THURSDAY, OCTOBER 6, 1870

SCIENTIFIC ADMINISTRATION

NO reflecting Englishman can contemplate the great events of the present time without desiring to extract from them such warnings and instruction as may be serviceable to his country in case she should be drawn into war. Accordingly the press teems with discussions on every branch of the military art. We leave these to others. In what respects the constitution, the discipline, the training, and the arming of one army are superior to those of the other, it is scarcely the function of this journal to point out. Taking the broad fact that the Prussian army has, up to the present point, proved itself superior on the whole to that of France, and indeed to any army that has ever existed—a fact that no unprejudiced person will deny—let us ascertain, if we can, whether there may not be recognised some one broad cause to account for so broad a fact.

In this inquiry we have been almost forestalled by the Chancellor of the Exchequer at Elgin. Mr. Lowe recited the lessons which he considered we have to learn from the Prussians. He spoke of their "intelligence," their "organisation and docility," their "extraordinary knowledge, forecast, and diligence." He enumerated nearly all the qualities that command success. But there was one word which that profuse enumeration did not contain—a word which Mr. Lowe no doubt felt unable to utter, and that word is—Science. A Government which refuses aid to astronomers anxious to observe so rare a phenomenon as a total solar eclipse, cannot be expected to vaunt the prowess of science. Mr. Lowe's statement of the causes of Prussian success was therefore incomplete; it was a mere reckoning of the bricks of the building, without a word of its architecture and design.

The Prussians, whatever their other qualities, are emphatically a scientific people, and to that predominating characteristic first and foremost are their recent military triumphs due. We do not mean that because they are great chemists, astronomers, and physicists, therefore are they necessarily great soldiers; so narrow a proposition would hardly be tenable. What we mean is that the spirit of science possesses the entire nation, and shows itself, not only by the encouragement given throughout Germany to physical research, but above all by the scientific method conspicuous in all their arrangements. What does the word Science, used in its wider sense, imply? Simply the employment of means adequate to the attainment of a desired end. Whether that end be the constitution of a government, the organisation of an army or navy, the spread of learning, or the repression of crime, if the means adopted have attained the object, then science has been at work. The method is the same, to whatever purpose applied. The same method is necessary to raise, organise, and equip a battalion, as to perform a chemical experiment. It is this great truth that the Germans, above all other nations, if not alone amongst nations, have thoroughly realised and applied. In all the vast combinations and enterprises with which they have astounded the world, no one has been able to point to a single deficiency in any one essential element. Every post has been adequately filled and every want provided for; from the monarch, the statesman, and the strategist, to the lowest grade in the army—each department complete, each arm of the service, whether cavalry, infantry, or artillery, trained to its own special duties, and efficiently equipped for their performance. This is the method of science, literally the same method which teaches the chemist to prepare his retort, his furnace, and his re-agents, before commencing his experiment.

This, we maintain, is the great lesson, of a material kind, which the war should teach us. Where is our science? At the Admiralty and the War Office, partisan placemen preside over technical administrations. Is that science? Under pressure of the newspapers or of private influence, a ship of war is built by an amateur in spite of the demonstration of our professional adviser that she must be unsafe, and she goes accordingly to the bottom with 500 souls in the first gale of wind. Is that science? One-half of the forces on which we reckon for the defence of the nation is composed of patriotic volunteers, with whom training is optional, and to whom efficient officers and arms are denied. Is that science? The government of London, the greatest metropolis in the world, is parcelled out to scattered knots of ignorant, sordid tradesmen, on whom no ingenuity has ever been able to fix a shadow of responsibility. Is that science? Have we before us the crudest outline of the strategical and military operations with which it is proposed that an invasion of this country should be repelled? Coming political policies always, in England, cast their shadows long before. Have we any indications of a coming military policy? Have we the means of calling together, in a short space of time, properly provided with the necessaries of a campaign, the forces requisite for carrying out a given military policy? Do we know, for instance, how our volunteers, who are reckoned on, man for man, as equivalent to regular troops, are to be employed?

We fear it is a terrible truth that absence of scientific method is as conspicuous with us as its presence is with the Germans. As a nation, we have never realised the necessity for system and completeness in utilising our material resources. The use for the scientifically trained mind has, in our idea, been limited to chemicals and the like.

In courage, energy, intelligence, and wealth, natural and acquired, England need shrink from no comparisons with other nations, but she has yet to awake to the want of that something in her arrangements that shall enable her to turn her enormous advantages to the best account. Science, using the word in its sense of the method applied to things, not to the things themselves, is that something.

OWENS COLLEGE, MANCHESTER

OCCASIONS may sometimes arise, and in fact have already arisen, when it becomes a necessity for a journal like ourselves, devoted exclusively to scientific matters, to direct some attention to what is going on around it in the general world. One of these lately occurred, and caused us to make the remarks we did recently on the apathy displayed by the Government towards scientific research. This week, in a similar manner, we desire to call the attention of our readers to some proceedings which took place on the 23rd ult. in Manchester. This we do because of the great interest these proceedings have to all scientific men, both on account of the ultimate benefit science generally will attain through them, and also on account of some one or two very remarkable speeches made on the occasion.

The laying of the foundation-stone of the new Owens College building by the Duke of Devonshire, its newly elected president, is an event of national importance. For in it we see clearly—and such is the view held by all the professors and governors of that institution—the beginning of the great Scientific University of the North of England. Owens College was founded some twenty years ago by the munificent bequest of Mr. John Owens, a Manchester merchant of the old school, who left his money to found an endowment for the promotion of learning in his native town of Manchester. He was wise enough to stipulate that his money should not be employed for any building purposes, but solely towards educational purposes, leaving it to his fellow-townsmen to provide the house accommodation. This was done at first on a small scale, but Owens College has been from that time gradually increasing in numbers year by year, until a few years ago it was found absolutely necessary that new buildings should be obtained to meet the constantly augmenting number of students. Subscriptions were immediately set on foot, and in a short time something like 130,000*l.* was raised. With this the present buildings have been undertaken. On Friday week the foundation-stone was laid by the Duke of Devonshire, in the presence of the Bishop of Manchester, Professor Huxley, Professor Tyndall, and all the professors and governors, and the chief notabilities of Manchester. In the address presented to the Duke of Devonshire, it is stated that the projected buildings will provide for 600 day students, and a much larger number of evening students, and will include both chemical and physical laboratories. The architect, Mr. Waterhouse, has provided for the permanent accommodation of the Natural History and Geological Museums, presented by the late Manchester Natural History Society and the Manchester Geological Society, and also for the large library and various lecture and examination rooms.

The Duke of Devonshire, in laying the stone, remarked that he looked upon this day as one very celebrated in the annals of Manchester, and one destined to make Manchester more and more renowned at no distant date, as possessing a college second to none in England, and one which would become the centre of the scientific culture of the north of England. No year passes without some considerable benefactions being made to the college, and as fast as funds accumulate, new professorships in all branches of science are being founded, and the college has already become one of quite national importance.

Professor Huxley and Professor Tyndall also spoke, the former congratulating the town on the great results it has attained without any State aid, this State aid having been refused, and showing the great benefits which could not fail to attend the increased college accommodation in the great manufacturing and mining district all round Manchester; and the latter showing that the past work achieved by the eminent and able professors of the college was a sure guarantee of the work which would be done in the future.

The proceedings wound up with a luncheon in the Town Hall, at which the most remarkable speech of the day was delivered by the Bishop of Manchester, Dr. Frazer. In replying to the toast of the Bishop of Manchester and the clergy of all denominations, he said he had no hesitation in replying to this toast, as Owens College had been founded for educational purposes, without any reference to special religious bodies, and he continued—

"I take a very large, broad, and comprehensive view of what is meant by Truth. I believe that everybody who earnestly seeks to propagate the truth, to preach the truth in the largest sense of the word, is doing good to his fellow men. I never believed that true Science is contrary to true Religion, or that true Religion ought to be afraid of any legitimate consequences of true Science. I know well, and the knowledge makes me speak with some tremulousness, that I am in the presence of those who are considered to be, and who have established their right to be considered to be, the ablest interpreters of the laws and phenomena of the physical and material world. I cordially welcome those gentlemen as teachers and propounders of the truth. If scientific men will only believe that we, the clergy of this kingdom, are not sceptics in disguise, or charlatans trying to palm off upon the world something that has been found to fail; if they will only believe that we want to tread calmly, step after step, where we find our remedies have succeeded, I think they will allow that we are searching after truth, the only truth I care to find—practical truth—truth that will elevate man in the scale of being—and I think they will admit that we are trying to follow out truth by strictly scientific methods. I do not care from what source it comes; I will welcome every means which is calculated to settle the disputed boundaries between Religion and Science, and show that both alike, in their legitimate province, minister to, and help to bind up the great temple of Truth."

The fearlessness with which the Bishop thought it his duty to speak out, would, if followed throughout the whole of England, serve to overthrow that unfortunate antagonism there is at present between Religion and Science, founded on an entire misconception of the aims and the value of the latter as compared to the former.

The further proceedings on this interesting occasion were the delivery of some very instructive speeches by Profs. Huxley and Tyndall, and also by Prof. Henry, of the Smithsonian Institution, Washington, which, however, our space prevents us from further noticing. Certain it is, however, that the proceedings of the opening day are such as every scientific man throughout the kingdom will welcome with pleasure, and we cannot doubt that a report of them will be interesting to our readers. We hope that this occasion will inaugurate a new era for science, and will serve to bind together in the strongest bands those untiring workers in the pursuit of truth, whether they be scientific men or the clergy of all denominations.

The present Government has so far entirely refused to assist Owens College by any grant of money similar to that which a few years ago fell to the share of Glasgow University. The Government alleges that since the Manchester merchants have done so much for the college they can easily do more, and so complete the good work they have so well commenced. A stranger and more disheartening reason it would be hard to imagine. Our rulers appear to have yet to learn that there is such a thing as principle in the application of public money to the promotion of the real progress of the nation. We look forward to the report of the Science Commission to define the principles on which these grants should rest; and we trust we may then have a Government both capable of understanding what these principles are, and of firmness in carrying them out into practice.

J. P. E.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.]

Aurora Borealis

THE Aurora Borealis noticed in the *Times* was observed here on Saturday the 24th inst. between 9 and 11 P.M. Another was observed on Sunday the 25th between 2.30 and 3.15 A.M.; and again another on the same day about 8.30 P.M.

I did not see the first, but I did see the two last, and the Aurora of Sunday morning appears to have been the most vivid of the three.

About 2.30 A.M. a strong red glare as of blood appeared above a thick black cloud about 40° eastward of north and 30° elevation. As this faded, the red glare appeared westward of north at the same elevation. The clouds did not extend to the horizon, which was pretty clear, and in half an hour they had passed away.

At 3.15 the sky was clear, and vivid yellowish rays extended nearly to the polar star. The rays had a gradual motion to the eastward. This was well observed by the rays passing in front of the stars of the tail of the Great Bear, which were at that time nearly parallel to the rays. I ceased observing about 3.30.

The Aurora observed at 8.30 P.M. appeared to me very faint in comparison to that at 3.20 A.M. I would hardly have noticed it if a friend had not pointed it out to me.

This same person had observed the Aurora of the 24th, and it was from his observation that I inferred that the Aurora of the morning of the 25th was also much brighter than that of the evening of the 24th.

N. A. STAPLES

Louvain, Sept. 30

Fuel of the Sun

I AM not mathematician enough to form any opinion on the merits of the controversy as to the "fuel of the sun;" that is to say, I am not able to decide whether it is consistent with the conditions of the equilibrium of the solar system that the sun's heat should have been kept up through the ages of geological time by the falling in of meteors. But I wish to state some evidence which proves that meteors are constantly falling in, though it does not touch the question whether this source is sufficient to account for the whole or any large part of the total supply of heat radiated away by the sun.

In the first place, the meteors have been seen. On Sept. 1, 1859, Mr. Carrington and another observer simultaneously observed two meteor-like bodies, of such brightness as to be bright against the sun's disc, suddenly appear, move rapidly across the sun from west to east, and disappear.

The fact that their motion was from west to east is important. If the supply of meteors to the sun is constant and tolerably regular, it is scarcely possible to doubt that the meteors, like the entire solar system, move round the sun from west to east, and occupy a space of the form of a very oblate spheroid, having its equator nearly coincident with the sun's equator.

If this is the case, the meteors ought to fall in greater numbers near the sun's equator than near his poles, making the equator hotter than the poles. Such is the fact. Secchi, without having any theory to support, has ascertained that the sun's equator is sensibly hotter than his poles. The instrument used was an electric thermo-multiplier, and the indications show, not the ratio, but the difference of the heat from the two sources compared.

It can scarcely be doubted that the meteors must enter the sun's atmosphere with a velocity not much less than that of a planet, revolving at the distance at which they enter. We know that the sun's rotatory motion is incomparably less than this, and consequently the meteors, revolving from west to east, ought to make the sun's atmosphere move round his body in the same direction, and with greater velocity in the equatorial regions, where most meteors fall in. This is what is observed. Mr. Carrington, also without any theory to support, has shown that the motion of the solar spots from west to east is most rapid in the latitudes nearest the equator. We cannot compare the motion of the spots with that of the sun's body, as we do not see his body. But the fact that the motion from west to east is most rapid in the equatorial latitudes proves that these motions are not due to any cause like that which produces trade-winds and "counter-trades" of our planet; for, supposing the sun or any planet to rotate from west to east, in any circulation that could be produced in its atmosphere by unequal heating at different latitudes, the relative motions of the atmospheric currents in high and low latitudes would be similar to that of the trade-winds and "counter-trades," and opposite to that which the motions of the spots indicate in the atmosphere of the sun. This will be true at all depths in the atmosphere.

JOSEPH JOHN MURPHY

Suggestions for the Improvement of Meteorological Investigation

THE position of Great Britain at the head of a vast empire encircling the globe, and soon to be at the centre of a network of telegraphs that will feel all the pulses of the world, imposes upon British naturalists and the British Government the duty of leading the way in the important work of meteorological investigation. In the hope of aiding the progress of this work, I venture, through your columns, to call public attention to the following suggestions:—

First:—The increase of the number of meteorological stations on and near the equator is very desirable. For instance, an increase of weather reports from the West Indies and the Atlantic States of North America, especially about latitudes 30° to 32°, would be highly valuable to the people of Great Britain and other portions of Western Europe.

Second:—In meteorological reports, we should recognise both the unity of the atmosphere and its division into areas corresponding with the great divisions of the earth's surface into land and water. As storms are generally confined within these areas, they may be called storm areas, or sections of the atmosphere in which disturbances are very closely connected. For instance, the area within which the greater storms that visit Great Britain begin and end, or circulate with destructive force, is bounded by the equator on the south, and the Rocky Mountains on the west. The northern and eastern boundaries are not yet determined. On September 7, 1869, the first "Northers" of the season visited New Orleans; on September 8th, storms passed over the Northern States; and between September 9th and 23rd, storms passed over Great Britain and Western Europe. Again, on October 1st, 1869, the barometer at Havana indicated the approach of bad weather; on October 2nd, 3rd, and 4th, there were heavy gales and rains at New York; on the night of October 4th, occurred one of the most destructive storms that has ever visited Maine and New Brunswick; on October 6th, there was a heavy gale in England. The destructive gale in England, on October 16th, was preceded by a hurricane in New England on October 11th. These two last-mentioned storms appear to have been closely connected not only with each other, but also with the extraordinary heat which prevailed in England on October 8th, 9th, and 10th, and in France on October 11th. All the storms mentioned, however, are only specimens of the many annual disturbances of the same kind whose connection with the Atlantic Ocean as a centre has been, or may easily be traced. They are referred to here, merely to show that about an eighth of the whole atmosphere constitutes, and may be named, the Atlantic storm area. To make a weather report of much practical value in Great Britain and Western Europe, it should cover the whole of this area. The number of places, however, from which reports are published, need not be so large as at present.

Third:—The records of the atmospheric conditions and changes should be arranged with reference to the latitude and longitude of each station. At present there is no system in tabulating meteorological observations. The weather tables now published in the daily papers are of comparatively little value to the general public, owing to their want of arrangement. A weather-table, to be of any great practical value in the northern hemisphere, should contain—first, a record of observations made at points south of the place for which the table is designed, and if possible on or near the equator and the 30th to the 32nd parallel; next, a record of observations made at western points within the limit of what I have ventured to call the storm area; next, a record of observations at northern stations about latitude 60°; and next, at eastern stations within the storm area. This statement is not to be understood as implying that all storms begin at the equator or at any one point of the compass, or that they are in all cases confined within one section of the atmosphere, or move in one direction.

