THURSDAY, AUGUST 10, 1871

## THE ORGANISATION OF LOCAL SCIENTIFIC EFFORT

AMONG the many topics of national importance which have been discussed at the recent meeting of the British Association, there is none which promises to bear more fruit, or which we more gladly bring before the notice of our readers, than a scheme already suggested in these columns, which has been discussed and adopted at a full and influential meeting of representatives of all branches of Science, the President of the Association, Sir William Thomson, being in the chair.

This scheme is essentially as follows :—It is proposed in the first instance, to make an attempt to extend and improve the present system of giving scientific lectures to the people, and by this means to awaken an interest in science and scientific progress in places where otherwise there would be little probability of such good work being done.

There is little need that we should expatiate on the extreme importance of this object, and on the value of the results which are certain to follow from an energetic carrying out of the proposal. With the example of Manchester and other large towns before us, it is not too much to hope that as soon as the scheme is properly developed, the beneficial effects already experienced in these places will become general throughout the country. In Manchester, to take one instance, we find that each Science Lecture has, on an average, been attended by upwards of one thousand persons, and that the interest excited by the lectures has not been a mere temporary amusement is evidenced by the fact that the lectures when reprinted have sold by tens of thousands. In Belfast, also, Science Lectures to working-men have been most successfully given for more than ten years. In this way it is clear that not merely the auditors, but a very large outside public, have benefited by this method of bringing science and its teachings home to everyone. A project, which has been so successful over limited areas, and which must be as successful if tried on a larger scale, is well deserving of being adopted and extended by so important a body as the British Association.

There is another consideration which renders the adoption of this scheme by the British Association doubly valuable. The danger attending the delivery of popular lectures has always been that true scientific method may be lost sight of in the desire of the lecturer to merely please the eye, or to keep up interest in the auditory by mere sensational display. It is to be hoped that we shall now have a guarantee at any rate against this evil. It is not possible always to make science amusing, but we now possess ample experience which goes to show that a scientific lecture delivered by a competent man, fully impressed himself with the dignity of what he is doing, is able to awake the interest and rivet the attention of those classes for whom the lectures are specially intended.

This, however, after all, is only one side of the project. We do not for one moment wish to undervalue the extreme importance of science lectures, but we must not forget that they will have missed their mark if they have not engendered the desire for something more durable (because more useful) in the way of scientific instruction, which can be obtained in a variety of ways, as, for instance, in Mechanics' Institutions, in the science classes of the Science and Art Department, or in other organisations which may be subsequently developed.

It is not, however, merely a question of scientific instruction. Throughout the country we find societies, field clubs, local museums, &c., all of which are more or less actively engaged in the pursuit of knowledge, local inquiries, or exploration, and all of which are working, more or less, at a disadvantage, in consequence of the chaotic state of our scientific arrangements, and from their lack of that power which springs from unity.

Now is it too much to expect that under the best possible conditions such engines of scientific advancement would be more useful than they are at present, or that there would be more of them? We have only to look at what has been done in some of the higher schools even, to satisfy ourselves upon this point. At Rugby, Clifton, Marlborough, not to mention other schools, we have museums and natural history societies existing side by side with the work of the school, and the masters testify in the most definite manner to the extreme importance of the culture obtained by such means. Now, if this is important for a limited number of schoolboys, how much more important must it be throughout the length and breadth of the land; where at present we find teaching going on without museums, museums existing in localities where there is no one to look after them, field clubs examining every inch of the ground, while a much richer region elsewhere is entirely unexplored, each worker, as it were, away from his support, and the workers few. It is as if an army were moving through a hostile country without commander, without plan, without any power of combination, and without either vanguard, Uhlan, or second line.

Here then we have plainly before us the ground to be viewed by the Committee to which we have referred, a Committee which we doubt not will be appointed by the British Association with full power to report upon, and, if necessary, to carry out at once, any measures which it may be desirable to take in the directions we have indicated. When once such a body is established, and its existence generally known, its work will soon take the most concrete form, a more concrete one than we have ventured to assign to it in this article; but it is clear that if limited in its functions in the first instance to the lecture arrangements to which we have referred, and to inquiries into the actual geographical position of and condition of our local societies, museums, field clubs, and the like, so that the committee should become the head-quarters of information on these subjects to those who wish to establish similar institutions in new districts, or to expand an existing one, the greatest possible good to science will follow. But it is not too much to hope that such a body would in time become the centre of influence as well as of information, would be able to mould actual and potential institutions into the best form for effective work, and would be able to economise their resources, and to increase the utility of each of them.

## KINGSLEY'S "AT LAST"

*At Last: a Christmas in the West Indies.* By Charles Kingsley. With Illustrations. In two volumes. (Macmillan and Co., 1871.)

A BOOK on the West Indies by an ordinary tourist would be hardly bearable. Mr. Trollope was amusingly brilliant as well as philosophical, and we read him with pleasure; but the author of "Westward Ho!" possesses a wealth of knowledge both in history and in natural science wherewith to illustrate his journey, which, even without his charming style and world-wide popularity, would render his book attractive to many a thoughtful reader. To him the air of the West Indies is "full of ghosts" of gallant soldiers and sailors, whose deeds of daring have made almost every bay and roadstead famous, and who, he thinks, might well ask us to render an account of our stewardship of those beautiful islands, which they won for us with precious blood, and which we, too ignorant and helpless to govern them properly, have misused and neglected. Passing by Dominica recalls one of those deeds, the record of which must thrill the heart of every Englishman: "here Rodney, on the glorious 12th of April broke Count de Grasse's line (teaching thereby Nelson to do the same in like case), took and destroyed seven French ships of the line, and scattered the rest, preventing the French fleet from joining the Spaniards at Hispaniola, thus saving Jamaica and the whole West Indies, and brought about by that single tremendous blow the honourable peace of 1783. On what a scene of crippled and sinking, shattered and triumphant ships, in what a sea, must the conquerors have looked round from the *Formidable's* poop, with De Grasse at luncheon with Rodney in the cabin below, and not, as he had boastfully promised, on board his own *Ville de Paris!*"

A little farther he comes in sight of "an isolated rock, of the shape, but double the size, of one of the great Pyramids, which was once the British sloop of war, *Diamond Rock*," and tells us the interesting tale, not of any magical transformation or nautical legend, but of one of those inspirations of genius which converted an almost inaccessible rock into a fortress, which was manned by 120 men and boys, and for a year and a half swept the seas, being "borne on the books of the Admiralty as Her Majesty's ship *Diamond Rock*."

More suited, however, to our present purpose is the reminiscence of the eruption of the volcano of St. Vincent in 1812, which lasted three days and nights, covering most of the island with ashes, and utterly ruining whole estates. In Barbadoes, eighty miles to windward, the dust fell so thick that total darkness continued till near midday, and strange to say, with the darkness was unusual silence, for the trade wind had fallen dead, and the everlasting roar of the surf was gone. As the dust-cloud drifted away and the sun again appeared, the trade wind blew suddenly once more out of the east, and the surf roared again along the shore. The authority for this fact Mr. Kingsley considers to be sufficient, but its explanation is by no means easy.

Arriving at Trinidad, our author fairly revels in the delights of tropical life, scenery, and vegetation. The flowers and forest trees, the creepers and climbers, and the noble palms, fill his soul with delight; and he is never tired of painting the scenes around him in his own picturesque and glowing language. The force and vigour of vegetable growth, the hum and glitter of insects, the strange birds and the howling monkeys, all have the more charm for him that he already knows so much about them, and that they satisfy an intelligent and highly-cultivated curiosity. Here is a little bit out of his picture of the "High Woods," as the virgin forests are called in Trinidad:—

"In Europe a forest is usually made up of one dominant plant—of firs or of pines, of oaks or of beeches, of birch or of heather. Here no two plants seem alike. There are more species on an acre here than in all the New Forest, Savernake, or Sherwood. Stems rough, smooth, prickly, round, fluted, stilted, upright, sloping, branched, arched, jointed, opposite-leaved, alternate-leaved, leafless, or covered with leaves of every conceivable pattern, are jumbled together, till the eye and brain are tired of continually asking 'What next?' The stems are of every colour—copper, pink, grey, green, brown, black as if burnt, marbled with lichens, many of them silvery white, gleaming afar in the bush, furred with mosses and delicate creeping film-ferns, or laced with the air-roots of some parasite aloft. Up this stem scrambles a climbing Seguine (*Philodendron*) with entire leaves; up the next another quite different with deeply cut leaves; up the next the Ceriman (*Monstera pertusa*) spreads its huge leaves, latticed and forked again and again. So fast do they grow, that they have not time to fill up the spaces between their nerves, and are consequently full of oval holes; and so fast does its spadix of flowers expand, that an actual genial heat and fire of passion, which may be tested by the thermometer, or even by the hand, is given off during fructification. Look on at the next stem. Up it and down again a climbing fern, which is often seen in hothouses, has tangled its finely-cut fronds. Up the next a quite different fern is crawling, by pressing tightly to the rough bark its creeping root-stalks, furred like a hare's leg. Up the next the prim little griffe-chatte plant has walked by numberless clusters of small cat's-claws which lay hold of the bark. . . . ."

