be a ship, another a kangaroo, and so on; not one of a dozen identifying the portrait as having any connection with himself." Such a statement from a careful observer is calculated to make us cautious in accepting Art as coeval with great antiquity, and with an exceeding low state of civilisation. On the other hand, we have stories, which seem authentic, of the true recognition of pictures by monkeys, and even by birds; but there is no case in which an ape, with all its imitative talents, ever scratched an imitation of the plainest object.

Astronomical and Meteorological Phenomena.

ROYAL ASTRONOMICAL SOCIETY.

The President, Mr. Pritchard, in his Anniversary Address, commenced by a reference to the circumstances which during the last few years have conspired to give to the cultivation of Astronomy a strong impulse in a new direction, and the rapid advances which the science has made towards completeness in some of the most difficult branches. The Address continued:—"Concurrently with this advance we find a remarkable enlargement to the optical power of refracting telescopes, and in the wide extent to which these powerful instruments are multiplied. This signal improvement and wide distribution of the chief instrument of astronomical research would of itself be sufficient to indicate the new direction which our science might be expected naturally to assume. And then, again, the vast and rapid strides of late years taken in our practical knowledge of the sciences of heat, electricity, chemistry, and light, have not only lent a new and unexpected aid to the prosecution of astronomy, but have unavoidably given and directed a new bias to the objects of her research. It is well known that less than fifty years ago, when the elder Struve commenced his illustrious career at Dorpat, the largest telescope available for his use was one constructed by our countryman, Dollond, of which the aperture was less than four inches. At the present day, admirably furnished instruments, exceeding the double of that aperture, are, as we are all aware, in the hands of many private observers in comparative abundance. Nay, further than this, an English artist, and a member of your own Council, has nearly completed an object-glass of the unparalleled aperture of twenty-five inches."

Add to these the introduction of Electrical time records and other such aids which we must regard as the proximate causes of the culture of the new branches of astronomical physics, rather than as their merely casual antecedents. The President then gave a rapid detail of the early Spectrum discoveries. He said:—"It was our countryman, Dr. Wollaston, who, in the year 1802, for the first time, observed a few of the more conspicuous dark lines in the solar spectrum. He does not appear to have regarded his discovery as of any further importance beyond the fact, that he thought these lines formed actual and generic lines of separation between the distinctive colours of the spectrum. . . . Had Newton a century before that day placed his prism close to his eye, instead of receiving the spectrum on a screen, it seems almost certain that he must have anticipated Wollaston's discovery. Thirteen years after the publication of Wollaston's memoir, Fraunhofer, by placing a prism of exquisitely pure glass in front of a small telescope, and then and therewith viewing a distant and narrow line of direct *sun-light*, observed and measured the positions of hundreds of these lines which had escaped his predecessor's rougher survey. . . . It was not until the year 1830 that Troughton's colleague, Mr. Simms, ingeniously adopted the collimating lens in the focus of the narrow slit, which now renders the spectroscope the compact and manageable instrument with which we are familiar. Nor herein ought we to forget the services rendered in this country by Mr. Browning and others in the abundant manufacture of admirable prisms at a moderate cost. But, however all this may be, certain it is that for many years after the discovery of Frauenhofer's Lines they were but rarely observed, and always spoken of with a species of mysterious awe. The suspicion that these interruptions in the solar light arose in some way from some absorption somewhere, either in the sun itself or in our atmosphere, was naturally insisted on by various writers, but by no one more strongly and intelligently than by Sir John Herschel in his well-known 'Treatise on Light.' Sir David Brewster, by an admirable experiment, added great force and gave a definite direction to this very probable suggestion. In the year 1832, just thirty years after Wollaston's discovery, this eminent philosopher examined the spectrum of light after it had passed through the coloured vapour of nitrous gas, and the result was the production of a vast number of dark linear interruptions in the luminous ribbon, which certainly resembled, and at first seemed to be identical with, Frauenhofer's Lines. Exact measurements, however, soon dispelled the notion of this identity; and other experiments, undertaken by Professor Daniell, of King's College, London, and by Professor Miller, of Cambridge, with other coloured vapours, demonstrated that these absorption lines in the spectrum were generally peculiar to the particular vapour through which the light had been made to pass before its dispersion by the refracting prism. . . . About three years subsequent to Sir David Brewster's experiment, Mr. Wheatstone made what has since proved to be a great advance in the explanation of the phenomena in question. This ingenious philosopher in the year 1835 discovered that the spectra produced by the incandescent vapours of several of the metals consisted of a comparatively few detached bright lines separated from each other by wide intervals of darkness. So definite were these bright lines in their relative arrangement, and so generically peculiar for each metallic vapour examined, that Mr. Wheatstone did not hesitate to declare that 'by this mode of (prismatic) examination, the metals might be distinguished from each other.' . . . What now took place between the year 1835, when Brewster and Wheatstone had recorded the result of their researches, and the year 1859, when Kirchhoff happily grouped all the phenomena in one consistent whole, very much resembles what occurred just before the dis-

... of gravitation by Newton, and at a more recent ... the state of chemical philosophy before the great works of Lavoisier and Dalton. . . . Whatever may have been the cause, or causes, it may safely be asserted of Foucault in 1849, of Stokes in 1850, of Augstrom in 1855, and of Balfour Stewart in 1859, that each of them was in possession of and enunciated truths which, had they been traced to their natural and inevitable consequences, would have led to that grand generalisation which will immortalise the name of Kirchhoff, and which forms one of the happiest and most remarkable discoveries of modern times."

STORM WARNINGS.—METEOROLOGICAL DEPARTMENT OF THE BOARD OF TRADE.

The memorials and communications to the Board of Trade respecting the discontinuance of Storm Signals have been presented to Parliament, on the motion of Colonel Sykes. They commence with a memorial from the Scottish Meteorological Society, dated July 18, 1866, approving the recommendations in the Report of the committee appointed by Government to consider what arrangements ought to be made for carrying on the Meteorological Department, presided over by the late Admiral Fitzroy, with the single exception that they think that in signalling the approach of storms, information should not be withheld of the direction whence they are expected to come. Amongst other memorials in favour of the renewal of the storm signals until, by further observation and scientific inquiry, a more perfect system may be adopted, are those from the Dundee Harbour Trustees, the Manchester and Edinburgh Chambers of Commerce, the Glasgow and Dundee Local Marine Boards, the Liverpool Underwriters' Association, the provost and magistrates and shipowners of Leith, and the last, dated March 8, 1867, was from the underwriters and shipowners of Glasgow and Greenock, who state: "As all our great storms have their origin in the west, south-west, and north-west, your memorialists respectfully submit that a less cumbersome yet more comprehensive knowledge of gale pressure would be obtained by confining the stations to those on the different coasts, with the head station at Greenwich, to which telegrams might be sent at least every six hours; these coast stations, it is suggested, should be Valentia, St. Kilda, Aberdeen, Yarmouth, and Penzance, from whence ample warning could be conveyed to the various ports, of approaching storms. In the event of a further grant of money being made by Parliament towards the meteorological service, your memorialists respectfully submit that a portion of said grant be employed in establishing a station at St. Kilda, from which point many of our winter storms could be anticipated, as there (as in October, 1860) the barometer has been known to fall $1\frac{1}{2}$ in. in less than twenty hours, and that many hours before the gale was felt; also that great benefit would be experienced were a storm-signal post erected on the Holy Isle, off Arran, connected by telegraph with the Cantyre coast, so that vessels sailing from the Clyde might take advantage of the shelter offered by Lamlash Bay, until such time as the gale had subsided, or the direction of the wind proved favourable. Your memorialists would respectfully submit that the line of telegraph now established across the Atlantic might be advantageously employed in making known some of our heavy westerly gales, as it is quite possible to do, two or three days before they approach our shores." The whole of the communications have been transferred from the Board of Trade to the Scientific Committee, which has been specially entrusted with the management of the Meteorological Department, and which, we hope, will not fail to recognise the course they should pursue, and follow it.

The Anniversary Address of the President of the Royal Society was largely occupied with the reorganisation of the Meteorological Department of the Board of Trade, and in preparing the preliminary arrangements of a system of British land meteorology, to be carried out under the direction of that Board. The suggestion which had been made by the Royal Society for the establishment of a small number of meteorological observatories supplied with self-recording instruments for the purpose of making a full, accurate, and continuous record of meteorological phenomena at certain selected stations, appears to have received the unqualified and emphatic approval of the committee nominated by the Government, and to have been viewed by them as the most effectual means of supplying a secure and adequate basis for the discussion of the variations of the weather in the British Islands. The Report of the committee of the Board of Trade contains many valuable suggestions regarding the treatment which the information accumulated in the office of the Meteorological Department of that Board should undergo, with the view of extracting from it the information it is capable of affording on the meteorological statistics of the ocean, and specially of the parts most frequented by British ships. This great branch of meteorological research was prominently urged on the consideration of Her Majesty's Government by the President and Council of the Royal Society in 1855; and in the subsequent establishment of the meteorological department of the Board of Trade it was recognised as being one of the chief functions of the office so constituted. The collection of a very considerable mass of information, embodied in the logs of ships to which instruments and instructions have been supplied, has been the result; but comparatively little advance appears to have been made in the labour of extracting, collating, combining, and discussing the valuable materials thus obtained. The work both of collecting further information and of discussing and arranging for communication to the public the information already in the office, and that which may hereafter be obtained, has been resumed under the general superintendence of the meteorological committee of the Royal Society, profiting by the valuable suggestions contained in the report of the committee of the Board of Trade. This forms the second portion of the duties which they have taken upon themselves. A third portion consists in the endeavour to make available for the benefit of mariners the information which reaches the office by telegraph early in the day as to the state of the weather at different points of the coast. A copy of this information is transmitted by the post after its reception to any port which desires to receive it. If the authorities at any port require any special telegraphic intelligence, it is furnished to them without unnecessary delay, on their agreeing to defray half the cost of transmission of the message, and stating the precise nature of the information required. Lastly, the committeee are prepared to convey, free of cost, telegraphic intelligence of the existence of any serious atmospherical disturbance which may have come to their knowledge to all ports to which it appears to them that such information would be of importance. From an early period the attention of the committee had been drawn to the importance of improving as far as possible the quality of the intelligence received from the coast stations. With this view they gave directions that all the telegraph stations at which observations are made should be inspected. The inspection of all the stations situated in the British Islands has now been completed. It is hoped that, as the result of these measures, the accuracy, and consequent value, of the reports received will be in future materially improved.

HURRICANE AT ST. THOMAS, WEST INDIES.

A FEARFUL Hurricane took place on the 29th of October, at the Island of St. Thomas, and caused immense destruction of shipping, besides reducing great part of the town to ruins. It appears that as many as fifty vessels were driven on shore—some on the coast of St. Thomas, and others on the neighbouring islands. Two of the steam-ships belonging to the Royal Mail Steam-packet Company, the *Rhone* and the *Wye*, were entirely wrecked, with great loss of life; two others, the *Conway* and the *Derwent*, also went ashore, and the *Tyne* and the *Solent* were dismasted. These six vessels were the property of the Royal Mail Company. The *Rhone*, which was one of the finest and fastest vessels of the Company's fleet, was a screw-steamer of 2,500 tons and 500-horse power, and employed on the main line across the Atlantic.

It appears that the *Rhone* was lying in the anchorage of the Tortola passage, off the island of St. Peter, distant about twenty miles from St. Thomas, as is customary when the yellow fever is prevalent, and that she had her steam up in case of being compelled to "run in" by a sudden hurricane, but so sudden and violent was the storm that all the efforts of those on board to get her away were futile, and she was driven upon the sand reefs of St. Peter's Island. The *Wye* was wrecked on Buck Island, the *Conway* went ashore on the isle of Tortola, and the *Derwent* at St. Thomas. The West Indian and Pacific steamship *Colombian* was also lost. The destruction of life and property in the island was very great.

STORM REPORT.

THE following letter, containing indications of the fearful storm which has visited the Western Islands, has been sent to the Board of Trade:—

"British Consulate, Martinique, St. Pierre, Oct. 11, 1867.

"Sir,—I have the honour to acquaint you, for the information of the Lords of Her Majesty's Privy Council for Trade, that, on the 7th instant, a sudden fall of the barometer indicated coming bad weather here; and, in effect, between ten and eleven o'clock p.m. the same day, the wind began to blow with extreme violence from the S.S.W., and serious fears were entertained for the safety of the town; when, happily, the storm gradually abated after a short time, without having caused any real damage. Unfortunately, however, it occasioned, a few hours later, a *ras de marée*, or ground-swell, which threw on shore here a brig, the *Zephyr*, half loaded with sugars for Marseilles; an English schooner, the *Anemone*, of St. Lucia, with cocoa from Trinidad; also two droghers and several barges and flats. With one exception, all the landing-stages have been also destroyed. At Fort de France, the sea became also extremely high, and, under the influence of the wind, cast on shore a French ship, the *Mélanie*, a small local steamer, and numerous lighters and boats. The reports from the interior of the colony make no mention of any damage having been done by the storm, but fears are entertained for the safety of the islands to the northward, where the full force of the hurricane is supposed to have made itself felt.

"WILLIAM LAWLESS, Consul."

METEOROGRAPH AT THE FRENCH EXHIBITION.