Fourth:—It is very important to obtain correct and copious data regarding the atmospheric currents between (say) 5,000 feet and five miles above the level of the sea, and especially at various points on and near the equator, and at about 30° to 32° North and South latitudes. Within these limits the rain-bearing currents of the atmosphere move. If self-registering meteorological instruments were placed permanently upon several of the leading mountain ranges of the world, and their records copied at stated intervals, we should obtain valuable data for determining the direction, velocity, and magnitude of the controlling atmospheric currents of the globe. More valuable still would be data obtained by the use of self-registering and self-regulating machines that would ascend to any desired height within the limit mentioned above, remain up for a time determined by clock-work, and then descend, bringing with them complete records of temperature, moisture, direction and velocity of currents, &c. Additional facts regarding the great atmospheric currents within the limits named are required to enable us to interpret correctly the oscillations of barometers near the surface of the sea. G.

New York

Colour Blindness

I HOPE your readers will bear with a few more observations from me on the foregoing subject. It is an undoubted fact that modes of nervous action which have once coexisted tend to excite each other afterwards. This the phenomenon known as Association of Ideas sufficiently proves. It is to this cause that I should be disposed to attribute the phenomenon of accidental or complementary colours. I do not, of course, mean that this latter fact can be resolved into Association of ideas, but that it and association depend on the same organic law. It is probable that in addition to this, however, the mutual excitation of vibrations comes in. Judging from the determination of wave-lengths by diffraction, the ratio of the wave-length of any given ray to that of the complementary one is not very far from 2 to 3 or 3 to 2; and, as the colours excited do not seem to be exactly complementary, it is probable that the vibration referred to is that chiefly excited. For an accurate determination of this question we should require to determine the wave-lengths for each colour in the liquid which surrounds the eye, or rather, perhaps, in the retinal substance. Such are the two causes to which I should be disposed to ascribe the phenomenon of accidental colours. From the former it would follow that the more completely the eye had been accustomed to white light, the more likely the person would be to become colour blind; and that colour-blindness might be remedied, or at least altered in character, by accustoming the eye to look at everything through coloured glasses.

There are, however, subjective causes which determine the eye to exhibit various colours in particular instances. Of these, jaundice, which makes the object appear yellow, is one. Derangement of the stomach, I believe, often invests objects in the dark with a blue tint. Colours of this description constantly mingle with our ordinary perceptions without being noticed, but when a finer distinction is needed it becomes necessary to avoid them. Thus, in some of the delicate optical experiments to which I referred in my last, the experimentalist must not operate after a long fast or a hearty meal, or after taking any alcoholic drink. He sometimes finds, also, that his two eyes differ in their appreciation of colours. Two instances of this subjective colouring recently came under my notice. In one case an old lady for some time saw everything red, which she attributed to looking very much at a red flower (which she greatly admired) in her sitting-room. She was advised to look a good deal at the green fields opposite her window, and soon recovered. In the other case a friend of mine, reading a note-book which he had marked with a blue pencil, was surprised to find that the marks appeared green. He showed me the book, and the marks were quite unaltered to my eye. He was reading hard, and somewhat nervous, but otherwise in good health. In most of the cases I have referred to, the subjective colouring was only temporary; but I have little doubt that there frequently exists a permanent subjective colouring which modifies all the phenomena of vision, and leads to effects, in some respects, similar to those of ordinary colour-blindness.

Some time ago the question was suggested to me whether a blind man (whose retina was not destroyed) could have a perception of extension by sight, or whether, in the uniform darkness which was supposed to surround him, he could distinguish extension at all? I tried the experiment by shutting my eyes, but finding that when the light was good a very perceptible amount made its way through the eyelids, I placed bandages over them in addition. I could never, however, obtain uniform darkness. Points over the field always appeared less dark than the surrounding ones, and the positions of these points were easily distinguishable. On making the experiment for the third or fourth time, I was rather surprised to see part of the visible surface covered by a faint blue. Subsequent observation confirmed this, and I now believe that it was only from habitual inattention to colours when the eye was shut (as well as the difference between colours on a dark and on a bright ground), that I failed to observe it on the first occasion. These colours are by no means confined to blue. In fact, I think I have seen every tint in the spectrum, and I never can close my eyes for three minutes without seeing some of them more or less distinctly. They generally only cover a patch which, however, is not fixed, and the colour first visible sometimes disappears altogether. I may, perhaps, add to this that I often see a collection of small, bright, round moving spots about the centre of the field of vision. These spots I can likewise see in the dusk with my eyes open. This affords a proof of subjective colours in my own eyes, but from their variability, I do not think my eyes have a predilection for any particular tint. I often see more than one of these colours at the same time. If the eye had a predisposition for any particular colour, it could probably be discovered in this way. The observations are worth repeating. A close attention to the sensations is required on account of their faintness.

I have mentioned the expedient of looking through coloured glasses. Professor Wartmann succeeded in this way in making colour-blind persons distinguish colours which they confounded with the naked eye—a fact quite explicable on my principles; but he found it impossible to predict what effect a glass of any given colour would produce. But might we not by repeated experiments hit upon the particular tint which would suit the eye of any particular patient? If, for example, we tried his eye with a solar spectrum, and interposed one or more coloured glasses of different tints, and in this tentative manner at last succeeded in making him see seven colours, each confined within the same limits that they are to the ordinary eye, it is pretty evident that these glasses would enable him to distinguish the colours of all objects in the daylight.

Not having read much on the subject, I cannot say how far these views are original. The subject is at least one which requires further investigation, and if I can induce some of the eminent contributors to your columns to take up the matter, my letters will not have been vain though the result may be to overthrow all that I have advocated. W. H. S. MONCK

Trinity College, Dublin

The Effect of Tannin on Cotton

IN your last number you mention the fact that cotton fabrics are rendered more durable by treatment with tannin, as if it was a new discovery, and state that "it is believed the change cannot be great, since it has escaped the notice of practical tanners."

In our neighbourhood (the coast of Northumberland) the fishermen have, for many years past, been in the habit of tanning their nets and sails with oak-bark or catechu.

At the tanyard with which I am connected, we tan a large number yearly, including many cotton nets. Not only does it render them more durable, but in some cases, where wet nets have heated and become tender, their toughness has been restored by tanning. I cannot attempt to explain the chemical action which takes place, and, indeed, the still more important ones by which leather is produced are very imperfectly understood.

HENRY R. PROCTER

North Shields, Sept. 26

The Intended Engineering College

IN my letter on the above subject, I alluded to Mr. Mason's magnificent foundation of an educational institution in Birmingham, and by a queer inadvertence wrote the Christian name "Oliver"; and shall be much obliged if you will insert this correction of my mistake. It is Mr. *Josiah* Mason, the well-known pen manufacturer and founder of the orphanage and almshouses at Erdington, who is so liberally and judiciously enriching the Midland metropolis

W. MATTIEU WILLIAMS

The Haze Accompanying Auroral Displays

I DOUBT if the haze, seen before and during Aurora, has received sufficient attention. The beautiful displays which we in Canada have so frequently seen of late, have been well adapted to lead us to inquire into their cause; and I think in making observations, the beauty of the luminous portion has led us to overlook other things which are equally important.

On the night of April 15, 1869, we had a grand exhibition of Aurora at Toronto. It spread itself all over the heavens, forming a glorious canopy, filling the south as well as the north.

Previous to any auroral display, however, the atmosphere became thick and hazy; I was viewing the setting moon through a telescope, and though there were no clouds, I found the definition become extremely bad; I thought my breath must have got on the eye-piece, but soon found this was not the case. I then went outside, and on looking round, found the whole atmosphere full of haze. It had not the appearance of fog, but the whole air seemed thick and turbid, and shortly auroral columns commenced forming. This haze was visible for hours. Referring to this feature, Prof. Kingston says (*American Journal of Science*, July 1869, p. 65):—"Throughout the night, a generally diffused luminosity prevailed, such as is commonly seen with a full moon and hazy sky. This was evidently not occasioned by the moon, which was scarcely four days old, and was low in the horizon, but was part of the aurora itself, the brilliancy of whose more active features it greatly impaired." This haze is seldom seen spread in this way all around us; but it is usually seen as a bank in the north, and is surmounted by the auroral arch; stars can be seen through it, but it greatly dims their lustre. Prof. Loomis says:—"The slaty appearance of the sky, which is a common feature of great auroral exhibitions, arises from the condensation of the vapour of the air, and this condensed vapour probably exists in the form of minute spiculæ of ice or flakes of snow. Fine flakes of snow have been repeatedly observed to fall during the exhibition of auroras, and this snow only slightly impairs the transparency of the atmosphere without presenting the appearance of clouds. It produces a turbid appearance of the atmosphere, and causes that dark bank which in the United States rests on the northern horizon. This turbidness is more noticeable near the horizon than it is at great elevations, because near the horizon the line of vision traverses a greater extent of this hazy atmosphere. When the aurora covers the whole heavens, the entire atmosphere is filled with this haze, and a dark segment may be observed resting on the southern horizon."

Whilst approving of the professor's description, I must dissent from his explanation of the cause. This haziness is seen during our hot summer nights, as well as our cold ones; and I have seen it when snow-flakes would be out of the question in such a temperature. Many reasons leads me to regard this haze as cosmical, falling on our earth from without; but at present, I will call attention to the appearance only, reserving my explanation for a future time.

A. ELVINS

NOTES

IT is with very great regret that we have to announce the death, at the age of fifty-two, of Dr. William Allen Miller, Professor of Chemistry in King's College, London, and treasurer and vice-president of the Royal Society. Professor Miller's writings have earned for him a position in the literature of chemistry, from which he will be very greatly missed.

WE understand that Professor Allman has resigned the Chair of Natural History in the University of Edinburgh. It has long been felt that the subjects of Geology and Mineralogy which have hitherto been taught from this Chair are of such vast and growing importance and extent, that they can no longer be properly included in it when a successor is appointed. It gives us the greatest pleasure to state that Sir Roderick Murchison, who has already done so much for the geology of his native country, has munificently come forward with the offer of 6,000*l*. towards the endowment of a separate Chair of Geology and Mineralogy, on the understanding that on this, as on former occasions, the Government will supplement the private grant by an equal sum. Here then we have an admirable occasion for the Government to show itself alive to the importance of fostering the cultivation of those sciences on which especially the future welfare of the country must largely depend.

THE new Faculty of Science in University College, London, was opened on Tuesday last, by an inaugural address by Prof A. W. Williamson, F.R.S. The discourse was devoted to an exposition of the importance of scientific method, and of the value of a scientific training, as an introduction even to the life of an ordinary man of business.

IN addition to his discourse to the Social Science Congress at Newcastle, Dr. Lyon Playfair delivered, on Thursday evening last, the inaugural address on opening the session of the Birmingham and Midland Institute. The subject of the lecture was announced as "The Inosculation of the Arts and Sciences;" and in its course the lecturer discussed the intimate union between science and labour. It is not science which creates labour or the industries flowing from it. On the contrary, science is the progeny of the industrial arts on the one side, and on the other of the experiences and perceptions which gradually attach themselves to these arts, so that the evolution of science from the arts is the first circumstance of human progress, which, however, quickly receives development and impulse from the science thus evolved. Industrial labour, then, is one of the parents, and science the child; but, as often happens in the world, the son becomes richer than the father, and raises his position. Apologising for the apparently pedantic form of the word, Dr. Playfair said he proposed to treat of the "inosculation" of arts and sciences, their junction with open mouths as when two arteries join and mingle their contents. It will be seen that science does not depend upon facts alone, but upon the increase of mental conceptions which can be brought to bear upon them; these conceptions increase as slowly as the common knowledge derived from experience—they both descend by inheritance from one generation to another, until science in its progress becomes a prevision of new knowledge by light reflected from the accumulated common knowledge of the past. In the progress of time common knowledge passes into scientific knowledge. The amazing changes which have taken place since 1838 are due to our better conceptions of forces and their mutual relations and conversions. Formerly heat, light, electricity, magnetism, and chemical affinities, were thought to be separate and independent existences, not even related to each other. Now we know that forces are convertible and interchangeable. This knowledge has already given great stimulus to their application, and will do so more in the future. Further, we know that the primary source of nearly all the power on the earth is the sun above.

THE publishing trade shows indications of its usual activity at this time of the year. Among the announcements of forthcoming works from the leading houses bearing more or less directly on science, we note the following. From Messrs. Longmans and Co. :—The Life of Isambard Kingdom Brunel, Civil Engineer, by Isambard Brunel, B.C.L. ; A System of Logic and History of Logical Doctrines, by Dr. F. Ueberweg, 1 vol. ; The Sun : Ruler, Light, Fire, and Life of the Planetary System, by Richard A. Proctor, B.A. ; Spectrum Analysis in its Application to Terrestrial Substances and the Physical Constitution of the Heavenly Bodies, familiarly explained by Dr. H. Schellen, Director der Realschule I. O. Cologne, translated from the German by Jane and Caroline Lassell, edited, with notes, by William Huggins, LL.D., D.C.L., F.R.S , 1 vol. crown 8vo., with coloured plates and other illustrations ; Select Methods in Chemical Analysis and Laboratory Manipulations, by William Crookes, F.R.S., &c., editor of the *Chemical News* ; A Handbook of Dyeing and Calico Printing, by William Crookes, F.R.S., &c., illustrated with numerous specimens of textile fabrics ; Text-Books of Science, a new series of elementary works on Mechanical and Physical Science, forming a series of Text-Books of Science adapted for the use of artisans and of students in public and other schools, in small 8vo., each volume containing about 300 pages. From Messrs. Macmillan and Co. :—The Sun, by Balfour Stewart, LL.D., F.R.S., and J. Norman Lockyer, F.R.S. ; The Beginnings of Life, including an Account of the present State of the Spontaneous Generation Controversy, by H. C. Bastian, M.D., F.R.S.; An Introduction to the Osteology of the Mammalia, by W. H. Flower, F.R.S. ; A Treatise on Magnetism, designed for the use of Students at the University, by G. B. Airy, Astronomer Royal; New Volumes of the School Class Book Series—Elementary Lessons in Logic, Deductive and Inductive, by Prof. Jevons, and Elementary Lessons in Physics, by Balfour Stewart, LL.D., F.R.S. From Messrs. Rivingtons :—Exercises adapted to Algebra, Part. 1, by J. Hamblin Smith ; A Manual of Logic, or, A Statement and Explanation of the Laws of Formal Thought, by Henry J. Turrell. From Messrs. Blackie and Son :—A translation, by Prof. Everett, of Prof. Deschanel's Elementary Treatise on Natural Philosophy, Part 1—Mechanics, Hydrostatics, and Pneumatics, illustrated with a coloured plate and many woodcuts. From Messrs. Asher and Co :—Man in the Past, Present, and Future, from the German of Dr. L. Buchner, translated by W. S. Dallas, F.L.S. From Messrs. Churchill :—A Manual of Botany, by Robert Bentley, Professor of Botany, King's College, London, and to the Pharmaceutical Society (second edition) ; A Laboratory Text-Book of Practical Chemistry, or Introduction to Qualitative Analysis, a guide to the course of practical instruction given in the laboratories of the Royal College of Chemistry, by W. G. Valentin, F.C.S. ; Handbook of Volumetric Analysis, or the Quantitative Estimation of Chemical Substances by Measure, by Francis Sutton, F.C.S., Norwich (second edition, much enlarged).

THE early publication is announced of "The Year-Book of Pharmacy," containing the proceedings at the yearly meeting of the British Pharmaceutical Conference, and a Report on the Progress of Pharmacy, which will include notices of all Pharmaceutical papers, new processes, preparations, and formulæ published throughout the world. It will be edited by Mr. J. C. Brough.

THE Professor of Chemistry to the University of Cambridge will begin a course of lectures on the Experimental Laws of Heat on Monday the 17th of October. He will also give instruction in Chemical Manipulation on Mondays, Wednesdays, and Fridays, at 1 P.M., beginning on the 10th of October, at the University Laboratory, which will be open daily from 10 till 6 for the use of students.