Again—"Look here at a fresh wonder. Away, in front of us, a smooth grey pillar glistens on high. You can see neither the top nor the bottom of it. But its colour and its perfectly cylindrical shape tell you what it is—a glorious palmiste, one of those queens of the forest which you saw standing in the fields, with its capital buried in the green cloud, and its base buried in that bank of green velvet plumes, which you must skirt carefully round, for they are a dwarf prickly palm, called here Black Roseau. Close to it rises another pillar, as straight and smooth, but one-fourth of the diameter, a giant's walking cane. Its head, too, is in the green cloud. But near are two or three younger ones, only forty or fifty feet high, and you see their delicate feather heads, and are told that they are Manacques (*Euterpe oleracea*), the slender nymphs which attend upon the forest queen, as beautiful, though not as grand, as she."

The wonderful flowers, the strange creepers and fantastic jungle ropes, the buttress trees, the orchids, and a hundred other characteristic tropical forms, are described in equally picturesque language. A giant Hura tree, forty-four feet in girth, and 192 feet high, is the occasion for some remarks on Darwinism. For this is a euphorbiaceous tree, and allied, therefore, to our humble spurges, as well as to the manioc, the castor-oil plant, the crotons, the scarlet poinsettia, and many other distinct forms.

"But what if all these forms are the descendants of one original form? Would that be one whit more wonderful,

more inexplicable, than the theory that they were each and all, with their minute and often imaginary shades of difference, created separately and at once? But if it be—which I cannot allow—what can the theologian say save that God's works are even more wonderful than we always believed them to be? As for the theory being impossible, who are we that we should limit the power of God? If it be said that natural selection is too simple a cause to pro-

CHINESE MAN AND WOMAN

duce such fantastic variety, we always knew that God works by very simple or seemingly simple means; that the universe, as far as we could discern it, was one organisation of the most simple means."

The beauty of many of the clearings in the forests must have made every traveller in the tropics think what scenes of surpassing beauty might be created by judicious clearing and planting, by helping Nature in a country and climate where, even unassisted, she can do so much, and where such a profusion of beautiful materials exists to

*COOLIE AND NEGRO*

work with. Mr. Kingsley remarks that "the plants most capable of beautifying any given spot do not always grow therein, simply because they have not yet arrived there, as may be seen by comparing any wood planted with rhododendrons and azaleas with the neighbouring wood in its native state. Thus may be obtained somewhat of that variety and richness which is wanting everywhere, more or less, in the vegetation of our northern zone, only just recovering slowly from the destructive catastrophe of the glacial epoch, a richness which, small as it is, vanishes as we travel northward, till the drear landscape is sheeted more and more with monotonous multitudes of heather,

grass, fir, or other social plants. But even in the tropics the virgin forest, beautiful as it is, is without doubt much less beautiful, both in form and colour, than it might be made. Without doubt also, a mere clearing, after a few years, is a more beautiful place than the forest, because by it distance is given, and you are enabled to see the sky, and the forest itself beside; because new plants, and some of them very handsome ones, are introduced by cultivation, or spring up in the rastrago; and lastly, but not least, because the forest on the edge of the clearing is able to feather down to the ground, and change what is at first a bare tangle of stems and boughs into a softly rounded bank of verdure and flowers. When in some future civilisation, the art which has produced, not merely a Dropmore or a Chatsworth, but an average English shrubbery or park, is brought to bear on tropic vegetation, then Nature, always willing to obey when conquered by fair means, will produce such effects of form and colour around tropic estates and cities as we cannot fancy for ourselves."

Much information is given as to the races that now people the West Indies, Negroes, Coolies, and Chinese. The Coolies are very well spoken of, and the system of immigration is said to work well and to be beneficial to all concerned. The contrast between the different races in manners, character, and appearance appears to have struck our author very much, and many clever sketches illustrate his descriptions. In the cuts which we here reproduce, the three widely different races, Negroes, Coolies, and Chinese are very characteristically represented. There are also some excellent illustrations of tropical scenery and productions, that representing "A Tropic Beach" being one of the best, and the cut of the "Little Ant-eater" being also excellent.

We must point out one fault in the book, a fault which nature-loving travellers often fall into, too free use of the local names of natural objects, which, though made familiar to themselves by daily repetition, are a great annoyance to the reader, who cannot possibly learn their meaning during the perusal of the book. Towards the end of the second volume, for example, we find these lines:—"Below were Mamure, Roseau, Timit, Aroumas, and Talumas (*Canna*), mixed with Myrtles and Melastoms, then the copper Bois Mulatre among the Cocorite and Jagua palms." All these names, with a hundred others, have been carefully referred to their respective species in foot-notes in earlier portions of the volumes, but that does not help either the botanist or the general reader to remember such a string of new and uncouth words. Local names should, we think, be used only for a very few of the most abundant and characteristic species, whose mention will be so frequent as to impress them upon the reader's memory. For the others, English equivalents should be used where they exist; and for the majority, the family, generic, or specific names, which will convey some distinct impression to the naturalist, and will enable even the general reader to obtain information by consulting a dictionary of natural history or an encyclopædia.

To conclude, the book is beautifully got up; it conveys much information on the society, politics, and natural history of one of the most luxuriant and interesting of the West Indian Islands, and cannot fail to be read with both pleasure and profit by every lover of nature.

A. R. W.

## OUR BOOK SHELF

*Notes of a Course of Nine Lectures on Light.* By John Tyndall, LL.D., F.R.S. (London: Longmans and Co., 1871.)

THE contents of this little volume fully justify the author in his prefatory remarks, and the intelligent student or teacher will find very great benefit by a perusal of these "Notes." Every statement is extremely clear, and the experiments hinted at are all extremely good. Such a publication is exceedingly well adapted to a certain class of minds, of which the latent powers are better brought out by hinting at solutions than by detailed explanations. The skeleton is brought before them, and they are called upon to clothe it for themselves. In fact, if physical science is to be used in order to educate and train as well as to inform the mind, we cannot dispense with a set of notes of this description. The author has dealt very fully with his subject, and he has not been deterred, when the occasion required, from stepping beyond the physical region into the physiological. Thus we have some very good remarks upon brightness, as well as upon the eye and its peculiarities with respect to light. On the other hand, he has not permitted himself to enter largely on the subject of dark rays, but has confined himself to those which affect the eye. A perusal of these Notes will benefit all who wish to become acquainted with the laws of light, and even if they sat down to such a task, having a previous acquaintance with every statement, they will rise with benefit; for a branch of knowledge, like a landscape, is never fully understood until it is regarded under different atmospheres and from different points of view.

B. S.

*Transactions of the Newcastle-upon-Tyne Chemical Society.* Vol I. (1868-1871.)

THE Newcastle-upon-Tyne Chemical Society has been established for nearly three years; during this period the Society has been very prosperous, both as regards the number of its members and the importance of the papers read at its monthly meetings. The members were fortunate enough to secure the services of Mr. Lowthian Bell as their first president, and of several experienced gentlemen as members of the committee, a fact which must have contributed materially to their success. The papers which have been read before the Society since its commencement, relate, as might be expected, principally to technical chemistry and analysis. Amongst them we find Mond "On the Recovery of Sulphur from Alkali Waste," followed by an interesting discussion. Dr. Lunge has contributed several valuable papers to the volume; they are chiefly abstracts of the more important analytical methods published on the Continent. The papers on the analysis of technical products constitute the principal part of the book, the number of those on original subjects being very small. The inaugural address by Mr. Bell contains an interesting historical sketch of the various chemical manufactures on the banks of the Tyne, showing how rapidly they have grown, until they have now reached an enormous magnitude. There is also a paper by Mr. Clapham on the commencement of the manufacture of soda on the Tyne, which contains a sketch of the difficulties that had to be overcome by the founders of this industry. Among the other papers may be mentioned several by Dr. Wright, and one by Mr. Swan, describing an improved form of anemometer.

A. P.

*Transactions of the Woolhope Naturalists' Club for* 1870. (Hereford, 1871.)

THIS volume is equal in interest and value to its predecessors, and still more varied in the nature of its contents. All branches of natural history are pursued with ardour by the Woolhope Naturalists, and good scientific work is done in the various sections. Zoology furnishes papers

"On the Habits of *Platypus cylindrus*," and on that vexed question "The Life History of *Rhipiphorus paradoxus*," by Dr. Chapman, "On Rare Birds," by Mr. James W. Lloyd, and "On Herefordshire Lepidoptera," by several contributors. In botany, we have papers "On the Reproduction and Growth of the Mistletoe," by the Rev. R. Blight, "On some Curious Algæ only apparent in times of Drought," by E. Lees, a number of contributions on edible fungi and other mycological subjects, by Dr. Bull and other ardent Herefordshire fungophagists, and a continuation of the notes on "Remarkable Trees of Herefordshire." Geology contributes papers "On the Coralline Formations of the Oolite Rocks, by Dr. Wright; "On the Remains of a Giant Isopod, *Prœarcturus gigas*," and "On *Eurypterus Brodiei*," by H. Woodward and others. Meteorology is represented by useful papers by Mr. H. Southall and Mr. E. J. Isbell. The illustrations are unusually abundant, including several of the fossils described, and photographs of remarkable trees, including one of a new mistletoe oak, which Dr. Bull has had the good fortune to find.

## *LETTERS TO THE EDITOR*

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

### Science Teaching in Schools—An Offer to the London School Board

MR. JONES'S letter on the above subject in NATURE, July 27, has much surprised me, his results being so utterly at variance with those obtained during my own experience, which dates from 1848, and has extended over a considerable area, including Edinburgh, Birmingham, and London.

