give pictures of the life and manners of persons of whom one would wish both one's sons and daughters to be ignorant. The English book is more demoralizing than the French prototype, because it is better written, and the immorality treated in such a calm, decent, matter-of-fact manner that it will circulate where a gross book would be at once discerned and discarded. Can nothing be done to put these books down; or at least to compel them into the regions where such works might be expected to be found? To see them circulating in respectable shops, side by side with the books that have received the stamp of being worth permanence, is a shame as well as a danger,—much more serious than adulterated bread or arsenicated sweetmeats. You may imagine I am in earnest when I have been at the pains to write all this. I have seldom felt so indignant as when I found the sort of book I had picked up, and I felt *degraded* when I closed it; and I who write this have served my apprenticeship to French novels."—We are very much surprised to hear that such books are exposed in the windows of *respectable* shops; and in the absence of some better evidence of the fact, should be much inclined to doubt the respectability.

Paris is at present in possession of thirteen different museums, not counting those at the Louvre and at Versailles. Besides the ancient and modern works of sculpture, these rich collections contain the most miscellaneous objects of mediæval art, as well as of Renaissance paintings, drawings, woodcuts, and engravings, Egyptian, American, Celtic, and Roman antiquities. The collection of the Jardin des Plantes, with its cabinet of comparative anatomy, founded by Cuvier, is not included in the above-mentioned number. All these collections are open to the student, as well as the six large public libraries, of which the Impérial contains 1,000,000 volumes and 80,000 manuscripts; besides these, there exists a number of valuable libraries of the different faculties, for the special branches of study, and of scientific institutions, most of which are open to the student; and those few for which a special permission is necessary, grant it without any difficulties. No wonder that Humboldt wrote to a friend in 1827, who had expressed his surprise at the German scholar having made the French capital his abode: "You are surprised at this? I am certain to find here, in one place, what I should have to look for in Germany in thirty-six places, and then very likely in vain."

Herr Gustav Freytag's new novel is announced as likely to be ready in a few weeks. The title is 'The Lost Manuscript.'

Tourists will be glad to learn that the Brocken, the highest mountain of the Harz Mountains, will by next spring be connected by telegraph with Ilsenburg: thus enabling them to ascertain the state of the weather, the friends they are likely to meet there, and the nature of the accommodation they can expect.

The first number of the fifth volume of the German Dictionary, begun by the Brothers Grimm, has just appeared. This national work has been continued by Dr. R. Hildebrand, who was a fellow-labourer in this undertaking in the Grimms' lifetime, and Prof. Karl Weigand, of Giessen. The number just published comprises the letter K to Kartenbild. It gives ample proof how fully Dr. Hildebrand has entered into the spirit of the undertaking, and how completely he operates in the sense of his great predecessors. We cannot judge how much of the material he found prepared by the Grimms. In the profuseness of linguistic and historical observations, in his etymological developments and the pleasing selection of quotations, Dr. Hildebrand follows close in the footsteps of his masters.

SCIENCE

BRITISH ASSOCIATION.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

SATURDAY.

'On the Mechanical Theory and Application of the Laws of Magnetic Induction and Electricity,' by Mr. J. B. THOMPSON.—In this paper electricity and magnetism were considered as a force in the same way as heat and light; and electric and magnetic induction were treated in correspondence with mechanics. The summary of the author's theories is:—That the phenomena called electricity and magnetism are two forms of force which may either be in conatus or in act. If in conatus, they are in a state of tension; if in act, then in a state of fluxion. Electricity is in conatus when in the static form of excitation, or when the voltaic circuit is not completed; in act, when the matter highly excited is brought in contact with matter less highly excited, or when the voltaic circuit is completed. Magnetism is in conatus when the magnetic vortical sphere is held constant by a constant electric current, or by hardened steel or magnetic iron ore, so that the earth-magnetism may flow in; in act, on its electric projection and recession, or when iron or some other paramagnetic is moved through this sphere. That electric conduction is by certain molecular movements of particular portions of matter. Those wherein this movement is easily excited are called conductors, and those wherein it is with difficulty excited are called insulators. That magnetic conduction is by the symmetrical arrangement into a vortical sphere of spirals of a general medium, which pervades all matter, and holds it in that form for the time being. That particular matter wherein the sphere is easily excited is called paramagnetic, and that wherein it is with more difficulty excited is called diamagnetic. That this sphere can be fixed by means of hardened steel or magnetic iron ore. That the magnetic vortical can be excited by means of spiral currents of electricity generally, and even by a tangent to such spiral. Also it can be induced by magnetic conduction in paramagnetics. That the magnetic force is only in a state of fluxion on the projection and recession of this sphere. That this sphere is projected in the direction of the exciting electric current, and recedes in the opposite direction. That the electric force is induced on the projection of the magnetic vortical, and also on its recession. That, consequently, for one inducing current there are two induced currents; therefore, it would appear that by induction electric excitation is multiplied. Finally, that these inductions and conversions of force are in strict accordance with the laws of mechanical motion. In connexion with the paper an induction machine was exhibited, the chief points of novelty in which appear to be these:—that it is self-acting; the current of voltaic electricity which produces the induced current also drives the machine; that the machine can be so adjusted that the quantity and intensity of the induced current shall range from that of 10 Daniell's cells to that of 1,000, and this without employing more than three or four cells. These are valuable properties to electricians who are engaged in experiments with electricity of high or even moderately high tension. Besides, it is applicable to whatever batteries are, having been used experimentally for telegraphy and for electro-depositing. For telegraphy through submarine and subterraneous cables there appears to have been a great objection to induction machines, or rather induction coils. The objection was, that these induction coils sent their electricity through the cables in sudden intense shocks, which injured the insulation of the cable. In this machine it is apparently a continuous flow, and no spark will jump from one electrode to the other, unless first brought in contact, as in batteries. When modified for electro-plating it is much more efficient than the ordinary battery; for though it deposits the metal more slowly on any one article, yet it deposits it much more firmly and with a better surface than the ordinary battery does, and it will deposit the same quantity on a thousand articles at once, which enables it to deposit ten times more metal in the same time than its own exciting battery would do. The construction of the machine is apparently very simple, and will not be easily deranged or speedily worn out.

'On the Development of Electricity from the Rays of the Sun and other Sources of Light,' by Mr. H. KEEVIL.—The subject of this paper was the motions excited in gilded leaves suspended by spider-threads in inverted glass jars by the sunbeams. The evidence adduced was insufficient to prove that electricity, instead of heat, was the cause of the movements.

'On the Rain-fall of the British Isles, 1862-63,' by Mr. J. G. SYMONS.—The resolution of the General Committee of this Association having involved two branches of progress in the collection of rain-fall statistics, it appears best to notice separately what has been done in each. To take first the grant for additional rain-gauges, and its appropriation. The whole of the existing stations contributing to the tables of rain-fall published in the British Association Report for 1862, together with all additional stations subsequently obtained, were laid down on blank maps; a list was then made of the localities where new stations were most urgently required, and this list was forwarded to the *Times*, with a letter requesting persons who had gauges in those districts to state so, and soliciting communications from persons willing to take charge of the new gauges to be placed. About three hundred replies were received to this letter. The applications being so much in excess of the number of gauges supplied by the Association, the task of selection was very onerous, but was greatly lightened by the large proportion of applicants who, on learning the state of the case, undertook to defray the cost of their own instruments, as well as to perform the necessary duties. Ninety-two additional stations have thus been established. Gauges at Owendoon, Pwllheli, Torquay, Whitchurch, Fontmell Magna, Hartland, Holywell, Whitby, Antrim, Bunninadden, Innishambo, Northallerton, Berriew, Letterkenny, Ennis, Kilkennel, Acol, Carmarthen, and Brithain, near Dolgelly, were erected out of the grant made last year; and a further grant will be applied for this year, in order to render the system still more complete. One most important step has been taken during the present year, namely, the organization of a series of stations in the north of Wales, special attention being paid to the district immediately round Snowdon, the principal object being to compare the fall in that part of the country with that in the Lake district of Cumberland and Westmoreland. Owing to the previous expenditure of the whole of the last year's small grant, the cost of this series of stations has been borne by Capt. Mathew, of Wern, Carnarvon. The gauges were specially constructed, with regard to their adaptability for the measurement of snow as well as rain; how far they will answer remains to be proved. It is proposed that there shall not be less than twenty-two stations, so as to render the series of observations as complete as possible. It cannot but be very gratifying to all those who are interested in the important practical question of the rain-fall in this country to find Capt. Mathew ready to take, single-handed, both the trouble and expense of organizing this extensive cordon of stations, almost, if not quite, as extensive as those supported for some years in the Lake district by the Royal Society. Details respecting the fall of rain can only be given advantageously in tables such as are appended to this Report; but the broad outlines characterizing the distribution of rain during 1862 and 1863 may be thus briefly sketched. Taking, first, the whole of the stations in England, Scotland, and Ireland, the average fall in each of the years 1860, 61, 62, and 63 is about 10 per cent. above the average of the last half-century, and the fall in the three years 1860, 61, 62 nearly equal, the difference being less than 2 per cent. of the total quantity, while 1863, which was rather drier than the others, only differed by 5 per cent. These very uniform results are surprising, considering that, in some districts, the fluctuation has been nearly 100 per cent. For instance, Holkham, 1860 was 35 inches, 1863 only 18 inches; Torosay Castle, in 1860, was 70 inches, and in 1863 was 111 inches, differences the reverse of each other—