THE prospectus of the South London Working Men's College for the coming session includes classes in the following departments of Natural Science :—Chemistry, Physics, Animal Physiology, Geology, Metallurgy, and Applied Mechanics, as well as in Political Economy. The presence on the Council of the names of Professors Huxley, Fawcett, and Tyndall, Sir John Lubbock, and Dr. Cobbold, are a sufficient guarantee of the quality of the instruction given.

PROFESSOR DUNCAN, F.R.S., will commence a course of evening lectures on Geology, at King's College, London, on Monday, October 10th.

THE first meeting for the session of the Royal Microscopical Society will be held at King's College, London, on Wednesday, the 12th inst., at 8 o'clock, when the following papers will be read by Dr. G. W. Royston Pigott, M.A. :—"On Aplanatic Illumination," and "On Aplanatic Definition, with Optical Illustrations."

A MEETING of the Leeds Field Naturalists' Society will be held on Tuesday, October 11th, at 8 o'clock, at the Young Men's Christian Association, South Parade, to consider the advisability of holding weekly meetings during the winter session.

OWENS COLLEGE, Manchester, has lately received a very valuable donation to its large geological collection, in the shape of a collection of fossil Marsupials from Australia. This collection was to have been presented to the British Museum, but the donor ultimately decided to bestow it on Manchester instead.

THE Jesuit College at Manilla, in the Philippine Islands, has established a meteorological observatory, with self-recording instruments, where records of earthquakes are made in that region so fertile of them.

A MAGNIFICENT refracting telescope, with an object-glass of 25 inches diameter, is being constructed at the manufactory of Messrs. Clarke and Sons, Cambridgeport, Massachussetts, for the National Observatory at Washington. The money for this valuable instrument was voted by Congress last session, and amounts to 50,000 dollars, about 10,000*l*. It is believed that this telescope, when completed, will be one of the largest in the world ; meanwhile, it will take four years to finish it completely.

THE closing of Paris deprives us of the communication of meteorological observations and the Registrar-General of the records of births and deaths. The next international congress should provide for the requirements of science.

THE recent great summer-heat in America has been attracting great attention there. According to the records of Yale College, it has been the hottest summer for the last 92 years. "From July 10, to Aug. 15, 1870, the mean daily temperature was, at New Haven, 85°, and no season since 1778 has shown so many consecutive hot days. Our highest temperature this summer was (July 17) noted at 98°, and this has only been exceeded four times during the period above indicated at New Haven, the thermometer rising to 100° one day each year in 1784, 1800, and 1845, whilst in 1798 it reached 101°." This will be very interesting to compare with the temperatures ascertained this year in England.

IN the aquarium of the Dublin Zoological Gardens there are several specimens of the blind fish (*Amblyopsis spelæus*) lately brought from the Kentucky caves by Prof. Mapother. The small specimens, being very transparent, show the vertebral column, the heart, and the optic bulbs very distinctly. In the largest there are dark red spots over the optic bulbs, probably due to their having been kept in an iron vessel, which may have given colour for a rudimentary pigment membrane.

IN the last part of the *Zeitschrift fur Biologie* is an interesting paper by Dr. Camerer, on the locality of the sense of taste, or, as he expresses it, "On the dependence of the sense of taste on the part of the oral cavity irritated." His experiments have been conducted on himself, his wife, a lady friend, and six peasant girls. He employed solution of common salt, quinine, sugar, and sulphuric acid as the exciting agents, and localised their action by pouring a drop or two into a small open tube that was pressed on different parts of the tongue, the determination of the test fluid being required without the subject of the experiment being made acquainted with the nature of the solution used. It is well known that there are three kinds of papillæ on the tongue—the conical, the fungiform, and the circumvallate. Dr. Camerer finds that the sensibility of different parts of the tongue depends essentially on the presence and on the number of the fungiform papillæ. The fungiform papillæ, he finds, are most abundant near the apex of the tongue, they are less numerous at the edges of the tongue, and disappear near the root. There are no papillæ on the under surface of the tongue. The latter part he finds to be destitute of gustatory sensibility, whilst the sensibility is most acute when the papillæ are most closely aggregated together. He states also that when a strong solution has been tasted of any of the above substances, the delicacy of the sensibility is impaired for twenty-four hours. Other direct and carefully conducted experiments showed that the gustatory sensibility resided in the fungiform papillæ themselves and not in the parts adjoining.

ACCORDING to the *Food Journal*, in Belgium the butchers use laurel oil on the door-posts and window-frames for the purpose of keeping away flies, with great success. So simple a contrivance would be a great boon to the *habitués* of our eating-houses and confectioners, and would be useful to every housekeeper. The emanation from minced laurel leaves is rapidly fatal to all small insects.

WITH a view further to promote the cultivation of the Rhea fibre, the Viceroy of India has sanctioned an expenditure temporarily of 8*l.* per month, at Shaharunpore and at Dehra Dhoon, a hill station.

THERE are now in London specimens of iron manufactured for the first time in Peru by the Peruvian Government Commission from magnetic iron ore, found within twenty miles of Lima, and from fair anthracite taken from a seam sixty feet thick at sixty miles from Lima. The Government is awaiting the development of the railways now in progress. Renewed efforts are being made to enlist English capital in the restoration of the silver mines.

MR. ADAMS, the Secretary of our Legation in Japan, has been rendering good service in doing all he can to protect the silkworm in those countries by his influence and advice, which are willingly received. At the last advices he had returned from a lengthened tour in the interior, on which he will report. In Japanese are some illustrated works on silk culture.

ON CERTAIN PRINCIPLES TO BE OBSERVED IN THE ESTABLISHMENT OF A NATIONAL MUSEUM OF NATURAL HISTORY*

IT having been now finally determined that the Natural History collections of the British Museum shall be removed from their present site to South Kensington, to form the nucleus of a National Museum of Natural History,† it appears to me that the principles upon which the proposed new institution are to be established and conducted, are well worthy of the special and most serious attention of the British Association for the Advancement of Science. The inauguration of a National Museum of Natural History by one of the nations that have contributed most largely to the advancement of the natural sciences, is an event that is not likely to recur very often. If the opportunity thus presented be properly taken advantage of, and the new institution started upon sound principles of administration and arrangement, there can be no doubt that a most material impetus will be given to the progress of natural science in this country.

Under these circumstances I think I need hardly apologise for troubling the section with a few remarks upon certain points which appear to me to be most essential to be observed in the establishment of a National Museum of Natural History. These, I trust, will at all events provoke discussion, and induce some of the many distinguished naturalists present at this meeting to turn their attention to this most important subject.*

The energies of our rulers, especially in these troubled times, are too fully occupied with ordinary politics to allow them to bestow much care on such a matter, and unless it be forced on their attention by the British Association, or in some other authoritative manner, the result will be, I fear, that the system of administration now followed in the British Museum as regards the Natural History collections, will be transplanted along with the collections themselves, and the excellent opportunity of a grand reform, which may never again present itself, will be utterly wasted.†

The remarks which I propose to offer to the section on this subject may be divided into three heads. First, I will say a few words concerning what appears to me to be the best mode of government of the proposed National Museum of Natural History. Secondly, I will speak of the form of building which in my opinion ought to be adopted; and lastly, of the arrangement of the collections within that building.

I. *Of the form of Government of the National Museum of Natural History.*

On this part of my subject I shall make but few remarks, having regard to the fact that, in common with many other of my fellow naturalists, I strongly committed myself on this point some years ago, and have in nowise changed my views since that period. In the memorial, of which I hold a copy in my hands, and which was presented to the Chancellor of the Exchequer in 1866, having been signed by 25 leading members of the Royal, Linnean, Geological, and Zoological Societies, it will be found to be stated that in our opinion the chief administration of the National Museum of Natural History should be entrusted to one officer, who shall be immediately responsible to some member of the Government. Those who are acquainted with the present mode of administration of the Natural History collections in the British Museum will, I am sure, readily agree to this proposed reform. It will be recollected that the government of the British Museum is vested by Act of Parliament in a body of fifty trustees, consisting principally of great officers of state, and of nominees of certain families whose ancestors have contributed to the heterogeneous contents of that building. Amongst these fifty trustees there are but two or three that are in any wise interested in Natural History. Their secretary and

* Read before Section D at the meeting of the British Association at Liverpool, on September 16, 1870.

† On the 3rd of August last a vote of 6,000*l.* was proposed in the House of Commons by the Chancellor of the Exchequer to clear the ground "for the erection of a Natural History Museum" on the site of the International Exhibition at South Kensington, and carried, after a division.

* For account of this discussion see p. 465.

† In the "bill to enable the Trustees of the British Museum to remove portions of their collections," prepared and brought in by the Chancellor of the Exchequer in 1862, it was proposed to be enacted that the trustees might remove the natural history collections to South Kensington and certain pictures to the National Gallery. But, in a subsequent clause, it was proposed to be added that "*except in so far as was therein before expressed, nothing therein contained should affect the rights, powers, duties, or obligations of the trustees of the British Museum.*" At that time, therefore, it was clearly intended to continue the rule of the trustees over the natura history collections when removed to South Kensington.

chief executive officer is the present principal librarian, with whose great literary qualifications for his position every one is well acquainted, but who would not, I am sure, claim for himself in any sense the name of a naturalist. It will thus be seen that the actual government of our Natural History collections is at present vested in persons who have no special qualifications for the task. But, it may be said, there is the Superintendent of the Natural History collections, and the keepers of the various departments into which they are divided—have they nothing to do with the administration? To this I reply, very little indeed, unless their advice is asked, or unless they choose to offer it. And, in the latter case, they can only address the trustees through the secretary, who is the only official present at the meetings of the trustees, and in whose hands, therefore, the administration of the Natural History collections is practically vested. This objectionable form of government, we think, ought to be replaced by appointing a director of the proposed new institution, "immediately responsible to one of the Queen's Ministers." This simple form of administration has been most successful in other scientific institutions, such as the Kew Gardens and Herbarium, and the Royal Observatory, and we believe it would be the best in the present case. It might, however, be advisable to give the Director of the National Museum of Natural History a board of advice, composed of the heads of the principal departments into which the Museum is divided. Or another mode of softening the despotism would be to appoint a board of visitors, consisting of distinguished naturalists. These might be delegates from the principal scientific societies of the country, each of whom would be specially bound to see that the particular branch of science, to the advancement of which his society is devoted, received its fair share of attention.

As regards the subordinate appointments in the Natural Museum of Natural History, these ought to be made, if not on the nomination of the director, at least not without his full sanction and approval. The director, being held responsible for the well-doing of the whole establishment, should certainly be allowed to select his own officers more or less directly. It is well known that some of the appointments made by the trustees in the departments of Natural History in the British Museum have been, to say the least of them, in no wise felicitous, and that in one case at least great public scandal has been caused by the notorious incompetence of the person nominated. It is in vain to address remonstrances to a body of irresponsible trustees, but if the director is required to sanction every nomination, we shall know to whom to apply in case of any appointment not being up to the mark.

II. *Of the form of Building of the National Museum of Natural History.*

In discussing the form of building best adapted for a great National Museum of Natural History, let us begin by considering the principal classes of persons for whose accommodation it is or ought to be constructed. These are—

1. The public at large, who go there to get a more or less general notion of the structure of natural objects and of their arrangement in the *Systema Naturæ*.

2. The students who use the Museum for scientific purposes.

3. The officers of the institution, whose business it is to amass and arrange the collections.

In the opinion of most members of parliament apparently especially of those who represent metropolitan constituencies, the first of these three classes is that whose accommodation ought to be first considered in the present case. In my opinion, and probably in that of most of those here present, the National Museum of Natural History ought to be constructed primarily for the accommodation of the third of the three classes. For, unless the officers of the institution have ample space and opportunity to examine and arrange the collection, it is obvious that neither the public nor the special student can be benefited thereby. At the same time I do not think that the public ought to be utterly excluded from their Museum four days in every week, as is now the case, and I therefore put it forward as an axiom that some system of construction of the New Museum should be adopted whereby the public can be admitted all day and every day to view the collections without interfering with the scientific work of the establishment or with the special examination of objects by students. There is, so far as I know, only one plan by which this object can be carried out—namely, by arranging the exhibited objects in large wall-cases, to which access is obtainable from the back by doors opening into workrooms adjoining the exhibition room. In this way any ordinary object can be removed out of the series into the adjoining work-room, and returned to its place without disturbing the public in front of the cases, just as any article can be taken out of the shop-windows in Regent Street without interfering with those who are looking into them from the pavement outside. This system of exhibition would be attended by the further very great advantage that the glass cases may be hermetically sealed on the side towards the public, and the ingress of dirt and dust thus prevented. Those who are acquainted with the filthy state of the specimens in the public galleries of the British Museum, in spite of frequent cleansings inflicted upon them, will readily appreciate the merit of this plan.*

This collocation of the exhibition galleries and corresponding working-rooms being insisted upon as of primary importance, the general form of the building must depend somewhat upon the site on which it is to be placed. My own belief, however, is that a hollow square, or something nearly approaching that form, will in many ways be most convenient for a National Museum of Natural History, and the sketches which I now exhibit, which have been prepared for me by my accomplished friend Mr. Osbert Salvin, will serve to show the general plan of arrangement which I propose. The building might be of three or four stories, since, in the system of exhibition which I advocate, it would not be necessary to have top-lights. The basement, which might be partly below the surface, would be dedicated to taxidermy and to rooms for unpacking, storage, and mechanical work of all sorts. In the outer galleries running round the whole length of the ground story, I should propose to arrange the entire series of vertebrates from the highest mammal to the lowest fish. The specimens, according to the system already spoken of, would be placed in hermetically sealed glass cases along the inner walls of the galleries. The inner series of rooms surrounding the interior of the hollow square would be the working-rooms for the officers of the museum and the students of natural history, and would communicate with the glass cases on the inner side of the outer galleries. Each set of working-rooms would, of course, be in immediate apposition to the glass cases containing the corresponding series of exhibited objects. The lights to these working-rooms would be furnished from the inner sides of the hollow square.

In the first story of the building I should propose to arrange the series of invertebrate animals in exactly the same way, with the rooms for officers and students immediately adjoining them on the inner side.

The third story might contain the botanical and mineralogical collections, and perhaps certain others which it might not be possible to introduce into the general series, unless room could be found for these collections in the second story.

* In an admirable article on this subject in NATURE, for May 26, 1870, Prof. Flower has attributed the original invention of this mode of exhibition to myself, I having first brought it under his notice. It appears, however, from a subsequent communication to NATURE by Prof. Flower (June 2, 1870), that the same plan had been already proposed by Dr. Hooker in the *Gardener's Chronicle* for 1858, p. 749 I can only, therefore, claim to be *an* (not *the*) original inventor of this method of arrangement.

In a circular building, the centre of the hollow square, I should propose to place the library above and lecture-theatre below. The library might be connected by light iron galleries with the different working-rooms, so that the students of every department would have equally ready access to it.

Such is a slight outline of the kind of building I would propose for a National Museum of Natural History. It is, of course, a mere sketch, and there would be, no doubt, many difficulties in the details to be surmounted, but none, I think, such as an experienced architect would not be able to overcome. The advantages of this plan would be :—

1. The museum might be opened to the public every day without interfering with the scientific work of the establishment or of the students. Under the present arrangement, the collections are only open two or three days in the week, during which scientific work is suspended, as regards all objects in the public galleries.

2. The exhibited specimens would be much better protected from dirt and dust than they are in cases opening in front.

3. The exhibition of the whole series of organic beings in one continuous range of galleries would be much more instructive to the public than any system in which (as in the British Museum) they are dispersed about in different rooms.

4. The library being in the centre, would be equally accessible from any one of the working-rooms surrounding the interior of the hollow square.*

III. *Of the Arrangement of the Collections in the National Museum of Natural History.*

The remarks which I have already made under the previous head will have served to show the section that I am an advocate of what has been called the "typical," but what it would be better, perhaps, to call the "representative" system of arrangement of the Natural History collections. Nor am I able to understand how any reasonable person can seriously maintain that every object in a National Museum of Natural History ought to be exhibited to the indiscriminating public. In accordance with the views of the memorialists of 1858,† who may be considered as having inaugurated the reform in our Natural History collections which I hope to see shortly carried out, the collections should be primarily separated into three series: (*a*), objects for public exhibition ; (*b*), objects for private study. The class *a*, which is to be arranged in the public galleries behind the hermetically sealed glass cases, should embrace a very full and well-selected series of representatives of the principal forms of every class. In some cases it may be necessary to place in this category examples of every species of a group, in others only a selection of each genus or of each family. Every specimen exhibiting the external form in this series should be carefully prepared and mounted in a natural attitude. The representative species of the group having been selected, specimens of both sexes and of all ages should be placed in the series, as likewise examples of variation, if any such are known. The skeleton and other preparations of the internal structure should be added, as also the eggs and nests in the case of birds, and examples of corresponding structures in other classes. In short, the utmost endeavours should be made to illustrate, by preparations, models, and drawings, the life-history of the selected "representative," in as complete a manner as possible. To every exhibited specimen should be attached a printed label, giving its scientific and popular name, locality, and origin, and some short explanation regarding its chief peculiarities and most noticeable points of interest. There can, I think, be no doubt whatever that a small but well-selected series of any branch of the kingdom of nature, arranged after this method, would be of much greater interest and much more instructive to the public at large, than ten times the number of objects arranged according to the present fashion of the British Museum.