I have no doubt whatever that Mr. Morris's system may be carried out successfully, provided suitable teachers are selected. There may at first be some difficulty in doing this, the worst rock ahead, that upon which I suspect Mr. Jones's experiment has split, being pedantry. Ignorance is curable, but the pedant only progresses from bad to worse, and the atmosphere of schools and colleges is especially favourable to the propagation of the virulent moral pestilence under which he is suffering.

As a set-off against the discouraging results of Mr. Jones's experiments, I may state that between 1848 and 1854 an experiment of teaching physical, economical, and moral science to children of the poorer classes of all ages between five and sixteen, was carried out in Edinburgh, under the direct supervision of the late Mr. George Combe and Mr. James Simpson. Experimental physics, chemistry, general physiology, and economic science, were taught by myself, while the subjects of the advanced special physiology of the brain and moral philosophy were taught by Mr. Combe. Mr. Combe's class included only the senior pupils of ten years and upwards; my own classes embraced the whole school, and the fundamental principle of the instruction was that of *teaching the same subjects to all the children from the youngest upwards*, by adapting the mode of instruction to their respective ages and capacities.

Of all the numerous subjects thus taught to these children, the one which I found the most difficult and unsatisfactory was that of English orthography, while the easiest were those branches of physical science which I was able to teach with the aid of direct objective illustrations. For example, we had a very good articulated human skeleton, which was an object of great interest to all the children—a sort of pet toy, in fact. I found it much easier to teach to young children between four and five years of age the names of all the bones in that skeleton, than to teach them the names of the letters of the alphabet. The alphabet was a work of many weeks, the skeleton of only a few days. Thus as regards mere names and the recognition of objects, in the first step of intellectual training, viz, the exercise of the senses, science was easier than the first of the "three Rs."

In the next step, viz. the action or uses of the bones and the letters, the advantage of the skeleton over the alphabet was found to be ridiculously great. A very respectable amount of knowledge of animal mechanics was attainable in less time and with less effort than was necessary to enable the children to say with any degree of certainty what *ough* spells, when presented in combination with other letters.

A dissertation on the mode of teaching the elements of the sciences to such young children would be out of place in this letter; I can only summarise the result of my experience by saying that any and every subject that is intelligible to a man of fifty years of age, may be taught to a child of five years of age—taught, of course in its beginnings, and with suitable illustrations.

The sceptical reader will perhaps better understand me when I remind him that simple addition and simple subtraction are the beginnings of the same mathematics as those by which the Senior Wrangler gains his worthily esteemed honours, and that the highest and most difficult problems of pure algebra are but addition and subtraction sums of a more complex character. Thus when a teacher throws six marbles on the floor and tells the children to count them, then shows four more in his hand, and after these have been counted throws them down with the others, and instructs the children to count the sum, and thus proceeds with further exercises upon picking up various numbers, and counting the remainders, he is teaching mathematics as truly as though he were demonstrating the most difficult problems of the differential and integral calculus. It is in this sense that I speak of science teaching to such young children, and in such a manner any and every branch of science may be taught simultaneously with the alphabet.

Many very sincere friends of education, resident in Edinburgh at the time above stated, were unconvinced of the possibility of thus communicating sound scientific knowledge to children, and in the course of an address on education delivered by Mr. George Combe, he made the following offer, viz.:—That the audience then present, consisting chiefly of artisans, should send to me on the following day some of their children, between ten and twelve years of age, that I should take the first twelve who presented themselves, and at once commence a course of ten or twelve lessons on physiology, at the end of which course the children should be publicly examined on the subject of the teaching.

The experiment was carried out successfully, a large audience assembled at the examination, and many were much surprised at the result, though there was really no good reason for astonishment, the attainments of the children being merely a natural and necessary result of plain unpretentious teaching of the simple and fundamental elements of a subject in which every human being is interested.

If the London School Board think it desirable, I shall have much pleasure in repeating the experiment. About twelve children, of nearly equal ages, taken at random, street Arabs if they please, may form the class. The materials I shall require are a skeleton and a set of Marshall's Physiological Diagrams. After ten or a dozen lessons of about one hour each, I will orally examine the children in any building or before any audience they may select, large or small.

To test the possibility of teaching another class of subjects, that of physiology might be followed by a similar number of lessons on that part of economic science which includes the natural laws upon which the relations between capital and labour, and some other fundamental elements of our social structure, depend. The examinations would be so conducted as to afford to all who attend them the means of judging whether the children had been crammed or truly taught, whether they would be likely to remember or forget the subject of their lessons, and how far this preliminary glimpse of the wonderful work they are themselves able to perform, might stimulate their intellectual appetite and awaken a slumbering sense of their own human dignity and responsibility.

W. MATTIEU WILLIAMS

The Green, Woodside, near Croydon

### Cramming for Examinations

I ENCLOSE one or two *bonâ fide* extracts from *elementary* examination papers which have during the past few years come under the notice of candidates officially. I do not wish thereby to reflect so much on the regulations drawn up by senates and committees, as upon the way in which those regulations are carried out by examiners. Though cramming is officially denounced, yet there is scarcely anything which is in greater demand; and, so long as this is the case, candidates will of course insist, in spite of their teachers, upon undergoing the operation.

There are few of the matriculation papers of the London University but proclaim cramming to be the order of the day. The papers in Chemistry cannot certainly be called very difficult;

this, however, is not surprising, since, for many years, the University has had for examiner one of our ablest chemists and a most eloquent teacher. Nevertheless, observe the following questions, in which the italics are mine :—

"*Describe by equations* as many processes as you know for the preparation of oxygen gas." (1870.)

"*Explain by an equation* the process of making ammonia, &c." (1870.)

"*Give the names and formulæ* of the oxides of nitrogen, &c." (1870.)

These few are the *worst* detected after careful search; but columns of NATURE could be filled at once with the most unnatural questions in all the other subjects. The following, taken at random, will serve as brilliant specimens; to me they are more heart-rending than the answers given by "Examiner," because even the worst of candidates are corrigible, while examiners do not appear to be so.

"Name the Sovereigns who were reigning in England at the close of each century from the ninth to the eighteenth successively." (1870.)

"Give some estimate of the population of England at the death of Charles II., &c." (1870.)

"Show how the present Royal Family is connected with the House of Tudor, tracing the pedigree to the end of the seventeenth century." (1869.)

"State the principal rules of English syntax." (1869.)

Moreover, candidates are positively compelled to cram their Latin and Greek translation; the one Greek and the one Latin subject are selected "one year and a half previously," which makes competition of talent against talent so far practically an impossibility; it is a mere trial of cramming against cramming. And is this portion of the examination of any practical value as proving the efficiency of a candidate? Let the university answer for itself: "Special stress is laid on accuracy in the answers to the questions in Greek and Latin grammar." Comment is useless.

A much lower standard for Latin translation, and no selection one year and a half previously, would ensure a finer and more useful knowledge of a noble language; besides this, a little rational conduct on the part of examiners, and a far more vigorous and effective supervision of the papers by the Committee of the Senate, would enable education to go hand in hand with instruction, and learning to part company with cramming.

Most of us know what school training should be; it should be such as would enlarge the mind, make it capable of comprehending the great and good, and open up a vista of happiness in early years. Teachers know what school training must be; it must be such as will satisfy inexorable examiners, many of whom appear to be totally unmindful, not only of what should, but of what can, be taught during an ordinary boy's school life.

To one who regards education as the only means of placing man "a little lower than the angels," the questions given at elementary examinations are more than painful.

TEM. AUG. ORME

University College School

## Volcano near Celebes

THE following note may be perhaps of interest for the readers of NATURE. March 2.—The Volcano Roeang, near Tagoelanda, the most southern of the Sangi Islands in the North of Celebes, began to make noises. March 5th.—In the evening, at seven o'clock, a frightful eruption took place; three minutes afterwards a large sea-wave reached the shore of Tagoelanda, about one mile distant from Roeang, and destroyed three villages with 416 men. The mountain worked till March 14, with a heavier final eruption. March 30.—I was at the place and ascended the volcano, which is, according to my measurement, about 2,100 feet high. To proceed into the crater was impossible in consequence of the thick damps of sulphur.

The temperature of the soil at the bottom of the mountain near the sea-shore some inches deep was 45° Réaumur. I brought home a large collection of stones, &c.; the masses thrown out were principally sulphur, ashes, sand, and mud, besides small and large stones, and even rocks. All details are contained in my diary. I then made a tour round the Sangi Islands, and am about at this moment to visit the isles of Bangka and Limbe in the north and east of North Celebes.

ADOLF BERNHARD MEYER

Manado, Celebes, April

## NOTES

VICE-ADMIRAL E. OMMANNEY, C.B., F.R.S., proceeds to Antwerp to represent the Royal Geographical Society of London at the Congress of Geographical Science, which will be held in that city between the 14th and 22nd of this month.

MR. W. CARRUTHERS has just issued his official report for 1870 of the Botanical Department of the British Museum. Several of the Natural Orders and European and British representatives of other orders have been completely rearranged. The most important additions which have been incorporated into the herbarium during the year are: from Formosa, collected by the late Mr. Oldham; from the Levant, 2,625 species by Prof. Haussknecht: from Martinique, by M. Hahn; and from various districts of Europe. A large number of fungi have been added from Europe, and from North and South America and Cuba, and among other palæozoic additions, an important series of Devonian plants from Canada, presented by Principal Dawson, of Montreal, illustrating his published memoirs.