in one case of 17 inches excess in 1860, in the other 41 inches in excess in 1863. Yet the general average throughout the country remains nearly constant; it is, in fact, a similar compensation in yearly totals to that which has prevailed during the drought now so much felt in the south of England at the very time that the north-west of Scotland has been suffering from want of dry weather. It is further evident, from the table of average fall, that there has been a series of three dry years in the midland counties of England, just as there has been a series of three wet ones in Ireland and along the west coast of Scotland. The drought at stations in the north midland counties has been more felt even than is warranted by the small fall in 1863, because the ground has had no chance of resuming its normal condition since the partial drought in 1861. The minimum recorded fall is 14·46 in 1863, at Southwell, Nottinghamshire, in which district seven stations return less than 17 inches. On the other hand, the maximum of 1863, namely, 173·84 at Seathwaite, is supported by 173 inches at Drishaig, by Dalmally, and by six other stations, with an annual fall between 100 and 150 inches.

'On the Temperature and Rain-fall of Bath,' by the Rev. L. Jenyns.—The author, having been resident in the neighbourhood but a limited number of years, and having during that time changed his residence three times, felt that no observations of his own would serve to furnish any results of sufficient value to be brought forward. He had, therefore, been obliged to content himself with a few returns sent him for the occasion by other observers, which, though not in all cases so full as could be wished, nor including all the heads of meteorological inquiry which ought to find a place in a complete register, were nevertheless the only ones, so far as we could ascertain, available for the purpose. The returns received relate to temperature and rain. The chief one on the temperature of Bath is a thermometrical register by Sir Vansittart Stonehouse, kept in the Circus for four years, commencing with 1858 and ending with 1861. The instrument employed was one of Six's self-registering thermometers. It had been compared with a standard, and was affixed to a north wall, at the height of four feet from the ground, and screened from the sun and radiation. The table gave the average daily maxima, minima, and mean, by which it appeared that the mean temperature of the seasons was, in spring 48°, in summer 60°, in autumn 50°, and in winter 60°. A second table showed the yearly extreme temperatures from the year 1858 to 1863, by which it appeared that the highest registered temperature last year was 80°, and the lowest 55°. According to these observations, the mean temperature of Bath for the last four years is 49 degrees, or very little more, and not higher than the mean temperature of Greenwich for the same four years. This is probably too low to be considered the average mean, and may be due partly to the position of the instrument, and partly to the short term of years for which the observations were made, one of those years especially (1860) having been a cold one throughout England. The mean of nine years' observations, 1842 to 1850, both inclusive, made by a gentleman, formerly resident in Bath, and furnished by him, is 51 degrees, so much higher than the above that we may consider the true mean temperature of Bath as a point yet to be correctly ascertained. It is not, however, so much in respect of its higher mean temperature, so far as it may be higher, that Bath has the advantage of other towns lying more to the east, as it is in respect of its less range of temperature, the climate in consequence being more moderate. Its milder winters are known to the public generally, but with respect to its summers there is a very prevalent mistake. Strangers often suppose that because Bath is comparatively mild in winter, it must be necessarily very hot in summer, and they consider it a place to avoid in that season. That this is to a certain extent an error, and that, whatever may be its climate in summer in other respects, it is not characterized by a temperature higher than that of other towns in England, excepting some lying considerably to the north, or, indeed, so high as many, will clearly appear to those who take the trouble to compare the maximum height of the thermometer at Bath during very hot weather with what it is elsewhere on the same days. This the author had done on many occasions; and the truth seems to be that, to the same degree to which it is less cold in winter, it is less hot in summer, the difference between the extreme temperatures of Bath and the extremes reached in other places apparently increasing as the weather itself becomes more extreme. Thus, in June, 1858, when the thermometer at Oxford, Norwich and Gloucester, rose to 90°, at Nottingham to 92° and at Greenwich to 94°·5, at Bath it was not higher than 84°. Again, in 1859, when at Oxford it was 86°, Gloucester 87°, Norwich 92°, at Greenwich 93°, at Bath it was only 82°. So, during the hot weather in May last, when the maximum temperature in other places ranged from 85° to 88°, at Bath it was never higher than 79°. In cases of severe cold in winter, there has been as great a difference on the other side. Thus, on that notoriously cold day, December 25, 1860, when the thermometer at Nottingham and Cambridge fell to minus 8°, at Bath it was not lower than plus 11, showing a difference of 19°. This difference was much greater than usual, but it was in proportion to the very unusual degree of cold on that occasion. Generally speaking, it is much less; and, without going further into details, having at various times compared the temperature at Bath, during periods of unusual heat or cold, with what it has been at other places on the same days, more especially with the recorded temperatures at the Greenwich, Cambridge and Nottingham Observatories, the author had found that, on an average, the maximum temperature has been 5° lower and the minimum 5° higher, at Bath, than elsewhere. Passing from the temperature at Bath to the rain-fall of Bath and the neighbourhood: the average yearly rain-fall in the town of Bath from 20 years' measurement (1842–1861 both inclusive) by a gentleman whose rain-gauge was at the top of his house, and 90 feet above the level of the sea, is 31·97 inches. This observer was unable to furnish the average fall for each separate month. There are, however, three other registers of rain, kept in the neighbourhood of Bath, which go more into detail. The first of these is by the Rev. F. Lockey, of Swanswick Cottage, about two miles north of Bath, on the road to Gloucester, whose gauge is 32 feet above the ground, and at the estimated height of 350 feet above the Avon. This register was commenced in 1834, and is still carried on. The second register of rain measurements was kept by the late rector of Radstock, in this county, at the Rectory House, about eight miles south of Bath, the gauge being 250 feet above the sea level. It comprises a period of ten years, commencing 1841, and terminating with 1850. The third register is one commenced by Mr. Mitchell, of this town, in 1860, at the Batheaston Reservoirs, about three miles north-east of Bath, the gauge being about 2 feet from the ground, and 226 feet above the sea. This register is valuable, for giving the number of days on which rain fell in each month, in addition to the amount of rain measured; but having, as yet, been kept only four complete years, the average number cannot be depended upon. He then read two tables, by which it appeared that the average rain-fall at Swanswick, amounting to 25·78 inches, is less than at Bath by 6 inches or more, and less than that at Radstock by between 8 and 9 inches, this last being 34·50 inches. The fall at Batheaston Reservoirs would seem to be intermediate between Bath and Swanswick, but it required to be measured for a longer term of years to judge of this accurately. The above differences are considerable, regard being had to the proximity of the several stations, but are probably not greater than would arise from the difference of level and the configuration of the ground. As public interest has been much excited by the great deficiency of rain during the present year, up to the end of August, the author stated, for comparison with other places, what the deficiency has been in this neighbourhood. It appears from the Swanswick measurements, that, whereas the average fall of rain in that locality for the first eight months of the year amounted altogether to 15·75 inches, the actual fall for the same eight months this year has been only 8·95 inches; the deficiency being 6·81 inches. This difference is very nearly the same as that observed at Clifton, by Mr. Burder. The deficiency at Swanswick was noticeable in all the months, except March and April, in which there was an excess—very small in April—but amounting to very nearly an inch in March. The author was aware that to form a correct judgment of any climate, equally for scientific as for sanitary purposes, regard should be had, not merely to temperature and the quantity of rain-fall, but also to the pressure of the atmosphere, as shown by the barometer, and humidity, as shown by the hygrometer. He regretted, however, that, under these heads, he was not aware of any observations in Bath that have been carried on for a sufficient period of time to afford useful results that could be relied on for accuracy.

'On the Rhombohedral System in Crystallography,' by Mr. A. R. Catton.—This paper was to prove that the laws of symmetry of every state in the Rhombohedral system were the same as those in the prismatic system. The establishment of this proposition necessitated the abolition of the Rhombohedral system, and all crystals hitherto included in it must in future be referred to the prismatic system, all crystals included in the Rhombohedral system being merely the particular forms which crystals of the prismatic system assume when one angular element is equal to 60°.

'On the Connexion between the Form and Optical Properties of Crystals,' by Mr. A. R. Catton.