ONE of the most interesting objects in the Exhibition was the Meteorograph, invented and exhibited by the Director of the Observatory at Rome, Father Secchi, and for which he has obtained the "Grand Prix." This apparatus, which is described in the *Society of Arts Journal*, is perfectly self-acting, and registers, in the form of a diagram, the changes of the atmosphere as they take place. On each side there is a board, covered with paper, moving vertically in a frame from top to bottom by means of clockwork. On one is registered, for two days and a-half, the indications of the barometer, psychrometer, and the hour and currents of rainfall. On the other board, which completes its course in ten days, the indications of the force of the wind, its direction, the metallic thermometer, the height of the barometer, and the hour of rainfall, are likewise repeated. The barometer tube is of wrought iron, bored out perfectly cylindrical. The upper part, forming the barometric chamber, is 2·36 inches in diameter, and the tube is 0·69 inch in diameter. This tube floats freely on the top of the mercury, and a great part of its weight is supported by a wooden collar driven on the lower part. The top is attached to one end of a lever, with a counter-weight at the other end; another lever is fixed to near the lower end, so as to keep it always in a vertical position. At each end of the suspending axis is a parallel motion, for carrying the pencil for tracing the diagram in a straight line on the two boards.

The psychrometer, or wet and dry bulb thermometer, for the purpose of determining the quantity of moisture in the air, is registered in the following ingenious manner:—A platinum wire passes through the glass at the bottom of the bulbs, so as to put the mercury in connection with a galvanic battery. The tops of the tubes are open, to allow of two other platinum wires, fixed in a frame, being, at a given moment, plunged into them, and when lowered to the level of the mercury an electrical current is established in the apparatus for holding the pencil to register the temperature and press it against the paper. A small carriage, carrying the pencil, on which is fixed a Morse instrument, is made to traverse in front of the paper every quarter of an hour. This movement is produced by the striking part of the clock, an eccentric being fixed on the wheel making one revolution each quarter of an hour. This eccentric moves a large triangular-shaped lever; to this lever is attached one end of a steel wire, the other end of which is attached to the frame on which are fixed the platinum wires at the top of the wires. In this manner the movements of the carriage and the frame are simultaneous, only the length of traverse of the carriage is greater than that of the frame, it being connected with a point on the lever farther from the fulcrum. Thus, when the carriage begins to move, the frame is lowered.

The moment the platinum wire touches the surface of the mercury in the dry bulb thermometer a current is established in the electro-magnet on the carriage, and the armature at the end of a lever is attracted towards it, whilst the other end, carrying a pencil, is pressed against the paper, and marks a point representing the height of the thermometer. The carriage travels on till the second platinum wire comes in contact with the mercury in the wet bulb thermometer; an electric current is established; an apparatus above the carriage breaks the current in the electro-magnet, and the pencil is removed from the paper. In returning, the carriage reproduces the breaking and opening circuit, only in the reverse manner, and another point is obtained, which indicates the end of the line. Thus a double row of points is obtained, arranged on two curved lines, one of which represents the height of the dry bulb, whilst the other represents the wet. The simultaneous motion of the carriage and frame is established simply by means of a steel wire, and is sufficient for the short distance between the psychrometer and the machine; in some cases, where they are some distance apart, clockwork is used, and cams, as an interruption of circuit, are attached to the clock. The time of rainfall is marked on the same paper by means of a lever carrying a pencil moved by electricity. The movement of the electro-magnet is produced by a small water-wheel placed under the gutter in a convenient part of the building, and which by revolving opens and closes the circuit of the battery.

The quantity of rain is measured in a reservoir placed at the bottom of the apparatus. The rain-water collected in a funnel placed on the roof passes, by means of a tube, to the reservoir, and raises a float carrying a rod with a pointer, which marks on a graduated scale. At the end of this rod is attached a small chain, which passes over a small pulley furnished with a disc of paper; the rotation of the pulley is in proportion to the quantity of rain. The pencil, fixed on a support, moves along the radius of the disc at the rate of about 0·20 inches per day, and in this manner the quantity of rain is marked each day on the wheel at a different place. The reservoir is 7·48 inches in diameter, whilst that of the funnel is 14 96 inches, or four times the area; thus the height marked on the scale is four times that of the actual fall. The direction of the wind is registered by four telegraphs. At the foot of the weather-cock is placed a circle with four metallic sectors, covered with platinum, against which a small projection on the axis is pressed. The apparatus is provided with four telegraphs, the electro-magnets of which are respectively in communication with the four sectors; each of these four telegraphs, by vibrating its lever according to the direction of the weather-cock, connects the circuit, and gives one of the four cardinal points. The register of intermediate winds is obtained by the combination of the two neighbouring ones. A vibration of the rod to which the pencil is fixed is produced by each revolution of the vane for measuring the velocity of the wind.

The velocity of the wind is measured by the anemometer invented by Dr. Robinson, which consists essentially of four hemispherical cups, having their diametral planes exposed to a passing current of air; they are placed at the end of four horizontal arms, attached to a vertical shaft or axis, which is caused to rotate by the velocity of the wind. On this shaft an eccentric is fixed, by means of which a succession of currents in opposite directions is produced. The apparatus is provided with three counters, which are put in motion by the electrical current, which passes by the middle counter, whatever may be the direction of the wind, and at each revolution of the vane the escapement wheel of the counter is advanced one tooth by means of the electric current. This counter gives the number of revolutions of the vane; this is reduced into kilomètres on the second dial of the counter. The velocity of the wind each hour is noted on the diagram, fixed by means of a chain, which is wound more or less, according to the strength of the wind, on a pulley. This chain is connected with a parallel motion, to which is fixed a pencil. This pencil, drawn by the chain, traces a line more or less long, corresponding with the length of chain wound on the pulley. This pulley is thrown out of gear every hour by means of an eccentric fixed on the striking part of the clock, and by means of a counter weight the chain is unwound, and the pencil makes its mark on the paper.

The metallic thermometer consists of a copper rod, the expansion and contraction of which act on a lever, which communicates with a pencil for tracing the curve corresponding with the variations of temperature on the paper. This rod is 52 ft. 6 in. in length. An apparatus on the same principle has been at work for the last seven years at the Observatory at Rome, with most satisfactory results, and an atlas of diagrams registered by it is exhibited. The galvanic battery used is a modification of the Daniell battery, with sand. The clock and wheel-work of the counters were made by M. Détouche, of Paris; the other parts by M. Eren-Brassart, of Rome. The wood-work is by M. Pietrocola, of Rome. The barometer tube, which is a forging requiring great care, made like a gun-barrel, was constructed in the workshop of M. Mazzocchi, gunsmith, of Rome.

NUMEROUS CASUALTIES FROM LIGHTNING.

The reports of deaths and injuries to person and property during, the thunder-storms in September, 1867, throughout the country, are unprecedented, at least in our recollection. At Ibury, near Banbury, one man was killed in a rickyard, and another man and a boy seriously injured. At West Bromwich, a man was killed in his cottage. At Oxhey, in Saddleworth, a man was struck and killed while travelling along with an electric machine on his back. Near Knighton, in Salop, a farm labourer was killed while on a ladder, and his son struck, but not injured. At Penegoes, near Machynlleth, the lightning passed down a chimney and killed another farm labourer: his wife was struck, but not seriously injured, a pig and a duck were killed in the yard, and furniture shattered. Two children were killed, and five others injured, at Smallburgh, in a school-room, while about to go to church; the bell-turret was first struck. At Exeter Ross, a man and horse were killed in a field. Lightning ran through a house at Heath Town, Wolverhampton, doing damage, but not injuring any of the family of a spindle-maker who were in the house at the time. A valuable horse was killed near a place called Whitehall, and another nearly killed. Rails on a branch of the Bolton Railway were torn up for some distance, the stump of a tree smashed, and a horse killed. Near Bouloc, in Haute Garonne, a man was killed by a ball of fire, and various others stunned. The *Giornale d'Udine* relates that a thunderbolt fell on the church of Anfagnano, in the district of

Palmo. Four women were killed on the spot; and seventeen other persons experienced violent shocks, and were more or less injured. At Boxford a farmhouse chimney was struck, and the house extensively damaged, a duck killed, and a man hurt. The railway station at Wigton was set on fire through the telegraph wires and lead gas pipes conducting the electricity, melting the pipes, and then setting fire to the gas. At Kirkaldy, in Scotland, the lightning struck the stack of Messrs. Brown's engine works, and rent it from top to bottom. The church at St. Pé-Saint-Simon, France, was greatly injured by lightning, which struck the clock tower, and, although leaving the bell hanging, rent the foundation; descending into the church, it tore up the flooring, destroyed the windows and several paintings, flattened a tin vessel on the high altar, and drove in the door of the tabernacle; thence it went to the side altar and mutilated a figure of the Virgin. At Sauzet (Lot) the wife of the bell-ringer and her son had ascended to the church tower to toll the bells, in accordance with a belief very general among the peasantry there, that by doing so the effects of the lightning might be neutralised. They had scarcely commenced when the building was struck, and the woman killed on the spot; the son uninjured. Thetimber-work of the belfry was set on fire.—*Mechanics' Magazine, abridged.*

SEVERE COLD IN PARIS.

THE Cold in Paris was intense during the late winter. On the Seine, two steamers usually employed between Paris and London were regularly ice-bound. As for the Seine, it had not been so completely tied up for the last 20 years as it now is. A person curious in dates has found that the first mention of the Paris river being frozen over was in 821, when it remained like a solid mass for nearly a month. The same occurred during the winters of 1044, 1067, 1124, 1125, 1205, 1210, and 1325. In 1407 the cold was so severe that the greater part of the vines and fruit trees were completely destroyed. It was still more intense in 1420, when numbers of the population perished, and the wolves prowled about the streets in search of food. In 1434 it began to freeze on the 31st of December, and continued with little intermission till the middle of March, and snow fell during 45 days without ceasing. In 1570 intense cold prevailed for three months. In 1608 the winter was so severe from the 21st of December, and fuel so scarce, that the smallest fagot of wood cost 35 sols. The cattle perished, and every species of game disappeared in the fields and forests. The ice was so thick on the Seine that waggons heavily laden passed over. In 1683 the cold was so intense during three weeks that numbers died. In 1709 the extreme cold caused a dearth of provisions, and in Paris and Versailles coarse oaten cakes were considered a luxury at the tables of princes, and of the wealthiest inhabitants. In 1740 a scarcity occurred by the same cause, and was so great that, by order of the Parliament of Paris, public prayers were offered up in the churches, and the relics of St. Geneviève, the patron saint of the city, and of St. Marcel, were carried in procession through the streets. In 1768 the large bells of many of the churches cracked from the cold. The winter of 1784 completely changed the aspect of Paris, and masses of snow and ice in the streets made them impassable. At the corner of the Rue Coq-St. Honoré a pyramid of snow was raised in honour of Louis XVI. who died on the scaffold nine years afterwards. On the 30th of December, 1786, the thermometer fell to 18¼ degrees below freezing point, and the ice on the Seine was twelve inches thick. The other winters when the cold was most severe, and the river pretty nearly as it now is, were those of 1799, 1810, 1811, 1812, 1814, 1829, and 1846.

LONDON RAINFALL.

The engineer to the Metropolitan Board of Works estimates that during the twenty-four hours between ten o'clock p.m. on the 25th July, 1867, and ten o'clock on the 26th, no less than 26 millions of tons of water fell upon the district drained by the great metropolitan system of sewers It is easily perceived that this is a very large quantity, but perhaps few persons can form anything like a correct idea of what 26 millions of tons of water actually means. Estimating the weight of a cubic foot of water at 62,321 lbs., a ton of water will require a cistern of the capacity of 35·94 cubic feet, and 26,000,000 tons would occupy a space of no less than 934,440,000 cubic feet. A tank of this capacity would be 1,850 feet in length, 1,263 feet in breadth, and 400 feet in depth; or a length equal to that of the Crystal Palace, a breadth equal to the length of Westminster Bridge, and a depth equal to the height of St. Paul's Cathedral.—*William Hughes, Associate of the Institute of Actuaries.*

The greatest rain in twenty-four hours Mr. Symons finds recorded at Greenwich was on the 14th of July, 1853, when 2·63 inches fell, being eleven per cent., or one-ninth of the yearly average. A ninth of the yearly average at Seathwaite (140 inches) is 15·6 inches; yet they have never had more than 6·6 inches in twenty-four hours; that is to say, not five per cent. against our eleven per cent. The amount registered at Camden Town between the 25th of July, 10 p.m., and the 26th of July, 9 a.m., 1867, was 1·82 inch. Although correctly entered for the rainfall day ending at 9 a.m., it may be well to mention that the total fall between 10 p.m. one night and the same hour next night is 2·21 inches. And from the registers it will be seen (1) that it is rather more than ten years since we had so heavy a rain as that night; (2) that in fifty-two years there have only been seven days on which the rain has been greater than in the present instance; or (3), if we take the twenty-four hours from the commencement of the rain, then only two instances out of fifty-two years. Moreover, during the same fifty-two years there were eighty-five days on which an inch or more of rain has fallen; of these eleven occurred between the 21st and 27th of July.

AERIAL RESEARCHES.