THE Monthly and Annual Reports have reached us of the Department of Agriculture of the United States of America for 1868 and 1869. The amount of information which is thus afforded by the Government to the citizens of the United States, may well astonish us in this country. They comprise Reports from practical men on a vast variety of subjects of the utmost importance to the cultivators of the soil: the cultivation of fruit; the manures best adapted for different soils; report of recent progress in steam culture; meteorological statistics; the physiology of *Trichina spiralis;* abstract of laws relating to fences and wild stock; tests for the authenticity of seeds; agricultural statistics; report of progress of beet-sugar manufacture in Europe, *et multa alia.*

THE discussion which took place before Parliament relating to the adoption of the metric system in England, is considered by French *savans* as highly discreditable to that body, and the result has occasioned much surprise there.

M. BRETON, one of the great Hachette firm, was returned a member of the Municipal Council of Paris in the Conservative interest. His majority was one vote, which was declared *nil*, as a man had voted without any right, and in spite of the exertions of the chairman of his voting section. Being older than M. Hérisson, his competitor, he was elected merely by the privilege of seniority. Two other publishers who had been candidates were unsuccessful, M. Gernier Baillière and M. Victor Masson.

NO stamp duty is to be imposed on newspapers in France, but a duty will be established on every description of printing-paper. For books it will 8*s.* per cwt. and for newspapers 16*s.* per cwt. Newspaper paper is of an inferior description, and will be charged twice as much as the superior kind. This absurdity is owing to the objection raised to the income-tax by several politicians, amongst them M. Thiers himself. But it is supposed he will very shortly give up his old prejudices.

MR. CARRUTHERS, the keeper of the herbarium at the British Museum, has been appointed consulting botanist to the Royal Agricultural Society.

ONE of the Whitworth Scholarships has recently been awarded to John Armitage, an artizan student at the Oldham School of Science and Art; last year he gained the Department Silver Medal for Practical Geometry, and in 1869 the silver medal for Machine Drawing. Last year James Taylor, another artizan student from this school, also gained a Whitworth Scholarship, as well as the Department Gold Medal for Mathematics and the silver medal for Theoretical Mechanics.

A LAUDABLE attempt to encourage floriculture in London is an exhibition which was held yesterday in the churchyard of St.

Botolph, Bishopsgate, under the patronage of the rector, Rev. W. Rogers, in which prizes were offered for the best collection of flowers grown in the City.

An exhibition of the Royal Cornwall Polytechnic Society will be held at Falmouth from the 11th to the 19th inst.

The *Revue Scientifique* for August 5 contains a report of a very interesting lecture delivered before the Collège de France by M. Claude Bernard on the Influence of Heat on Animals, accompanied by a series of very careful experiments.

We have received letters from a number of correspondents on the various subjects opened out by Mr. Howorth's "New View of Darwinism," and the replies to it; but the great pressure on our space compels us to close the discussion.

The most recently received parts of the Bulletin de l' Académie Impériale des Sciences de St. Petersbourg, viz., vol. xv. part 3-5, and vol. xvi. part. 1, contain among others the following important papers:—Note on the Approximate Rectification of Certain Curves, by J. Somoff; On Tremblings of the Earth, by F. Argelander; Observations on the Planets at St. Petersburg, by A. Sawitsch; On the Physical Properties and Calorific Power of certain Petroleums of the Russian Empire, by M. Sainte-Claire Deville; On the Nervous System of Star-Fish, by Ph. Owsiannikof; Studies of Ozone, Oxygenated Water, and Ammonium Nitrite, by H. Struve; the Nervous System of *Lepas anatifera*, by Dr. E. Brandt; On Polydactylism, by Dr. Gruber; Short Diagnosis of New Plants from Japan and Mantchuria, by C. J. Maximowicz; On the Young of *Idothea entomon*, by E. Brandt; On the Gulf Stream to the East of the North Cape, by A. Middendorff; On the Osteology of the Hand and the Foot, and other Anatomical Papers, by W. Gruber; Rotation of the Plane of Polarisation by the Effect of Electro-Magnets, by Jegorof; On the Organisation of Gregarinidæ, by A. Stuart; Histological Studies on the Nervous System of Mollusca, by Ph. Owsiannikof; On Cerium, by D. Mendéleyf; On the Influence of the Displacements of the Axis of Rotation in the Interior of the Earth or the Level of the Sea, by Dr. H. Gylden.

A second edition is just published of Prof. Corfield's Digest of Facts relating to the Treatment and Utilisation of Sewage. It has been revised throughout, and is issued entirely on the author's own responsibility, and not under the auspices of the British Association Committee. Considerable and important additions are made to the matter contained in the first edition.

The second volume of the "Flora of Tropical Africa," containing the orders Leguminosæ to Ficoideæ, has just been issued. The work has been divided as follows among the botanists whose names are attached to the respective orders: Leguminosæ (Cæsalpinieæ and Mimoseæ), Rosaceæ, Saxifrageæ, and other small orders, Prof. Oliver; Cucurbitaceæ, Begoniaceæ, and Melastomaceæ, Dr. Hooker; Leguminosæ (Papilionaceæ), Mr. J. G. Baker; Passifloreæ and Samydeæ, Dr. M. T. Masters; Combretaceæ and Myrtaceæ, Prof. M. A. Lawson; Crassulaceæ, Mr. James Britten; Lythraceæ, Mr. W. P. Hiern. The proportion of new species described is very large.

The Coal Commission appointed on June 28, 1866, "to inquire into the several matters relating to coal in the United Kingdom," have unanimously agreed to their report. The whole work of the Commission will be published as soon as possible in three volumes, with maps, sections, &c., which are all far advanced towards completion.

M. Panceri, in a memoir recently presented to the Association of Naturalists and Physicians at Turin, claims to have established that the phosphorescent substance in fishes, in whatever part of the body it may be situated, is always fat, and that the phenomenon is due to its slow oxidation in contact with air. The skin of fishes is permeable to gases, and the oxidation of the sub-cutaneous fat proceeds without difficulty. Phosphorescence shows itself, as a rule, some time after death, and continues until putrefaction commences; as soon as a true decomposition sets in, accompanied by the disengagement of ammonia, phosphorescence ceases. Phosphorescence is prevented by the presence of fresh water, alcohol, or carbonic acid; oxygen, on the other hand, strengthens the phenomenon.

The charge against Mr. Hampden of libelling Mr. Wallace was tried on Thursday week in the Secondary's Court. Our readers will remember that a wager of 500*l.* having been made between Mr. Hampden, who affirmed that the world was flat and not round, and Mr. Wallace, it was decided against the former, who thereupon abused Mr. Wallace as a liar and a swindler. The action now tried was for damages for these and other similar libels, and Mr. Hampden was condemned to pay 600*l.* damages.

Mr. Heliodoro Ruiz, of Opin, in Colombia, New Granada, informs the Government of that country that he has been successful in treating snake bites by cauterisation. The province abounds with snakes of a deadly character, and he has treated seventy cases of bites. He simply drops melted sealing-wax on all the fang marks, and he considers the result is due less to cautery than to the complete exclusion of the air by the adhesion of the wax. At first he administered internally a few drops, but he has discontinued it, not finding it necessary.

Senor Primo Lozano, of Quibdo, in Colombia, reports to the Tiempo of Bogota that he has discovered a new way between the Atrabo and the Pacific superior to that by Napipi and Truando. The Napipi route has been repeated again by the U.S. explorers.

On the 25th May a waterspout passed over the hill stations of Ootacamund in Southern India.

On the 23rd May an earthquake was felt at Nynee Tal in the Himalayas. At that English hill station there is a beautiful lake, and it is now to be noted that since the earthquake it has emitted a strong sulphurous smell.

An earthquake was felt on two days in May at Gilghit, above Cashmere, on the 22nd and 23rd.

On the night of the 7th of June Calcutta was visited by one of the severest thunderstorms known for many years. Several houses were struck by lightning in the southern division of the city, but there was no loss of life.

On the 19th June a strong earthquake was felt at Brooklyn and in the neighbourhood of New York. The shock was vertical.

The largest tamarind tree in India, in the Khosru Gardens at Allahabad, fell down on the Queen's birthday. The stem was quite hollow. It was an ancient and well-known sight.

Iron telegraph poles have been introduced with great success in Switzerland, and their use is now being extended daily. It is considered that in a short time these iron posts will altogether replace wooden poles throughout Germany. We understand, also, that they are being largely adopted in connection with the Indian telegraph service.

A species of fish-crow (*Corvus caurinus*) is very abundant in the Oregon and Washington territories, where it is very troublesome to the Indians, stealing their dried fish and other provisions. It is never killed by them, from superstitious feelings, but is driven away by children set to watch for that purpose. In winter it subsists principally upon the refuse food and offal thrown out by the natives from their lodges, and is an attentive hanger-on at the residences of the white settlers. It is cunning, but very

tame and impudent, allowing a very near approach, and when closely pursued retiring but a short distance. Like some species of gull, this bird is in the habit of carrying clams high in the air and then dropping them, in order to break the shell. Dr. Studley says: "In watching one thus employed I was very much amused at the unsuccessful endeavours he made to break the shell of a clam by letting it drop upon soft ground. He continued for a long time carrying and recarrying the same clam high aloft and fruitlessly dropping it on the prairie sod. He nevertheless persisted in his efforts until I became tired of watching him. What the result was I am unable to state."

## *THE BRITISH ASSOCIATION MEETING AT EDINBURGH*

EDINBURGH, *Wednesday Morning*

THE proceedings of this year's meeting are now rapidly drawing to a close, so near, in fact, is the end, and so apparently far back in time is the beginning, that already it is easy to sum up the results, and to get a general view of the meeting in its various aspects.