'On a New Formula for calculating the Initial Pressure of Steam,' by Mr. R. A. Peacock.—Some years ago the author had occasion to attempt to calculate the probable pressure of steam at the highest known temperatures, and found, amongst other things, that between the pressures of 25 lb. per square inch and 300 lb. to the square inch, the latter being the highest pressure to which trustworthy experiments had been carried, the law of increase was approximately: That the temperature of high-pressure steam of, say, 25 lb. to the square inch and upwards, increases as the 4½ root of the pressure; and that, conversely, the pressure of the steam of, say, 25 lb. to the square inch and upwards, increases as the 4½ power of the temperature. At lower pressures than about 25 lb. per square inch, a different law prevails. As it is necessary to verify the new formula by comparison with some well-known formulæ and experiments, the author has attempted to do so in a very voluminous table, and graphically in a very carefully-executed diagram. What is to be gathered from these is, that the new formula agrees with Dr. Fairbairn's experiments, from about 40 lb. to 60 lb., and very nearly with Regnault's, between 220 lb. and 336 lb.

Section B.—Chemical Science.

Monday.

'On the Premature Decay of the Frescoes in the Houses of Parliament, its Cause and Remedy,' by Mr. W. Poole King.—He said: Having lived for many years upon the Durdham Down limestone, and for a long course of time made observations on the walls built with mortar from this stone, which I understand has been brought from Bristol, and used for the plaster on which the national frescoes have been painted by special recommendation from authority, and having frequently examined those walls, both in and out of doors, I recognized that effects were taking place on the walls of the Houses of Parliament exactly similar to those which I had been accustomed to see in constant operation. All the beds of Durdham Down limestone are of marine origin, being full of marine shells; and, although in the long lapse of ages since they were deposited, the marine salt, with which the stone must have been saturated, has, for the most part, been washed out, yet still a trace of it remains, insensible to an ordinary analysis. It is the general practice to burn this stone into lime with braize (or cinder, taken from the scavenger's yard), and this braize always contains sulphur. In this Chemical Section, I need hardly say, that in thus burning

the minute quantity of marine salt in the stone is converted, for the most part, into sulphate of soda, or the salt well-known in commerce as "Glauber Salt." On most of the walls that grow cold in winter, I have found needle-form crystals, varying from a bloom 1-100th of an inch to needles of an inch in length, and in some instances, in damp old walls, such as the cloister-walls of a cathedral, the crystals stand out to the length of 1½ inch. At first I examined these crystals chemically. They were generally composed of sulphate of soda, in rare instances found mixed with nitrate of potash, and sometimes with small quantities of muriate of lime and magnesia. I soon became familiar with these bunches of needle-form crystals, and from their taste and general appearance could not mistake them. When the weather becomes dry, all these bunches of crystal effloresce and are converted into a loose white powder, much of which drops from the wall, carrying with it shales of plaster, or flakes of paint, or films of whatever material the surface of the wall is covered with. Moisture will condense on the wall, if allowed to grow cold in damp weather; the white powder is then dissolved, and the liquor, a solution of sulphate of soda, is absorbed by the mortar or plaster. Architects are in the habit of proving the value of the various kinds of stone presented for their use, for the endurance of frost, by a saturated solution of sulphate of soda, similar to this liquor, which on crystallizing imitates the heaving and splitting action of ice forming from water. Accordingly, this liquor is no sooner absorbed as the wall dries, than it aggregates into ice-like crystals, and the plaster is disintegrated and heaved by the dynamical force developed in their formation. The plaster having sustained this injury, the salt transforms itself, and shoots out into bunches of needle-form crystals, only to fall again into the terrible white powder, as the air becomes warm and dry. Thus a constant succession goes on of solution and desiccation, with the changes of the weather and temperature; and if the wall be permitted to cool with the frost, the ruin of the plaster is insured. Sulphate of soda exists, not only in Durdham Down limestone, but unfortunately also in much abundance in all the lias mortars, in London clays, and in many other stones. In fact, I doubt if any London wall is free from its presence. We, may, therefore, observe this kind of action of destruction going on more or less almost everywhere. A marked instance of its injurious effect can be seen in the Crystal Palace, where not only the surface of the richly-decorated walls is attacked, but also the plaster-cast statuary suffers, and requires constant renovation. In Rome and Florence, indeed, many frescoes have remained entire, with their colours smooth and in good order, for hundreds of years; but then these frescoes are on plaster made from travertino, a limestone of freshwater formation, free from salt, and the lime has been burnt with wood charcoal, in which there is no sulphur. In a late view which I had of the admirable fresco which Mr. Herbert has just finished, I find that the robing-room in the House of Lords was kept with a wet floor. If this apartment be ever allowed to grow cold, can we doubt that the fate of this glorious work of art is sealed? Damp will condense in drops on its surface, and be absorbed. These drops will dissolve whatever trace of sulphate of soda exists in the plaster, or perhaps in the mortar of the wall. The salt will aggregate together (probably by the force of dialysis), then form icelike crystals, to heave the plaster and show itself in a bloom on the surface of the fresco, and then desiccate into a dry powder, to be re-dissolved by the first moisture which comes over it, and then be re-absorbed again, till at last it will aggregate into blotches, and the destruction be complete. To preserve this fresco I should recommend that the robing-room be kept always warm, and as dry as possible, so that the sulphate of soda may not pass into solution and aggregation; and surely such a work of art, of which the nation is so justly proud, is worth the cost of any expense incurred in its preservation. The "liquid glass process," I understand, has been tried, to secure the preservation of Mr. Herbert's fresco, but I doubt its power to prevent the plaster absorbing any drops of moisture which may come on its surface. Indeed, if there be any soda in the preparation of liquid glass it may accelerate the work of destruction, for carbonate of soda is almost as efflorescent a salt as sulphate of soda, into which, however, the former is often converted by the sulphurous acid gas seldom absent from London air. I conclude that fresco painting on freshwater limestone walls, kept constantly warm and dry, will have the best chance of endurance for ages yet to come, for the delight of our remote successors.

'On an Apparatus for the Preservation or Disengagement of Sulphuretted Hydrogen, Carbonic Acid or other Gases,' by Mr. M. Lyte.

'On the Black Stones which fell from the Atmosphere at Birmingham,' by Dr. Phipson.—The stones fell in great quantities during a violent storm which broke over the town in the month of August. They were small, angular, and black, presenting here and there a few indications of crystallization. They acted very slightly on a magnetic needle; they gave a lightish-coloured streak, and when finely pulverized were partially soluble in hydrochloric acid. The analysis which he had made of them proved that the stones were not aerolites, but small fragments of basaltic rock, similar to that which existed a few leagues from Birmingham, near the parish of Rowley. He believed that the stones had been carried to Birmingham by a waterspout.

'On a New Method of Extracting Gold from Auriferous Ores,' by Mr. F. C. Calvert.

Mr. Fuller (Secretary), on behalf of Mr. Griffith, read a communication from the Committee 'On the Transmutation of Spectral Rays,' stating that the experiments were not yet completed, and suggesting the re-appointment of the Committee.

Mr. Fleeming Jenkin read an interesting Report from the Committee 'On Thermo-Electric Phenomena,' the effect of which was that, not having completed their experiments, they desired to defer their Report to another year.

'On the Medicinal Muds of the Island of Ischia,' by Dr. Phipson.

'On the Colouring of Agates,' by Prof. Tennant.—Some interesting details were given respecting the structure of agate and the artifices resorted to by the workmen of Oberstein in colouring the agate ornaments manufactured at that place and distributed over Europe. A large number of specimens were exhibited, not only of ornaments but of the stones, both cut and uncut, the former well adapted to show the structure. The black colour is produced by steeping the specimens in oil, and then blackening them by the action of sulphuric acid.

Mr. Tennant asked Mr. Tomlinson to speak on the subject, when that gentleman gave some particulars respecting the organization of the factory at Oberstein, and remarked that the principle of colorization depended on the structure of the stones: they consisted of alternate bands of crystalline and amorphous quartz, the latter only absorbing the colouring matter, which consisted mostly of oxide of iron. The workmen kept the pebbles in tubs of water containing the oxide for a longer or shorter time according to the tint required; the crystalline bands remained white, the non-crystalline absorbed the colour throughout.—Prof. Sullivan remarked that the structure of agate illustrated beautifully the difference between *colloids* and *crystalloids*. The alkaline silicates, by repose, formed these two classes of bodies, and he had no doubt a similar action had been at work in the formation of agate.

'On the Artificial Production of Anhydrite,' by Mr. A. Gages.

'On a Specimen of Tin Ore hitherto undescribed,' by Mr. F. Field.

'On Copper Smelting,' by Mr. P. Spence.

'On the Presence of Nickel in Metallic Lead,' by Dr. Machattie.

'A Suggestion on the Detection of Poisons by Dialysis,' by Dr. Machattie.

'On the Precipitation of Aluminous Silicates from Solution,' by Dr. Sullivan.

'On the Rational Formula of Rosaniline,' by Prof. Wanklyn.

'On the Composition of certain Organic Dyes,' by Prof. Wanklyn.

'On the Molecular Constitution of Carbon Compounds,' by Mr. A. R. Catton.

Section C.—GEOLOGY.

SATURDAY.