MR. GLAISHER, F.R.S., has given, at the Royal Institution, a *résumé* of his recent aerial researches. He stated that in compliance with the wishes of a committee of the British Association, he had undertaken the examination of various questions in meteorology and general physics at various distances above the earth, in a balloon at different seasons of the year. In numerous large diagrams, he gave the results of about twenty ascents, some very recent. He warmly eulogised the excellent scientific apparatus with which he had been provided, especially the Herschel-Browning Spectroscope, whereby he had been able to distinguish numerous additional Fraunhofer's lines in the solar spectrum. In some amusing anecdotes, he expressed the ludicrous exaggerations of some amateur aëronauts, and stated that even experienced observers like himself had need to be on their guard. In conclusion, he expressed a hope that much scientific information had been acquired by means of his aërial expeditions; such as the breaking down of the law which asserts that the temperature of the air rises as we ascend at the rate of 1 deg. Fahr. for every 300 ft., whereas, in some cases, he found the temperature rise—the remarkable decrease in humidity, till at the height of five miles there was scarcely any moisture at all.

Mr. Coxwell, in a lecture given by him at the Crystal Palace, has stated that the members of the select committee who made an ascent with Mr. Coxwell himself at Aldershott, were fully satisfied that Ballooning could be made a valuable ancillary to our present agencies of war. Dr. Lardner showed, in a letter to the *Times* in 1859, that balloons could be converted into most destructive machines for depriving the enemy's forces of all power over their senses. He said that balloons filled with certain gases, the odours of which deprive men of all power of action, might be lowered into the opposite camp, and he had no doubt that the effects would be terribly destructive. Mr. Coxwell showed models of balloons illustrating the progress of aërostatic science from its earliest stages to the present time, and also exhibited one of cylindrical shape, formed like a cigar with the sharp end cut off, which he said was the kind of machine which should be employed in observations during warfare, as it offered least opposition to the wind, and presented the smallest amount of surface to the shots of the enemy.

THE ROYAL OBSERVATORY, GREENWICH.

From the Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the annual visitation of the Royal Observatory, June 1, 1867, we extract the following:—Referring first to the telegraphic system of the establishment we find that the eight telegraph wires are now led (by arrangement with the Electric and International Telegraph Company) underground to the Greenwich railway station, and thence to the poles of the South-Eastern railway, and by a cable under Deptford Creek. At Deptford station, by the liberal permission of the South-Eastern Company, a turnplate is fixed, into which two of the wires are led; and from the Admiralty wire which passes through the High-street of Deptford, a loop is led into the same turnplate, so that the Admiralty loop can practically be extended into the Royal Observatory, and can, when necessary, be interrupted there. The Astronomer Royal states that he has been desirous of maintaining this command of wire with the hope that he may yet have occasion to use it for the transmission of signals to Devonport in reference to the exhibition of time signals on the Start Point, or in other directions for similar purposes.

The proposed line of railway through the town of Greenwich and on the north side of the Hospital Schools, promoted by the South-Eastern Railway Company, which was considered unobjectionable in reference to the interests of the Observatory, received the entire sanction of the legislature in the summer of 1866. But no action is yet taken on it, and no immediate action is contemplated. The London, Chatham, and Dover Company have made no new application for sanction of their line of junction with the South-Eastern Company's line (rejected last year on a point of standing orders). It seems not impossible, says the report, that in a few years we may have to fight the whole battle over again.

With respect to the Astronomical Instruments, the Astronomer Royal observes:—I alluded in my last report to the probability of finding the astronomical flexure of the telescope, after cutting away small portions of the central cube, sensibly changed. Cast iron, apparently, is always in a state of constraint, and the removal of a strained part usually alters the form and stiffness of all that is left. Very lately a most careful set of observations has been taken by Mr. Dunkin for determining the astronomical flexure with the help of the new collimating reversed telescopes; and the co-efficient for southern objects, which formerly was $+0''\cdot76$, is now $-0''\cdot34$. [This is confirmed by another series of observations.] The difference of flexures of the two ends has, therefore, been altered more than a second of arc. I have no information on the state of the absolute flexure. The plan of stretching the horizontal wire in the field of view has proved unsuccessful; the wire soon broke, apparently from dampness of atmosphere.

Some results of observation had given rise to the idea that there is really a personal equation in the determination of the runs of micrometer-microscopes by different persons. A very careful series of observations was made, expressly to determine this point; care being taken to adjust the eyepieces accurately to focus. All appearance of personal equation then vanished. I think that these experiments throw great light on the origin of supposed personal equations where there is no movement of the object observed.

Attention has been given to the compensation of the Chronograph Barrel Clock-pendulum, and its rate is now very steady. It is known to the visitors that the one-second punctures on the barrel-sheet follow each other on a spiral whose interval of coils is one-tenth of an inch; and that, for easily reading these, an impressed spiral line is necessary. Hitherto, the spiral line has been traced by ink flowing from a glass pipette. The difficulty, however, of procuring pipettes suitable to our wants has induced us to employ the continuous indenture produced by a steel point. It requires the application of greater force for turning the barrel under it, but in other respects it is very satisfactory. The motor clock is in good order. This clock is kept to mean solar time with all the accuracy that we can give to it, by application at pleasure of magnetic or galvanic attraction or repulsion on a magnet fixed to its pendulum. It is used to maintain several clocks in the Observatory to accurate mean solar time, and to distribute seconds' galvanic currents and hourly galvanic currents (the latter through England); and also to change connections of wires which enable us to receive signals from distant clocks and time balls.

The South-eastern Equatorial is in excellent order. No alteration has been made in the telescope, except by the introduction of a solar eyepiece, with a green glass in front of the field glass. A direct-view spectroscope, the property of Mr. Stone (first assistant) has sometimes been used with it. The chronometer carried at the eye end of the telescope, and adjusted by galvanic regulating action to exact sympathy with the transit clock is perfectly successful. To give audible indications of the seconds' currents, one of the old galvanic chronometers is used. The water-clock, which gives motion to the equatorial, is driven by the force of water from the ordinary supply pipes acting through a turbine, the opening of the last tap being determined by Siemen's chronometric governor. The mean velocity of the clock, as I believe, does not depend upon the openings of the preceding taps, but the rapid inequalities of velocity do depend on them in a way which it is very difficult to explain from theory. A tap has now been established in the immediate vicinity of the water-clock, and by experiments on this we have acquired complete mastery of the instrument. It can now be made to move uniformly, without any sensible inequality, and with astronomical accuracy.

The new Portable Altazimuth by Mr. Simms has been tested by observations for the latitude, and found to be sensibly perfect. I may mention that a study of defects in the vertical circle of a small Altazimuth formerly used by me, and an inspection of the operations in the instrument maker's workshop, have convinced me that the principal error to be feared in instruments of this class is ovality of the graduated limb; this cannot be eliminated by two microscopes, and such an instrument should never be fitted with two only. Our instrument has four. The portable transit by Mr. Brauer was received in the summer, and appears to be everything that could be desired. I had fully expected that employment would have been found for both these instruments in determination of a fundamental American longitude, but the necessity has been removed, as I shall explain in a subsequent section.

Turning to the Astronomical Observations, we find Professor Airy stating that, long ago, it has been indicated by continental writers that the best employment for a principal established observatory is the determination of fundamental places of important stars, and fundamental elements of the motions of the earth, moon, and planets. From the foundation of the Greenwich Observatory these objects have been kept steadily in view, and as much so in the last as in preceding years. In particular, the moon has received that extraordinary attention which has been given to her at all times in our history, but more particularly in the last twenty years, when two instruments have been directed to her on every possible day of observation. Stars observed with the transit circle are:—Clock-error-stars, to the number of 118; nautical almanac stars, as far as they are visible to us; azimuth stars, among which we may with advantage sometimes include stars of the Redhill catalogue; stars culminating with the moon, or occulted by the moon; completions of our own published catalogues; completion of the re-observation of Bradley's catalogue (of the whole number, about 1,211, the number wholly observed is 1,065, and the number partially observed 1,159); stars used in the British, American, and Indian surveys; stars useful for refraction theories; proper motion stars (including Sirius); variable stars; Argelander's special list of stars.

The Equatorials have been used principally as instruments for observations of phenomena not requiring circle measurement, and for inspection of special appearances. Drawings of Saturn exhibit no trace of that supposed difference between the outline of the ball and the outline of the ball's shadow on the ring, which has been ascribed to the curvature of the ring's surface. Drawings of the spot Linnæus on the moon leave no doubt that it is still a very shallow cup. Complete preparations were made for an elaborate system of instrumental measures during the solar eclipse of 1867, March 5 (somewhat similar to those made successfully during the solar eclipse of 1860), by which the errors of the tabular elements of the moon's place, and the tabular semi-diameters of the sun and moon would have been determined. The bad weather prevented the carrying out of this intention. Eight occultations of stars by the moon have been observed (four disappearances and four reappearances), and seventeen phenomena of Jupiter's satellites. The end of the solar eclipse of 1866, October 8, and the beginning of that of 1867, March 6, were observed.

The Meteorological Instruments, whether those read by eye for indications at the moment, those read for definite part registers, those which give continuous mechanical registers, or those which give continuous photographic registers, are all in good order. They include barometers, dry and wet thermometers, radiation thermometers, thermometers in the Thames, Osler's and Robinson's anemometers, Osler's and six other pluviometers. The photographic barometer has shown a tendency in its indications to "jump," indicative of some friction which I have not yet investigated. In Osler's anemometer a surface of two square feet is now exposed to the wind instead of one foot as formerly; and the plate is supported by weak vertical springs instead of rods running on rollers. Its indications are much more delicate than formerly. This change was made by Mr. Browning. With the new pressure-plate of Osler's anemometer the pressures per square foot registered in the last six months are larger than any that we have had before. Whether any part of this is due to the circumstances that the plate is larger and its motion easier, or whether it is wholly due to the great violence of the wind in this stormy season I am unable to say. With Robinson's anemometer there is connected a revolving barrel moved by clockwork to be covered each day by a sheet of paper, on which a pencil carried by the anemometer makes a trace, exhibiting continuously the speed of the wind and the aggregate of its motion.

With regard to Magnetical and Meteorological Observations daily communication is made to M. le Verrier for his meteorological bulletin; and weekly communication to the Registrar-General for his sanitary report. The meteors on November 14 were well observed. Eight thousand three hundred were registered. The variations of frequency at different times were very well noted. The points of divergence were carefully determined.

Under the head of Chronometers, Communications of Time, Determinations of Longitude, the Astronomer Royal reports as follows:—On 1867, May 3, we have on hand 192 chronometers, thus classified:—95 box chronometers, 14 pocket chronometers, and 10 deck watches, the property of the admiralty; 17 on trial for purchase to replace six bought by the Japanese authorities; 56 makers' chronometers on competitive trial. All chronometers, except those which have been in our hands so long that we have great familiarity with their rates, are compared every day with a clock which is sympathetic with the motor-clock; those in the excepted case are compared once a week. All are subjected to some weeks' trial in a temperature not exceeding 90 deg. Fahr. All estimations of the value of chronometers to be purchased, and all superintendence of repairs rest with me. For issuing chronometers to the outports, a new system of packing has been introduced. It is found that with reasonable attention the chronometers can be sent safely by railway to almost any distance.

The Motor Clock, and the apparatus connected with it, are in good order. This clock is compared and regulated by an easy practical process. It maintains various clocks in sympathy with itself; it regulates clocks in London, sends signals through Britain, drops the Deal time-ball, fires guns at Newcastle and Shields (I think also at Sunderland), and puts communications in such a state that we can receive automatic reports from the signal places, as we may desire. I may, however, specially mention that daily signals are now sent to some places in Ireland; and that, during the expedition of the "Great Eastern" for laying down the Atlantic cable, time signals were sent on board twice a day to enable her constantly to determine her longitude.

A most important determination of Longitude has been made. In the autumn of 1866, arrangements were made by me, with the view of determining the longitude of a primary point in Newfoundland, by galvanic currents through the Atlantic cable, in the spring of 1867. However, in October of 1866, the authorities of the United States Coast Survey determined to act, and my friend Dr. B. A. Gould, having made all necessary arrangements at Heart's Content, and on arriving in London having secured the friendly assistance of the directors of the Atlantic cable, proceeded to establish a transit instrument at Foilhommerum, in Valentia. Advantage was taken of this opportunity for determining the longitude of Foilhommerum from Greenwich. After overcoming various difficulties all operations were successful. I have been favoured by Colonel Sir H. James, superintendent of the Trigonometrical Survey, with the geodetic measure of difference of longitude between Foilhommerum and my first station, Feagh Main; and I have the longitude of Feagh Main, found by different methods, as follows:—By chronometers in 1844, 41m. 23·23s.; by galvanic communication with Knights Town in 1862, 41m. 23·37s.; by galvanic communication with Foilhommerum in 1866, 41m. 23·19s. Dr. Gould, immediately after his return to America, determined the arc of longitude from Heart's Content to Cambridge, U.S. The collected results for longitude of Cambridge from different sources are— By moon culminators, Walker in 1851, 4h. 44m. 28·42s., Newcomb in 1862-3, 4h. 44m. 29·56s.; by eclipses, Walker in 1851, 4h. 44m. 29·64s.; by occultalion of Pleiades, Pierce, 1838-42, 4h. 44m. 39·91s., 1856-61, 4h. 44m. 30·90s.; by chronometers, W. C. Bond in 1851, 4h. 44m. 30·66s., G. P. Bond in 1855, 4h. 44m. 31·89s.; by Atlantic cable, 1866, 4h. 44m. 30·99s.