On the other hand, the great mass of the collections (*b*) intended only for the private examination of experts should be treated after a very different fashion. In this division of the collections, the object is to arrange specimens in as small a space as possible, and, at the same time, in the most convenient manner for easy examination. The work-rooms immediately adjoining the part of the public galleries appropriated to division *a* of any class, will, of course, be devoted to the reception of division *b* of the same class, so that the whole *a* and *b*, being separated only by the partition-wall at the back of the glazed cases, which will be pierced by frequent doors, will practically form but one collection. In these work-rooms, moreover, should be assembled together the whole of the specimens relating to the particular class to which they are devoted. In the British Museum, according to the present system, the mounted specimens are in one room, the skins in a second, the skeletons in a third, and the spirit-preparations in a fourth. So that, in order to make a complete examination of a small mammal, for instance, it may be necessary to go to four or five different parts of the building, ranging from the galleries to the cellars, and from the extreme north-east corner of the former to the furthest south-west corner of the latter. In the new National Museum of Natural History, it is to be hoped, this inconvenience will be remedied by the entire amalgamation of the various collections of skins, mounted specimens, spirit-specimens, and skeletons, into one uniform series. Besides the greater convenience of this mode of arrangement, another obvious advantage will be that the future student will be induced to devote his attention rather to the whole structure of the organism than to confine it to one particular part. If bird-cabinets were accompanied by skeletons and corresponding specimens in spirits, there can be no doubt that a much more perfect system of ornithology than any that we have yet attained to would be quickly arrived at. Our new national museum must take the lead in this great reform, and set an example to other collections. In the same way, as every naturalist will allow, our conchological brethren will lose nothing by having the soft bodies of the mollusca close at hand to aid them in their investigations on the form of the external shell. There may be, of course, some exceptional cases in which it will be practically impossible to adopt this course, but, as a general rule, the principle should be insisted upon that every specimen, of whatever nature it may be, should be located in the rooms devoted to the reception of the class to which it belongs, and should be placed as nearly as possible in immediate apposition to its nearest natural allies.

To carry out these principles to their legitimate issue, I do not hesitate to support the view put forward by Prof. Flower* and other naturalists, that the palæontological department of the British Museum, as at present constituted, ought to be totally abolished, and its contents distributed amongst the zoological and botanical collections, so that extinct forms may be studied in association with their nearest living representatives. The arguments in favour of this plan are, I think, unassailable, and although some little difficulties may be met with in carrying it out, there are none, in my opinion, that may not be overcome by judicious treatment. There is no doubt, I believe, that the progress of palæontology and palæophy-

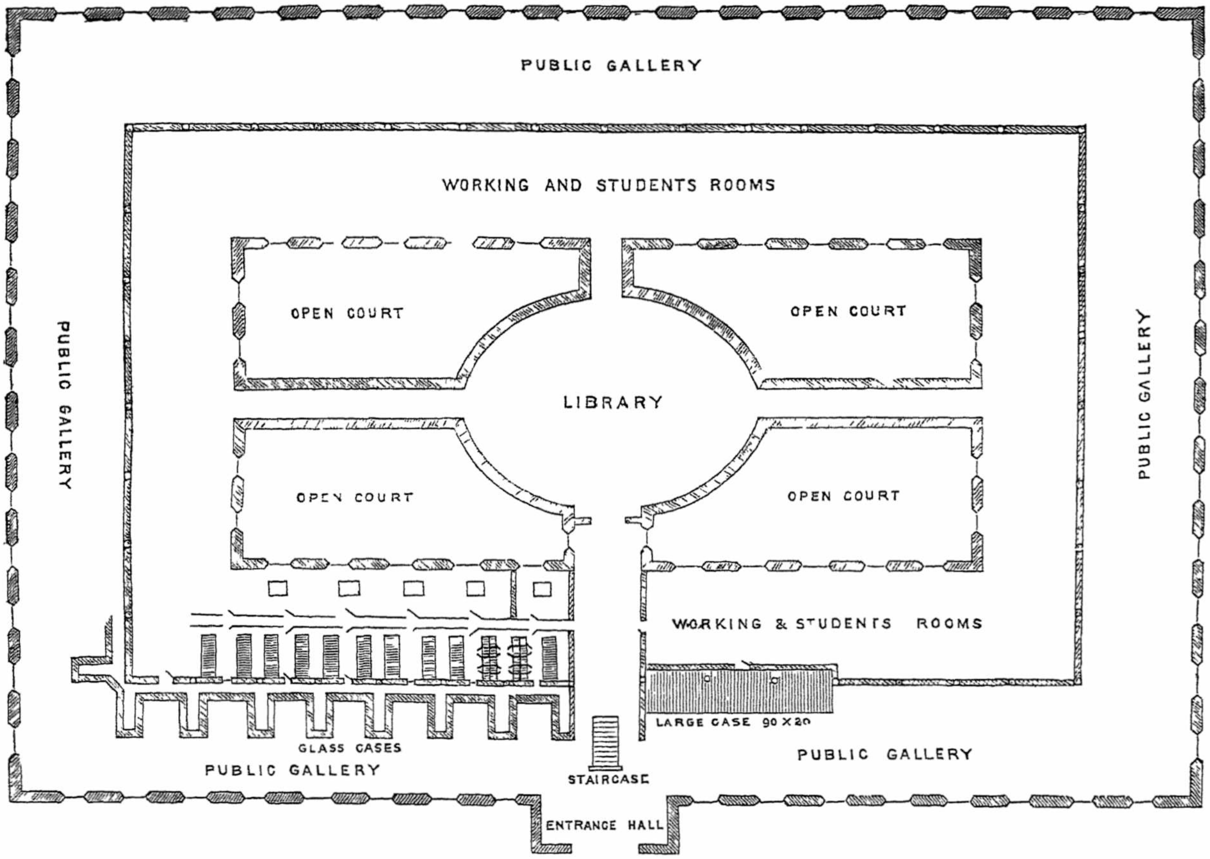
* A great deal has been said by those who have advocated the retention of the Natural History collections in their present site, about the importance of keeping up their conjunction with the National Library. It is, of course, obvious that their removal will necessitate the acquisition of a special Library of Natural History for the new museum. I believe, however, that a library of the kind, sufficiently comprehensive for all practical purposes, can be got together without much difficulty and at a comparatively small cost, and that, when formed, it will be of much greater use for those working at the collections than the present overgrown establishment at the British Museum. It must be also recollected that the library of the British Museum is only available for the use of the officers. The books cannot be brought to the specimens nor the specimens to the books by ordinary students.

† See this memorial, as reprinted in NATURE for June 9, 1870.

* See NATURE for May 28, 1870.

tology has been much retarded by the neglect of the students of the extinct forms of animal and vegetable life to make themselves sufficiently acquainted with the structure of the corresponding forms now in existence. So long as fossils were looked upon as the products of numerous successive and independent creations, there might have been some excuse for this mode of dealing with them. But now that we regard animated nature, past, present, and future, as one and indivisible; now that we acknowledge the stream of life, since its first appearance on this planet, to have been unbroken and continuous, let us exhibit its products, whether existing or extinct, in one continuous and unbroken series. The structure of an extinct organism can only be correctly understood after study of the nearest allies at present in existence. The best palæontologist must be he that has deduced his knowledge of extinct beings from comparison of their remains with the corresponding parts of those now alive. Those who appreciate these truths will not fail to allow that the proposed amalgamation of the palæontological collection in the general series in the new Museum of Natural History, will be a decided step in advance, and one imperatively called for in the present state of natural science.

I have now, I think, touched upon some of the principal points on which changes are required in our present system of treatment of the collections of natural history belonging to the nation. It would be easy to go into further particulars in which reforms are needed. Especially I might call attention to the inadequacy in point of numbers of the present staff of officers in some of the Natural History departments of the British Museum, the insufficiency of the yearly sum allowed for acquisitions, the vexatious regulations concerning the examination of specimens, and the miserably insufficient accommodation for private study. But all these things we may well hope to see altered in a new institution, and I will not



take up time by enlarging upon them. In conclusion, however, I will recapitulate the principal topics touched on in the following propositions, which I trust the members of the British Association will agree with me in putting forward as the "platform" of reforming naturalists.

1. The administration of the New Museum of Natural History should be vested in a director, who should be immediately responsible to one of the Queen's Ministers.

2. The collections should be primarily divided into two series: *(a)* those intended for public exhibition; *(b)* those reserved for private study.

3. The collections *a* (for public exhibition) should be arranged in their natural order, in one continuous series of galleries, so as to give the best possible general idea of the principal forms of life, and of their arrangement according to the natural system.

4. The collections *b* (for private study) should be arranged in rooms immediately adjacent to the public galleries, in such a manner that the corresponding portions of *a* and *b* should practically form but one series, and that the private student should have access at all times to objects in the public galleries.

5. A complete Library of Natural History should be furnished for the special use of the institution, and be placed in some central portion of the building, equally accessible to all departments.

6. The collection of osteology, the spirit-preparations, the skins in store, the series of British animals, the collection of "nests and nidamertal structures," and all other subordinate collections, should be amalgamated in the general series.

7. The collections of the Palæontological Department should likewise be amalgamated with the general series.

P. L. SCLATER

SOCIAL SCIENCE CONGRESS, NEWCASTLE

DR. PLAYFAIR'S OPENING ADDRESS TO THE EDUCATIONAL SECTION

IN the address delivered by Dr. Lyon Playfair before the National Association for the Promotion of Social Science, he began by referring to the lamentable position of English education at present. Speaking of the Act of last session, he pointed out that it deals with the quantity of education, and not with its quality; and insisted on the absolute necessity of introducing instruction in Science into our primary schools. The following are some of the more important passages of the address on this point:—

The educational principle of continental nations is to link on primary schools to secondary improvement schools. The links are always composed of higher subjects, the three R's being in all cases the mere basis of instruction. Elementary science, and even some of its applications, is uniformly encouraged and generally enforced. I shall not detain you with examples, as they are to be found in any work treating of continental schools. But as we have no schools corresponding to the secondary improvement schools for the working classes, we suppose that we can do without the higher subjects used as links. With what result? Our primary schools, on the whole, do not teach higher instruction than a child of eight years of age may learn. In our class of life, our children acquire such knowledge as a beginning; with the working classes, they get it as an end. What an equipment for the battle of life! No armour-plate of knowledge is given to our future artisan, but a mere thin veneer of the three R's, so thin as to rub off completely in three or four years' wear and tear of life. I am speaking on official record, for we are assured by inspectors, that nothing under Standard IV. suffices for permanent use, and yet the Committee of Council ell us that four-fifths of the children of ages at which they leave school pass only in lower standards. Recently, under Mr. Corry's minute, inducements have been given for subjects higher than the three R's, but for some reason it produces scarcely any result. So, under our present system of elementary teaching, no knowledge whatever bearing on the life-work of the people reaches them by our system of State education. The air they breathe, the water they drink, the tools they use, the plants they grow, the mines they excavate, might all be made subjects of surpassing interest and importance to them during their whole life; and yet of these they learn not one fact. Yet we are surprised at the consequences of their ignorance. A thousand men perish yearly in our coal-mines, but no schoolmaster tells the poor miner the nature of the explosive gas which scorches him, or of the after-damp which chokes him. Boilers of steam-engines blow up so continually that a committee of the House of Commons is now engaged in trying to diminish their alarming frequency; but the poor stokers who are scalded to death or blown to pieces, were never instructed in the nature and properties of steam. In Great Britain alone more than one hundred thousand people perish annually, and at least five times as many sicken grievously, out of pure ignorance of the laws of health, which are never imparted to them at school; they have no chance of learning them afterwards, as they possess no secondary schools. The mere tools of education are put into the hands of children during their school time without any effort being made to teach them how to use the tools for any profitable purpose whatever; so they get rusty or are thrown away altogether. And we fancy that we have educated the people! Our pauperism, our crime, and the misery which hovers on the brink of both, increase terribly, and our panacea for their cure is teaching the three R's up to Standard III. The age of miracles has passed by, and our large faith in our little doings will not remove mountains. It is best to be frank. Our low quality of education is impoverishing the land. It is disgracefully behind the age in which we live, and of the civilisation of which we boast; and until we are convinced of that we cannot be roused to the exertions required for its amendment. In censuring the low condition of knowledge in our primary schools, as represented by the results of the Revised Code, I do not aim to restore them to the position which many of them had before it. That code was, in fact, rendered necessary because their aggregate teaching was not sufficiently large and diffused to justify the increasing expenditure. In imitation of our classical schools, verbalism and memory-cramming had grown up as tares and choked the growth of the wheat. Words had taken the place of conceptions. A child could tell you about the geography of the wanderings of the children of Israel, but had no conception whatever of the ordinary phenomena around it. It was hopeless to put to them the commonest scientific questions. Whence comes the water that fills the Thames? What is the origin of hail, snow, rain, or dew? Why does the sun rise in the east, or set in the west? What produces night and day, summer and winter? In history they could rattle out to you the names and dates of kings and queens, perhaps even the names and ages of all Queen Anne's children as they died in childhood; but, as a true historical conception, apart from memory cramming of words and dry facts, to be vomited forth upon the examiner, it required a very good school under the old system to find it. Words, instead of ideas, were worshipped. Inspection, under the old system, did something to correct this tendency to verbalism and cram; under the new system they had no time, and, if they had, would find fewer of the higher subjects taught in any way. The teaching of science, if properly done, is the reverse of all this, and will go far to remedy its defects. Books in this case ought only to be accessories, not principals. The pupil must be brought in face of the facts through experiment and demonstration. He should pull the plant to pieces and see how it is constructed. He must vex the electric cylinder till it yields him its sparks. He must apply with his own hand the magnet to the needle He must see water broken up into its constituent parts, and witness the violence with which its elements unite. Unless he is brought into actual contact with the facts and taught to observe and bring them into relation with the science evolved from them, it were better that instruction in science should be left alone. For one of the first lessons he must learn from science is not to trust in authority, but to demand proof for each asseveration. All this is true education, for it draws out faculties of observation, connects observed facts with the conceptions deduced from them in the course of ages, gives discipline and courage to thought, and teaches a knowledge of scientific method which will serve a lifetime. Nor can such education be begun too early. The whole yearnings of a child are for the natural phenomena around, until they are smothered by the ignorance of the parent. He is a young Linnæus roaming over the fields in search of flowers. He is a young conchologist or mineralogist gathering shells or pebbles on the sea shore. He is an ornithologist and goes bird-nesting; an ichthyologist and catches fish. Glorious education in nature, all this, if the teacher knew how to direct and utilise it. But as soon as the child comes into the school-room, all natural God-born instincts are to be crushed out of him; he is to be trained out of all natural sympathies and affections. You prune and trim, cramp and bind the young intellect, as gardeners in olden times did trees and shrubs, till they assumed monstrous and grotesque forms, altogether different from the wide-spreading foliage and clustering buds which God himself gave to them, and which man is idiot enough to think he can improve. Do not suppose that I wish the primary school to be a lecture theatre for all or any of the "ologies." All the science which would be necessary to give a boy a taste of the principles involved in his calling, and an incitement to pursue them in his future life, might be given in illustration of other subjects. Instead of mere descriptive geography drearily taught and drearily learned, you might make it illustrative of history, and illustrated by physical geography, which, in the hands of a real master, might be made to embrace most of what we desire to teach. The properties of air and water, illustrations of natural history, varieties of the human race, the properties of the atmosphere as a whole—its life-giving virtues when pure, and its death dealings when fouled by man's impurities—the natural products of different climes, these and such like teachings are what you could introduce with telling and useful effect. Far better this than overlading geography with dry details of sources and mouths of rivers, of isothermal lines, latitudes and longitudes, tracks of ocean currents, and other tendencies towards the old verbalism and memory-cramming. If I have explained myself with clearness, you will see that while I advocate the introduction of higher subjects into our schools, I wish them to be of immediate interest and applicability to the working classes. The main difficulty in education is getting them to stay long enough at school. Teach them, while you have them, subjects of interest and utility. The short time will thus be made productive, and inducement will be offered for its extension. Six months spent in teaching future labourers the geography of the wanderings of the children of Israel, is sheer waste of time, either for their eternal or temporal interests. Think of the few precious hours as the training for a whole lifetime, and let us use them by giving living and intelligent learning, not obsolete and parrot instruction. Those who are believers in the teaching of the great secondary schools of this country will deem my aspirations for the improvement of primary education, low and utilitarian. Frankly I admit the latter. Such a style of education will never realise Lord Brougham's hope that the time may come when every working man in England will read Bacon; but it might contribute to the fulfilment of Cobbett's desire, that the time might come when every man in England could eat bacon. I deny, however, that the utilitarian view of primary education is ignoble. The present system is truly ignoble, for it sends the working man into the world in gross ignorance of everything that he is to do in it. The utilitarian system is noble, in so far as it treats him as an intelligent being, who ought to understand the nature of his occupation, and the principles involved in it. The great advantage of directing education towards the pursuits and occupations of the people, instead of wasting it on dismal verbalism, is that, while it elevates the individual, it at the same time gives security for the future prosperity of the nation. In the industrial battles of peoples, we are content to leave our working classes armed with the old Brown Bess of warfare, while men of other countries are arming themselves with modern weapons of precision. In the competition of nations, the two factors of industry—raw material and intellect, applied to its conversion into utilities—are altering their values. The first is rapidly decreasing, the second quickly augmenting in value. We anchor our hopes on the sand, which the advancing tide of knowledge is washing away, while other nations throw out their anchors on firm ground accumulating around, and enabling their vessels to ride in safety. There are instances of nations, rich in the natural resources of industry, yet poor from want of knowledge how to apply them; and there are opposite examples of nations utterly devoid of industrial advantages, but constituted of an educated people who use their science as a compensation for their lack of raw material. Spain is an example of the first class, and Holland of the second. Having pointed out at some length the contrast between these two countries, in consequence of the difference of their culture, Dr. Playfair proceeded to show the necessity of good physical training, to argue in favour of a compulsory educational system, and of graded education, and to define the true position and qualifications of teachers in primary schools.