'On the Occurrence of Fish Remains in the Old Red Sandstone at Portishead, near Bristol,' by Mr. W. H. Baily.—The author stated that, having had occasion to visit Portishead about two years previously, he was invited to examine the collection of fossils made by the Rev. B. Blenkiron, a gentleman resident in that neighbourhood, now curate of the parish. Amongst those shown to him were some slabs which had been collected from the shingle of the beach. Upon these he observed bones and scales of fish, some of which he was enabled to identify with characteristic Old Red Sandstone species. On examining the cliff, he was successful in obtaining, from the base of a conglomerate bed, an additional scale of *Holoptychius nobilissimus*. On a subsequent and recent visit, he made a more detailed examination, collecting similar fish remains, associated with plants, from red flaggy beds, exposed on the shore between high and low water. He described the geology of the parish of Portishead as presenting many features of interest, independent of its other local attractions, such as beauty of scenery, &c. Portishead Point, to the north, consists of a steep ridge of carboniferous limestone, the beds dipping at a considerable angle, 60° N.N.E.; some of them being very fossiliferous. The lower beds, which occasionally appear, for a short distance, along the north shore of Woodhill Bay, are of a pink colour, and sometimes full of crinoidal joints, accompanied by a few corals, probably Michelinea. The shore of the bay beyond this becomes flat for about a quarter of a mile, the beach being covered with shingle, principally derived from the Old Red Sandstone cliffs, from whence the fish remains were obtained, commencing a little to the south-west of Beach Cottage, and continuing, with tolerable uniformity, for rather more than eleven chains; their greatest height being about 34 feet. The ground above this, forming the commencement of Portishead Down, attains, however, more to the south, a considerable elevation, 364 feet being given as its highest part, near Down Farm. This tract of Old Red Sandstone extends along the coast, to the south-west, for about four miles, being occasionally exposed on the beach, and sometimes covered unconformably by a great conglomerate, composed of angular and partially-rounded blocks of limestone, &c., imbedded in a yellow cementing paste (one of these blocks measuring nearly six feet in length). This irregular deposit was formerly called Dolomitic Conglomerate, but is now considered to be part of the New Red Sandstone series. Diagrams, showing horizontal and vertical sections of the cliff, were exhibited, measurements of the principal beds having been taken at each chain for that purpose. The series of deposits were found to consist of alternations of deep red, micaceous, flaggy beds, and shales varying in thickness, with compact sandstones and quartzose conglomerates, the general dip being about 20° south. The fish remains alluded to in this communication, of which enlarged drawings were exhibited, were found both in the conglomerate and the micaceous flags; they consisted of scales of *Holoptychius nobilissimus* and *Glyptolepis elegans*, with other bones, and a fragment of scale, having an external ornamentation, like that of Bothriolepis or Asterolepis; together with what appeared to be fin rays of a fish like Glyptolepis or Platygnathus, in a yellowish sandstone.

'Remarks on Two Outliers of Lias in South Warwickshire, and on the Presence of Lias or Rhetic Bone-bed at Knowle, its furthest Northern Extension hitherto recognized,' by the Rev. P. B. Brodie.

'On Traces of Glacial Drifts in the Shetland Islands,' by Mr. C. W. Peach.

'On Boulder Clay Fossils,' by Mr. C. W. Peach.

'On the Boulder Clay and Drifts of Scarborough and East Yorkshire,' by Mr. J. Leckenby.

'On the Cause of the Extrication of Carbonic Acid from the Interior of the Earth, and on its Chemical Action upon the Constituents of Felspathic Rocks,' by Dr. Daubeny.—The author made some comments upon a theory advanced by Prof. Bischoff, of Bonn, in his work, entitled

'Elements of Chemical and Physical Geology,' in which the elevation and dislocation of certain rocks were attributed to the decomposition of felspar, through the agency of the carbonic acid disengaged from the interior of the earth, seeing that the products of the decomposition of granite are found to possess a lower specific gravity, and, therefore, occupy more space than the original materials of the rock. Such a change would, doubtless, occur in granite and trap, if acted upon by carbonic acid at temperatures below 212°, but above that point the very opposite would be observed, inasmuch as the silicic would then take the place of the carbonic acid, and, consequently, if brought into contact with earthy or alkaline carbonates in the interior of the earth, would produce silicates and expel carbonic acid, as, indeed, was long ago pointed out by the author of this paper, in his work on Volcanoes, and is insisted upon by Prof. Bischoff himself, in other parts of his volume. It seems difficult, therefore, to attach much importance to the cause assigned by Prof. Bischoff for the elevation of strata, especially considering that the loss of substance incurred by the rock through the removal of its alkali by the agency of carbonic acid would go far towards counterbalancing any expansion due to the lower specific gravity of the kaolin resulting, and moreover recollecting that no theory which professes to account for the elevation of certain portions of the earth's surface ought to be accepted if it does not embrace likewise the corresponding phenomenon of the sinking or depression of others.

'Notes on the Volcanic Phenomena and Mineral and Thermal Waters of Nicaragua,' by Commander B. Pim, R.N.

'On the Old Pre-Cambrian (Laurentian) Island of St. David's, Pembrokeshire,' by Mr. J. W. Salter.

'On some New Forms of Olenoid Trilobites from the Lowest Fossiliferous Rocks of Wales,' by Mr. J. W. Salter.

'On some New Points in the Structure of Palæchinus,' by Mr. W. H. Baily.

MONDAY.

Sir C. Lyell said: "Mr. President and gentlemen, I wish to lose no time in communicating to this Section a letter which I have received from Mr. Henwood, whose important work on mineral veins and other valuable publications on geology and mining are so well known to you. He has pointed out a great oversight which I inadvertently made when I stated, in my inaugural address, on Wednesday last, viz., that we had no published scientific account of the Wheal Clifford Hot Spring, near Redruth, in Cornwall. I was first informed of the existence of this spring by Dr. Percy, of the Royal School of Mines. He referred me to Mr. Warrington Smyth, the result of whose two visits to Redruth, and whose observations on the springs, in 1855 and 1864, I have referred to in my address. Unable to learn from these gentlemen, or from my friend, Dr. Daubeny, that any account had been printed of this 'hot lode,' I wrote to Dr. Horton Davy, who was unable to obtain for me, after speaking to the miners at Redruth, any reference to any published data on the subject. I now find that, so long ago as the year 1819, in the Reports of this Association, Mr. Fox has given notice of the temperature (76° Fahr.) of the water when the river was 170 fathoms deep, and that subsequent observations by him, Mr. Henwood, and Mr. Francis, between the years 1838 and 1857, had been published in the Cornwall Government Transactions, in our own British Association Reports, closing with a notice, by Mr. Fox, of the temperature (reaching 116° Fahr.) at the depth of 255 fathoms in the year 1857. Mr. Fox had detected the chlorides of calium and sodium, but it remained for Prof. Miller to discover læsium, and that large and extraordinary amount of lithium which gives to the solid contents of this spring its peculiar and unique character. I feel sure that Mr. Henwood and Mr. Fox, for both of whom I have always entertained the highest regard, and the trustworthiness of whose observations I have ever appreciated, having frequently had occasion to cite them in my works, will do me the justice of believing that I regret extremely, on more grounds than one, that my attention was not directed to their printed Reports on this Cornish spring, inasmuch as they would have enabled me to compare the former and present condition of the spring at various depths. At the same time I am not aware, at present, that any of the conclusions to which I arrived, from the data furnished to me, would have differed essentially, even had I profited, as I could have wished, by their previous labours. I am also informed by Prof. Phillips that, in his Presidential Address to the Geological Society of London four years ago, he alluded to this Cornish spring."

'On a Bone-breccia, with Flints, found in the Lebanon,' by the Rev. H. B. Tristram.

'On the Formation of the Jordan Valley and the Dead Sea,' by the Rev. H. B. Tristram.

'Notice of a Bitumen and Sulphur Deposit at the South-west Corner of the Dead Sea,' by the Rev. H. B. Tristram.

'On the Geology of Palestine,' by the Rev. H. B. Tristram.

'On the Geology of Otago, New Zealand,' by Dr. Hector.

'On the Coal Measures of New South Wales,' by Mr. W. Keene.

'On the New South Wales Coal Field,' by Mr. J. Mackenzie.

'On the Position in the Great Oolite, and the Mode of Working, of the Bath Freestone,' by Mr. J. Randell.

'On the Significance of the Sequence of Rocks and Fossils,' by Mr. H. Seeley.

'On the Species of the Genus Pteraspis,' by E. R. Lankester.—In this paper, the author first reviewed the present state of our knowledge of those remarkable fossils of the Old Red Sandstone, the Cephalaspis and Pteraspis, which he stated was in a very unsatisfactory condition. Cephalaspis had been taken in hand by Sir Philip Egerton, but Pteraspis was in a state of complete confusion. His friend Prof. Huxley had intended to work at the latter genus, and had made drawings and notes for the purpose, but had finally relinquished his intention, and handed his material very kindly to the author. From this and other material at his disposal, the author was enabled to establish three genera,—Pteraspis, Cyathaspis, Scaphaspis, in place of the one Pteraspis. In the first, the shield consists of seven separable pieces, it includes *Pt. rostratus*, Ag., *Pt. Crouchii*, Salter. In the second genus, Cyathaspis, the head-plate is separable into four pieces only; it contains *Cyathaspis Banksii*, and a new species, *Cy. Symondsii*. The last genus is characterized by the shield being composed of one simple, oval, indivisible plate. Scaphaspis includes *Sc. Lloydii*, *Sc. Lewisii*, *Sc. truncatus*, and *Sc. Ludensis*.—At the conclusion of the paper Mr. T. S. Salter, late of the Survey, expressed his approval of the author's views.