METEOROLOGY OF 1867.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the Year 1867, by James Glaisher, Esq., F.R.S., President of the Meteorological Society.

1867 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 26 yrs.	Mean Temp. of the Dew Point	Mean Tension of Vapour	Weight of Vapour in a cubic ft. of Air	Mean additional Weight required for Saturation	Mean Degree of Humidity. Saturation=100	Mean Weight of a cubic foot of Air	Relative proportion of Wind: N.	E.	S.	W.	Mean Amount of Cloud 0 to 10	Rain: No. of Days it fell	Amount collected
	In.	°	°	°	°	°	°	°		°	In.	Grs.	Grs.		Grs.							In.
Jan. . .	29·514	55·0	6·6	48·4	39·5	28·5	11·0	34·2	—4·1	29·7	·165	2 0	0·3	83	554	7	4	9	11	7·8	18	2·79
Feb. . .	29·911	57·1	32·9	24·2	50·7	39·5	11·2	44·7	+6·0	40·0	·247	2 8	0·5	84	549	3	4	9	12	7·7	13	1·22
March	29·624	59·1	24·5	34·6	44·5	33·0	11·5	37·7	—4·0	32·5	·184	2·1	0·5	82	552	11	12	4	4	7·9	20	2·28
April .	29·629	64·8	30·5	34·3	58·7	42·3	16·4	49·0	+2·2	43·0	·277	3·1	0·9	80	539	3	3	9	15	7·4	20	2·16
May . .	29·736	83·6	31·9	51·7	64·7	44·7	20·0	53·4	+0·5	45·4	·304	3·4	1·1	74	537	6	10	10	5	6·6	12	2·34
June .	29·935	82·1	44·4	37·7	70·2	49·1	21·1	58·1	—1·0	50·0	·361	4·0	1·4	75	535	12	4	5	9	6·1	7	1·77
July . .	29·730	81·5	43·3	38·2	71·1	50·8	20·3	59·4	—2·3	51·7	·384	4·3	1·4	76	530	6	6	10	10	7·0	12	5·81
Aug. . .	29·829	89·0	40·9	48·1	73·3	53·4	19·9	62·0	+0·8	55·5	·441	4·9	1·3	80	528	2	3	14	12	6·2	11	2·64
Sept. . .	29·915	79·9	35·5	44·4	68·0	50·3	17·7	57·6	+0·5	51·6	·382	4·3	1·0	81	535	5	4	11	10	6·3	12	2·92
Oct. . .	29·758	64·8	30·8	34·0	57·2	42·0	15·2	48·7	—1·9	45·2	·302	3·4	0·5	88	542	5	4	12	10	6·5	21	2·14
Nov. . .	30·119	64·0	27·5	36·5	47·8	35·3	12·5	41·4	—2·6	37·5	·225	2·6	0·4	87	557	12	5	5	8	6·9	5	0·42
Dec. . .	29·854	55·2	21·2	34·0	42·2	32·1	10·1	37·5	—3·0	34·4	·199	2·3	0·3	89	556	9	4	7	11	7·9	12	1·97
Means	29·796	69·7	30·8	38·8	57·3	41·8	15·6	48·6	—0·7	43·0	·289	3·3	0.8	82	543	80	63	105	117	7·1	163	28·46
																Sums					Sums	

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

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

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

[*Concluded on next page.*

The month of January opened with a low temperature and severe frost; till the 5th day the deficiency of temperature was nearly 15° daily. On the 4th day this defect was as large as 23°, and the temperature was as low as zero at many places, and below zero at several. Snow fell frequently all over the country, to an unusual amount, and rendered communication both by ordinary roads and by railroads difficult, and in some places traffic was wholly suspended. This unusually severe weather was succeeded by a sudden thaw, and a succession of heavy gales of wind from the west and south-west. The great change in the temperature broke up the frost, and cleared away the snow very rapidly, the sudden meeting of which caused rivers to overflow in many parts of the country. From January 6th to the 10th days the average excess of daily temperature amounted to 7°.

On the 11th day another frosty period set in, and extended to the 22nd day; during this period there were several very heavy falls of snow, particularly in the northern parts of the kingdom, where several persons perished in the snow, being overtaken by it, and frozen to death. The deficiency of temperature for these 12 days was on the average 9¾° daily.

On the morning of the 23rd day the weather underwent a rapid change; the mean temperature of this day was no less than 20° of higher temperature than that of the preceding, thus introducing a period of almost unparalleled warm weather of the extraordinary duration of 35 days, or till February 26th. The average excess of temperature during this period was 7° daily; and we must go back as far as 1779, or 88 years, for a similar period of the same length of higher temperature. In the years 1794 and 1850, the same temperature was nearly experienced. The melting of the snow at the beginning of this period, together with the heavy falls of rain, caused inundations in various places, and especially in some parts of Yorkshire and Lincolnshire.

From February 27th to the end of the quarter, with the exception of the five days from March 23rd to 27th, the weather was always cold and of a wintry character; there were frequent falls of snow and sleet up to a very late period in the month, all over the country. Till March 22nd the deficiency of temperature averaged 6½° daily.

The months of January and March will be remembered for their severe frosts and heavy falls of snow, that of February for its high temperature, and the whole quarter for a very unusual succession of high winds and gales.

The weather during the month of April was changeable, being at times very unsettled and stormy, with occasional heavy gales of wind and frequent falls of rain. The temperature of the air was subject to frequent variation, but was generally in excess over its average for the period. May opened with unsettled weather, but a remarkable change took place on the 6th, when a period of clear sky with brilliant sunshine set in. The temperature rose on the 6th and 7th of May to an excess of 15° and 17° above their averages. For the 42 days ending the 12th of May, the mean daily excess of temperature was 4½°. On 13th May a great change of weather took place; the summer-like weather which so suddenly set in, in the 2nd week in May, was as suddenly succeeded by a period of severe cold weather, the sky became cloudy, and the temperature lowered at night to below the freezing point; from the 21st day to the 25th the weather was more like winter than is ordinarily experienced in May, and the mean temperatures of these days were from 10° to 14° below their averages; the mean deficiency of daily temperature from 13th May to 26th May was 7° nearly. For a few days at the end of May and the beginning of June the weather was moderately fine and warm, the average daily excess of temperature being 4°. From 3rd June the weather was changeable, there being a few hot days together succeeded by long periods of cold weather, and upon the average of the last 28 days of the month there was a deficiency of temperature amounting to more than 1½° daily.

The cold period which set in on 3rd June continued throughout July, and extended to 7th August; during this time the weather was changeable and very unsettled; the amount of cloud was great, there was very little sunshine; and during the first week in August the temperature was unseasonably cold; some of the nights were frosty. From the beginning of July to the 7th August the deficiency of temperature was more than 3° daily on the average. From 8th August to the end of the quarter the weather was better; at about the middle of August there were a few days of hot weather, but generally the temperature was but little in excess above the average, and frequently for two or three days together was below. For the 54 days ending 30th September the average excess of temperature was 1¾° daily.

At the end of September the weather became cold, with prevalence of fog, and this weather continued till the 13th of October, with great fluctuations in the pressures of the atmosphere. From the 1st day of October to the 13th the average deficiency of mean temperature amounted to 8¼° daily. From the 14th to the 18th the weather was warm everywhere, and rain fell on each day; from the 18th the weather was generally mild, with frequent rain and a damp atmosphere; till the 1st day of November the excess of average temperature, for the 19 days ending this day, being 3¼° daily. During the month of November the temperature fluctuated frequently from above to below the average, but was chiefly below; the month proved to be one of the finest of Novembers, with but little fog and mist, and with a smaller quantity of rain than in any November for 50 years. The average deficiency of temperature from November 2 to December 1 was 1·6° daily. In the 1st week of December a sudden change took place in the weather, which became very stormy. Rain, hail, sleet, and snow fell at different parts of the country, and there was a great hurricane, causing great destruction both on land and sea. From

December 2nd to the 10th the temperature was low, and the average deficiency daily was as great as 9½°. Another great change took place on December 11th; the frost departed, and the temperature in the 7 days ending the 17th was in excess over the average by 7¼° daily, and from this time to the end of the year the weather was changeable, clouds and fogs were prevalent, and a good deal of rain fell over the country. The average deficiency of temperature in the 14 days ending December 31st was 2¾° daily. The month of December was remarkable for its sudden changes from one extreme to the other.

The reading of the barometer at Greenwich on the 1st day of October was 30·31 in., the highest in the month; it was 29·40 in. on the 8th, and this fall was accompanied by a gale of wind; on the 22nd it passed above 30 in., and continued above this point for a short time. It decreased to 29·2 in. on the 27th.

For several days preceding the 27th the wind was light; on the morning of that day pressures to 4 lbs. on the square foot were recorded, after 9 A.M. to 17 lbs., and early in the afternoon the extreme gust of 30 lbs. was registered, and after this the gale subsided. From November 2nd to the 13th the reading was constantly above 30 in.; it then decreased to 29·4 in. by the 15th, where it remained till the 17th, the wind during this time blowing strongly; the reading passed again above 30 in. on the 18th, and remained above till the 30th; it then decreased very rapidly to 28·7 in. by the 1st and 2nd of December, and those heavy gales took place to which reference has been made above, and which caused disasters at sea to be more numerous and the loss of life to be greater than usual.

The mean temperature of January was 34°·2, being 2° below the average of the preceding 96 years, 4°·1 below the average of the preceding 26 years, and lower than that of any of the preceding 5 years.

The mean temperature of February was 44°·7, being 6°·4 higher than the average of the preceding 96 years, 6° above the average of the preceding 26 years, and higher than that of any year since 1779, when it was 45°·3. In 1794 and 1850 the same mean value (44°·7) was obtained.

The mean temperature of March was 37°·7, being 3°·3 below the average of the preceding 96 years, 4° below the average of the preceding 26 years, and 2°·8 lower than that of last year.

The mean temperature of April was 49°·0, being 3°·1 higher than the average of the preceding 96 years, and higher than that of any year since 1845, excepting 1863, which was 49°·1.

The mean temperature of May was 53°·4, being 0°·8 higher than the average of the preceding 96 years, and higher than either of the two preceding years.

The mean temperature of June was 58·1, being the same as the average of the preceding 96 years, and 1°·0 below that of last year.

The mean temperature of July was 59°·4, being 2°·0 lower than the average of the preceding 96 years, and lower than that of any year since 1841, excepting 1862, which was 59·1.

The mean temperature of August was 62°·0, being 1°·8 higher than the average of the preceding 96 years, and higher than that of any year since 1861.

The mean temperature of September was 57°·6, being 1°·1 higher than the average of 96 years, and 1°·2 higher than that of last year.

The mean temperature of October was 48°·7, being 1°·0 lower than the average of 96 years, and lower than that of any year since 1854.

The mean temperature of November was 41°·4, being 1°·6 lower than the average of the preceding 96 years, and lower than that of any year since 1861.

The mean temperature of December was 37°·5, being 1°·6 lower than the average of 96 years, and 3°·0 lower than that of last year.

The mean high day temperatures were respectively 3°·8 and 5°·4 below their averages in January and March, and 5°·8 above the average in February.

The mean low night temperatures were below their respective averages in January and March to the amounts of 5°·1 and 2°·2, and in February 6° above the average.

Therefore in January and March both the days and nights were cold, whilst in February they were very warm.

The fall of rain was 1·1 in. above the average in January, was but slightly different in February, and again above the average in March to the amount of 0·7 in.

The mean high day temperatures were respectively 1°·3 and 0°·2 higher than their averages in April and May, and 0°·9 lower in June.

The mean low night temperatures were above their averages to the respective amounts of 3°·3 and 0°·5 in April and May, and 1°·1 below the average in June.

Therefore in April and May both the days and nights were warm, whilst in June they were cold.

The fall of rain was 0·5 in. above the average in April, 0·2 in. above the average in May, and 0·2 in. below the average in June.

The mean high day temperature was 2°·6 below the average in July, and respectively 0°·7 and 0°·4 above in August and September.

The mean low night temperature was 2°·1 below the average in July, and respectively 0°·4 and 1°·2 above the average in August and September.

Therefore in July both the nights and days were cold, and in August and September were somewhat warm.

The fall of rain was 3·2 in. above the average in July, 0·2 in. above in August, and 0°·5 in. above the average in September. Of the large amount of rain which fell in July, viz.,

·8 in., the great quantity of 3·7 in. fell on one day—the 26th.

The mean high day temperatures were respectively 1°·5, 1°·4, and 3°·1 lower than their averages in October, November, and December.

The mean low night temperatures were 2°·1, 2°·2, and 3°·5 lower than their respective averages in October, November, and December.

Therefore for the three months, October, November, and December, both the days and nights were cold.

The daily ranges of temperature were higher than their averages for October, November, and December to the respective amounts of 0°·6, 0°·8, and 0°·5.

The fall of rain was 0·7 in. in defect in October, 2·0 in. in defect in November, and 0·1 in. in excess in December.

The months of February and March were not favourable for agricultural operations; in the former month, owing to frequent rain and the flooded state of the land, and in the latter month spring farm work was frequently interrupted by its protracted wintry character, damaging growing crops, and checking vegetation.