THE BRITISH ASSOCIATION

LECTURE ON STREAM LINES IN CONNECTION WITH NAVAL ARCHITECTURE, BY PROF. RANKINE

THE lecturer stated that his object was to give a brief summary of the results of some application of the mathematical theory of hydrodynamics to questions regarding the designing of the forms of ships, and the mutual actions between a ship and the water in which she floats. The art of designing the figures of ships had been gradually developed by processes resembling those called "natural selection," and the "struggle for existence" in the course of thousands of years, and had arrived in skilful hands at a perfection which left little more to be desired, when the object was to design a ship that should answer purposes and fulfil conditions which had previously been accomplished and fulfilled in the course of practical experience. But cases now frequently arose in which new conditions were to be fulfilled; and purposes accomplished beyond the limits of the performance of previous vessels, and in such cases the process of gradual development by practical trials made without the help of science was too slow and too costly, and it became necessary to acquire and to apply scientific knowledge of the laws that regulate the actions of the vessel on the water and of the water on the vessel. Amongst the questions thus arising were the following: What ought to be the form of the immersed surface or skin of a ship in order that the particles of water may glide smoothly over it? And, the form of such a surface being given, how will it affect the motion of particles in its neighbourhood, and what mutual forces will be exerted between the particle of water and that surface? Practical experience, unaided by science, answers the first question by saying that the surface ought to belong to a class called "fair surfaces" (that is, surfaces free from sudden changes of direction and of curvature) of which various forms have in the course of ages been ascertained by trial, and are known to skilful shipbuilders. That answer is satisfactory so far as it goes; but in order to solve problems involving the mutual actions of the ship and the water, something more is wanted, and it becomes necessary to be able to construct fair surfaces by geometrical rules based on the laws of the motion of fluids, and to express their forms by algebraic equations. There were many very early attempts to do this, but through not being based on the laws of hydrodynamics, they resulted merely in the finding of empirical rules for reproducing when required forms which had previously been found to answer in practice, and did not lead to any knowledge of the motions of the particles of water or of the forces exerted by and upon them; and they had little or no advantage over the old process of modelling by the eye and hand, and of "fairing" the lines with the help of an elastic rod called a "batten." As regards this process, indeed, the mathematical methods about to be referred to are to be regarded, not as a substitute for it in designing the form of a ship, but as a means of arriving at a knowledge of the mutual actions between her and the water, which the old process is incapable of affording. The earliest method of constructing the figures of ships by mathematical rules, based on hydrodynamical principles, was that proposed by Mr. Scott Russell about twenty-five years ago, and since extensively practised. It consisted in adopting for the longitudinal lines of a ship curves imitated from the outlines of waves in water. The motions which surfaces formed upon this model impress on the water were known to a certain degree of approximations. These "wave-lines," however, although they were fair curves in the sense already mentioned, were by no means the only fair curves, but were only one class out of innumerable classes of curves having the property of gliding smoothly through the water; and it was well known in practice that vessels had proved successful whose lines differed very widely from wave-lines. It was therefore desirable that methods should be devised of constructing by mathematical rules based on the laws of the motions of fluids, a greater variety of curves possessing the requisite property of fairness, and not limited to the wave-line shape. Such had been the object of a series of researches that had been communicated to the Royal Society at different dates since 1862. They related to the construction of what it has been proposed to call stream-lines. A stream-line is the track or path traced by a particle of water in a smoothly and steadily flowing current. If, when a ship is gliding ahead through the water with a certain speed, we imagine the ship to be stationary, and the water to be flowing astern past the ship in a smooth and steady current with an equal average speed, the motions of the ship and of the particles of water relatively to each other are not altered by that supposition; and it becomes evident that if the form of surface of the skin of the ship has the property of fairness, all the tracks of the particles of water, as they glide over that surface, are stream-lines, and the surface itself is one containing an indefinite number of stream-lines, or, as it has been called, a stream-line surface. It is also to be observed, that when we have deduced from the laws of the motion of fluids the relations which exist between the form of the stream-lines in different parts of a current, and between those forms and the velocities of the particles as they glide along different parts of those lines, we know the relations between the form and speed of a ship whose surface coincides with a certain set of these stream-lines, and the motions of the particles of water in various positions in the neighbourhood of that ship. The lecturer then proceeded to explain, and to illustrate by diagrams, the methods of constructing stream-lines. These methods were based upon the application to stream-lines in a current of fluid of a mathematical process which had previously been applied by Mr. Clerk Maxwell to lines of electric and magnetic force. A current of fluid is represented on paper by drawing a set of stream-lines so distributed that between each pair of them there lies an elementary stream of a given constant volume of flow. Thus, while the direction of flow is indicated in any given part of the current by the direction of the stream-lines, the velocity of flow is indicated by their comparative closeness and wideness apart, being evidently greatest where these lines lie closest together, and least where they are most widely spread. If, upon the same sheet of paper, we draw two different sets of stream-lines, these will represent the currents produced in one and the same mass of fluid by two different sets of forces. The two sets of lines form a network, and, if through the angles of the meshes of that network we draw a third set of stream-lines, it can be proved from the principle of the composition of motions, that this third set of lines will represent the current produced in the same mass of fluid by the combination of the forces, which, acting separately, would produce the current represented by the first two sets of stream-lines respectively. The third set may be called the resultant stream-lines. Suppose, now, that a third set of component stream-lines are drawn representing the current produced by a third set of forces : this will form a network with the previously drawn resultant stream-lines, and a set of lines drawn through the angles of the meshes of this new network will represent the resultant current produced by the combination of the three sets of forces ; and so on to combinations of any degree of complexity that may be required. In order to draw a system of stream-lines suited for the longitudinal lines of a ship, three sets at least of component stream-lines must be combined. One of these is a set of parallel straight lines, representing a uniform current, running astern with a speed equal to the actual speed of the vessel. A second set consists of straight lines radiating from a point called a focus in the forepart of the vessel, and they represent the diverging motion that is produced by the ship displacing the water near her bows. The third set of component stream-lines consists of straight lines converging towards a second focus in the afterpart of the vessel ; and they represent the motion of the water closing in astern of the ship. The resultant stream-lines thus produced present a great variety of forms, all resembling those of actual ships having all proportions of length to breadth, and all degrees of bluffness and fineness at the ends, ranging from the absolute bluffness of a sort of oval to a bow and stern of any degree of sharpness that may be required. It has been proposed to call stream-lines of this sort Oögenous Neoïds ; that is, ship-like lines generated from an oval, because any given set of them can be generated by the flow of a current of water past an oval solid of suitable dimensions. The properties of these curves were investigated in 1869. They have, however, this defect, that the absolutely bluff ovals are the only curves of the kind that are of finite extent ; all the fixed curves extend indefinitely in both directions, ahead and astern ; and in order to imitate the longitudinal lines of a fine-ended vessel, a part only of some indefinitely extended curve must be taken. In 1870 an improvement in the construction of such curves was introduced, by which that defect was overcome ; it consisted in the introduction of one or more additional pairs of foci, involving the combination of at least five sets of component stream-lines. By this device it is possible to imitate longitudinal lines of actual vessels by means of complete closed curves, without rising portions of indefinitely extended curves ; and thus the motion of the particles of water, as shown by the stream-lines that lie outside the closed lines representing the form of the vessel, becomes more definite and accurate. The lecturer mentioned that the idea of employing four foci and upwards had been suggested to him by the experiments of Mr. Froude on the resistance of boats modelled so as to resemble the form of a swimming bird ; for which purpose stream-lines with four foci are specially adapted. It has been proposed to call such lines Cycnogenous Neoïds—that is, ship-like curves of shapes like that of a swan. In such curves the outer foci—that is, the foremost and aftermost—are situated in or near the stem and sternpost of the vessel, which are represented in plan by small horse-shoe curves, as if they were rounded off at the corners instead of being squared, as in ordinary practice. The inner foci are situated respectively in the fore and after body. When the foci of the longitudinal lines of a vessel have been determined, the proportion borne by the aggregate energy of the motion impressed on the particles of water to that of the motion of the vessel herself can be approximately determined. The lecturer next proceeded to explain the bearing of some of the mechanical properties of waves upon the designing of vessels, especially when these properties are taken in combination with those of stream-lines. It had long been known that ships, in moving through the water, were accompanied by trains of waves, whose dimensions and position depended on the speed of the vessel ; but the first discovery of precise and definite laws respecting such waves was due to Mr. Scott Russell, who published it about twenty-five years ago. The lecturer now described in a general way the motions of the particles of water in a series of waves, and illustrated them by means of a machine designed for that purpose. He showed how, while the shape of the wave advances, each individual particle of water describes an orbit of limited extent in a vertical plane. The periodic time of a wave, its length, the depth to which a disturbance bearing a given ratio to the disturbance at the surface of the water extends, and its speed of advance, are all related to each other by laws which the lecturer explained. He then stated that Mr. Scott Russell had shown that when the vessel moved no faster than the natural speed of advance of the waves that she raised, these waves were of moderate height, and added little or nothing to her resistance ; but when that limit of speed was exceeded, the waves and the resistance caused by them increased rapidly in magnitude with increase of speed. His own (Professor Rankine's) opinion regarding these phenomena was, that when the speed of the vessel was less than or equal to the natural speed of the waves raised by her, the resistance of the vessel consisted wholly, or almost wholly, of that arising from the friction of the water gliding over her skin ; and he considered that this opinion was confirmed by the results of practical experience of the performance of vessels. The wave motion, being impressed once for all on the water during the starting of the vessel, was propagated onward like the swell of the ocean, from one mass of water to another, requiring little or no sensible expenditure of power to keep it up. But when the ship was driven at a speed exceeding the natural speed of the waves that she raised, these waves, in order to accompany the ship, were compelled to spread outwards instead of travelling directly ahead ; and it became necessary for the vessel, at the expense of her motive power, to keep continually originating wave-motion afresh in previously undisturbed masses of water ; and hence the waste of power found by experience to occur when a ship was driven at a speed beyond the limit suited to her length. This divergence or spreading sideways of the train of waves had a modifying effect on the stream-lines representing the motions of the particles of water. It caused them, in the first place, to assume a sinuous or serpentine form ; and then, instead of closing in behind the ship to the same distances from her course at which they had been situated when ahead of her, they remained permanently spread outwards. In other words, the particles of water did not return to their original distances from the longitudinal midship plane of the vessel, but were shifted laterally and left there, much as the sods of earth are permanently shifted sideways by the plough. The place of the water which thus fails to close in completely astern of the vessels is supplied by water which rises up from below and forms a mass of eddies rolling in the wake of the ship. This was illustrated by a diagram. Lastly, the lecturer explained the principles according to which the steadiness of a ship at sea is affected by storm-waves, and the difference between the properties of steadiness and stiffness. The mathematical theory of the stability of ships had been known and applied with useful results for nearly a century ; but in the course of the last ten years it had received some important additions, due especially to the researches of Mr. Froude on the manner in which the motions of the waves affect the rolling of the vessel. A stiff ship is one that tends strongly to keep and to recover her position of uprightness to the surface of the water. A steady ship is one that tends to keep a position of absolute uprightness. In smooth water these properties are the same ; and a stiff ship is also a steady ship. Amongst waves, on the other hand, the properties of stiffness and steadiness are often opposed to each other. A stiff ship tends as she rolls, to follow the motions of the waves as they roll. She is a dry ship ; but she may be what is called uneasy, through excessive rolling along with the waves. The property of stiffness is possessed in the highest degree by a raft, and by a ship which, like a raft, is broad and shallow, and whose natural period of rolling in smooth water is very short compared with the periodic time of the waves. In order that a ship may be steady among waves, her natural period of rolling should be considerably longer than that of the waves ; and in order that this property may be obtained without making the vessel crank, the masses on board of her should be spread out sideways as far as practicable from her centre of gravity ; this is called "winging out the weights." A vessel whose natural period of rolling in smooth water is only a little shorter or a little longer than that of the waves, has neither the advantages of stiffness nor those of steadiness, for she rolls to an angle greater than that of the slope of the waves ; and her condition is specially unsafe if her natural period of rolling is a little greater than that of the waves, for then she tends to heel over towards the nearest wave-crest, to the danger of its breaking over her deck. This is called "rolling against the waves." The most dangerous condition is that of a vessel whose period of rolling in smooth water is equal to that of the waves that she encounters, for then every successive wave makes her roll through a greater angle; and under these circumstances no ship can be safe, how great soever her statical stability. All these principles have been known for some years through Mr. Froude's researches. The lecturer exhibited a machine he had contrived for illustrating them, in which the dynamical conditions of vessels of different degrees of stiffness and steadiness were approximately imitated by means of a peculiarly-constructed pendulum hanging from a pin, whose motions imitate those of a particle of water disturbed by waves.