The meeting has certainly been in every respect a most successful one; the weather has done all in its power to conduce to the enjoyment of the members, and to belie the southern notions as to climate. First, as to the attendance: The numbers attending the former meetings here have been almost, if not quite, doubled, and, in fact, we may assume that they have been much larger than was expected, otherwise another, though in some respects a less convenient arrangement for the sectional work would have been adopted. As it is, we have had all the sections massed in the University in the various class-rooms—an arrangement which reduces the necessary locomotion to a minimum, and gives the greatest facility to those who choose to visit all the sections, affording a striking contrast to the great waste of time and other inconveniences which resulted from the disconnected positions of some of the sections at Liverpool. The drawback is, that the numbers being so large, the small class-rooms have quite broken down in the matter of accommodation, and ingress and egress have been almost impossible.

But in British Association Meetings, as in other things, numbers alone must not be too much considered; and this leads us to the wonderful galaxy of physicists who apparently have come to Edinburgh to do honour to the President. The brilliancy of the gathering, both of British and Foreign men of science in the mathematical and physical section, has been the subject of general remark, and we refer to it, not at the expense of the other sections, but as an indication of what has happened there also, though not to such an extraordinary degree. Joule and Colding, Cayley and Sylvester, Thomson and Tait, Janssen and Huggins, Clifford and Spottiswoode, are combinations not to be seen every day, and the extreme interest of the discussions carried on under such conditions may be easily imagined, much more easily imagined, indeed, than described. Prof. Zenger, of Bohemia; Dr. Paul Güssenfeldt, of the University of Bonn; Prof. Van Beneden, of Louvain; E. L. Youmans, of New York; Rev. J. R. Loomis, LL.D., President of University of Lewisburg, U. S.; Prof. Dr. E. H. von Baumhauer, Secretary of the Dutch Society of Science, Haarlem; Dr. C. H. D. Buys Ballot, of Utrecht; C. Gilbert Wheeler, Professor of Chemistry at the University of Chicago; Dr. Baron R. Eötvös, Professor of Mathematics and Physics at the University of Pesth; Dr. D. Bierens de Haan, Professor of Mathematics, Leiden; are among the foreigners who have attended the meetings in addition to those alluded to last week; not to mention the names of many distinguished English and Scotch *savans*, who attend as representatives of various scientific bodies in different parts of the country.

Then as to the number of papers presented. With the exception of the Mechanical Section, presided over by Prof. Jenkin, the supply of papers has been superabundant with a quality above the average. So numerous have been the papers in some sections, that divisions have been formed to enable them to be get through.

As to the local conditions of success, we need only say that the meeting is in one of the most beautiful cities of the world, the society of which takes its tone from a wide diffusion of intellectual culture, and where hospitality takes no refusal, and just escapes killing by kindness.

This meeting may be said to have really commenced on the day before the meeting of the General Committee, and of the delivery of the President's address, in consequence of the attendance of so many men of science at the graduation ceremonial of the University, to which we referred last week, when we gave the names of those who had the honorary degree of LL.D. conferred on them. We may here add that the recipients were introduced by Prof. Macpherson, the Dean of the Faculty of Law, in a way which greatly enhanced the value of the honour.

This ceremony was followed by the "capping" of ninety-six gentlemen who had just completed their studies. One of the secrets of Edinburgh's great success as a medical school appears to us to lie in the mode of bringing out originality among her students, which we would gladly see adopted in the science teaching of our English Universities. When a student takes the degree of M.D., he is required to write a thesis on some subject belonging to the sciences related to medicine. Gold medals are awarded for such theses as contain an amount of original work which is deemed worthy of the honour. The consequence of this is, that every year two or three, or even more, really good original memoirs are produced. These are, in very many instances, the nuclei of still greater things in after-life. Powers of research, which might otherwise have lain dormant, are brought out; and so at an early period of life, men get into the habit of doing original work. We are assured by Edinburgh men that the system is, as one would have expected, fraught with excellent results. Our wealthy English universities would do well to take a lesson from their poorer sister; and, instead of rewarding so highly mere grinding in science, they would do well to do something more to develop doers of original scientific work. On this occasion the gentleman who obtained the highest honours is Dr. Urban Pritchard.

This ceremony, after all, however, was merely the prelude. Prof. Bennett's graduation address was the first sensation of the meeting. Indeed, those who had come north with more acquaintance with Dean Ramsay's stories than with the present tone of thought, were simply astonished at the boldness with which Mr. Bennett handled subjects on which, it was imagined, any expression of opinions such as his would not be tolerated. Here, for instance, is a specimen:—

"At the congress of naturalists and medical men held at Innsbruck in 1869, Helmholtz claimed for Germany the principal agency in the progress of modern science. She owes this superiority, he said, to the boldness of her *savans* in propagating truth, whilst, he asserted, that in England and France they dare not do so openly, for fear of compromising their social interests. But I trust the time is past, even in Scotland, when scientific truth has anything to fear from superstitious bigotry or clerical intolerance. It is true that we are constantly hearing that there is a tendency to place new scientific doctrines in opposition to religious beliefs. But I would suggest that the cause of this is not that scientific men are irreligious, so much as that religious men are unscientific. It is utterly impossible, in these days, to oppose the most obvious facts, or persecute the great discoverers of the day, because the writers of the Old and New Testament, 1,800 or 3,000

years ago, knew little of astronomy, chemistry, and physics. Such, however, has been the unfortunate policy of the Church for many centuries. I need not remind you that the great Galileo died a prisoner of the Inquisition, and that Servetus was publicly burnt in Geneva, by the authority of Calvin. The true cause, unquestionably, of the present chasm in thought which divides the literary and religious from scientific men is, that the former have been bred up in ignorance of physiology, that is, of all that relates to their own bodily structure, functions, and requirements. Unfortunately, their education causes in them a want of appreciation and an incapacity of comprehending scientific truths. . . . . Clergymen and most religious teachers are totally insensible to the errors and discrepancies of language they use in the pulpit; so that, when the scientific man takes his place in church, he is surprised at the manifest ignorance of established truths constantly preached to the people."

The main object of the lecture was to insist upon the fact that physiology in some form or other should constitute a part of the education of every one. A Committee of the British Association for the Advancement of Science strongly recommended it in 1868; and wherever it has been tried it has been attended with marked success, especially in girls' schools, and to illustrate this point Mr. Bennett showed how, adding that "Perhaps women in all classes and degrees of society have more to do with the preservation and duration of human life even than men; and in all ranks of society should have physiology taught them. It should be an essential subject in their primary, secondary, and higher schools. So strong are my convictions on this subject, that I esteem it a special duty to lecture on physiology to women, and whenever I have done so, have found them most attentive and interested in the subject, possessing indeed a peculiar aptitude for the study, and an instinctive feeling—whether as servants or mistresses, wives or mothers—that that science contains for them, more than any other, the elements of real and useful knowledge. In advocating the propriety, therefore, of introducing physiology as an essential part of education to all classes of society, I would observe in the last place, that when you enter upon the duties of your profession, you will find too frequently that your best efforts are frustrated by parents, nurses, or attendants on the sick, who, not comprehending, are therefore incapable of carrying out your instructions. I have myself seen, only too frequently, the most melancholy deaths produced in families, and extreme wretchedness occasioned, from carelessness or ignorance of what ought to be done—arising entirely from an unacquaintance with the most common rules requisite for the preservation of life."

It is a strange rider to this to add, that the University here has just by its vote rendered the higher education of women in these subjects impossible for the present so far as Edinburgh is concerned, though it is fair to remark that the majority was so narrow that it is not too much to hope that ere long this decision, which is eminently to be regretted, will be reversed.

At the meeting of the General Committee on Wednesday, the reports of the Council, in which they gave an account of their stewardships for the past year, and the report of the Kew Committee, were read. It is not necessary to give either of these documents *in extenso*, but the following references to them may be useful. The connection between the Association and Kew Observatory is to cease, and the Government is to be informed of the Association's desire to see its direction and maintenance transferred to the Royal Society, who will administer the means placed at the disposal of science by the munificence of Mr. Gassiot. Dr. Hirst has resigned his office as joint general secretary, and Mr. Douglas Galton, C.B., F.R.S., has been elected to succeed him. Those who know Mr. Galton will heartily congratulate the Association on his willingness to undertake the duty. Prof. Van Beneden, Dr. Crafts, Dr. Anton Dohrn, Governor Gilpin, of Colorado, H.H. the Rajah of Kolapore, M. Plateau, and Prof. Tchebichef have been added to the list of corresponding members. The consideration of some revised regulations drawn up by the Council for regulating the proceedings of the several sections was postponed for a future meeting.

An important recommendation has been urged by the committees of the Biological and of the Geological sections, which is likely—if accepted by the Council—to increase much the scientific value and interest of the meetings of the Association. It has been recommended that, in addition to the various rooms provided for the meetings of the sections, sale of tickets, &c., a room be annually provided for the purposes of a temporary museum. It cannot be doubted that such a museum would be a great success. In the meetings of the British Medical Association and the Archæological Association similar museums are very important features of the proceedings. A good-sized room, provided with a number of glass-cases arranged on tables, such as are always to be hired in large towns, would constitute the machinery of the museum. One or two reliable members of the Association would have the management of it, and exclude undesirable or worthless objects, whilst whipping in all of special interest; members would bring new and rare geological specimens, zoological specimens, human crania, flint-weapons, physiological apparatus, chemical apparatus, and microscopes, which would all be arranged judiciously and ticketed. We have no hesitation in saying that such a museum, when once brought into working order, would be the greatest attraction of the meeting. The proposal was originated by Mr. Ray Lankester.