Vegetation at the end of April was generally backward, and the cold weather in the middle of May greatly checked progress. June was dry; and the hay crop was generally stated to be good in quality and large in quantity, and stacked in good condition. No signs of the potato disease were reported up to the end of June; the wheat crop was variously reported as very light and thin in some places and much better in others.

Vegetation at the end of July was in a backward state, and the crops in many localities had sustained considerable damage from heavy rain. On Thursday night, 25th July, heavy rain began to fall all over the south of England, continuing almost uninterruptedly next day; the amount registered varied from 1½ inch to 3¾ inches, being the heaviest rain-fall in the space of a day I have ever known. The crops were extensively laid. The Thames and its tributaries overflowed their banks; and in other parts the rivers flooded the neighbouring land, inundating the crops in some places. The harvest prospect at the end of July was unpromising; in the most forward south-eastern districts a partial corn reaping had begun.

In August the crops greatly improved by the fine weather in the middle of the month, and but little rain fell in England, but it fell very nearly daily in Scotland, sometimes heavily, where the crops were extensively laid and continued quite green. At the end of the quarter the harvest in England was nearly completed, and was nearly so in Ireland, but in Scotland about one-third of the crops remained uncut.

The hay crop is said to be one of the heaviest and best secured for many years. The potato crop is large in bulk, but the disease is much complained of, particularly in Scotland.

At the beginning of October the outstanding portion of the crops in the Scottish uplands, and the late districts of England, Scotland, and Ireland, was but small, and the gathering was very frequently interrupted by rain. The most reliable reports at the close of the harvest, estimate the oat crop as the best of the season, and barley as the next in order for bulk, but showed considerable variation both in quality and weight. The wheat crop was also very varied; some proved to be of good quality, but taken as a whole, was below an average. Beans were a good average, but there was a small crop of peas. Potatoes were a large crop, but disease was spoken of in different places.

The fine weather in November enabled a great deal of field work to be done all over the country, and a great breadth of land was sown. In December the stormy weather stopped all outdoor farming work for some time. At the end of the year the accounts of the growing wheat crop were generally favourable all over the country. Upon the whole, the quarter was favourable for agricultural purposes.

ASTRONOMY AT THE ANTIPODES.

Astronomy is making good progress at the Antipodes. Mr. R. L. J. Ellery, Director of the Melbourne Observatory and Government Astronomer to the colony, has published an octavo volume, containing *Results of Astronomical Observations made in the Years* 1863, 1864 *and* 1865. The new observatory, intended to replace the former one at Williamstown, stands in an inclosure in the centre of a large park, where it commands an almost uninterrupted horizon, and is free from dust, smoke and vibration.

NEW MAP OF THE MOON.

The Lunar Committee of the British Association have issued two sections of their map on a scale of 200 inches to the moon's diameter, comprehending two areas of 25 superficial degrees in each, which are equal to 17,688 square miles English in the two. On these sections, printed red, the plains, craters, mountains, valleys and other objects are laid down in outline, each *known* object being distinguished by a reference number to the text which accompanies the two sections, and which treats, first, of the materials used in constructing the map; secondly, the arrangement of objects in zones for facilitating observation; thirdly, the kind of observations to be made for perfecting the work; fourthly, a descriptive catalogue of 203 known objects; fifthly, the full-moon aspects; and sixthly, copious tables of the lines of disturbance on the two areas. The portion of the moon embraced by the sections extends 6° westwardly from the first meridian, and 10° southwardly from the equator; the corresponding portion of Beer and Mädler's map is given in a plate accompanying the text.—*Athenæum.*

Obituary.

PERSONS EMINENT IN SCIENCE, ART, OR LITERATURE.

MICHAEL FARADAY, whose life had been spent from early years in the single pursuit of scientific discovery, died on Sunday, August 25, 1867, in his 73rd year. His biography is best told in his well-known letter to Dr. Paris, often printed:—

"My dear Sir,—You asked me to give you an account of my first introduction to Sir H. Davy, which I am very happy to do, as I think the circumstance will bear testimony to his goodness of heart. When I was a bookseller's apprentice, I was very fond of experiment, and very averse to trade. It happened that a gentleman, a member of the Royal Institution, took me to hear some of Sir H. Davy's last lectures in Albemarle Street. I took notes, and afterwards wrote them out more fairly in a quarto volume. My desire to escape from trade, which I thought vicious and selfish, and to enter into the service of Science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir H. Davy, expressing my wishes, and a hope that, if an opportunity came in his way, he would favour my views; at the same time I sent the notes I had taken at his lectures. The answer, which makes all the point of my communication, I send you in the original, requesting you to take great care of it, and to let me have it back, for you may imagine how much I value it. You will observe that this took place at the end of the year 1812, and early in 1813 he requested to see me, and told me of the situation of Assistant in the Laboratory of the Royal Institution, then just vacant. At the same time that he thus gratified my desires as to scientific employment, he still advised me not to give up the prospects I had before me, telling me that Science was a harsh mistress; and, in a pecuniary point of view, but poorly rewarding those who devoted themselves to her service. He smiled at my notion of the superior moral feelings of philosophic men, and said he would leave me to the experience of a few years to set me right on the matter. Finally, through his good efforts, I went to the Royal Institution early in March of 1813, as Assistant in the Laboratory; and in October of the same year went with him abroad, as his assistant in experiments and in writing. I returned with him in April, 1815, resumed my station in the Royal Institution, and have, as you know, ever since remained there. —I am, dear Sir, very truly yours, "M. FARADAY."

In 1821, while assisting Davy in pursuing the investigation of the relations between electricity and magnetism, first started by Oersted, he made the brilliant discovery of the convertible rotation of a magnetic pole and an electric current, which was the prelude to his wonderful series of experimental researches in electricity. These investigations procured him the honour of being elected Corresponding Member of the Academy of Sciences in 1823, and Fellow of the Royal Society in 1825. In 1827 he published his first work, a volume on *Chymical Manipulation*; and in 1829 he was appointed Chymical Lecturer at the Royal Military Academy at Woolwich, a post he held, in conjunction with his duties at the Royal Institution, for many years. In 1831 his first paper appeared in the *Philosophical Transactions* on the subject of electricity, describing his experimental studies of the science, and from that time for many years the *Transactions* annually contained papers by Faraday giving the method and results of his investigations.* These papers, with some others contributed to scientific journals on the same subject, were subsequently collected at different intervals in three volumes under the title of *Experimental Researches in Electricity.* The first volume appeared in 1839, and contained the contributions to the *Philosophical Transactions* up to that date. The second volume was published in 1844, and the third in 1855. It is not too much to say that by the experiments thus described Faraday formed the science of electricity. He established the identity of the forces manifested in the phenomena known as electrical, galvanic, and magnetic; he ascertained with exactness the laws of its action; he determined its correlation with the other primal forces of the natural world. While he was still pursuing the brilliant career of investigation which thus proved so successful, the Chair of Chymistry was founded at the Royal Institution in 1833, and Faraday was naturally appointed the first Professor. In 1835 he was recommended by Lord Melbourne for a pension of 300*l.* a year, in recognition of his great distinction as a discoverer. From that time his career has been one of increasing honour. Oxford conferred on him an honorary degree upon the first occasion of the meeting of the British Association at the University. He was raised from the position of Corresponding Member to be one of the eight foreign Associates of the Academy of Sciences. He was an officer of the Legion of Honour, and Prussia and Italy decorated him with the crosses of different Orders. The Royal Society conferred on him its own medal and the Romford medal. In 1858 the Queen most graciously allotted to him a residence at Hampton Court, between which and Albemarle-street he spent the last years of his life, and where he peaceably died. The belief in the disinterested zeal and lofty purity of life of the students of philosophy, which was one motive for Faraday's petition, when a lad, to Davy to enable him to become a servant in the humblest walks of science rather than to spend his days in the pursuit of trade, was redeemed by Faraday's whole life. No man was ever more entirely unselfish, or more entirely beloved. Modest, truthful, candid, he had the true spirit of a philosopher and of a Christian, for it may be said of him, in the words of the father of English poetry,—

"Gladly would he learn, and gladly teach."

* It was among the most pleasurable duties of the Editor of the *Arcana of Science and Art*, and the *Year-Book of Facts, alter idem*, to condense, year by year, these valuable papers, to suit his limited space.

The cause of science would meet with fewer enemies, its discoveries would command a more ready assent, were all its votaries imbued with the humility of Michael Faraday.

At the French Academy of Sciences, M. Dumas announced the death of Professor Faraday in the following terms:—"The labours of that incomparable philosopher are known to the whole world; but the ineffable kindness, frankness, and ingenuousness of his nature could only be appreciated by his intimate friends. It is nearly 50 years ago when I first met Mr. Faraday, and from that time I had frequent intercourse with him. I therefore had an opportunity of watching his glorious upward progress, and saw his natural and simple modesty increase in the same proportion as the strength of his genius and the splendour of his services. If his discoveries have immortalized him, and if he is remembered as one of the most fruitful minds of this century, he also leaves, to the honour and dignity of science be it said, the example of a pure life and a noble heart. England will not be alone in mourning his death."

Professor Sir W. Thomson, at the late meeting of the British Association at Dundee, remarked with much feeling, as to what Faraday had done for science:—"All *that* lives for us still, and parts of it we shall meet at every turn through our work in this (Mathematical) Section. I wish I could put into words something of the image which the name of Faraday always suggests to my mind. Kindliness and unselfishness of disposition; clearness and singleness of purpose; brevity, simplicity, and directness; sympathy with his audience or his friend; perfect natural tact and good taste; thorough cultivation;—all these he had, each to a rare degree; and their influence pervaded his language and manner, whether in conversation or lecture. But all these combined, made only a part of Faraday's charm. He had an indescribable quality of quickness and life. Something of the light of his genius irradiated all with a certain bright intelligence; and gave a singular charm to his manner, which was felt by every one surely, from the deepest philosopher to the simplest child who ever had the privilege of seeing him in his home—the Royal Institution. That light is now gone from us. While thankful for having seen and felt it, we cannot but mourn our loss, and feel that whatever good things, whatever brightness may be yet in store for us, *that* light we can never see again."

See, also, a luminous account of Faraday's contributions to science, from the pen of Professor de la Rive, translated from the *Bibliothèque Universelle*, at pp. 105–6 of the present volume.

WILLIAM, EARL OF ROSSE, known to the public at large as the framer of the great reflecting telescope at Parsonstown, in Ireland. As Lord Oxmantown he sat as M.P. for King's County from 1821 till the end of the first reformed parliament, when he retired from political life for the purpose of devoting himself to philosophical pursuits. In 1841, on his father's death, he succeeded to the title. Lord Rosse resided chiefly at Birr Castle, in

Ireland, where he set up his first telescope, in 1831. It had a concave speculum of 3 feet diameter, a focal distance of 27 feet, and was so nicely balanced by means of weights over pulleys that it could be raised or lowered to any angle with the greatest ease. The success of this instrument, the construction of which he had himself superintended, and a considerable part of which he had worked upon with his own hand, encouraged him to further effort. With a newer and more gigantic instrument, 52 feet in length and 7 feet in diameter, having a 6-feet speculum, many of the nebulæ previously seen merely as luminous patches were resolved into stars, and in others a spiral form and arrangement was detected. New nebulæ were discovered in considerable numbers, and wherever the instrument was directed new stars were seen in immense profusion. The second telescope was completed about 1848; and results were announced to the Royal Society in 1850. This magnificent instrument is described and figured in the *Year-Book of Facts*, 1845. Sketches of some of the more remarkable nebulæ were published in the *Philosophical Transactions* for 1850.* Lord Rosse was elected, in 1849, President of the Royal Society (of which he had been a Fellow since 1824), in succession to the late Marquis of Northampton. This post he held for the usual time of five years, and resigned it in 1854. In 1842 the University of Cambridge conferred on deceased the hon. degree of LL.D., and in the following year he presided over the meeting of the British Association at Cork. In 1853 his lordship was elected one of the members of the Imperial Academy of Sciences at St. Petersburg, and he was made a Knight of the Legion of Honour by the Emperor of the French in 1855. He was also a member of many learned societies on the Continent. The remains of Lord Rosse were interred in the church of St. Brandon, Parsonstown. They were removed in the morning to the chapel of Trinity College, where the first part of the funeral service was performed, and were thence brought by special train to their last resting-place. The *cortége* consisted of the Fellows, officers, and students of the University, to the number of over 300. Between 4,000 and 5,000 tenantry on his lordship's estates joined the procession on reaching Parsonstown. Within a period of ten days, died the Earl of Rosse; Sir James South, another celebrated worker in the same direction; and Lord Wrottesley, whose high astronomical attainments are well known. These three *savans* were all devoted to the pursuit of the same science—astronomy.