SECTIONAL PROCEEDINGS

Section A.—Mathematical and Physical Science

On the Mode of Action of Lightning on Telegraphs, and on a New Method of Constructing Telegraph Coils.—Mr. S. Alfred Varley. He remarked that when lightning storms occur in the neighbourhood of telegraph wires, although the wires may not be actually struck, powerful currents are induced in them which may be sufficiently strong to fuse the coils, but which more frequently simply demagnetise, and as often reverse the magnetism of the magnetic needles situated in the coils of needle telegraph instruments. Thus, not only is a considerable amount of damage done annually to telegraph instruments, but telegraphic communication is very liable to serious interruption. Mr. Varley mentioned a number of observations going to prove that an interval of dust separating two metallic conductors opposes practically a decreasing resistance to an increasing electrical tension, and that incandescent particles of carbon oppose about $\frac{1}{60}$th part of the resistance opposed by a needle telegraph coil. Reasoning upon these data, he has constructed an instrument, the main feature of which is what he terms a "lightning bridge." Two thick metal conductors, terminating in points, are inserted usually in a piece of wood. These points approach one another within about $\frac{1}{18}$th of an inch in a chamber cut in the middle of the wood. This bridge is placed in the electric circuit in the most direct course which the lightning can take, and the space separating the two points is filled loosely with powder, which is placed in the chamber, and surrounds and covers the extremities of the pointed conductors. The powder employed consists of carbon (a conductor) and a non-conducting substance in a minute state of division. When this instrument is used, therefore, lightning which strikes a circuit finds in its direct path not a space of air but a bridge of powder, consisting of particles of conducting matter in close proximity to one another. These the lightning connects under the influence of the discharge, and the particles are thrown into a highly incandescent state. The secondary current, developed by the demagnetisation, finds an easier passage across this heated matter than through the coils. These lightning bridges have been in use since January 1866, and at the present moment there are upwards of 1,000 doing duty in this country alone. Yet not a single case has occurred of a coil being fused when protected by them. The reason why a powder consisting entirely or chiefly of conducting matter cannot be safely employed is, that although it can oppose a practically infinite resistance to the passage of electricity of the tension of ordinary working currents, when a high tension discharge occurs, the particles under the influence of the discharge generally arrange themselves so closely as to make a conducting connection between the two points of the lightning bridge. In the course of his exposition, Mr. Varley endeavoured to prove that when telegraphic circuits protected by ordinary protectors are struck by lightning, it is to the secondary current and not to the main discharge that the fusion must be attributed. He also pointed out the defects of the protector, which consists of two silk wires wound side by side upon a bobbin.

Mr. Varley also read a second paper containing *A Description of the Electric Time Signal, at Port Elizabeth, Cape of Good Hope.* After an elaborate account of the Liverpool time ball, he proceeded to say that in the year 1859, Sir Thomas Maclear, the Astronomer Royal of the Cape of Good Hope, inspected the electrical time signals in this country, with a view to erecting time balls in connection with the Royal Observatory at Cape Town. Sir T. Maclear remarked the greater rapidity of action of the Liverpool trigger, and this led to Mr. Varley's afterwards designing and constructing at different times two triggers for use in the Cape. Both these triggers discharged more rapidly than the Liverpool trigger. In September 1864, he was requested to construct a trigger for discharging a time ball to be erected at Port Elizabeth. He considered the intervention of any relay or secondary apparatus to be objectionable. He therefore determined if possible to construct the trigger sensitive enough to be discharged by the batteries in the Cape Town Observatory, and in its construction he adopted a modification of a principle first introduced by Professor Hughes in his printing telegraph (described at the Newcastle meeting).

The trigger was constructed with a soft iron armature, rendered magnetic by induction from a compound bar magnet, and which strongly attracted the soft iron cores of an electro-magnet, but which was prevented from actually touching the poles of the electro-magnet.

A spiral spring attached to this armature was so adjusted that it nearly overcame the magnetic attraction induced by the bar magnets.

The time current polarised the electro-magnet in the opposite direction to that induced by the bar magnets, and as the attraction between the armature and the soft iron cores was already almost overcome by the spiral spring, a very small amount of polarisation in the opposite direction was necessary to release the armature, which was rapidly pulled away by the spiral spring, and the trigger discharged.

There were some other alterations made in the general mechanical construction of this trigger, but they may be regarded as matters of detail.

The rapidity of discharge was very great, $\frac{1}{20}$th part of a second only elapsed between the arrival of the time current and the falling of the ball.

From a report in the Port Elizabeth paper of August 29, 1865, giving an account of the inauguration of this time signal, and forwarded to Mr. Varley by Sir Thomas Maclear, it appears that the time elapsing between the time current leaving the Observatory at Cape Town and the receipt at Cape Town of the signal announcing the falling of the ball, is only $\frac{1}{15}$th of a second.

The time which elapsed between the Greenwich current reaching London and the falling of the ball at Liverpool was $\frac{11}{20}$th of a second. In other words, the Algoa ball is discharged from a distance of 500 miles in less than $\frac{1}{7}$th of the time of that of the Liverpool ball.

What is being daily done in the Cape can, however, be best summed up by a short quotation from a letter received from Sir Thomas Maclear, giving an account of the successful inauguration of this time signal. After detailing the general arrangements, Sir Thomas Maclear goes on to state: "A few tentative signals having proved satisfactory, the 'preface' was issued from the Observatory at ten minutes before one o'clock, and at the instant of one o'clock, the Observatory time-ball clock closed the circuit discharging the Observatory ball, the Simon's Town ball, twenty-four miles distant; the Cape Town time gun, three miles distant; and the Port Elizabeth ball, distant 500 miles."

On the present State of the Question relative to Lunar Activity or Quiescence.—W. R. Birt, F.R.A.S. From the time of Schröter, the question of change on the moon's surface has been more or less agitated. The *Selenotopographische Fragmente* contains numerous instances of what he considered to be changes of a temporary character, and a few of a more permanent nature, as the formation of new craters. It is, however, notorious that he failed to establish the fact of a decided change in any one instance; nor is this to be wondered at when we consider the paucity of the materials he had at his command. Notwithstanding the comparative neglect into which the observations recorded in the "Fragments" have fallen, and the judgments passed upon them by some of the best known selenographers, there can be no question that they embody the results of zealous and persevering attention to the moon's surface, and ought not to be passed over in the examination of any given spot, the history of which we are desirous of becoming acquainted with *during the earliest period of descriptive observational selenography.*

The labours of Schröter's successors, Lohrmann, and Beer and Mädler, have added greatly to the number of objects, either as delineated on their maps or referred to in their letter-press. Lohrmann appears to have carefully studied Schröter's results, as we find him quoting the measures obtained by Schröter in several instances. On examining the results of the two greatest selenographical works of the present century, and comparing the one with the other, we find precisely the same kind of phenomena presenting themselves which in a great measure perplexed Schröter; but as Lohrmann and Madler worked independently of each other, and Madler evidently had a very low idea of the value of the preceding labours of Schröter, these phenomena passed unnoticed at the time. Upon consulting the three works for elucidating the history of any given object, such results as these are frequently obtained. An object is found in Schröter designated by a Greek or other character, and its appearance described in his text. This object may be altogether omitted by Lohrmann, but given on Beer and Mädler's map, and objects are by no means rare which may be found on Lohrmann, but omitted by Beer and Mädler, and *vice versa*.

Were the results of the labours of Julius Schmidt during a period of nearly thirty years given to the public, there can be no doubt that our knowledge of selenography would be greatly advanced. His chart must contain a large proportion of the objects previously recorded by Schröter, Lohrmann, and Beer and Mädler; and judging from the instances already alluded to, of *apparent omissions* by one or other of the above-named observers, it is highly probable that the number of such instances would be much increased. The value of his measures (4,000) of the altitudes of lunar mountains for comparison with or addition to those of Schröter and Mädler, cannot admit of a doubt. His published catalogue of rills is very valuable in this respect. It is to Schmidt that we are indebted for one of the most important announcements bearing on the subject of lunar activity, that of a change in the crater *Linné*, "which," says Mädler (Reports British Association, 1868, p. 517) "has hitherto offered the only authentic example of an admitted change." He had previously said (same report): "What has lately been observed in the crater *Linné* proves, at all events, that *there* real changes have taken place, and that, too, under circumstances even visible to us." Further on, however, the great selenographer remarks that on the 10th of May, 1867, his eye having undergone an operation for cataract, he attempted an observation of *Linné* in the heliometer of the Observatory at Bonn, and found it shaped exactly, and with the same throw of shadow as he remembered to have seen it in 1831. "The event," he says, "of whatever nature it might have been, must have passed away without leaving any trace observable by me." The doubt still hanging over this object is well known, and it may be regarded as furnishing, at least, one of the instances of the present state of the question of activity. The uncertainty attaching to the question of change in this particular instance mainly arises from the difficulty of deciding upon the accuracy or otherwise of the delineations of Lohrmann and Beer and Mädler, although both describe it as showing a diameter of five or six English miles. Generally speaking, the observations between October 1866 and July 1870, all agree in its present appearance, differing greatly from that which it must have presented according to the delineations and descriptions of the two selenographers just named, also that no change of a physical character has taken place in it during the 3½ years it has been under observation. It has been supposed that photography would solve all such difficulties, and that photograms of the lunar surface taken under similar angles of illumination and visual ray would agree with each other; but here again precisely the same difficulties present themselves which perplexed Schröter, and which have been met with in comparing Lohrmann's and Beer and Mädler's works. Objects figured by the earlier selenographers occur on some photograms, but not on others, of about the same phase of illumination. There appears to be an agency capable of affecting the visibility of objects, rendering them indistinct or invisible on some occasions; while, on others, they are distinctly seen on the photograms. Whatever operations may have taken place in the crater *Linné*, producing phenomena the recurrence of which is *rare*, in all the examples above mentioned, from Schröter's time to the present, we have phenomena of a different character, exceedingly difficult of explanation, and constituting an important element in the solution of the question of present activity or quiescence; for unless it be fully proved that *all* these instances depend upon changes of visual and illuminating angles, a strong suspicion will exist of their being more immediately connected with the moon itself. To effect such a proof, however, is a matter of no small difficulty. Mädler alludes to the performance of calculations of the most varied kind as necessary for the delineation of lunar forms, and in the case before us the calculation of several elements for *each separate observation*, and they are very numerous, is absolutely essential for the purpose of referring the phenomena observed to changes of illumination and visual ray. Calculations of this kind have not been made to any great extent, and the consequence is, that the entire question remains involved in doubt. During the last seventeen months, as many as 1,227 observations of the spots on *Plato* alone have been made, and although the varying state of the earth's atmosphere affects in no slight degree the visibility of such delicate objects, phenomena are presenting themselves which call for a much more rigorous treatment than has yet been accorded to them. The affirmation of change on, or quiescence of, the moon's surface, must depend, not upon the accumulation of desultory and undiscussed observations, but upon such as are undertaken on a well-arranged system, and discussed with reference to every known agency capable of affecting them. The present state of the question is therefore one of *doubt*, one that calls for observation of the most vigorous character, and discussion of the most rigorous nature to settle it. Observation of late has been tending towards a registration of minute detail detected on the moon's surface, but discussion in various ways is behind the requirements of selenography, and until it can keep pace with observation the doubt alluded to above must remain.

SECTION B.—CHEMICAL SCIENCE

On Artificial Alizarine.—Mr. W. H. Perkin, F.R.S. In introducing Mr. Perkin the President said that that gentleman might be regarded as the representative in England of artificial colouring matters, and that the subject to be treated of was one of great importance, both theoretically and in its practical aspects. The author referred to the use of madder and its preparation called garancine, in the production of Turkey red dye and then traced the history of the investigations of chemist regarding the chemical nature of the colouring matters contained in madder-root. About thirty-nine years ago those investigations commenced, and ever since that time they have been continued by many eminent chemists, among others by Graebe, Liebermann, Schunck, Strecker, Laurent, Anderson, and others, as also those of the author himself. Two colouring compounds had been obtained from madder known as alizarine and purpurine. The exact composition of alizarine had been the subject of much discussion among chemists. From that compound a hydrocarbon derivative had been obtained which is called anthracene, and then from anthracene, as an ingredient of coal-tar and mineral pitch, alizarine had been produced by the action of various chemical agents. Alizarine, thus artificially produced, yields with mordants the same colours on cotton goods as the natural alizarine from madder-root. Mr. Perkin performed a great variety of experiments in order to demonstrate the chemical identity of the artificial and natural alizarine when absolutely pure. He had also, during upwards of twelve months, been engaged in studying the properties of anthracene and its compounds, all of which are very markedly fluorescent. There were many difficulties in the way of obtaining artificial alizarine in large quantities, but they were gradually disappearing. In the discussion which followed, Dr. Schunck, F.R.S., referred to the alleged differences between the natural and the artificial alizarine, and said he had no doubt whatever that the two were identical, and he thought the confusion had arisen from persons examining impure products. The artificial product was generally supplied impure, but the impurities could be separated. He was quite satisfied as to the importance of alizarine, and that it was the only essential dye product of madder. Some years ago he had shown that the finest madder pinks contained nothing but alizarine.

SECTION C.—GEOLOGY

On the Extension of the Coal-fields beneath the newer Formations of England.—Mr. Edward Hull. Having referred to the paper by Sir R. I. Murchison, on the parts of England and Wales in which coal may or may not be looked for, the author expressed his gratification that his own views coincided in the main with those of his chief, especially as regarded the absence of coal in the eastern and portions of the midland counties, now overspread by mesozoic formations. The author showed that there was evidence for believing that the coal measures were originally deposited in two continuous sheets, one to the north, and the other to the south of a ridge of old land formed of Silurian rocks which stretched eastward from Shropshire to the south of the Dudley coal-field. This ridge, or barrier, had never been altogether submerged beneath the waters in which the coal measures were deposited. Towards the north, the boundaries of the coal formation were formed by the Cambro-Silurian rocks of North Wales, the Lake District, and portions of the southern uplands of Scotland. Over the region north of the barrier, the coal measures were deposited in greatest thickness towards the north-west; while over that south of the barrier they were deposited in greatest force in a westerly direction.

At the close of the coal period, disturbances of the strata, resulting from lateral pressure acting in north or south directions, took place over the whole carboniferous area of the north of England, whereby the strata were thrown into a series of folds, the axis of which ranged along approximately east and west lines. These disturbances were accompanied and followed by enormous denudation, by which the coal measures were swept away over large tracts of the north of England, and the northern limits of the Lancashire and Yorkshire coal-fields were determined. As regards the tract south of the central barrier, it was inferred, on the ground of parallelism of direction with the east and west flexures of the north of England, that the northern and southern limits of the South Wales coal-field, the axis of the Mendip Hills, and the easterly bend of the culm-measures of Devonshire, were all referable to the same geological period, *i.e.*, that which intervened between the deposition of the carboniferous and the Permian rocks.

After the deposition of the Permian beds over the inclined and denuded surfaces of the carboniferous rocks, disturbances (accompanied by denundations) occurred along lines nearly at right angles to those of the preceding period, *i.e.*, along north and south lines (approximately). To this epoch the axis of the Permian chain, and all north and south trendings of the strata, were probably to be referred. Some of the results brought about by these movements were the disseverance of the Lancashire and Cheshire from the Yorkshire and Derbyshire coal-fields, the determination of the western limits of the Flintshire and Denbighshire coal-field, the disseverance of the Forest of Dean coal-field from that of South Wales, and the uptilting of the lower carboniferous rocks along the eastern margin of the Somersetshire coal-field beneath the Jurassic formations.

From these considerations it seemed clear to the author that to the intersection of these two systems of disturbances (*i.e.*, the E. & W. with the N. & S.) and the concomitant denudation, the basin-shaped form of nearly all the British coal-fields (sometimes partially concealed by newer formations) might be attributed.

The author then proceeded to show that over these carboniferous basins, the Permian and Triassic rocks were distributed according to a well-defined plan, the Triassic strata thinning away towards the south-east of England; and concluded by discussing the views of Sir R. I. Murchison, Professor Ramsay, and Mr. Godwin-Austen regarding the absence or presence of coal under the cretaceous and tertiary strata of the south of England.

On the History and Affinities of the British Coniferæ.—Mr. W. Carruthers. Having pointed out the great divisions of this natural order, the author traced their appearance and development in the stratified rocks. The *Araucarieæ*, now represented by fifteen species, all confined to the southern hemisphere, made their appearance in the carboniferous period, where at least eight species determined from the wood structure had been found. In the secondary rocks six species had been found based on the cones, and these showed an affinity to the group of modern Araucarias found in the Pacific Islands. The *Pineæ*, a large group chiefly confined to the northern hemisphere, appeared in the Old Red sandstone, as determined by H. Miller; a single species had been determined from wood in the coal; the species greatly increased in the secondary rocks, where several species of cedars had been detected. The *Taxodieæ*, represented among living plants by fifteen species, chiefly from the northern shores of the Pacific, made their appearance in the secondary rocks, one species being abundant in the Stonesfield slate, and were continued by species of Sequoia in cretaceous and Tertiary rocks. The two species from the Gault are associated with pines having the characters peculiar to the species associated with the existing mammoth trees of California. The *Cupresseæ*, represented by the cypresses, and in our native flora by the juniper alone, are known only in Tertiary strata by a few species of fruits and foliage. The *Taxineæ*, containing nearly 100 species, found all over the world and represented in Britain by the yew, made their appearance in the carboniferous rocks, as determined by a fruit described by Dr. Hooker, and shown by him to be nearly related to the living *Salisburia*. The supposed Taxineous wood from the North American Devonians, to which Principal Dawson gave the name of *Prototaxites*, was a remarkable *Alga* of enormous size. Several Taxineous fruits had been found in the Eocene strata at Sheppey.