'On the White Lias of Dorsetshire,' by Dr. T. Wright.—In this paper, the author showed that the term white lias, as used by Buckland, Smith, De la Beche and others, required a more correct definition than had been given to it hitherto, as it included beds of a light colour, which belonged to two distinct zones of life, the upper half consisted of light-coloured lias beds, with *Ammonites planorbis*, and *Astrea liassica*, forming the zone of *Ammonites planorbis*, whilst the lower portion of the white lias was composed of a series of light-coloured concretionary limestone, having a rubbly character in parts, with a conchoidal fracture. These thick beds were at Up-Lyme, Axminster, and Penarth Bay from 20 to 25 feet in thickness, and contained a great number of small shells in the form of moulds: *Pecten Valoniensis*, *Axinus modiola*, and *Cardium Rhæticum* had been found in them at Up-Lyme. Dr. Wright considered this lower portion of the white lias belonged to the *Avicula contorta* beds, or infra-lias of some Continental authors, as no true lias fossil shells were found in it. He had correlated these beds with some of the upper beds of the Contorta series, at Garden Cliff and West Cliff, on the Severn, and at Penarth, Glamorganshire, and he had come to the conclusion that the concretionary white lias at the base of the Pinhay Bay section must be considered as the upper portion of the *Avicula contorta* series.

SECTION D.—ZOOLOGY AND BOTANY.

MONDAY.

'On certain Points in the Anatomy of the Earth-Worm,' by Mr. E. R. Lankester.

'Notice of a New British Rhizopod and some other Marine Animals,' by Mr. W. A. Sanford.

'On the Decay of Species, and the Natural Provision for extending their Duration,' by Dr. Daubeny.—The author said it may be assumed as an acknowledged fact, not only that every organized being has a limit to his existence, but also that the species themselves, both in the animal and vegetable kingdoms, wear out after a certain period. But it still remains to be inquired whether there are not certain natural contrivances for postponing this inevitable termination to a later period than would otherwise happen. Confining himself to the vegetable kingdom, Dr. Daubeny suggested that one of these provisions would seem to be the introduction of new varieties, which, by diverging somewhat from the original type, acquire fresh vigour, and thereby tend to prolong the existence of the species from which they are derived. One of the modes by which this variation in character is secured, follows as a consequence from the mode by which plants are reproduced through the instrumentality of the floral organs; by the concurrent action of which an individual, intermediate in character between its respective parents, and therefore slightly divergent from both, is the result: so that this mode of multiplying the individuals of a species seems to fulfil an important end, even in cases where, as in plants of low organization, the increase of the species is sufficiently provided for by means of buds. Accordingly, plants propagated by cuttings seemed in general to adhere very uniformly to the same type, and to be more limited in their deviation than those produced from seeds. But this deviation from the permanent type was still more completely carried out where the pollen of one plant is made to act upon the embryo of another; and here, perhaps, may arise those numerous contrivances to prevent self-fertilization which Mr. Darwin and others have pointed out. To the same cause, perhaps, was owing the increased vigour which a plant obtains by the removal into a fresh locality or into a deserted country. Many, no doubt, might regard it as a sufficient explanation of these facts, to appeal to the changes produced in the constitution of a plant by such causes as tending to multiply the chances of some members of the species becoming adapted to the changes in the external conditions which occur in the course of time, and which might otherwise have proved fatal to its continued existence. There were, however, reasons for believing that this solution did not embrace all the facts of the case, and that, even where every facility for producing the utmost amount of variation of which the species was susceptible existed, a period at length arrived when a species dies out, although the climate, soil, and other external conditions continue, so far as we could perceive, propitious.

'On the Natural History and Cultivation of the Oyster,' by Mr. F. Buckland.—The author began by stating that a new phase was now presented in the study of natural history, viz., its application to practice; it costs just as much time and labour to examine useless things as things which would be commercially beneficial to mankind, such as the salmon, the oyster, the herring, the sole, the turbot, &c. That it is, moreover, profitable to cultivate the waters, he showed by instancing the Tay, the rent of which was 15,000*l.* per annum, and of the Spay, which produced 12,000*l.* worth of salmon annually. Calculations he had made showed that the trawling-ground in the North Sea was worth tenpence per square acre, and that the Bay of Galway was worth more per acre than the land surrounding it. Having heard that there had been a general failure of spat this year on the English coasts, he had travelled over a large extent of seaboard to see if he could ascertain the cause; but the whole thing was enveloped in mystery. He then went, in company with his friend, T. Ashworth, Esq., to the Ile de Ré, near Bordeaux, where the breeding of oysters has been carried on so successfully for the last five years. He paid a high compliment to the sagacity and perseverance

of Dr. Kemmerer, resident physician in the island; the statistics of which in wine, salt and oysters he (Mr. Buckland) had tabulated; and to M. Bœuf, a stonemason, who was the first to hit off the method of cultivating oysters artificially. He then traced the oyster's history from its birth upwards, describing in amusing language the mode in which the mother ejects the young in clouds like fine dust, and the perils and troubles to which the young and delicate creatures are subjected during the few days they had to swim about and amuse themselves before they became permanently settled for life, for, when once fixed to an object, they were never able again to change quarters afterwards. It has been said that it was impossible to cultivate oysters; but to prove that it was done in the Ile de Ré, he had brought over witnesses in the shape of tiles, stones, broken bits of pottery, and even glass, to which oysters had attached themselves, like grapes, in large bunches; and in order that the locality might be understood, he exhibited a series of photographs which Mr. Ashworth had caused to be taken, and which were now submitted to the meeting by his permission. All these were explained, and reasons given why the oysters chose one place and not another,—why they died here and lived there; and elucidated principles which he earnestly requested the audience to remember, as there could not be too many observers in this most important branch of natural industry, which he trusted would be shortly applied to British shores. With regard to the failure of spat this year, which was so general that it extended even partially to the Ile de Ré, he stated, that hitherto the attention of scientific men had not been directed to the point. An event, moreover, which the ladies would appreciate, had taken place in Ceylon, viz., the sudden death, from unknown causes, of whole banks of the pearl-bearing oysters, the consequence of which would be that the price of pearls would be enormously increased. He concluded by stating that, in consultation with the learned and energetic Prof. Coste, and other French Government officers,—Dr. Grammont, M. Gerbe, M. Tayeau, M. Bourie, and Dr. Kemmerer,—he had submitted five principal causes of the failure of the young oysters in England and France. To these all had agreed; still there must be other causes as yet to be discovered; and he trusted this important national subject would be earnestly taken up by the numerous talented and highly scientific members of the British Association who were then present.

'Some Observations on the Salmonidæ, chiefly relating to their Generative Function,' by Dr. J. Davy.

'An Account of the successful Accomplishment of the Plan to Transport Salmon Ova to Australia,' by Mr. T. Johnson.

'On some New Hydroid Zoophytes, and on the Classification and Terminology of the Hydroida,' by the Rev. T. Hincks.

'On the Medusoid of a Tubularian Zoophyte, and its Return to the fixed Condition after the Liberation of the Ova,' by the Rev. T. Hincks.

'On the Whalebone Whale of the British Coasts,' by Dr. J. E. Gray.

'On New Corals from the Shetlands,' by Dr. J. E. Gray.

Sub-Section D.—Physiology.

SATURDAY.

'On the Combination of Food in the Meals of the Labouring Classes,' by the President.