SIR JAMES SOUTH, F.R.S.—He was the son of a dispensing druggist who towards the close of the last century carried on business in High-street, Southwark, Borough; but James South entered upon a higher branch of the medical profession, and became a member of the Royal College of Surgeons. For some years he practised his profession in Blackman-street, and in the intervals of business

* See "The Nebulæ and the Rosse Telescope," in *Notable Things of our own Time*, by the Editor of the *Year-Book of Facts*.

pursued the study of astronomy, in connexion with which he made some extremely valuable observations. In 1822 and 1823, in conjunction with Sir John Herschel, he compiled a catalogue of 380 double stars. After this he removed to Campden-hill, Kensington, where he constructed an observatory, to which he devoted the closest attention during the remainder of his life, and which has achieved an European fame. He was one of the founders of the Royal Astronomical Society, and was for a time its president. In 1830, on the recommendation of the Duke of Wellington, who was then Prime Minister, he received the honour of knighthood, and for several years past he enjoyed a pension of 300*l.* a year on the Civil List for his contributions to astronomical science. The account of Sir James South's astronomical observations during his residence in Southwark is published in the *Philosophical Transactions* for 1825, and is accompanied by an interesting description of the five-foot and seven-foot equatorials with which they were made. One of these instruments is still mounted, and in excellent condition, at the Campden-hill Observatory. There are also in the observatory a seven-foot transit instrument and a four-foot transit circle, the latter celebrated as having formerly belonged to Mr. Groombridge, and as having been the instrument with which the observations were made for the formation of the catalogue of circumpolar stars which bears his name.

Lord Wrottesley, some years President of the Royal Society.—He was the second peer; but his family had been settled at Wrottesley, in Staffordshire, almost beyond legal memory. The fourth possessor of the estate, and third of the name, was one of the first Knights of the Garter. Lord Wrottesley was educated at Oxford, where he graduated in 1819, and began to be known in London, about 1827, in the scarce character—as it was in that day—of an Oxonian man of science. He was then practising at the bar. He joined the Committee of the Society for the Diffusion of Useful Knowledge, of which he continued a member to the last. Among their earliest treatises is one number from his pen, on Navigation. He was soon known at the Astronomical Society, of which he was for some years Secretary, and afterwards President. He did not long continue to practise as a barrister, but settled at Blackheath, where he built a small observatory. Here he trained, as his assistant, Mr. Hartnup, who is now Director of the Observatory at Liverpool. In 1839 Lord Wrottesley received the Gold Medal of the Royal Astronomical Society for his *Catalogue of the Right Ascensions of* 1,318 *Stars.* In 1841 he commemorated his succession to the baronetcy by establishing an observatory at Wrottesley. In 1853 he called the attention of the House of Lords to Lieutenant Maury's scheme of meteorological observations and discoveries. On November 30, 1854, he succeeded the Earl of Rosse as President of the Royal Society, which office he resigned in 1857, being succeeded by Sir Benjamin Brodie. He served on several important Royal Commissions, and was the author of *Thoughts on Government and Legislation,* "Lord Wrottesley," says the *Athenæum*, "was a strong man in all good work, but he did not make much show, even in science, and hardly ever came forward in political life. He was, we believe, one of the Boundary Commissioners under the first Reform Bill. His characteristics were plain manners, kind feelings, sound judgment, and useful intellect. A stranger at the Royal Society would look with some surprise when he saw a quiet gentleman, utterly devoid of all mark of pretension, step into the chair of Newton; and his surprise would be augmented if he chanced to be told that the unassuming President was a man of such splendid descent that many held his father to have derogated when he accepted a peerage.

The Chevalier Gaetano Bonelli, ex-Director of the Italian Telegraphs, inventor of the well-known telegraph apparatus which bears his name, and of the electric loom. Signor Bonelli was a distinguished man, of great inventive powers, and scarcely passed the prime of life.

Prince Maximilian, of Neuwied, the celebrated traveller.

Onufrio Cuxiatore, the able Director of the Observatory at Palermo.

Sir William Snow Harris, F.R.S., the inventor of the only safe method of lightning conductors.—At an early age he devoted himself entirely to the study of the elementary laws of electricity and magnetism. The eminence to which he attained is sufficient evidence of his natural talent, and of his patience and perseverance in scientific research. In 1820 he first discovered his mode of conducting lightning discharges by means of broad copper plates, and his writings soon attracted much attention. In 1831 he was admitted a Fellow of the Royal Society, upon the ground of scientific merit, having contributed at different times some valuable philosophic papers, which were presented to the Society by Sir Humphry Davy and Mr. Davies Gilbert. In 1835 the Society awarded him the Copley medal, one of the highest honours in its gift, and which for upwards of one hundred years has been awarded to the authors of brilliant discoveries. In 1839 his "Inquiries concerning the Elementary Laws of Electricity," third series, were printed in the *Philosophical Transactions* as the "Bakerian Lecture," and earned the bequest of Mr. Henry Baker, F.R.S. In 1841 Her Majesty was pleased to confer upon him an annuity from the Civil List of 300*l.*, "in consideration of his services in the cultivation of science." The pension was not granted him, as some have erroneously supposed, for his invention of lightning conductors, Lord Melbourne, through whom the communication of the royal wishes passed, having guarded carefully against any construction of that kind being put upon this gracious act, for although Snow Harris's system of lightning conductors had been before the public ever since 1820, and had been pronounced by a mixed naval and scientific commission appointed in 1839 to investigate and report on lightning conductors for ships, to be "superior to all others," and was earnestly "recommended to be generally adopted into the Royal Navy," it, nevertheless, had not been adopted in 1841. In fact, it was not until the year 1843, after every conceivable opposition to it, arising from interest, prejudice, superstition, and ignorance, had been encountered and vanquished, that it was at last ordered to be universally employed in all Her Majesty's ships. The value of the invention will be instantly appreciated when we state that loss or damage by lightning in the Royal Navy has been since that time absolutely unknown, while previously the material damage alone had been estimated at 10,000*l.* per annum, to say nothing of the loss of life and of the services of ships of war obliged to undergo repairs at critical periods on foreign stations. With the light lately thrown on cases of this kind by the history of Mr. Snider, it will readily be believed that Mr. Snow Harris experienced the greatest possible difficulty in obtaining any solid recompense from the Government for his most valuable invention, to perfect which he had sacrificed his profession, and devoted all his energies for many years, although he had placed it without reservation at the public service. It is true that in 1847 the honour of knighthood was conferred on him, and he had on several occasions been honourably mentioned in both Houses of Parliament, but upwards of ten years were allowed to pass before any grant was made to him. In 1860 he was appointed scientific referee of Government in all matters connected with electricity, and in this capacity had to superintend the fitting of his conductors to the Royal Palaces, the Houses of Parliament, the powder magazines, and other important public buildings, the very last upon which he was personally engaged being the Royal Mausoleum at Frogmore, in which are deposited the remains of the late Prince Consort. Sir William Snow Harris is also the inventor of an improved mariner's compass, of another method of lightning conductors for iron ships, now being applied to our fleet of ironclads, and is the author of many interesting treatises on electricity, thunder-storms, and electro-magnetism. Up to the time of his death he was engaged in preparing a work on *Electricity in Theory and Practice.* His son now fills the post of resident civil engineer superintending the construction of the Spithead forts under Mr. Hawkshaw.—*Times.*

Antoine Francis Claudet, F.R.S., the eminent photographer. Shortly after the discovery of the Daguerreotype, M. Claudet communicated to the French Academy of Sciences a paper on the discovery of a new process for accelerating the production of the daguerreotypic image by the addition of bromide and chloride of iodine to the iodide of silver; thus permitting a portrait to be obtained in fifteen or twenty seconds. This discovery was, with the fixing of the image by chloride of gold, the completion of Daguerre's invention. In 1849 M. Claudet communicated a paper to the French Academy upon the use of a new instrument called the Focimeter, the object of which was to secure the good focus of photographic portraiture. In 1848 he communicated a paper upon a new apparatus called the "Photographometer," the object of which was to measure the intensity of the photogenic rays and to compare the sensitiveness of various compounds. This paper was also read before the British Association of Birmingham, 1849. At the Universal Exhibition of 1851, M. Claudet received the Council medal from the President of th(jury for his numerous discoveries in photography. In 1853 M. Claudet was elected a member of the Royal Society, for his various scientific labours and discoveries in connexion witl photography. His certificate of admission was signed by Sir John Herschel, Sir David Brewster, Prof. T. Graham, Prof. Wheatstone, Prof. Faraday, Mr. Babbage, and other eminent members of the Society. In the same year he had the honour of taking the portrait of Her Majesty and several other members of the royal family, and was appointed Photographer in Ordinary to Her Majesty. In 1855 M. Claudet obtained a first-class medal at the French International Exhibition for his eminence in the profession. In 1858 he communicated a paper to the Royal Society upon the "Stereomonoscope," an instrument founded upon the principle of the *inherent property* of the ground glass of the camera to produce in relief the image of the camera-obscura. In 1862 M. Claudet was elected member of the jury at the London International Exhibition, and obtained the medal of the jury. In 1850 a medal was presented to him by the Society of Arts and Manufactures of London for the invention of a new machine for cutting glass, whatever might be the curvature of its surface. He received this medal from the hands of H.R.H. the late Prince Albert. M. Claudet was a Chevalier of the Order of the Legion of Honour, and he had tokens presented to him by the late Emperor of Russia and King Louis-Philippe. (*Athenæum.*) Among the earliest and most successful followers of Daguerre, M. Claudet was almost the last to abandon the use of metal plates for the more modern and improved processes of photography; and it was in some degree due to his skill and knowledge that the Daguerreotype at first made such progress in this country, while the inventor's own countrymen were as eagerly bent upon developing the new art in the direction traced by our Fox Talbot. M. Claudet's nice discrimination and manipulative dexterity gave to the productions of his camera an extraordinary refinement.

M. Pelouze, the eminent French chemist, Master of the Mint in Paris, and whose name will be familiar through his researches to all our readers. The day previous to his death, the *Chemical News* says that he had been attacked by heart dropsy, and he expressed an urgent desire once more to breathe the pure air of the heights of Bellevue (near Meudon). No sooner was he in the carriage than a faintness came over him, from which he recovered with much difficulty. His family yielded to his wish by taking him to the desired spot, where he arrived in the evening only to die on the following morning at seven. He was born at Valognes, in the department of the Manche, in 1807, and was, in his first outset of life, a simple laboratory student. He became successively Professor at the Polytechnic School, Professor of the French College, Member of the Academy of Sciences, Verifier of the Mint Assays, Member of the Municipal Council of Paris, Director of the St. Gobian Glass Works, and, lastly, President of the Commission of the Mint, the highest post that a practical chemist can aspire to. M. Pelouze died with resignation, and in the faith of a Christian. He was buried at Montmartre Cemetery, in the family tomb, the corpse being followed by an immense *cortége*, composed of all the *élite* of society, the principal members of the Academy, six carriages of the Municipal Council, and the National guard in full uniform. M. Fremy the distinguished chemist of the *Conservatoire des Arts et Métiers*, delivered the usual funeral oration.

VICTOR COUSIN, the celebrated historian of Philosophy. M. Cousin has not only bequeathed his magnificent library of 14,000 volumes to the Sorbonne, but has made arrangements in his will by which it is to remain in its present locality. The rooms which it occupies are to be added to the library apartments of the Sorbonne, and all the furniture, engravings, &c. are to remain intact. M. Cousin further endows the Sorbonne with an annual income of 10,000 francs to defray the expense of keeping his library; appoints M. St.-Hilaire chief librarian, and leaves him all his papers, on condition that he is to write the testator' biography.

JEAN DOMINIQUE AUGUSTE INGRES, the famous French painter; pupil of David.

DR. DAUBENY, F.R.S., a name familiar to Oxford men. He was a younger son of the Rev. James Daubeny, rector of Stratton, and was born in 1795. He was educated at Magdalen College, Oxford, where he took his B.A. degree in 1814, when he was second-class in classics. In 1815 he gained the Chancellor's Prize for an essay, "*In illâ Philosophiæ Parte quæ Moralis dicitur, tractandâ, quænam sit præcipue Aristotelicæ Disciplinæ Virtus?*" In due course he obtained a lay Fellowship at Magdalen, and applied himself to the study of medicine, and for several years practised his profession. In 1822 he was elected to the Professorship of Chemistry. In 1829 he relinquished the practice of his profession, and devoted himself to the study of the physical sciences, particularly to chemistry and botany. In 1834 he was elected to the Professorship of Botany. He was also curator of the Botanical Gardens at Oxford. Dr. Daubeny took an active part in the proceedings of several Congresses held for the promotion of physical science, and was a voluminous writer on scientific subjects. Among his numerous works may be mentioned a *Description of Active and Extinct Volcanoes*, a second edition of which was published in 1848, *An Introduction to the Atomic Theory*, and *Lectures on Roman Agriculture*.

DR. THOMAS CLARK, late Professor of Chemistry in Marischal College, Aberdeen. Dr. Clark's methods of testing and purifying water are well known. The soap test devised by him has been used by chemists for twenty-five years without receiving modification or improvement. This process for softening water on a large scale is also much used at the present time, and was, indeed, mentioned by several fellows in a discussion at a late meeting of the Chemical Society. The subject of water seems to have been the one to which Dr. Clark specially devoted himself, and to which almost all his papers in scientific journals refer. His writings have a peculiar charm in them from the modesty with which he expresses himself. Though not a Fellow of the Royal Society, Dr. Clark, had he lived, probably would have been made one at the next election, since we learn from the *Chemical News* that his friends were circulating a certificate for signatures.