Notes on Fossil Crustacea.—Mr. H. Woodward. A considerable number of new species was described which had been met with during the past years belonging to strata from the Silurian to the Tertiary. The author expounded the changes in the larva of the living King Crab, and showed the remarkable resemblances between its early condition and the palæozoic *Trilobites*. The earliest known King Crab occurs in the Upper Silurian, so that the pedigree of these two ancient forms dove-tailed into each other in Silurian times, and these contemporaneous forms approached much nearer to each other than would be expected from a comparison of the living King Crab with the Trilobite.

Report on Earthquakes in Scotland.—Dr. Bryce.

On the Tertiary Coal Fields of Southern Chili.—Mr. G. A. Lebour. This was a detailed description of the beds of coal, and those intercalated with them. The list of fossils appeared to Prof. Harkness and Mr. Carruthers to indicate a Secondary rather than a Tertiary age.

Section D.—Biology

Mr. Edward Atkinson, of Leeds, read a paper on the *Osteology of Chlamydophorus truncatus*—a fine male specimen of which had been presented to the Philosophical and Literary Society of Leeds. First glancing at the bibliography of this little quadruped, the author proceeded to draw attention to some points in the structure of its skeleton. The general conformation of the head is very remarkable, differing from all other Edentates in its relative dimensions, excelling its congeners both in altitude and in breadth as compared with length. He also alluded in detail to the structure of the lower jaw, the ear, the scapula, sternum, and pelvis. With regard to the dentition, his observations were not quite in accord with those of Harlan or Hyrtl. *C. truncatus* is a true monodont with eight grinders on either side of both maxilla and mandible. Those of the lower jaw perforate the whole depth of the bone, dimpling the inferior margin. The first tooth of the lower jaw has no opponent, and therefore no masticatory surface. The eighth upper tooth is also without an antagonist, but its analogue in front has a double facet.

Mr. R. McAndrew, F.R.S., presented a report on the *Marine Mollusca of the Gulf of Suez.* This report gives the general result of a dredging excursion to the Gulf of Suez in February and March 1869. Mr. E. Fielding accompanied the author. Leaving Suez on the 10th February in a boat of about twelve tons burthen, with one of about five tons for dredging, and a small boat for landing, the party reached Tur in about three weeks' time. Their crew consisted of Maltese and Neapolitans, an Arab, who proved an excellent diver, and a native of Tur, who acted as pilot. From Tur they crossed over to the Point of Zeite and the desolate islands situated towards the western side of the Straits of Jubal. After working about a week among these, and finding it a very rich collecting ground, they bore away to Ras Mahommed, where they ended their labours, proceeding from this to Tur, from whence they went by land to Suez. The number of species obtained (not including the Nudibranchiates) was 818. Of these 619 have been identified, the remaining being still undetermined. About 355 have not previously been recorded as from the Red Sea. Of these 53 species, including three genera, are new to Science, and have been described by Messrs. H. and A. Adams. Professor Issel, of Genoa, records 640 species as from the Red Sea, and his list includes 100 new species. Some of these were figured but not described in Savigny's "Description de l'Egypt." Mr. McAndrew dwelt on the extraordinary dissimilarity between the Fauna of the Red Sea and that of the Mediterranean; the number of species common to Japan, the Philippines, Australia, and to the Red Sea, is worthy of further observation In addition to the Mollusca, a collection of Echinoderms, Crustacea, and Corals, was made and divided among the British, Edinburgh, and Liverpool Museums. The sponges collected were sent to Dr. Bowerbank, except one, which had been described by Mr. Carter as a new genus under the name of *Grayella.*

Professor Wyville Thomson, F.R.S., read a report on *Some of the Echinoderms of the Expedition of H.M.S. Porcupine.* The impression was very general that through the exertions of Forbes, McAndrew, Jeffreys, and others, the marine fauna of the British Islands was now pretty well known. It was also thought that below a depth of some 300 or 400 fathoms animal life became extinct. Through the investigations of Dr. Carpenter and the author in H.M.S. *Lightning*, and since then by investigations carried on in H.M.S. *Porcupine*, with the additional help of Mr. Jeffreys, not only had the number of new species found been very great, but animal life had been found abundant to the enormous depth of upwards of a mile. Confining himself now to the Echinoderms, he might say that the fauna became not so much a local fauna as one of depth and temperature. All the well-known Scandinavian forms were met with in the "cold area"—such as *Pteraster*, *Euryale*, &c.; while in the "warm area," such wonderful genera as *Pourtalesia* and *Brissingæ*, having possibly its nearest ally in forms found in the Ludlow rock, but also a new soft-bodied genus belonging to the Diademidæ, were met with. All the new forms, embracing both new genera and species, would be described in full in the forthcoming report.

Dr. M'Intosh, F.L.S., read a preliminary report on *Certain Annelids dredged in the expedition of H.M.S. Porcupine*. The specimens were chiefly procured from water under 500 fathoms off the coast of Ireland. They are on the whole of a northern type, many of the rarer having been previously procured by Mr. Jeffreys off the Shetland Islands, and well known in the northern seas generally. There were several new and most interesting species, including a *Sthenelais*—a form allied to *Leanira Malmgreni*, but probably requiring a new genus for its reception; a *Eunice*, *Nothria* and *Chætozone*, the *Antinoe Sarsi* of Kinberg, and the *Petta pusilla* of Malmgren were, besides, added to our fauna. The author tendered his thanks to Professors Carpenter and Wyville Thomson, and more especially to Mr. Gwyn Jeffreys, for their kindness in securing the collection.

Dr. G. W. Child read a Paper on *Protoplasm and the Germ Theory*. Mr. Samuelson read a Paper *On the Controversy on Spontaneous Generation, with new experiments*. In the interesting discussion which followed, the President, Dr. Hooker, Mr. G. Bentham, and Mr. Crace Calvert took part.

Mr. P. L. Sclater read a Paper on *Certain Principles to be observed in the Establishment of a National Museum of Natural History*. [This Paper will be found *in extenso* in another column, with a woodcut. The following is an epitome of the interesting discussion which followed.]

Mr. Wallace entirely agreed with all the main principles advocated by Dr. Sclater, such as the separate government of the Natural History Museum, the association of Palæontology with Zoology, and the separation of the collections into a "typical and a scientific series," both of which should be at all times available; but he differed from him on a point which he considered to be no less important than any of these, viz., as to the mode of arrangement of the specimens which would be most efficient for all the purposes such a museum should fulfil. In a national institution, if any part of it was set apart for the elevation, instruction, and amusement of the public, these purposes should be carried out in the most efficient manner, and this could not be done by the system of wall-cases advocated by Dr. Sclater, and which he (Mr. Wallace) believed to be radically wrong. The objections to these wall-cases were numerous:—

1. They admit of any object being seen by the smallest number of persons at once, so that any one person studying an object, almost necessarily monopolises it, and prevents others from approaching it, an inconvenience that reaches its maximum in the recessed cases exhibited in Dr. Sclater's plan.

2. Objects in wall-cases can be seen only on *one* side, which, as *all* sides of natural objects require to be seen, would necessitate many specimens to do the duty of one.

3. The observer on the one side, from which alone he can see an object, will generally stand in his own light, and will often have distinct vision further impaired by reflection from the glass.

4. When small objects occur alternately with large ones, a great waste of space occurs, and the attention is distracted from the less conspicuous object.

5. The use of wall-cases on one side of a gallery for an entire museum, is an expensive and wasteful mode of arrangement.

Objections (1) (2) and (3) are of the greatest importance. A public national museum must accommodate the thousands who throng to it on holidays, when alone the working classes can reap its benefits; and they should be invited and induced to examine and study, not merely to gaze and pass on. Teachers and parents should be able to give information as to the groups exhibited without interfering with other visitors, none of which things are possible with a range of wall-cases. The system advocated by Mr. Wallace was that of detached cases on tables or on the floor, of various sizes, and each exhibiting one typical object or group of objects, capable of being seen on *all sides*, and admitting of convenient examination in the best light by the *greatest number* of persons at once. The system had been adopted in a new museum at the India House, and at South Kensington, and was advocated by Dr. Gray, and partially exemplified in the great gorilla case, the groups of birds of paradise, and other detached cases in the British Museum. The numerous and very great advantages of this system should not be lost for the sake of an infinitesimal increase of convenience to scientific men. The great majority of specimens exhibited in the public galleries would consist of *common species*, of which an ample series of specimens would be preserved in the scientific collection for study. Of the few rare species which it might be advisable to exhibit to the public, perhaps not more than one a week would be required for scientific examination, and all such might be so mounted as to be easily brought into the students' room, adjacent to the gallery, when required. The man of science would thus *lose nothing*, while the public would gain incalculably; and so greatly was Mr. Wallace impressed with the educational superiority of one mode of arrangement over the other, that he believed it would be better to have the very rare and unique species represented by drawings or models only in the public department, rather than have the whole collection arranged in wall-cases, for the one purpose of allowing the scientific man to get them out more easily on the rare occasions when he required them.

Prof. Archer, of Edinburgh, said: However some of us may differ from Dr. Sclater in his opinions about the arrangements of the contemplated National Museum of Natural History, none of us will, in the slightest degree, differ from him in his belief that this is a subject of paramount importance. I am compelled to say that I do not agree with him as to his arrangement of wall-cases and back entrances, for some considerable experience has convinced me that unless under some peculiar circumstances, as in narrow galleries where there is too little space for detached cases, wall-cases are entirely a mistake. In this respect my own personal experience perfectly coincides with the opinions of Mr. Wallace, but Mr. Wallace has even underrated the advantages of the system he advocates, for he has only indicated by his diagrammatic illustrations a series of cases similar in size, placed at equal distances. But at South Kensington, where the question of constructing cases best adapted for the display of objects in a Museum, has received a greater amount of intelligent attention than in any other museum, they have shown that you can make cases which will admit of a perfectly symmetrical arrangement, and yet be of various sizes, so that small objects as well as large ones may be so exhibited as to permit of their being examined from all sides, instead of from only one point of view as in wall cases. Wall space is valuable for illustrations, especially pictorial ones, but when you arrange groups of animals in them, it is certain that if they are tolerably suitable for the exhibition of large specimens they cannot be equally fitted for small ones. There is one other point in which I cannot agree with the author of the paper, and that is, in the line he draws between the requirements of a Public Museum and one for the use of students in natural history. My own views are to exhibit as much as you can without injury to the specimens, because you never know what portion of your visitors are earnest students or pleasure-seeking idlers; and still further, you do not know how soon this class may be converted into the former.

Prof. Newton thought that being connected with a museum which was emphatically "national," he should be wanting in his duty if he did not express his general agreement with the principles laid down in Mr. Sclater's paper. What might be called the "structural" part of this very important question had been dwelt upon by previous speakers, but there was another part on which they had scarcely touched. This was the constitution of the governing body and officials of the New Museum. First it had been stated in the paper (and the statement was true) that of the fifty trustees of the British Museum only two or three were scientific men. That the museum was what it was, reflected, then, the greatest credit on the energy of those two or three. But care must be taken that the museum of the future, whether sent to South Kensington or kept in Bloomsbury, should be relieved of the burden of the Trustees; it was essential that their authority should cease, and that scientific authority alone should be supreme. Secondly, with regard to the mode of appointment of the officials—that was a matter for great deliberation. He believed that the system adopted a few years ago had not yet had time to produce all the mischievous results which would follow if it were persevered in; but it was clear to him that in future they should have nothing to do with competitive examinations and Civil Service commissioners, in appointing assistants to the different departments, and he would prefer, as was suggested in the paper, that appointments should be made by the mild despotism of the director or superintendent of the museum.

Department of Zoology and Botany

Dr. B. W. Richardson read the *Report on Methyl Compounds*. He commenced his report by giving a review of some results of his previous reports, describing at length the action of nitrite of amyl and hydrate of chloral, both of which had proved of the greatest service in the treatment of disease. The former had been applied most usefully in the treatment of tetanus; the latter had been so largely applied as a narcotic, that since the discovery of its narcotic properties by Liebreich, more than a million persons had been successfully subjected to its influence. After his review of the past, the author brought forward new matter of research, introducing detailed accounts of the action of ethylate of sodium, ethylate of potassium, sulphur alcohol, sulphide of ethyl, bromide of ethyl, and triethylic ether. The facts respecting the action of these substances were all rich in interest, but two may be named specially, viz., in relation to the ethylates of sodium and potassium, and to triethylic ether. The first, when brought into contact with the surface of the body, acts as the most potent of known caustics, and promises to be rendered painless as well as caustic. The second is a new volatile anæsthetic, the sleep produced by which is deep, gentle, and apparently free from danger. In a final part of his report, Dr. Richardson dwelt on some general physiological observations, which attracted considerable attention. He showed that by the action of some of his anæsthetics, he could induce insensibility to pain without fully destroying consciousness; and he explained that in time this progressive step would be entirely realised. He described the effect produced by repeating applications of volatile agents upon the external nerves' expanses; and on the results of direct experiment, he explained that certain agents, such as nitrite of amyl, act immediately through the nervous system without any absorption of them by the blood. At the close of his report, Dr. Richardson showed how the elementary modification of the bodies of an organic series influences the physiological action of each compound, and expressed a hope that, by continued research, physiologists, moving with the chemists, would speedily bring the subject of the action of medicinal agents into the ranks of positive science.

Dr. Brown-Sequard read two papers on the *Apparent transmission of abnormal conditions due to accidental causes, and on various alterations of Nutrition due to Nervous Influence.*

The President of the Association (Professor Huxley) said: The great theoretical problem they had now to determine was what effect artificial modifications and external conditions had upon living organisms—whether they produced changes which, being transmitted hereditarily, became the basis of new races. Referring to a resolution which had been brought forward at a former meeting, which endeavoured to pledge the Association to abstain from making grants of money to persons engaged in experiments which involved vivisection, he said they had before them that day one of the most experienced physiologists and vivisectors of his day, and he had only to ask the audience to form their own judgment as to whether Dr. Brown-Sequard was likely to inflict one particle of pain upon any creature whatever without having a plain and definite purpose in view. For himself he might say that nothing was more grievous to him than to think of the existence of pain in anything whatever. He hated to see it inflicted upon animals, and he carried his objection to its infliction so far that he disliked even to see a man beating his wife. Neither Dr. Brown-Sequard nor himself were indifferent to pain, and he hoped that in no sense were they cruel. He thought that the gentleman who brought forward the resolution to which he had referred, hardly knew what he was dealing with. If his friend Dr. Brown Sequard would pardon his referring to a matter personal to him, he would remind the meeting that that great experimental physiologist, and that accomplished vivisector, who had, he supposed, performed as many vivisections as any man in the world, some years ago thought it advisable to turn the vast knowledge of the diagnosis of disease which he had obtained by this means into actual practice, and he (Professor Huxley) could assure them, from what he knew, that before long his wonderful mastery over symptoms caused his consulting rooms to be absolutely crowded by human beings suffering under multiform varieties of nervous disorders, who sought at his hands and from his knowledge that relief which they could not obtain elsewhere. The prevention of cruelty to animals, when understood in its proper sense, was as good an object as men could devote themselves to, but when they confounded the brutal violence of the carter or the wife-beater with an experiment carried out by a man of science, gently and for the purpose of relieving misery, the enthusiasts in that cause should change their name, and convert themselves into a society for the promotion of cruelty to mankind. If that question came before the Association again, and he hoped it would, he trusted they would recollect that the order of nature was such that certain kinds of truth were only attainable by experiments upon living animals, and that when they might result to the welfare of thousands and thousands of untold human beings who might otherwise be suffering unimaginable misery, those experiments were perfectly justifiable.