'On the Inhalation of Oxygen Gas,' by Dr. B. W. Richardson.—The paper was supplementary to one which he had laid before the Section at the meeting of the Association held at Oxford. The author said his experiments on the inhalation of oxygen had led him to an almost precise knowledge of the condition under which oxygen would most freely combine with blood. It had been stated in almost every modern work on physiology that oxygen inhaled in the pure form is a narcotic poison. These statements are based on the researches of Mr. Braighton, in which the late Sir Benjamin Brodie took part. The observations of Mr. Braighton, in so far as the recital of the phenomena observed by him were concerned, were strictly correct; but the inferences that had been drawn from him were nearly altogether incorrect, and were, at the best, so narrow as to be comparatively valueless. In fact, Mr. Braighton had seen but one form of oxygen inhalation. The author next stated that the influence of oxygen in inhalation was modified—1. By dilution of the oxygen; 2. By dilution of the blood; 3. By the activity of the oxygen; 4. By the presence or absence in the blood of bodies which stop combination. On the point of dilution of oxygen, Dr. Richardson stated that a certain measure of dilution was required, not because the body consumed too quickly in pure oxygen, but because neutral oxygen would not combine with the carbon of the blood unless it were diluted. In atmospheric air the dilution is just sufficient to do no more than alter combination; and the quantity of oxygen may be increased, with absorption at 60° to 65° Fahr., if the oxygen is raised in amount to three parts of the gas to two of nitrogen. Beyond this, the combining power is reduced, and oxygen not absorbed. Hence animals die in the gas as it approaches the pure state; they die not by a narcotic process, but by a process of negation. On the point of dilution of the blood, the author said that blood possessing a specific gravity of 1·053 seemed to have most steady power in absorbing oxygen, as it existed in common air; by increasing the quantity of water in the blood to a limited extent, say until it lowered the blood to 1·060, the absorption of oxygen is increased to a maximum, and after that it is diminished. Below 1·055 the absorption of oxygen steadily declines. In respect to the activity of the oxygen, the most differing results are obtained according to the activity. If the oxygen be made fresh from chlorate of potassa it sustains life even in the pure form, and the activity of the functions is increased; if electric sparks are passed through the gas, or the gas be heated 100°, the same is the fact. On the other hand, if the gas is exposed to ammonia, to decomposing animal matter, or even to living animals, over and over again, it loses, even when diluted, its activity, and no longer combines with the blood. In reference to the last point, Dr. Richardson said that there were conditions of blood in which the power of absorption was limited. Alcohol, chloroform, opium, and certain alkaline products, formed in the blood in disease, prevented absorption of oxygen, and death not uncommonly took place from this cause. Great increase of water did the same. After this description, Dr. Richardson added that the question had often been put, whether the inhalation of oxygen could be usefully applied in the treatment of disease. Priestley, Beddoes, Hill, and many of those who lived when oxygen was first discovered, had formed the most sanguine expectations on this point; they saw before them an elixir, if not *the* elixir vitæ. Chaptal, in speaking of the effects of oxygen in consumption, said of it: it raises hope, but, alas! it merely spreads flowers on the path to the tomb. Since then various opinions of the extremest kind have been expressed, the differences having arisen from the entire want of order that has been followed in the inquiry. One man has used pure oxygen, the other diluted; the one active, the other negative oxygen. The one has given the gas to anæmic people, whose blood is surcharged with water; the other to diabetic or choleraic persons, whose blood is of high specific gravity: the one has given it heated, the other at the temperature of the day. If even a stick of phosphorus were exposed to oxygen under such varying conditions the phenomena obtained would be as variable as those which had been registered in physic regarding oxygen as a remedy. The difficulties of arriving at uniform results had been almost insurmountable from another cause, that of obtaining oxygen in a practical form for inhalation. Fortunately, this difficulty is now removed. The discovery by Mr. Robbins of a mode of evolving oxygen, by acting on peroxide of barium and bichromate of potassa with dilute sulphuric acid, had given him (Dr. Richardson) the opportunity of inventing a little apparatus for inhaling oxygen, which could be carried anywhere and used at a moment's notice. The author here exhibited and described the apparatus. It consists of two glass globes, with a double-valved mouth-piece connected with the escape-tube of one globe. The powder containing the oxygen was placed in one globe, and dilute sulphuric acid was poured on it. The oxygen gas was evolved and passed over into the second globe, which was half filled with water. From this, after being washed in passing through the water, the gas was inhaled. The apparatus was so arranged that any dilution of oxygen recommended—say, three parts of oxygen to two of nitrogen—could be secured; and by changing the water in the second globe, so as to have hot, or temperate, or very cold, the activity of the combination could be graduated.

'Note on the Action of the Bromides of Lithium, Zinc, and Lead,' by Dr. G. D. Gibb.—The first of these was prepared with the view of treating gout and rheumatism of the throat and neck. In small doses it acts as a tonic, gentle stimulant, and sometimes as a diuretic, and may be combined with other agents with advantage. The bromide of zinc he had found to relieve impaired nervous power; whilst the salt of lead he proposed as a soothing and cool local agent in certain inflamed states of the mucous membrane.

'On a Vocal Organ of an Aquatic Insect,' by Mr. R. Garner.

'On the Functions of the Liver,' by Dr. J. Goodman.

'On the Lymphatics in the Liver of Man and the Pig,' by Dr. L. T. A. Carter.

'On the Presence of Valves in the Abdominal Veins,' by Dr. E. Crisp.

MONDAY.

'What is the best Method of Estimating the Nutritive Value of Foods and Dietaries,' by the President.

'On the Nutritive Elements in the Dietary of the Labouring Classes,' by the President.

'On the Relative and Special Applications of Fat and Sugar as Respiratory Food,' by Dr. T. Hayden.

'On the Use of Milk and Scotch Barley as an Article of Diet,' by Mr. G. Frean.

'On the Alimentary Character of Nitrogen Gas,' by Mr. F. Barham.

'On Meat as a Source of Entozoa,' by Dr. T. S. Cobbold.

'On the Lentil as an Article of Food, and its Use from the Earliest Historical Time,' by Mr. C. G. Monteith.

Section E.—Geography and Ethnology.

SATURDAY.

'Account of an Expedition across the Rocky Mountains into British Columbia, by the Yellow Head or Leather Pass,' by Viscount Milton and Dr. Cheadle.—This journey was undertaken with a view to discover the shortest route between the Red River settlement and the gold district of Cariboo, in British Columbia. The pass by which the party crossed the Rocky Mountains had been formerly used by the *voyageurs* of the Hudson Bay Company; but it had been long abandoned. The route followed, after descending from this pass, namely, by the Thompson River, had never before been attempted, owing to the dense growth of primitive forest and the dangerous navigation of the streams. The enterprise was successfully accomplished by Lord Milton and his companion, though not without the loss of nearly all their baggage and provisions, and several narrow escapes of life. Enough was seen to convince them that this was the best line for the construction of a road from Canada, *viâ* Red River, into British Columbia, as it was the most direct one practicable, and was far removed from the United States frontier. A great portion of the country to the east of the mountains was noticed to have been completely changed in character by the agency of the beaver, which formerly existed here in enormous numbers. The shallow valleys were formerly traversed by rivers and chains of lakes which, dammed up along their course, at numerous points, by the work of these animals, have become a series of marshes in various stages of consolidation. So complete has this change been, that hardly a stream is found for a distance of 200 miles, with the exception of the large rivers. The animals have thus destroyed, by their own labours, the waters necessary to their existence. In the Thompson and Frazer river valleys, the travellers noticed a series of raised terraces on a grand scale. They were traced for

100 miles along the Thompson, and for about 200 miles along the Frazer River; forming three tiers on each side of the valley, each tier being of the same height as the corresponding one on the opposite side. The lowest terrace was of great width, and presented a perfectly level surface, raised some 30 or 40 feet above the water. The second was seldom more than 100 yards wide, and stood at about 50 or 60 feet above the lower one. The third lay at a height of 400 or 500 feet above the river on the face of the inaccessible bluffs. They were all perfectly uniform and free from the rocks and boulders which encumber the present bed of the river, being composed of sand, gravel and shale, the detritus of the neighbouring mountains. The explanation of these phenomena is to be sought in the barrier of the lofty cascade chain of mountains, through which the Frazer has pierced a way lower down the valley. At a former period, the valleys of the Frazer and the Thompson seem to have been occupied by a succession of lakes, the cascade ridge then forming a barrier which dammed up this great volume of water. The highest tier of terraces would mark the level at which it then stood. Some geological convulsion caused a rent in the mountain barrier, allowing the waters to escape partially, so as to form a chain of lakes at the level of the middle terraces; and subsequently, after long periods of repose, two other similar disturbances successively deepened the cleft, and drained the waters first to the height of the lowest terrace, and finally to their present level. In the course of the paper, the country east of the Rocky Mountains was highly extolled as a promising region for settlement, especially by an agricultural population.

Sir J. Richardson bore testimony to the geographical value of the paper, stating that a great part of the ground travelled over by Lord Milton, to the west of the Rocky Mountains, had not been previously visited by a European. Mr. Thomas Drummond, the botanist, had crossed, alone, with his gun and plant-box, a new pass very near to the one traversed by Lord Milton's party, and most of the rest of the country described had been surveyed and mapped by Mr. Thompson. He was totally opposed to the authors of the paper with regard to the suitableness for settlement of the region to the east of the Rocky Mountains. Grain for the use of a regiment of soldiers, stationed at Red River, had to be transported a distance of 1,500 miles, and was there worth its weight in silver. He saw no prospect of the country becoming settled: a line of telegraph, however, was now being laid across it, and we should soon be able to communicate with Canada and the United States, *vid* Siberia and Behring's Straits.—Lord Milton said the cause of the scarcity of grain at Red River was owing to the ignorance of the settlers. He saw a farmer there who had planted wheat for eleven successive years on the same piece of ground, and, on seeing the scantiness of the crop at the eleventh harvest, had asked a newly-arrived Scotch settler the reason of it.—Dr. Cheadle also replied to the same effect: stating that the cultivation of the rich soil to the east of the Rocky Mountains was necessary to the prosperity of the mining country to the west; for British Columbia would never yield grain for its own consumption, owing to the sandy nature of its soil and the absence of vegetable mould.