Thanks to the exertions of Dr. King, who urged strongly the formation of a separate section for Ethnology, the meeting of the Committee was not altogether dull, and this gentleman, who is a born Irishman, if not an Irishman born, fairly convulsed the Committee by his method of appeal. First he urged that there should be a separate section, because the Queen and Prince Consort "had come in their yacht to visit all the sections" at the Southampton Meeting. Next he complained that at Exeter the ethnologists "were put into a room which would not hold them," but the appeal was unavailing, Prof. Huxley's *quietus* came in due time, and the matter—and Dr. King—dropped.

The definite acknowledgment of Anthropology as a department of the Biological Section of the British Association, has led to the admission of a wide range of subjects in that department. "What is man?" is a question which cannot be answered by comparative anatomy alone. Dr. Tristram proposed in committee that Psychology be recognised as a distinct branch of Anthropology. This proposal was overruled by the declaration of the president, that man as a compound being could not be discussed apart from the psychological aspects of the question.

The Anthropological Department has, consequently, been flooded by papers of the most controversial tone on this side of the investigation of humanity. The most provocative papers on the subject were those of Mr. Staniland Wake, on Man and the Ape, and of Mr. Kaines, on the Anthropology of Comte. Both these papers are vigorously attacked on the Psychological side; the opponents of Positivism taking their stand on the contemptuous rejection of metaphysics by the writers. But the Positivist papers necessarily invoked the theological element, as they assumed at the outset that the whole metaphysical side of the question must be expunged, as being a question of which physicists were incompetent to judge. This led to as universal an affirmation of the tripartite nature of man, by various speakers, led by Mr. Boyd Dawkins, and the impossibility of admitting the premises of the writers on his origin until the origin of his spirit had been demonstrated to be material.

Among the topics of general conversation during the

first part of the meeting, have been the proposed dredging exploration, which it is understood will be undertaken by the Government, following the example set by the American, Swedish, and other nations, and the proposed Eclipse Expedition to Ceylon next December. The former announcement has been hailed with the liveliest satisfaction; and the Government is on all hands congratulated on its appreciation of the importance of this work. The feeling touching the Eclipse Expedition is of an entirely opposite character, as it has leaked out that this year, as last, affairs have been delayed and badly managed. After Messrs. Lockyer's and Janssen's papers on Friday, Sir William Thomson said he joined very warmly in what Mr. Lockyer and M. Janssen had urged. M. Janssen had asked that Britain should join France and Germany in this friendly struggle, and it would be a disgrace to England if it did not accept that challenge, and do its very best to beat both France and Germany in the struggle, adding that all the efforts of all the nations would not be too much for the importance of the work. The *Scotsman*, in a leading article on this subject, after urging an appeal to Government on the part of the British Association, writes as follows:-

"The Chancellor of the Exchequer, in fact, who is *de facto* the keeper of the nation's purse, is *de jure*, so far as science is concerned, the keeper of the nation's honour; and may the time be long distant when the honour of England shall be tarnished by her relinquishing those expeditions and scientific explorations to the precursors of which we all look back with so much pride. Surely, from this point of view, it should be a subject of regret to the leaders of science now among us that the progress of the nation's best interests should be liable to be thwarted by the jealousies and self-seeking of individuals, and we are glad to learn that the action of the British Association, which we are informed becomes necessary in consequence of some such cause as this, is likely to be carried forward with such vigour that Her Majesty's Government will willingly yield to the demands of science, while at the same time a salutary lesson will be read to those who attempt to make the progress of science—the national importance of which is thoroughly acknowledged here—subservient to their own selfish interests. We have been the more anxious to make these remarks, because we think the time has arrived when the general interests of science and truth demand that any effort, by whomsoever made, to retard the progress of knowledge, should be publicly met without respect of persons and without hesitation; and we may express a hope that the Parliament of Science, now assembled in this city, will counteract the efforts of an oligarchy in the same bold manner as the Parliament of the nation has recently done." In these remarks we cordially concur.

We may dismiss this subject by stating that an application for aid is to be sent off to the Government to-night.

The President's address, delivered in the evening in the Music Hall, was received with enthusiasm. The Emperor of Brazil, who seems to have come over to this country to show how easily our own rulers might further the progress of science if they chose, occupied a seat on the platform, which was as crowded by the general committee as the body of the Hall was by the ordinary members. Prof. Huxley, in resigning the presidential chair to Sir William Thomson, reminded his auditors of the achievements of the new president, which in this age of cultivation of science and in the pressing rivalry of able and accomplished men in all directions, entitled him to the appellation of an "intellectual giant," adding, as the poet says of Lancelot,—

Gentler knight
There never broke a lance.

On the morrow the sectional work began in real earnest, and has continued with but small interruptions ever since—the interruptions consisting in excursions on the Saturday, by which the geological, chemical, and botanical sections protested against that rule of the Council which attempts to discountenance such blandishments during the Association, forgetting, as it seems to us, the extreme value of local inquiries which it is impossible to carry out otherwise, as every moment is so fully occupied. Our notice of the sectional work may here be very brief, as we shall give in their proper places notices of all papers of importance or interest.

After the reading of the addresses, in Section A Dr. Carpenter made an interesting communication with reference to oceanic currents. Sir W Thomson and Prof. Stokes joining in the discussion, which was followed by a paper by M. Janssen on his balloon experiences. Among the papers submitted to the Chemical Section the most popular was perhaps one relating to the working of hæmatite ore. The Geological Section had some papers of local interest, as also a report on Scotch earthquakes. Of the zoological papers, a report from the Close-Time Committee, and a paper on the rarer raptorial birds of Scotland, gave rise to a discussion on the extirpation of indigenous animals. This was followed by an important paper on co-operation among natural history societies. The Anthropologists discussed such subjects as longevity, and the degeneration of race in Britain; the Geographers received notes of researches in various parts of the world; and among the subjects taken up in the Economic Science Section was that of the Merchant Company's schools.

On Friday the proceedings in Section A were opened by papers by Mr. Lockyer and M. Janssen on the recent and coming eclipses. The Chemical Section had, among other papers, a report on recent progress in chemistry in the United States. The geologists received a report on the exploration of Kent's Cavern, besides papers detailing the results of researches in various departments of the science. The Anthropologists discussed, among other subjects, that of ancient hieroglyphic structures. In the Biological Department, spontaneous generation formed the subject of a small discussion between Dr. Calvert and Dr. Bastian, and an important paper was communicated by Prof. Thistleton Dyer on mimicry in plants. The geographical programme included papers on the geography of Moab and the famous Moabite stone. In the Economic Section a lively discussion took place on the Merchant Company's Education Scheme, introduced by Mr. Boyd's paper of the preceding day.

On Saturday, Monday, and yesterday, the flow of papers still continued, the Anthropological Section soon becoming notorious for actual or probable rows, though nothing very serious took place. The questions of state aid to science, and obstacles to science teaching in schools, were discussed yesterday in Section A, and here our notice must stop.

To-day we have the final General Meeting, and as many of the recommendations which have been made during the meeting will be discussed there, it will be well to delay our notice of them till next week, merely remarking here that we never knew a larger number of valuable recommendations made for action or money grants. In the meeting of the General Committee on Monday, Bradford was fixed upon as the next place of meeting after Brighton, with Belfast in reserve for the year after. The appointment of Dr. Carpenter as next president was moved in a highly eulogistic speech by Prof. Huxley; the officers of the Association were re-elected with the exception of Dr. Hirst, who, as before stated, is succeeded by Mr. Douglas Galton; and the following Council was appointed for the ensuing year: Messrs. Bateman, Beddoe, Debus, Fitch, G. C. Foster, M. Foster, F. Galton, Gassiot, R.A.C., Godwin-Austen, Huggins, Gwyn-Jeffreys, Lockyer, Merrifield, Ramsay, Simon, Tyndall, Wallace, Williamson, Sir Stafford Northcote, Sir Charles Wheatstone, Colonel Strange, Colonel Sykes, and General Strachey.

The lectures and conversaziones have been great successes, the former we hope to be able to give at some length next week. We must not conclude this letter, written from Edinburgh—the den of the great "Red Lion" Forbes—without adding that the Red Lions dined together on Monday, Lion King Rankine occupying the chair.

The following papers were contributed to this section by unknown authors :—

TO THE CHIEF MUSICIAN ON NUBLA

A TYNDALLIC ODE. *Tune:* "THE BROOK"

I COME from fields of fractured ice,
Whose wounds are cured by squeezing,
They melt and cool, but in a trice
Grow warm again by freezing ;
Here in the frosty air the sprays,
With fern-like hoar frost bristle,
Their liquid stars, their watery rays,
Shoot through the solid crystal.

I come from empyrean fires,
From microscopic spaces,
Where molecules with fierce desires
Shiver in hot embraces ;
The atoms clash, the spectra flash,
Projected on the screen,
The double D, Magnesian b,
And Thallium's living green.

This crystal tube the electric ray
Shows optically clean,
No dust or cloud appear—but stay :
All has not yet been seen :
What gleams are these of heavenly blue,
What wondrous forms appearing ?
What fish of cloud can this be, through
The vacuous spaces steering ?