Dr. R. McDonnell, F.R.S., of Dublin, said that the President of the Association had viewed the admirable communication of Dr. Brown-Sequard from the Darwinian point of view, one of the greatest interest. He, like Professor Humphry of Cambridge, regarded such communications rather in their practical bearings, but first he might be allowed to say, how entirely he concurred with the President in his observations on the subject of experimental researches conducted upon animals. Indeed Dr. Richardson's report was in itself the most unanswerable argument that such experiments are undertaken with the hope of diminishing human suffering, and whosoever would oppose such an important and indeed successful means of attaining this end must be prepared to submit to the imputation of desiring that pain should remain unalleviated. Dr. McDonnell then alluded to the subject referred to both by Dr. Richardson and Dr. Brown-Sequard in speaking of the transmission along the nerves of certain sensations, and their being intercepted. He said that he had long felt some difficulty about adopting the hypothesis of Dr. Brown-Sequard that there existed distinct conductors for various sensations, as those of heat, pain, tickling, contact, &c. In explanation of the remarkable cases sometimes met with in which an individual who felt perfectly the contact of one's hand yet could not distinguish heat or cold, he proposed another hypothesis than that of distinct conductors, and he was indeed happy, on this occasion, to have an opportunity of submitting this hypothesis to the section and to Dr. Brown-Sequard for consideration. His (Dr. McDonnell's) hypothesis was, in fact, an application of the undulatory hypothesis to the propagation of nervous sensation—he supposed that sensations such as those of heat, pain, contact, as well as those of various colours, of form, of sound, were waves of different wave-lengths; and that, under certain circumstances, some waves were absorbed or intercepted while others passed on to the sensorium. He, in fact, drew an analogy or illustration of his hypothesis from Prof. Tyndall's well-known experiments on the absorption of radiant heat by vapours or scents passed into the air filling a glass tube. The glass tube in this experiment represented the nerve tubule, the slight change effected in the air contained within it produced by the introduction of the minutest quantity of scent causes an absorption *in transitu* of some waves of heat, others pass; thus, according to his supposition, might be explained the effect on vision of santonine. The experiment of seeing the complementary colour upon gazing at a white ground after looking upon a coloured disc, might be explained thus: A slight chemical change is effected in the nerve tubule by gazing at the coloured disc; when the white ground is looked upon, all undulations pass through *save* those which are absorbed, viz., those of the colour previously looked at. This, of course, gives the complementary colour. Many phenomena connected with sensation, Dr. McDonnell conceived, would find in this hypothesis a simpler explanation than in that of distinct conductors.

Department of Ethnology and Anthropology

On the Anthropology of Lancashire.—Dr. Beddoe, President of the Anthropological Society of London. The author drew a marked distinction between the inhabitants of North and South Lancashire, both as to their ethnological history and their present physical characteristics. In the former, he believed the Norse element to preponderate, having been introduced, probably, by colonisation from the Isle of

Man and even from Dublin. The people were still tall and fair, and often strikingly Scandinavian in aspect. The remaining British element might be partly Gaelic. In the south of the county, immigration and physical degeneration connected with the great development of the cotton manufacture, had been, and were, effecting changes in the prevailing physical type, which had previously been more Anglian and British, while the Norse element had been comparatively weak. The paper was partly based on numerical data.

On the Ottoman Turks.—Dr. Beddoe. This paper mainly consisted of a minute physical description of the Ottomans of Anatolia, with notices of certain tribes of Yuruks and Turkomans scattered about Asia Minor. The physical type, which for brevity's sake, he called Turanian, was much more prevalent among the former than was generally supposed. It was doubtful whether there was any need for invoking the influence of climate or other *media* to account for the elevation that had occurred in the Ottoman physique. Inter-marriage with the women of subjected races soon after the conquest, and absorption of foreign elements, might sufficiently account for it, and as these had been most prevalent in Rumelia, and in the large towns, it was there that the original Turanian type had been most obscured.

Mr. John S. Phené read a paper on *A recent examination of British Tumuli and Monuments in the Hebrides, and on the western coast of Scotland.*

On the Builders of the Megalithic Monuments in Britain.—Mr. A. S. Lewis. The author divided the inhabitants of Britain into three leading types, the Kymric, long-headed, dark-haired, and light-eyed; the Iberian, dark-eyed and dark-haired; and the Teutonic, round-headed, light-haired, and light-eyed. He controverted the idea now gaining ground that the Iberians represented the aboriginal race, and that they exclusively were the builders of megalithic monuments. He attributed these monuments to Iberians and Kymry indifferently, and believed the latter race to have come to Britain before the former. These views he supported by, among other arguments, a careful consideration of the statistics of the physical characteristics of the inhabitants of Great Britain, collected by Dr. Beddoe, President of the Anthropological Society of London, from which he showed that the Iberians were found in the largest numbers in the southern part of the island, while the monuments were found throughout it, and this distribution of races seemed also to show that the Iberians were a later arrival than the Kymry. Mr. Lewis stated, however, that the statistics were not sufficiently numerous to be absolutely conclusive, and appealed to the members of the Association to assist in collecting further statistics of the physical characteristics of the inhabitants of their own districts.

On the Massagetæ and Sacæ.—Mr. H. H. Howorth. Relying upon the Chinese authorities translated by Stanisias Julien and V. St. Martin, the author identified the Massagetæ with the Ta Yuetchi or Great Yuetchi, and the Sacæ with the Sse or Szu of the Chinese authors. A close criticism of all the information about the Massagetæ and Sacæ furnished by the Greeks, enabled us to say that they were two names for one race, or at most for two branches of one race, Massagetæ being probably the native form, and Sacæ its Persian equivalent. Western writers throw little light on what this race was. The Chinese authors prove that it was a branch of the Thibetan race, called by them the Khiang, which was predominant in Central Asia before the aggrandisement of the Turks in the sixth century. The same authors enable us to connect the Massagetæ and Sacæ with the Indo-Scyths who overthrew Bactria and the Greek civilisation of Asia in the second century, B.C. Sacæ is equivalent to the Sah and Saka of the Indian Epics, and to the more Western Scyth, and in the cuneiform inscriptions is the Aryan substitute for the Semitic Gimiri, the Cimmerii of Herodotus. These facts enable us to destroy the old nonsense about the Sacæ and Saxons, the Massagetæ and Goths, the Cimmerian and Welsh, having been related to one another. Sacæ, Massagetæ, and Cimmerii were all Turanians and in fact Thibetans.

Mr. Dendy read a paper on *Shadows of Genius.*

On the Racial Aspects of Music.—Mr. Kaines. The author drew attention to the settled melancholy which pervaded the music of the north of Europe—a characteristic not observable in the music of the south of Europe, or of the other people of the globe. He endeavoured to account for this physically and practically, and showed there were vast differences in the temperaments in the peoples in the north and south of Europe. Of the one it might be said "melancholy marked it for her own," while cheeriness and brightness marked the other. The first seemed saddened by the mysteries of life, death, God, and immortality. Mr. Kaines noticed briefly the great religious revolution which had taken place in Europe, and how it had (probably) powerfully influenced its music. Protestantism broke the spell under which the human intellect was bound by Roman Catholicism, and enlarged the sphere of man's knowledge only to show him how much there was that he could never know. Catholicism, in engaging to answer all the intellectual and moral needs of man, took from him responsibility, and gave him a restfulness to which Protestantism is a stranger. The change from the old to the new (or rather revised) faith, had not been without its effect on music, and the emotional cravings and wild unrest which characterised the music of our times, might be attributable to this cause.

A long and interesting discussion ensued, in which Mr. James Smith, Dr. O'Callaghan, the Rev. Mr. Owen, Dr. Evans, Dr. Hitchman, and others took part.

SECTION E.—GEOGRAPHY

Mr. Winwood Reade read a paper on the *Upper Waters of the Niger*, and as we understand that he will shortly read a similar communication before the Geographical Society, a brief abstract of his paper will be sufficient for the present. Last year Mr. Reade made an exploring journey from Sierra Leone to the Niger, and visited the gold mines of Bouré, a country mentioned by many travellers, but which he has been the first to reach. Leaving Sierra Leone on January, he went to Falaba, as Major Laing had done before him fifty years ago, though by a different route. Like Major Laing, he was detained at Falaba, and not permitted to pass that important town. He returned to Sierra Leone, bringing with him messengers from the King of Falaba to the Governor of Sierra Leone, and these, grateful for the kindness and liberality with which they had been treated, promised Mr. Reade that he should be allowed to pass Falaba if ever he should visit them again. He determined to go back with them at once. The promise was kept; Falaba is only fifty miles distant from the Niger or Toliba (great river), and within a month after leaving Sierra Leone he reached that river, which has now, in its western course, been touched by explorers at three distinct points: by Mungo Park, at Segou, in 1796; by Caillié, at Couroussa, in 1828; and in 1869 by Readin, at Farabana, where the river is only a hundred yards broad. The author of the paper claims to have discovered the most direce and the shortest route to the Western Niger. Without presuming to compare himself with such giants in travel as Park and Caillié, he pointed out that while Caillié had not been able to reach the Niger under two months, nor Park (nor subsequently the followers in his footsteps, Dochard in '21 and Mage in '64) under four months, he had reached it in one month. Mr. Reade expressed his thanks to Mr. Swanzy, who had borne the expenses of his two years' African travel; to Mr. Heddle, a merchant at Sierra Leone; and to the Governor-in-Chief, Sir A. Kennedy.

Sir H. Barkly, K.C.B., who was in the chair, having thanked Mr. Reade for his paper, Mr. F. Galton made some interesting remarks on the Niger, and said that the discovery of its being only 250 miles from Sierra Leone would, without doubt, have an important influence on the political future of that colony. Lord Houghton asked why nothing had been done by the Sierra Leone Government during the last fifty years to explore the country lying interior of their colony. Mr. Reade said that he was unable to answer that question, but perhaps the extreme difficulty of getting through the coast tribes had something to do with it; as he had explained in his papers it cost him two journeys to make the insignificant distance of 250 miles. We may explain to those who follow these abstracts with their maps that the position of Falaba is correct; and that Bouré or Buri (which is a country, not a town) is approximately correct, as laid down by Caillié, who passed near it. But the tract of country between Falaba and Caillié's first position on the Niger (Couroussa) must be mapped afresh. Mr. Reade does not intend to alter the position of the Niger's source, as laid down by Major Laing from native information obtained by him at Falaba. He was prevented by the wars constantly prevailing in that region from visiting the source, but the information which he collected respecting its position confirms in all essential particulars that obtained in 1822 by Major Laing.

SECTION F.—ECONOMIC SCIENCE AND STATISTICS

On the Aptitude of North American Indians for Agriculture.—James Heywood, M.A., F.R.S. Indian Reservations in Canada are under the control of the Secretary of State at Ottawa. Mr. W. Spragge, Deputy-Superintendent of Indian Affairs, presents annually to the Secretary of State a report on the Canadian settlements of Indians. The Six Nations Indians in the Tuscarora reserve, near Brantford, on Grand River, in the province of Ontario, form the most important settlement of aborigines in Canada. Their reservation comprises 55,000 acres, surrounded on all sides by thriving communities of white settlers. The Indian population of this reserve amounts to about 3,000 persons, including 2,800 of the Six Nations, and about 200 of the Mississaguas, or Ojibbeways, located near the river New Credit, at the southern extremity of the Tuscarora reserve. According to a report of Commissioners, appointed by Sir Edmund Head, Governor-General of Canada, in 1856, the Six Nations Indians were settled in the Tuscarora reserve, by Mr. Thorburn, the Commissioner, in "farm lots, averaging 100 acres each by actual survey." The total clearing of the Tuscarora reserve "amounted in 1856, to 7348 acres, more than half of which had been done by the Indians themselves, the remainder having been chopped by squatters, who had been removed from the land." "Most of these squatters were compensated for their improvements to the amount of more than 8,000*l*., paid from the funds of the Six Nations Indians." The Commissioners of 1856 report that the Six Nations Indians cultivate on their reserve "separate farms, and each is secure in his possession from the other Indians on the lot he occupies. His heirs inherit his improvements, but the soil belongs to the Six Nations in common. The Indian has no right of transferring his portion of land to another. The revenue of the Six Nations Indians amounts to 39,489 dollars annually." Besides the two Schools in the New Credit district, maintained by the Indian bands of that locality, there are in the portion of the Tuscarora reserve inhabited by the Six Nations, eight Schools, principally supported by the New England Company, a London corporation, formed under the Commonwealth, whose funds are devoted to the extension of civilisation and Christianity among the aborigines in British Colonies, and especially in Canada. Mr. Henry Lister, a member of the New England Company, visited the Tuscarora reserve in 1868, and reported of the Six Nations Indians that their chief crops were "wheat, Indian corn, oats, and hay." Most of the Indian houses in this reserve, Mr. Lister described as "cottages of one or two rooms, built of boards or logs, and usually heated by a stove. There is not a single village," Mr. Lister remarks, "on the reserve; each house stands in its own lot of about 50 acres." An agricultural society was formed in 1868, among the Six Nations Indians of the Grand River, at an annual subscription of one dollar (about four shillings), for each member, and their first show was held on the 15th of October, 1868, on a farm within the reserve. The policy hitherto pursued in Canada, with regard to Indians, has been to induce them by means of small annuities to remain, to a great extent, as residents in the Indian reservations of the Dominion to which their lands or settlements may respectively belong. According to the Rev. Edward R. Roberts, missionary to the New England Company at Chemong, near Peterborough, in Canada, the province of Ontario was "divided into districts, with reference to the Indians. The land of each district was valued at a certain rate per acre, and the interest of the aggregate sum was paid half-yearly to the Indians included in that district, which constituted their annuity. And, in addition, each band of Indians had a reserve of land in a particular locality for their settlement. The aggregate annuity of the several bands," Mr. Roberts observes, "remains the same, whatever changes by death, birth, or emigration may take place. If a band of Indians becomes less in number, those who remain receive proportionably more annuity. While, however, an individual Indian (or family) ceases to receive his annuity from the fund appropriated to the band he leaves, he may be received into another band, by application, and a vote of the people; but as such an accession to their numbers diminishes their individual annuity by allowing others to share it, an application of this sort is seldom acceded to, as might be expected."

SECTION G.—MECHANICAL SCIENCE

On the Extent to which existing Works and Practice militate against the profitable Utilisation of Sewage.—Mr. J. Bailey Denton, M. Inst. C.E. The author stated that, notwithstanding the great amount of attention devoted by chemists and other scientific persons during the last twenty-five years to the treatment of sewage, the general opinion arrived at now is that the refuse of towns can only be made to give up its fertilising elements by transporting it direct to the land either by the agency of matter or earth. In support of this view he made two quotations from the reports prepared by the Rivers' Pollution Committee of Inquiry. It is generally admitted that wherever people are congregated, and a number of dwellings exist together, it is not possible to provide for the largely increasing use of water, by a population doubling itself within the period of fifty years, without underground conduits for the discharge of liquid sewage. In nearly all our cities and large towns systematic sewage already exists. In the midland and southern towns water-closets are comparatively numerous, though privies with cess-pools still predominate, but in the northern towns water-closets are comparatively few, and the middens nearly universal. After mentioning various instances in which there is infiltration of subsoil water into the sewers, doing mischief in a variety of ways, the author called attention to the evil of indiscriminately admitting a largely disproportionate quantity of water into the sewers, without any power to regulate the time and extent of dilution. Assuming, with the Rivers Pollution Commissioners, that sewage must be utilised upon the land by the process of irrigation, Mr. Denton proceeded at some length to consider the conditions which should be observed in order to obtain the maximum amount of benefit from sewage farms. He concluded by saying, "With a sewage farm naturally or artificially drained, and the surface sloped so as to make the absorption and filtration of sewage certain; intermittent filtration may be practised by itself at any time when it is desirable to resort to it independently of irrigation. At seasons when the sewage may be applied profitably to vegetation, of course the two processes will proceed together; but it will only be by operations admitting alike of combined or separate action that purification and profit may be secured free from all chance of malaria. With the prospect of applying the sewage of towns extensively to land by way of irrigation, it is most desirable that the proper preparation of land to receive it should be indisputably understood and acted upon.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Sept. 12.—M. Faye communicated a note on the mode of observing the approaching transit of Venus, in which, after giving some account of Mr. Newcomb's memoir on the same subject, he suggested an application of photography by means of electrical apparatus. M. Faye also presented a note on the chemical agents to be employed in opposition to miasmatic infection, in which he remarks upon the application of the phenic compounds to this purpose.—M. Dumas and M. Chevreul made some observations on the subject of this paper.—A letter was read from M. Sédillot on the surgical indications and the consequences of amputations in connection with wounds.—M. C. Bernard presented a note by M. Rabuteau, on the means of annulling the effects of insufficient alimentation. The author described the effects produced by Coffee in diminishing the waste of material in vital operations, and maintains that by the free use of coffee life may be supported in full activity with much less than the theoretical amount of nourishment. Cocoa and Tea partake of the same qualities.

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