'On the Physical Geography of the Peruvian Coast Valleys of Chira and Piura, and the adjacent Deserts,' by Mr. R. Spruce.—This was an elaborate description of the soil and climate of those districts of northern Peru in which the different Peruvian varieties of the species of cotton-tree, named *Gossypium barbadense*, are so successfully cultivated. The memoir will be published by the Indian Government for distribution amongst the planters in India, where these varieties of the cotton-plant were introduced by Mr. Clements Markham. The districts described are remarkable for the absence of rain, the only humid and fertile districts being the valleys of the numerous short streams which flow from the Andes to the Pacific. Seasons of heavy rain, nevertheless, occurred at long intervals, in some cases of seventeen years.

Commodore Maury, in explaining the probable cause of the remarkable dryness and exceptional rains of northern Peru, described the equatorial cloud-belt of the earth, and said that it was a proof of the sharp limitation of this belt that at Guayaquil (which was covered by it) there was a humid climate, whilst at Piura, only 120 miles further south, but outside the belt, not a drop of rain fell for seventeen years. The cloud-belt was suspended over that narrow zone which lay between the termini of the northern and southern trade winds, and he attributed the occasional rainy seasons at Piura to exceptional variations in these termini which caused the ordinary annual oscillation of the cloud-belt to extend a little further to the south than was usually the case.

'On the River Purus, a great Affluent of the Amazons,' by Mr. R. Spruce.—This great affluent of the Amazons, which has long been thought to be the same as the *Madre de Dios* of southern Peru, and as likely to become a channel of communication between that fertile region and the Atlantic, has been recently navigated nearly to its head waters by Senhor Serafim, a half-caste Brazilian, and his itinerary, reduced to shape by Mr. Spruce, formed the subject of the paper. No astronomical observations or bearings were taken; but Mr. Spruce concludes, from the number of days the journey occupied and the rate of travelling, that Senhor Serafim reached to within a few miles of Mr. Markham's furthest point, when he descended the Tambopata from the Andes, in 1860. No obstruction was found to the free navigation of the river from its mouth to the extreme point reached.

'On the Delta of the Amazons,' by Mr. H. W. Bates.—The area which geographically constitutes the Delta of the Amazons forms an irregular triangle, measuring about 180 miles each way. Contrary to what might be expected in the mouth of a great river lying on the Equator, the country in and around it has a pleasant and salubrious climate. The islands and neighbouring mainland are not formed wholly of fluvial deposit: this is the case only with a portion of the area, 120 miles distant from the sea; the remaining portion, or that lying nearest the sea having a rocky base and a sandy soil, the product of the disintegration of the rocks. The author concluded that this alluvial portion of the area was the true delta, and that at no very distant period the seaward portion of the present delta formed a series of islands lying off the mouth of the river. These islands he proved to be of great antiquity by an analysis of their Fauna, which showed (in the groups examined) a large proportion of endemic species. The strong affinity of the Fauna of the south side of the delta with that of Guiana also tended to show that the two regions could not have been formerly separated by a gulf 180 miles wide, impassable by these species. Had this been the case, the southern margins would more naturally have been peopled from Brazil further south, there being no known barrier to hinder the migration of species from this direction. All the facts furnished by the physical geography and the Fauna pointed to the result, that an ancient tract of land or chain of islands bridged over the space between Guiana and what are now the southern borders of the Delta.

Mr. A. R. Wallace confirmed the conclusions of the author of the paper so far as the island of Mexiana was concerned, which lies in the mouth of the Amazons. He found here, when he visited the place in 1849, beds of sandstone, and believed that very little of the land was due to river-deposit. Mexiana was exposed on two sides to the open sea, yet so vast was the volume of fresh water poured from the mouth of the Amazons that even at high tide, when the stream rose 12 feet, the water was always sweet and drinkable, at least near the land.

'A Remarkable Storm and Beach Wave at St. Shotts, Newfoundland,' by Mr. K. Maclea.

'On the supposed Stone, Bronze and Iron Ages of Society,' by Mr. J. Crawfurd.

'An Account of the Human Bones found in Tumuli situated on the Cotteswold Hills,' by Dr. H. Bird.

Section F.—ECONOMIC SCIENCE AND STATISTICS.

MONDAY.

'Some Remarks on the French Calculating Machine,' by Major-Gen. Hannyngton. — (The machine itself was exhibited.)

'On Life Tables, by the Swedish Calculating Machine,' by the President.—(With Photographs of the machine by A. Claudet.)

'On the Causes which produce the present High Rate of Discount,' by Prof. Fawcett.

'On Statistics relating to the Royal Navy,' by Prof. Levi.

'On Military Statistics of certain Armies, especially of those of the United States,' by Mr. E. B. Eliott.

'On the Registration of Births and Deaths in Ireland,' by Mr. J. Wilson.

'On Statistics of the Coal Trade: Colliers employed, Wages paid, and Social Condition of the Miners employed in the Northern Portion of the Bristol Coal Field,' by Mr. Handel Cossham.

Section G.—MECHANICAL SCIENCE.

MONDAY.

The Report of the Committee 'On the best means of Providing for a Uniformity of Weights and Measures with reference to the Interests of Science,' was read before this Section by Mr. J. Heywood.—The Report had been previously read and discussed before Sections B. and F.—(See *Athen.* p. 436.)

Prof. Rankine, one of the Committee, dissented from that part of the Report which recommended the adoption of the metric system, and read a paper 'On Units of Measure,' in which he arrived at the conclusion that while the advantages of decimal multiplication and division as applied to units of measure are incontestable, the question between different units, such as the mètre and the inch, is one of convenience, in which the interests of science and of trade cannot be separated; and inasmuch as the British inch and multiples of the inch are already established, and used for practical purposes in regions inhabited by one-fourth of mankind, their use ought not to be abandoned in scientific writing.

A discussion ensued, in which Mr. J. Scott Russell, Sir J. Bowring, Prof. Williamson, Mr. W. Tite, M.P., M. Ansas, Dr. Gray, Mr. J. Yates, Mr. W. Ewart, M.P., and Mr. W. Fairbairn took part.

Mr. J. Scott Russell read the Report of the Committee 'On Gun-Cotton,' from which it appears that the investigation is now placed in the hands of a Government Committee of scientific and practical men, who are engaged in a systematic course of experiments relating to the manufacture and keeping qualities of gun-cotton, and its use for artillery, small arms, and in engineering; and the Committee of the Association consider their work accomplished, as the investigation is now being made with greater facilities and means than could have been at their disposal. Mr. Scott Russell added some observations on the progress made since the last meeting in the application of gun-cotton. He stated that General Hay, of the Hythe School of Musketry, had constructed a new form of cartridge suited for the Whitworth rifle; that he had found that the use of gun-cotton was cleanly, and had not the disadvantage of fouling the gun; that it had much less recoil, although the effect was the same; that one-third of the weight of charge was the equivalent proportion, and that it did not heat the gun. The General had fired at a target with gun-cotton at 500 yards. Twelve successive shots were all placed in a space one foot wide by two feet high, and the value of the practice was measured by the fact that the mean radius of deviation from the centre was between nine and ten inches. Thus, therefore, the use of gun-cotton in musketry had been proved by English-made gun-cotton in English rifles by an English general, to perform all that the Committee last year reported of Austrian gun-cotton on the faith of the Austrian General Lenk. The next application of gun-cotton made during the past year was to the driving of tunnels, shafts, and drifts in connexion with engineering work. It had been stated by the Committee that one-sixth of the weight of charge of cotton was equal in blasting effect to gunpowder, and this had been proved in practice in a number of instances. At Wingerworth colliery, in driving a shaft through soft but solid rock, one-thirteenth of the weight of gun-cotton as compared to gunpowder, and in the slate quarries

at Llanberis, at Allan Heads, one-seventh were required. At Allan Heads, in some lead mines, a tunnel was being driven seven miles long. The drift was 7 feet by 5 in the hardest limestone. Both ends were worked with gun-cotton fired by an electric battery. The great advantage experienced was that the air was not contaminated by smoke, and that the work could be carried on more rapidly. The next application of it had been to the detaching of large masses of rock. This had been tried in several places, and it was found that one pound of gun-cotton was able to detach from 30 to 60 tons of rock.

Mr. F. A. ABEL added some remarks on the chemical condition and manufacture of gun-cotton. He stated that the manufacture of it was much safer and more uniform than that of gunpowder, and when made its stability is permanent and could be relied on. He believed the Report of the French chemists against its permanency was founded on experiments made with imperfectly-manufactured material. Working with large quantities during the last twelve months he was satisfied it did possess permanence, though he stated that under certain conditions of packing and exposure to too high a temperature a slight change did take place: this he believed arose from some foreign ingredients in the cotton.