I light this sympathetic flame,
My slightest wish to answer,
I sing, it sweetly sings the same,
It dances with the dancer ;
I whistle, shout, and clap my hands,
I hammer on the platform,
The flame bows down to my commands
In this form and in that form.

THE BRITISH ASS

(*Sung by a Cub at the Red Lions' Feed, Edinburgh, August* 7, 1871)

*Air:* "THE BRITISH GRENADIERS"

SOME men go in for Science,
And some go in for Shams,
Some roar like hungry Lions,
And others bleat like Lambs ;
But there's a Beast that at this Feast
Demands a special glass,
So let us bray, that long we may
Admire the British Ass !
With a tow, row, row, &c, &c.

On England's fragrant clover
This Beast delights to browse,
But sometimes he's a rover
To Scotland's broomy knowes ;
For there he finds above all kinds
The Plant that doth surpass
The Thistle rude—the sweetest food
That feeds the British Ass !

We've read in ancient story
How a great Assyrian swell
Came down from all his glory
With hornèd beasts to dwell.
If you would know how it happened so,
That a King should feed on grass,
In Section D, Department B,
He had joined the British Ass !

On Grecian senses charming
Fell the music of the spheres,
But voices more alarming
Salute our longer ears.
A swell profound doth now propound
How life did come to pass,
From world to world the seeds were hurled,
Whence sprung the British Ass !

In our wandering through Creation
We meet these burning stones,
That bring for propagation
The germs of flesh and bones.
And is it not a thrilling thought
That a huge misguided mass
Will come some day to sweep away
Our dear old British Ass !

The child who knows his father
Has aye been reckoned wise,
But some of us would rather
Be saved that sweet surprise,
If it be true that when we view
A comely lad or lass,
We find the trace of the monkey's face
In the gaze of the British Ass !

## SECTION A.

THURSDAY, *Aug.* 3.—*Speculations on the Continuity of the Fluid State of Matter*, by Prof. James Thomson, of Belfast. The author proceeding from the researches of Dr. Andrews on the Continuity of the Liquid and Gaseous States of Matter, in which it has been discovered that there is gradual transition between the ordinary liquid and the ordinary gaseous states of the same matter by courses passing through temperatures and pressures above those at which boiling can take place, showed that there is probably also a theoretical continuity having a real and true significance directly across temperatures and pressures of boiling points. This he showed by supposing there to be conditions partly stable and practically attainable, and partly unstable, corresponding to curved reflex junctions of the curves shown by Dr. Andrews for the gaseous and liquid states,* where they are interrupted at the boiling breach of continuity. As these new views of Prof. Thomson form the subject of a paper submitted to the Royal Society and intended to appear in an early number of the Proceedings, we hope to give a fuller account of them in a future issue.—Prof. Thomson also drew the attention of the Section to the existence for each of the various substances, (water, or carbonic acid, for instance,) of a remarkable point of pressure and temperature, at which alone the substance can exist in three states, *solid*, *liquid*, and *gaseous*, together in contact with one another. This point of pressure and temperature he designates as *the triple point ;* and he shows how this point belongs to three important curves, as being their intersection. On this subject also we propose soon to give a fuller exposition of Prof. Thomson's views.

## SECTION B.

ON Thursday, after the address of the President, Dr. Andrews, which has already appeared in our columns, Mr. Dewar presented his *Report on Thermal Equivalents of the Oxides of Chlorine.* The results were merely preliminary, and exhibited in a remarkable manner the difficulties attending this class of investigations. Dr. Gladstone followed with a paper, which he had prepared in conjunction with Mr. Alfred Tribe, *On Some Experiments on Chemical Dynamics.* He commenced by referring to a paper recently communicated to the Royal Society, in which it was shown that in various decompositions of metallic solutions the chemical change, in a given time, is not in proportion to the amount of salt present, but that twice the quantity gives three times the chemical action, and also that while silver is deposited in copper, in the decomposition of nitrate of silver by copper an actual passage of the nitric element towards the copper plate occurs.

In the present paper, the authors exhibited this latter phenomenon in a dissected form, with other observations. A copper plate was immersed in copper nitrate, and a silver plate in silver nitrate ; while the two metals were connected by a wire, and the liquids by a porous cell. Silver deposited upon the silver plate, and the copper plate dissolved ; the sp. gr. of the copper nitrate increased from 1·015 to 1·047, and only a trace of this salt passed into the cell which originally contained silver nitrate. The passage of $SO_4$ ($SO_4$ $H_2$ ?) was also found to take place by an analogous experiment.

Similar experiments were made in which the nitrate of silver was kept constant, but the nitrate of copper was increased in equivalent multiples. It was found that the silver deposited increased with the increase in copper salt, being about double when the copper salt was seven times as strong, and that the effect of successive additions gradually diminished. This is in strict accordance with other experiments showing that when the copper plate is immersed in a mixture of the nitrate of copper and silver, the amount of silver deposited is increased, though in a diminishing ratio, by successive additions of copper salt. That this acceleration is not produced by a copper salt only was proved by repeating the experiments with various other nitrates. The tabulated results show that the increased effect does not de-

* The reader will find these curves engraved in NATURE for August 4, 1870, p. 279.

pend simply upon the nitric element, but likewise on the nature of the salt.

In the discussion which followed, some curious facts were elicited with respect to the action of sugar on metallic iron. It is well known that hitherto it has not been possible, on account of this action, to convey sugar in iron ships; but Dr. Calvert stated that he had discovered a very simple method, which entirely prevented the action, and he had no doubt that henceforward sugar would be as safely carried in iron ships as in wooden bottoms.

Mr. Thos. Ainsworth then read a paper *On Facts Developed by the working of Hæmatite Ores* in the Ulverstone and Whitehaven districts from 1844-1871. The communication was exceedingly well illustrated by diagrams and specimens; but the conclusions arrived at by Mr. Ainsworth were pretty generally combated.

On Friday the proceedings commenced with a paper by Prof. Wheeler, of Chicago, *On the Recent Progress of Chemistry in the United States*. Mr. Henry Deacon gave an account of his *Chlorine Process as applied to the Manufacture of Bleaching Powder on the larger Scale*. A note *On Regianic Acid*, a product derived from walnuts, was then communicated by Dr. Phipson. It was followed by a paper by Dr. Calvert *On the Estimation of Sulphur in Coal and Coke*. The sulphur found in coal or coke often exists in two states, partly as sulphuric acid combined with lime, and partly as sulphur combined with iron; it is only the latter combination which lessens the commercial value of the fuel. By boiling the powdered coal with a solution of carbonate of soda, the lime composed is decomposed, and by washing the sulphuric acid may be removed; in the residue is contained the sulphur, combined with iron, which is estimated by any of the methods familiar to chemists. Mr. E. C. C. Stanford next gave the results of *Some Preliminary Experiments on the Retention of Organic Nitrogen by Charcoal*; these he intends to prosecute still further, and to communicate his observations to the next meeting at Brighton. Mr. I. Smyth gave an account of *Some Improvements in Chlorimetry*. In his opinion the use of the milky solution of bleaching powder as employed in the usual methods of chlorimetry is unsatisfactory, and he accordingly recommends that the chloride of lime be decomposed by a solution of carbonate of soda and filtered from the precipitated carbonate of lime when the amount of available chlorine may be determined in the filtrate by any of the usual methods. Professor Delffs, of Hiedelberg, exhibited some splendid *Crystals of Sorbin*. This body was discovered nearly twenty years ago by Pelouze, but hitherto nobody has succeeded in preparing it from the source indicated by the distinguished French chemist. Dr. Delffs attributed the want of success to the fact that it was usual to combine the preparation of malic acid with that of sorbin, and he showed that it is only when the production of the former substance is dispensed with that sorbin is obtained. By strictly following the method given by Pelouze, Dr. Delffs obtained a large quantity of fine crystals of Sorbin, but on searching for malic acid in the residue, he found that not a trace was present. He attributes its absence to its combination with the radical of alcohol (the malic acid being contained in the alcoholic extract of the berries of *Sorbus Aucuparia*, the source of the body), whereby malate of ethyl is formed, while by assimulating two atoms of water is converted into sorbin. It would appear therefore that no sorbin is contained ready formed in the fruit of *Sorbus Aucuparia*.

Dr. Emerson Reynolds gave an account of his experiments *On the Action of Aldehyde on Sulpho- and Oxygen Ureas*, and exhibited a variety of preparations of these compounds.

Mr. W. Chandler Roberts, chemist of the Mint, read a short paper *On the Molecular Arrangement of the Alloy employed for the British Silver Coinage*. The paper proved that the homogeneous character of the alloy of silver and copper is destroyed by the cooling of the molten mass, the silver being concentrated in the centre.

Dr. Moffatt read a paper on *Ozonometry*, in which he stated that ozone test papers do not become permanently coloured in the neighbourhood of cesspools, and that the brown coloration when found is removed by the products of putrefaction. He also stated that light, the humidity of the atmosphere, and the direction of the wind, influence the colouring of the test paper, moisture with heat accelerating chemical action, while strong wind causes a great quantity of ozone to impinge upon the test paper in a given time. To counteract the effects of these, he recommended the test paper to be kept in a box. He next described a tube ozonometer which he had had in use, and gave results obtained by an aspirator ozonometer, and concluded by stating that the results obtained by the aspirator ozonometer were not satisfactory.

## SECTION C.

*On the Progress of the Geological Survey in Scotland*, by Prof. Geikie.