VALENTINE KNIGHT, President of the Horological Society of Great Britain, which position he had filled since the establishment of the society in 1858. Mr. Knight was possessed of a large fortune, the foundation of which he laid as a watch-dial maker in Clerkenwell. Although for many years he had ceased to occupy himself with business, he nevertheless maintained a close connection with the watch and clock making interests of Clerkenwell, and has been a liberal supporter of societies connected with the trade. Mr. Knight took an active part in the practical advancement of Horological Science, and will be regretted by a large circle of friends, who will not readily forget his urbane and kindly disposition.—*Mechanics' Magazine.*

SIR JOHN LUBBOCK, F.R.S., who united, in a remarkable degree, the knowledge of business and science.

JAMES RENNIE, popular writer on Natural History. (*Insect Architecture, &c.*)

JOSHUA ALDER, the eminent Naturalist, of Newcastle-on-Tyne. He had been some years in weak health, but continued working on his intended work on the British Tunicata until within a few days of his death. He published some excellent papers on the Mollusca and Zoophytes of Northumberland, and was the person generally referred to on all difficult points in the natural history of the British species of these animals. He published, in conjunction with Mr. A. Hancock, the beautiful and standard work on the Nudibranchiate Mollusca of the British Islands, which was so highly esteemed as to be republished on the Continent.

F. J. FOOT, one of the senior geologists of the Irish branch of H.M. Geological Survey. He was drowned in Lough Key, near Boyle, while skating, and in the act of proceeding to the assistance of two others who were immersed, but whose lives were saved.

JOHN MACGILLIVRAY, Naturalist of H.M.S. *Rattlesnake.* He had just returned from an expedition to the Richmond River, and was preparing to leave for the islands of the South Pacific, when his career of usefulness was cut short by death. John MacGillivray was the eldest son of the late William MacGillivray, Regius Professor of Natural History, Marischal College, Aberdeen. He was intended for the medical profession, and had all but completed his studies when the late Lord Derby offered him the appointment of naturalist on board H.M.S. *Fly*, which was about to make the voyage round the world. On his return to England, he was appointed naturalist to H.M.S. *Rattlesnake*, employed on the Government Survey, and recorded the results of a three years' cruise in two interesting volumes. His next appointment brought him to Sydney in 1856, and the rest of his life was devoted to scientific investigations into the natural history of Australia and the neighbouring islands. He spent nearly five years among the savage inhabitants of the South Sea Islands, where he had many strange adventures and hair-breadth escapes.

William Kidd, a popular illustrator of Natural History.

William John Hamilton, the eminent geologist. Mr. Hamilton became a member of the Geological Society in 1831, and in the following year was elected one of its Honorary Secretaries, which office, or else that of Foreign Seeretary, he continued to occupy almost uninterruptedly till 1854, when he was elected its President. Mr. Hamilton was elected President of the Geological Society for the second time in 1865. His later contributions to geology were on Tuscany, and the best account that has yet been given on the Eocene basin of Mainz was the result of his examination of it, and of the large collections of the fossils he formed there in 1852. For some years he had devoted much time and expense to recent conchology, under a sense of the dependence of the history of the Tertiary period of geologists on a knowledge of existing forms of shells, and their geographical distribution, with which objects in view he had already formed a very large collection. It was in the hope that he might some day turn this knowledge to the service of geology that he joined in the excursions which several of his fellow-members of the Geological Society made into the districts of the Faluns of Touraine and the crag of Antwerp.—*Athenæum*.

Count Girolamo Antonio Dandolo, Director of the Venetian Archives. He was the last male representative of an ancient family. By the preface to the first volume of the *Venetian Calendar*, we are reminded that the fall of the Republic took place on the following 12th of May; and in that same preface the cordial assistance rendered by Count Dandolo for the compilation of the *Calendar* is deservedly eulogised. In like manner, at the time of his death, he was aiding to complete the second volume. In the course of last summer, at the request of the Master of the Rolls, he enabled our Record Office to procure sixty-three photographed pages of ciphered despatches, written by the Venetian ambassador in London, from the 12th of March, 1555, to the 7th of April, 1556.

Captain Cresswell, R.N., who attained some celebrity in 1853 in connection with Arctic exploration. On his return to his native town (Lynn, Norfolk), Captain (then Lieutenant) Cresswell was entertained at a public dinner, at which the late

Admiral Sir E. Parry emphatically declared that he was the first person who had traversed the long-attempted north-west passage. Captain Cresswell subsequently sailed for China, where his health failed from the extreme change of climate, and he passed away at the early age of thirty-nine.

PROFESSOR J. W. M'GAULEY, Editor of the *Scientific Review*, and author of several well-known works in various departments of science and literature. The late professor was formerly lecturer of Natural Philosophy to the Board of National Education, where he acquired a high and deserved reputation. He contributed many articles to scientific periodical literature, and to the proceedings of the British Association.

DR. PETRIE, the well-known writer on Irish archæology, Vice-President of the Irish Academy, and formerly President of the Hibernian Academy. In 1832, for his Essay on the history of the "Round Towers," Dr. Petrie received the prize offered by the Irish Society, in all, 900*l.*, on account of the work; besides this, other rewards were bestowed upon him, including a pension of 300*l.* per annum. He directed the historical and antiquarian departments of the Irish Ordnance Survey. His principal work is *The Ecclesiastical Architecture of Ireland anterior to the Anglo-Norman Invasion;* his collections of Irish antiquities are of considerable value.

M. HITTORFF, Architect, of Paris. He was member of the Institute and of the Legion of Honour, Knight of the Black Eagle of Prussia, and Member and Royal Gold Medallist of the Royal Institute of British Architects. He was architect of the Cirques de l'Empereur and de l'Impératrice, of the great Church, or rather Basilica, of St. Vincent de Paul, of the fountains and pavilions in the Champs Élysées, and of various Mairies and other important buildings. His knowledge of classic antiquity and his various publications, especially that on the art of polychromy as applied to monumental art, placed him in the highest rank among the writers on his art, and his death will leave a great loss in that department of architectural knowledge and scientific research. His last work is the noble Station of the Chemin de Fer du Nord.

GODFREY SYKES, Captain Fowke's chief helper in the decorative portions of the new buildings at the Kensington Museum. His talent lay in decorative art. Few artists of the present day have made so distinctive a style of their own as he has done, founded chiefly upon a study of the works of Michael Angelo and Raphael, whose effigiés he had designed for mosaic in the Museum.

EDWARD HAWKINS, F.S.A., many years Keeper of the Department of Antiquities in the British Museum. Mr. Hawkins published several valuable works on numismatic subjects, all of which contain numerous plates, drawn with scrupulous accuracy under his own eye, chiefly by the late Messrs. Corbould and Fairholt. As such, may be mentioned *an Account of the Anglo-*

Gallic Coins in the British Museum, and *The Silver Coins of England*, which is still the text-book on the subject. Mr. Hawkins also prepared and put in type fifteen years since a considerable portion of a complete history of all known English medals, under the title of *Numismata Britannica.* This work, it is understood, is now in progress towards completion, and will shortly be made public. Mr. Hawkins was for many years Fellow and Vice-President of the Royal Society, Fellow and President of the Numismatic Society, and Vice-President of the Society of Antiquaries. To the *Transactions* of each of the two last Societies, he gave many valuable papers; and as keeper of his own department of the Museum, he contributed much to the efficiency and accuracy of the eighth, ninth, and tenth parts of the *Account of the Ancient Marbles in the British Museum*, printed between the years 1839 and 1845, at the expense of the Trustees.

Baron Marochetti, R.A., the sculptor, who owed more of his success in life to royal and noble patrons than artistic merit. He is popularly known by his equestrian statue of Richard Cœur de Lion, now at Westminster; it was one of the art trophies of the Great Exhibition of 1851, and purchased by the influence of the desperate efforts of a clique, with a sort of conventional reputation as patrons of art. His statues and groupes possessed vitality and occasional elegance, but want finish; and, notwithstanding high patronage, he had been thirteen years in England before the Royal Academy elected him an Associate, and five years longer before he was made R.A. He is described as a genial and accomplished gentleman. The bronze lions of the Nelson Column, in Trafalgar Square, designed by Sir Edward Landseer, R.A., were cast under the direction of Baron Marochetti. He was only 63 years old at his death. One of the best of Marochetti's later bronzes is the fine statue of the late Duke of Wellington, which now adorns the principal entrance to the park of Strathfieldsaye. It is of heroic proportions, the attitude is easy but majestic, and the likeness is, as in the majority of Marochetti's statues, admirable.

Edward Hodges Baily, F.R.S., R.A., the most graceful sculptor of his time.—"The greatness of Baily is not a thing of time and season; depending on accident for its recognition, and on fortune for its permanence. Baily belongs to the enduring memories of English Art; and the future will be as proud of his achievements and as jealous of his fame as we are now of Flaxman's."—*Athenæum.*

Professor John Goodsir, anatomist.

Dr. F. H. Ramadge, medicine.

W. B. Costello, medicine and surgery.

H. M. Wood, architect.

Sir Robert Smirke, Architect, the builder of the late Covent Garden Theatre, the central part of the Custom House, the General Post Office, Millbank Penitentiary, and the British

Museum. He was born in 1780; was elected an Academician in 1813, and was knighted in 1831. He was an extremely estimable man in private life, and leaves a very large circle of sorrowing friends.

CRABB ROBINSON, the principal instrument in procuring for University College the works of Flaxman, which now constitute the Flaxman Gallery. His executor has handed to the Council a trust deed for 2,000*l.*, the interest of which is to be expended on the Gallery.

J. G. S. VAN BREDA, for many years Perpetual Secretary of the Dutch Society of Sciences at Haarlem, and a most zealous promoter of science, died last month, aged nearly seventy-nine.

GEORGE CAMPBELL DE MORGAN, M.A., Vice Principal of University Hall, and Secretary of the Mathematical Society, of which he was one of the earliest projectors.

O. W. LANG, naval architect. He received his professional education under the auspices of his father, Mr. Oliver Lang, formerly master-shipwright of Woolwich Dockyard; and, during the early part of his career, assisted him in the construction of all the ships he so successfully designed for Her Majesty's Navy, among which were the *Black Eagle*, *Medea*, *Niger*, and *Terrible*, the latter the finest paddle war steamship ever produced, and also the *Royal Albert*. In 1828 he entered the service at Woolwich Dockyard as an experienced naval architect, and in 1831 was appointed to assist (the then) Captain Symonds in the construction of ships of war. In 1837 he was appointed to Devonport, and in 1843 to Deptford, to re-establish that yard. In the following year he joined Chatham Dockyard as assistant master-shipwright, and in 1853 he was promoted to be master-shipwright at Pembroke, where he built the royal yacht, *Victoria and Albert*. His last appointment was in 1858, to Chatham, and he remained there until his retirement in 1862, when he was the senior master-shipwright in the service by more than six years. In the mercantile navy, Mr. Lang's reputation was at an early age very great, and continued steadily to increase up to the present time, he having met with universal success in every undertaking. At the age of eighteen he designed the *Ruby* for the Gravesend Company, which was subsequently purchased by the General Steam Navigation Company, and was the fastest steamer on the Thames for many years.

Twenty-four years ago, in 1845, the *Porcupine* and *Spitfire* steam vessels were designed and built by him in Deptford Dockyard. They were both very successful; but his reputation was chiefly established by the *Garland* and *Banshee*, both built from his designs and under his superintendence, and the latter, especially, obtained a world-wide fame. These vessels were exposed to a most severe competition from his opponents, and so complete was their success that Mr. Lang was ordered to design and build in Chatham Dockyard the *Vivid*, for the Dover station (when the service was performed by the Admiralty), and the *Elfin*, despatch-yacht, for Her Majesty. All these vessels were built on the diagonal principle, which was introduced by him. Subsequently to this, he, in 1859, designed and built the *Nankin*, 50-gun frigate, for the experimental squadron; but, from some unexplained reason, she was at once put into ordinary in Chatham Harbour, and not commissioned until 1854, when she beat every ship she fell in with, and was officially reported to be "very easy, stiff under canvas, a most excellent sea-boat, and in all respects a complete man-of-war."

In the great revolution in the building of ships of war, Mr. Lang played a conspicuous part. A short time after the drawing for building the *Achilles* was received at Chatham, he submitted, through the captain-superintendent, a design for giving her a flatter floor (one exactly similar to that proposed for his iron-cased frigate in 1859), and increasing her displacement sufficiently to allow the armour plating to be carried all round the ship, instead of only amidships, as then intended. This alteration was adopted, as to the flatter floor and increased displacement; but, instead of completely armour-plating her, the Admiralty ordered her to have a belt of armour-plating at the water-line only, as at that time ordered to be fitted to the *Enterprise*, *Research*, and *Favourite*, by which the rudder-head, tiller, steering-wheel, &c., were left unprotected. To obviate this, Mr. Lang again proposed to armour-plate the *Achilles* at the fore and after ends as high as the main-deck, undertaking, at the same time, not to increase the weight of the hull; in fact, by doing away with the armour-plated bulkheads, &c., he saved 12 tons, and completely protected the rudder-head, tiller, steering-wheel, and everything on the lower-deck. The Admiralty, after testing the correctness of his calculation of weights, adopted this plan in the *Achilles*, and afterwards in many other vessels. While at Chatham Mr. Lang also built the *Royal Oak*, the first at sea of our converted wooden armour-plated ships by many months, and thus (the *Achilles* being the first iron ship ever built in the establishment) he was the pioneer of iron shipbuilding in Her Majesty's dockyards.