'On a Machine for Testing Girders,' by Mr. J. I. STOTHERT, and Mr. R. PITT.

'On the Construction of Shot-Proof Targets,' by Mr. J. PRIDEAUX.

FINE ARTS

ROMAN DISCOVERY.

Rome, Sept. 28, 1864.

Righetti, a wealthy commoner of this city, has lately purchased an old palace for an old song, being in one of the dirtiest parts of Rome, called the Biscione; it is close to the Piazza Campo dei Fiori, and not far from the Farnese Palace. Extensive repairs were indispensable, for the building was in a most rickety state, and, on setting people to work to dig for a foundation, they came upon a pavement composed of large slabs of that marble called "Porta Santa," which is a dull, veined marble, of a reddish hue, which comes from the Island of Iasus, in the Archipelago, and is properly called "Marmor Jasseuse"; it is, however, better known by its modern name, which it derives from its forming the jambs of the jubilee door at St. Peter's. This pavement was found thirty feet below the present level of this part of Rome; and here, likewise, they came upon a massive wall, near which they found a piece of building somewhat resembling a Noah's Ark without the boat: the sides were of brick and the roof was formed of large blocks of travertine resting upon these walls, and uniting with bevelled edges at the top ("rigging" as they call it in Scotland). There were two gable ends, each formed of one huge block of travertine; on several of the blocks are seen, large and well cut, the letters F C S, which, as yet, the archæologists here cannot explain. Great difficulty was encountered in consequence of the hole continually filling with water, and preventing the work going on; but a steam-engine was procured to work the pumps, which are now plied night and day. On opening the "ark," it was found to contain a magnificent gilt bronze statue of a youthful Hercules, fourteen feet high, but lying on his back, or, as the Romans graphically describe it, "*panza per aria*."

In Art, this statue equals the finest that ever Greece produced, and the careful manner in which it has been hidden and the means taken to protect it, argue that its value was known and appreciated. I suspect it must have been hidden in the fourth century to prevent its being carried off to Byzantium by the son of Constantine, who made off with everything he could lay his hands on in the shape of works of Art, to enrich and adorn the city which thenceforward was to bear their imperial name. It is interesting to know that the coins found in and about the statue were those of Domitian, Decius and Maximinius, commonly styled the *Herculeus*. There were likewise coins of the Lower Empire.

Over the gilding, which is very thick and bright (and the *patina* of which is still perfect), is a rough calcareous incrustation, which must be carefully removed before the beauty of the statue can be thoroughly enjoyed. It was found imbedded in marble-chips, such as form the sweepings of a sculptor's studio, and also wedged in by masses of architectural fragments. Inside the figure was found a very pretty little female head sculptured in Parian marble. The back hair is gathered up in a net, much in the style as worn by ladies in the present day, and which fashion prevailed from the time of Heliogabalus down to Constantine, as we see by referring to other statues and busts. The period of Art to which this little bust belongs is that of Constantine, and therefore inferior. Other relics may yet be found in the statue, which is far from empty.

On the first indications of this discovery, much speculation arose as to whether it were equestrian or not, and whether it might not prove to be a portrait statue of Pompey the Great, since the place where they are excavating is on the site of Pompey's Theatre, which was the first ever made of stone in Rome; and that its size was considerable is known from the fact that it accommodated 20,000 spectators. These speculations as to what it is are now pretty well at rest, as the statue speaks for itself; at the same time, as there is a deal of that incrustation above mentioned adhering to the features, there are some who insist that it is a portrait of Domitian represented as Hercules. It has been raised to within ten feet of the surface, and men are busy exploring, in the hope of finding one of the feet, which is missing. The club has come up in three pieces, and the lion's skin, which has hung over the shoulder (similar to that of the Theban Hercules in the Vatican), and which has evidently been cast separately, is especially interesting to us moderns, as showing the mode in which the ancients executed their work of casting.

Hercules being the tutelary deity of Pompey the Great, it was natural that his image should be chosen to adorn the building he erected. As a work of Art, this statue is far superior to that found in the Forum Boarium, which is also gilt bronze, and is now in the Capitol. It has evidently been executed by artists in the time of the Empire, and stood in the Temple of Hercules in the Forum. The beautiful marble statue of Hercules bearing Telephus, which adorns the "Pio Clementino" in the Vatican, was found in the Campo dei Fiori and placed where it now stands by Julius the Second. It should be remembered that the noblest fragment of antiquity existing, was presented by that same Pontiff to the Vatican; it is a portion of a Hercules, and if I am not mistaken, I have seen a drawing by Flaxman, in which he restores it from an ancient gem representing Hercules and Hebe. This fragment was also found in the Campo dei Fiori (Pompey's Theatre), and is known as the Torso of the Belvedere.

R. MACPHERSON.

FINE-ART GOSSIP.—The second Exhibition of the Works of Modern Artists in connexion with the Yorkshire Art-Union, was to open, in Leeds, on the 8th inst. (to-day). In its Catalogue will be found the names of many well-known contributors.

As Birmingham contains a population of 200 artists, no one need be surprised to hear that it is proposed to establish a permanent Art-gallery in that town; pictures to be removed at the time of sale, and contributors to have the option of replacing their unsold works at pleasure.

The obituary of this week announces the death, on Monday last, of Mr. C. Winston, barrister, well known as the author of the valuable 'Hints on Stained-Glass Painting.' Mr. Winston died suddenly, of heart disease, aged fifty.

A bulky Blue Book, containing the evidence given before the Committee on Schools of Art, has just been published. The volume includes the Report of the Committee which has been for some time before the public.

The beautiful Church of St. Mary, Beverley, famous for its graceful Early Perpendicular front, is in the course of complete restoration. The chancel has been in the hands of Mr. C. Brodrick, of Leeds. Mr. G. G. Scott has commenced to restore the nave; the interior is to be fitted with open seats.

The ancient church of Selsey, Sussex, is to be demolished because, as alleged, it is two miles from the congregation. It is a thirteenth-century church, and remarkable for containing stone benches round the piers of the nave. Selsey will be remembered as the seat of an Anglo-Saxon bishopric, since transferred to Chichester; the ancient cathedral has been long since destroyed, probably by incursions of the sea.

No branch of the decorative arts has been so much cultivated of late in this country, as that of staining or painting on glass. Hundreds of churches now contain examples of this kind of work, and some of these edifices derive great benefit, both architecturally and decoratively, from the same. We are persuaded that the aspect of most, if not all, church interiors so decorated would be improved if the look of rawness which results from the juxtaposition of the coloured glass with the white or yellow wash of the walls and mullions were mitigated by painting the latter with patterns, or some other kind of chromatic decoration. This practice would not only be in accordance with ancient usage, but suitable to modern taste, which desires the introduction of colour to interiors of this class. Although thus sanctioned, the thing itself is very rarely done, and the effect of most coloured windows is seriously marred. We know no reason why the practice should not be universal; the cost of such decorations could not add much to that of a window, and it would add greatly to the beauty of churches, if something like a framework in colour were given to the light-openings.

The Committee of the Northampton Architectural Society, which was appointed to consider the plans for the restoration of the famous church at Brixworth, has agreed that it is not worth while to retain the late Perpendicular work of the chancel, and approves of the suggestion to rebuild the apse upon its old foundations, care being taken to preserve the two ancient bays on the north side, the inner face of the wall thereof being kept entire, instead of giving a new face to the wall; the position of the chancel screen should be retained as of old. The two windows in the north wall of the nave are not worth retaining; the lines of the ancient piers are sufficiently marked to insure the restoration of the north arcade, with the introduction of but a small portion of new work. On the south side it is proposed to remove the square Perpendicular window and restore the arch into which it is inserted; to retain the second bay from the west with the Decorated window and the Norman arch above it. It is suggested, with much good sense, that whatever insertions are made to this ancient and interesting edifice should be distinctly shown as of modern origin, so that the common deceitful practice of restorers is protested against.

By way of further contributions to the North Wales Guide-Book, let us say that the church of Llandegai, near Bangor, is furnished with a beautiful avenue of yews leading to the west door, and that trees of that sort surround the edifice on all its sides. The church itself, which is of Decorated character, has been very badly restored and injured by ignorant hands. Ignorance could not ruin the four beautiful arches of the crossing of Llandegai Church. Near the altar is a monument, by Sir R. Westmacott, to Lord and Lady Penrhyn—a sculpture which may be studied, not without profit of a sort, by the already taught. At the west end is a very interesting monument of alabaster to an unknown knight, or peer, and his lady. The effigies wear costumes of the fifteenth century, and exhibit ample traces of colouring; the carving is admirably free, yet severe, and the work of a noble school of monumental sculpture. The knight wears a collar of roses and suns, alternately placed, and is in full armour, except the head; the lady has a beautiful carcanet; "weepers" of angels, bearing shields, fill niches on the sides of the pedestal of this tomb. Built into a wall at the "Friar's School" in Bangor, which was intended for the education of townsmen's children, are some very