Sir William Lawrence, Bart., Serjeant-Surgeon to the Queen.

Sir Archibald Alison, D.C.L., the popular historian.

Sir George Smart, the celebrated musical conductor, in his 91st year. As one of those who organised the Philharmonic Society, he left no stone unturned to acquaint himself with every foreign novelty. He made a journey to Vienna to come to some understanding with Beethoven as to the ideas which that strange man of genius entertained respecting the performance of his own music. He was "first foot" (as the Scotch say) in welcoming to England Weber, who died a guest in his house. He was as cordial as he was far-sighted in respect of Mendelssohn. He had (further to illustrate his universality) the first-fruits of Signor Rossini's "Stabat," which was in England originally produced at his house with Miss Louisa Pyne and her sister as the principal singers.—*Athenæum*.

Clarkson Stanfield, R.A., the celebrated marine painter.

John Phillip, R.A., painter. He studied in London, under Mr

T. M. Joy. It was not, however, till after after a visit to Spain—where he went in search of health—in the year 1851, that Phillip found his true field as a painter. His last pictures were his best. The English School has lost in his death a great colourist.

John Hardman, artist in metal and glass.

Robert Archibald Armstrong, Gaelic philologist.

William Dargan, of Dublin, the eminent railway contractor. The first important employment he obtained was under Mr. Telford, in constructing the Holyhead road. He there learnt the true art of road-making, then applied for the first time by his chief, the secret of which was raising the road in the middle that it might have something of the strength of the arch, and making provision for the effectual draining off of the surface water. When that work was finished Mr. Dargan returned to Ireland and obtained several small contracts on his own account, the most important of which was the road from Dublin to Howth, which was then the principal harbour connected with Dublin. Mr. Dargan was the first to extend the benefits of the railway system to Ireland, and he became the contractor of the first railway in Ireland—the Dublin and Kingstown line—a most prosperous undertaking, which has always paid better than any other line in the country. For several years it stood alone. People were afraid to venture much in railway speculation. Canal conveyance was still in the ascendant. A Company was formed for opening up the line of communication between Lough Erne and Belfast, and Mr. Dargan became the contractor of the Ulster Canal, which was regarded as a signal triumph of engineering and constructive ability. Other great works followed in rapid succession: first the Dublin and Drogheda Railway, then the Great Southern and Western, and the Midland Great Western lines. In fact, the only important lines in Ireland with which Mr. Dargan was not connected are the Londonderry and Enniskillen and the Londonderry and Coleraine, which were constructed by Mr. William M'Cormack. At the time of the Irish Exhibition in 1853 Mr. Dargan had constructed over 600 miles of railway, and he had then contracts for 200 miles more. All his lines have been admired for the excellence of the materials and workmanship. His aptitude for business was marvellous. When his mind was occupied with the arrangements of the Exhibition of 1853 he had in his hands contracts to the aggregate amount of nearly two millions sterling. He was the man who found the capital for the Exhibition. He began by placing 30,000*l.* in the hands of the committee, and before it was open in May, 1853, his advances reached nearly 100,000*l.*, of which his loss amounted to 20,000*l.* From a great public meeting resulted a suitable monument to Mr. Dargan—the Irish National Gallery, erected on Leinster Lawn, with a fine bronze statue in front looking out upon Merrion-square. The Queen offered him a title, which he declined.

William ———, C.E., of Victoria, a colonist of some twelve years' standing, nearly nine years of which time was passed in Bacchus Marsh. He was the son of the real inventor of Steam Navigation, who, in 1789, fitted a boat with a steam propelling apparatus, which was tried on the Forth and Clyde Canal, and with such success that Lord Dundas and the Duke of Bridgewater earnestly assisted Mr. Symington in further developing his invention. Mr. Symington, now deceased, was the "inventive son of an inventive father," for he, besides other inventions, perfected a plan for preserving potatoes, and also one for preserving milk. He was born in Falkirk, Stirlingshire, on March 22, 1802. In 1844 he received the Gold Medal of the Society of Arts, for his invention for desiccating or extracting moisture from various substances—such as woollen and silk fabrics, wood, &c., and for purifying casks. Mr. Symington also exhibited at the Great Exhibition of 1851 an improved gun wad, made of wood, which was then rejected by the Admiralty authorities as unsuitable for adoption by them, but at the present time this gun wad is almost exclusively used in the service; and Mr. Symington fitted up at the Woolwich Arsenal one of his desiccating machines for the very purpopse of drying or seasoning gun wads of his own invention. He also effected an improvement in projectiles, for smooth-bore guns, obviating the necessity of rifling.—*Mechanics' Magazine.*

Gideon Scott, for the space of nearly half a century intimately connected with mechanical and civil engineering works in England: for eighteen years he was managing foreman for the Messrs. Rennie; and during that time he superintended the construction and erection of the flour, oatmeal, and chocolate mills in the Royal Victualling Yards at Plymouth, Gosport, and Deptford. The celebrated biscuit machinery at Gosport and at Plymouth was mainly invented by Mr. Scott, and wholly erected under his management. As a civil engineer he also distinguished himself in later years, and he successfully constructed several building docks for the Government at Chatham, Sheerness, and at Woolwich. The Admiralty Pier at Dover was carried out to the distance of 600 ft. under Mr. Scott's management, and he also lent valuable aid in the erection of many railway bridges across rivers and streams. His knowledge and experience in regard to hydraulic engineering were profound and extensive, and he was frequently consulted thereon by the most eminent architects and engineers of this and other countries. Mr. Scott was the friend of Watt and of John Rennie, as well as of other celebrated men of the last generation. His death took place when he had attained the mature age of 75 years.—*Ibid.*

William Baddeley, C.E., for many years connected with the *Mechanics' Magazine*, in which appeared his Annual Reports of the London fires. Mr. Baddeley had been connected with the London Fire Brigade ever since its formation by Mr. Braidwood. He was the original promoter of the London Society for the Protection of Life from Fire, and was for many years superintendent of the Society, having been latterly made an inspector. [illegible] their appreciation of Mr. Baddeley, the Society presented him with the sum of 250*l.*, on his retirement from the post of inspector, which he was obliged to resign through age and infirmity. Mr. Baddeley was the originator of the movement which led to the adoption of enquiries into the causes of fires. He also brought out several important improvements in fire engines, including the hand engine, which is in use by the brigade to the present day. He was a most prolific inventor in various directions, chiefly, however, in apparatus for the prevention or suppression of fires. He gave most of his inventions to the public. Mr. Baddeley's last effort was the organisation of volunteer fire brigades in London, one of which—the Holloway brigade—is superintended by his son.

William Carpmael, the well-known and highly esteemed Patent agent, of Southampton-buildings, Chancery-lane. Mr. Carpmael's was not only a name familiar to every one engaged directly or indirectly in matters connected with the Patent Laws, for the reform of which he was a strenuous and persistent advocate. Mr. Carpmael was born on February 27, 1804. In early life he was a pupil of Professor Millington, C.E., &c.; and he afterwards studied law under Mr. Colman, special pleader of the Temple. Subsequently Mr. Carpmael became a member of Lincoln's Inn. We thus see the course of training Mr. Carpmael underwent, which so eminently befitted him for his subsequent successful practice as a patent agent. Mr. Carpmael's scientific attainments gained for him a membership of the Royal Institution, and of the Institution of Civil Engineers, of which body he was formerly a member of council. He was also member of the Society of Mechanical Engineers, and of the Institute of Naval Architects. In Mr. Carpmael the Metropolitan Board of Works has lost one of its earliest members, he having been a member from the commencement. As an author Mr. Carpmael is well known by his sound practical and useful work on the Patent laws. He took a most active part before the various committees of the Houses of Parliament, and on Bills connected with the amendment of the Law of Patents.—*Mechanics' Magazine.*

Captain John Norton, the able writer on matters of gunnery, &c. He invented many improvements in rifles and projectiles. We believe him to have been the original inventor of the bullet now used with the Enfield rifle, and known as the Minié bullet, and for which Minié received the Government premium.—*Mechanics' Magazine.*

Elias Howe, the inventor of the sewing-machine. A native of Massachusetts, he first worked on a farm, then in a cotton-mill at Lowell, and afterwards as a machinist at Boston. He was twenty-eight years old when he invented his sewing-machine, and had to wait and struggle through seven anxious years before its merits were recognised. In that period 8,000 machines had been constructed. In the year ending last June, more than 170,000 machines were made in the United States. For some years Howe received a royalty on each one, and at the time of his death had accumulated a fortune of 2,000,000 dollars. He died at the comparatively early age of forty-eight.

ALFRED KING, C.E., who had acted as Engineer in chief to the Liverpool Gas Light Company for about forty-one years. During that period he had to provide gas for a population which increased from about 200,000 to 500,000 persons.

JOHN BETHELL, only brother of Lord Westbury. He was the second son of Dr. Bethell, of Clifton, and was educated for the common law bar. He subsequently practised as a solicitor in London, and in 1833 became interested in a factory for making screws, bolts, and rivets by Lemuel Wright's machinery, for the improvement of which he took out his first patent in 1834. Having contracted a taste for science, he became intimate with Dr. Neil Arnott, and the late Dr. Ure, from whom he learned very sound views of Physics and Chemistry. In 1835 he patented a very complete system of diving apparatus. This apparatus, upon which the Jury of the Exhibition of 1862, Class 10 A, report that no improvements in construction or principle have since been made, consists of an air-tight dress and helmet, to which air is supplied of a density proportionate to the depth descended by the diver, together with an arrangement of available air-bladders and weights which enable him to rise or sink in the water. There were also marine lamps and reflectors to render visible submarine objects, and sight tubes to enable the eye to see more clearly through water.

Upon becoming an Associate of the Institution of Civil Engineers in 1838, Mr. Bethell read a paper, and showed experiments to recommend the use of the galvanic battery to explode submarine and simultaneous land blastings. He states in this paper that he exploded a sunken ship with gunpowder by means of a platinum wire, connected with coated wires attached to a pile, as far back as 1834. In 1838 Mr. Bethell introduced the process by which he was most generally known, viz., the preserving timber from decay and the attack of insects and worms by impregnating it with oil of tar, commonly called creosote oil. This invention recommended itself to the judgments of Messrs. Brunel and Stephenson, and was adopted at once on a large scale. It has also been very successfully employed in India and South America against the white ants. In India a similar material, viz., Rangoon petroleum, has been used from time immemorial against these insects. Creosoting is almost indispensable in marine works, as it forms the only known protection against the ravages of the teredo and limnoria terebrans. Mr. Bethell obtained prize medals for his creosoting process in 1851 and 1862. Creosoted sleepers are now upon the London and North-Western Railway between Manchester and Crewe, which have seen 27 years' service.

In 1840, Mr. Bethell took a patent for treating inferior animal and vegetable oils, by depositing the mucilaginous and gelatinous matter from them, and mixing them, or distilling them over, with light hydrocarbons, to obtain good lamp oils. In a patent taken by him in 1848, a very ingenious mode of drying grain, upon a system of endless cloths on revolving rollers is described; also a method of preserving meat by injecting into the arteries of a newly-killed beast pyroligneous acid, and afterwards common brine; also a very excellent mode of preserving milk or acid wines by impregnating them with carbonic acid gas. In 1853, he patented a new method of preserving wood by injecting it with a solution of metallic salt, heating it in a stove to drive off the water of the salt solution, and then plunging it in a cold bath of creosote oil. In the same year he patented an improved method of "retting" flax by the aid of warm water. In 1854, he patented a method of making coke from non-coking coal, by previously mixing it with from 20 to 25 per cent. of coal-tar pitch. In 1855, he patented a method of preserving meat, vegetables, and fruits, by drying out the water contained in them, at a temperature lower than that required for the coagulation of albumen. Meat and vegetables preserved by him in this manner were supplied to our troops in the Crimea. In 1857 he took out a provisional specification for a method of building composite ships of T iron and wooden planks. In the same year, he patented a steam plough, consisting of a rotary digger or excavator combined with a traction engine. In 1858, he patented a method of separating iron pyrites from coal, the former to be used in the making of vitriol. In the same year, he obtained a provisional specification for a method of protecting iron cylinders from the action of sulphate of copper and other salts used in preserving wood. In 1861, he patented the use of steatite or soap-stone in railway greases; and in 1864, a method of injecting timber with hydrocarbon vapours. Mr. Bethell also bestowed much labour upon a plan for concentrating all the London gas-works at a site some miles down the river. He carried on for some time a distillery of beetroot spirit in Berkshire; and endeavoured for years to obtain the removal of the Customs regulations, which practically forbid the introduction of the profitable beet sugar and spirit industries into this country. He also effected considerable improvements in the extraction of copper from ores of low percentage. He left to his widow and sons the management of many important creosoting and chemical works in England and abroad.

Franz Bopp, Philologist, who in his first work fully initiated the mode of treating languages, which he expanded in his Comparative Grammar. His *Analytical Comparison of the Sanskrit, Greek, and Teutonic Languages, showing the Original Identity of their Grammatical Structure*, gained him the appointment to an Extraordinary Professorship of Oriental Literature and General Philology at the University of Berlin. This was elevated into an Ordinary Professorship in 1852, and held until his death.

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