When the British Association last met in Scotland, I had the honour of bringing before this Section a report upon the progress of the Geological Survey, from the time of its commencement here in 1854 by Professor Ramsay, under the direction of the late Sir Henry De la Beche, up to the year 1867, under the supervision of the present Director, Sir Roderick Murchison. During the four years which have since elapsed, considerable advance has been made in the survey of the southern half of Scotland, and I propose now, with the sanction of Sir Roderick, to present to you a brief outline of what has been done, and of the present state of the Survey.

At the time of my previous report rather more than 3,000 square miles had been surveyed. Since then we have completed 2,700 square miles additional, making a total area of nearly 6,000 square miles. Of this area 3,175 square miles have been published on the one-inch scale, and three sheets, representing in all 632 square miles, are now in course of being engraved. The whole country is surveyed upon the Ordnance Maps on the scale of six inches to a mile, and from these field-maps the work is reduced to the one-inch scale, which is the scale adopted for the general Geological Map of the country. In addition to that general map, however, maps on the larger or six-inch are published of all mineral tracts. In this way five sheets of the six-inch maps have now been published, embracing the whole of the coal-fields of Fife, Haddingtonshire, and Edinburghshire, with a large portion of the coal-fields of Lanarkshire, Renfrewshire, Ayrshire, and Dumfriesshire.

The area over which the field-work of the Survey has extended lies between the mouths of the Firths of Tay, Forth, Clyde, and Solway, eastwards to the borders of Roxburghshire and the mouth of the Tweed. It includes the counties of Fife, Kinross, the Lothians, Lanark, Renfrew, Peebles, Ayr, Wigton, Kirkcudbright, Dumfries, and Selkirk, with parts of Stirling, Dumbarton, and Perth.

Of the geological formations examined, the Lower Silurian rocks of the southern uplands cover a considerable space upon the published maps. Until three years ago the mapping of these rocks continued to be most unsatisfactory, owing to the want of any continuous recognisable section from which the order of succession among the strata could be ascertained, and to the great scarcity of organic remains. Our more recent work among the Leadhills, however, has at last given us the means of unravelling, as we hope, the physical structure and stratigraphical relations of the uplands of the south of Scotland. The rocks there are capable of division into several well-marked groups of strata, characterised by distinct assemblages of fossils. We have a lower or Llandeilo series with a suite of graptolites, and forming probably an upper part of the Moffat group, and a higher or Caradoc set of beds, with a considerable assemblage of distinctive fossils. This higher group we believe to be on the same general horizon as the limestones of Wrae and Kilbucho in Peeblesshire.

The Lower Old Red Sandstone has now been mapped completely over the whole of its extent between Edinburgh and the south of Ayrshire. Fossils have only been met with at one locality in the latter county, where *Cephalaspis* occurs. The most characteristic feature of the formation is the enormous development of its interbedded volcanic rocks. Between Edinburgh and Lanarkshire, also, there occurs in this formation a local but violent unconformability, connected probably with some phase of the contemporaneous volcanic activity of the region.

Most of the detailed work of the Survey has lain upon Carboniferous rocks. In the lowest formations of this system, known as the Calciferous Sandstones, the Survey has now been able to trace a twofold division completely across the country, from sea to sea, viz. a lower group of red sandstones, and a higher group of white sandstones, green, grey, and dark shales, cement-stones, limestones, and occasional coal-seams. All these strata lie beneath the true Carboniferous Limestone. They are becoming daily more important from their containing in some places highly bituminous shales, from which paraffin oil can be made. The Carboniferous Limestone series, with its valuable coals and ironstones, has been mapped, and in great part published, for the eastern and south-western coal-fields, and this is also the case with the Coal-measures. Much addi-

tional information has been obtained regarding the development of volcanic action in central Scotland during the Carboniferous period.

The Permian basins of Ayrshire and Thornhill have been surveyed and in great part published. Much fresh light has in the course of this Survey been thrown on the interesting Permian volcanoes of the south-west of Scotland.

Attention has been continuously given to the superficial accumulations. These are now mapped in as great detail as the rocks underneath, and plans are being prepared with the view to an issue of maps of the surface geology.

By a recent order of the Director-General, each one-inch map is now accompanied at the time of its publication, or as soon thereafter as possible, with an explanatory pamphlet, in which the form of the ground, geological formations, fossils, rocks, faults, and economic minerals, are briefly described, and such further information given as seems necessary for the proper elucidation of the map. These pamphlets are sold at an uniform price of 3*d*. Detailed vertical sections are published for each coal-field. For the construction of these sections, records of boring operations are procured and recorded in the register-books of the Survey. Since 1867 more than 312,200 feet of such borings have in this way been entered in our books. Sheets of horizontal sections on a large scale are likewise issued to form, with the maps and explanations, a compendium of the geological structure of each large district.

Another feature of the work of the Survey is the collection of specimens of the rocks and fossils of each tract of country as it is surveyed. Since my previous report to this Section of the British Association, we have collected 1,011 specimens of rocks, and 7,500 fossils. These are named and exhibited, as far as the present accommodation will permit, in the Museum of Science and Art at Edinburgh.

The work of the Geological Survey is carried on, as I have said, under the guidance of its Director-General, Sir Roderick Murchison, a name which has long been a household word at the meetings of the British Association, and one to which I am sure you will permit me to make on this occasion more than a passing reference. While the Survey advances, as I have shown, steadily over the face of the country, unravelling piece by piece the complicated details of its geological structure, to Sir Roderick belongs the rare merit of having himself led the way, by sketching for us, boldly and clearly, the relations of the older rocks over more than half of the kingdom. Much must undoubtedly remain for future investigation, but his outline of the grand essential features of Highland geology will ever remain as a monument of his powers of close yet rapid observation and sagacious inference. At one time I had hoped that the Chair of this Section might be filled by him, and that we should be permitted to listen anew to his expositions of the rocks of his native country. There is no one among us who does not regret the absence of the familiar face and voice of the veteran of Siluria. We meet once more on Scottish ground, and for the first time we have not here with us the man who has laid a deeper, broader impress on Scottish geology than any other geologist either of past generations or of this. There is, however, on the present occasion, a special cause for regret. Only within the last few months he founded a Chair of Geology in the University within whose walls we are now assembled—the first and only chair of the kind in Scotland. It would have been a fitting and grateful duty on the part of the University to welcome one of its most distinguished benefactors. I am well aware, indeed, that this Section-room is no place for the obtrusion of personal sentiments; yet I would fain be allowed to add in conclusion an expression of my own deep regret at the recent illness and consequent absence of one to whom, over and above the admiration which we all feel for his life-long labours and his personal character, many years of friendly intercourse have bound me by the closest ties of affection.

## SECTION D.

### BIOLOGY

### Opening Address by the President, Professor Allen Thomson

In now opening the meetings of the Biological Section, it is my first duty to express my deep sense of the honour which has been conferred on me in appointing me to preside over its deliberations. I trust that my grateful acceptance of the office will not appear to be an assumption on my part of more than a partial connection with the very wide field of science included under the term Biology.

I would gladly have embraced the opportunity now afforded me of conforming to a custom which has of late become almost the rule with presidents of sections—viz., that of bringing under your review the more valuable discoveries with which our science has been enriched in recent times, were it not that the subjects which I might have been disposed to select would require an amount of detail in each which would necessarily limit greatly their number, and that any attempt to overtake the whole range of this wide-spread department of science would be equally presumptuous and futile on the part of one whose attention has been restricted mainly to one of its divisions. I am further embarrassed in the choice of topics for general remark by the circumstance that many of those upon which I might have ventured to address you have been most ably treated of by my predecessors, as for example, in the sectional addresses of Dr. Acland, Dr. Sharpey, Mr. Berkeley, Dr. Humphry, and Dr. Rolleston, as well as in the presidential addresses of Dr. Hooker and Prof. Huxley. I must content myself therefore with endeavouring to convey to you some of the ideas which arise in my mind in looking back from the present upon the state of Biological science at the time when, forty years since, the meetings of the British Association commenced—a period which I am tempted to particularise from its happening to coincide very nearly with that at which I began my career as a public teacher in one of the departments of biology in this city. In the few remarks which I shall make, it will be my object to show the prodigious advance which has taken place, not only in the knowledge of our subject as a whole, but also in the ascertained relation of its parts to each other, and in the place which biological knowledge has gained in the estimation of the educated part of the community, and the consequent increase in the freedom with which the search after truth is now asserted in this as in other departments of science. And first, in connection with the distribution of the various subjects which are included under this section, I may remark that the general title under which the whole Section D has met since 1866, viz., Biology, seems to be advantageous both from its convenience, and as tending to promote the great consolidation of our science, and a juster appreciation of the relation of its several parts. It may be that, looking merely to the derivation of the term, it is strictly more nearly synonymous with Physiology in the sense in which that word has been for a long time employed, and therefore designating the science of life, rather than the description of the living beings in which it is manifested. But until a better or more comprehensive term be found, we may accept that of Biology under the general definition of "the science of life and of living beings," or as comprehending the history of the whole range of organic nature—vegetable as well as animal. The propriety of the adoption of such a general term is further shown by a glance at the changes which the titles and distribution of the subordinate departments of this section have undergone during the period of the existence of the Association.

#### *History of the Section*

During the first four years of this period the Section met under the combined designation of Zoology and Botany, Physiology and Anatomy—words sufficiently clearly indicating the scope of its subjects of investigation. In the next ten years a connection with Medicine was recognised by the establishment of a sub-section or department of Medical Science, in which, however, scientific anatomy and physiology formed the most prominent topics, though not to the exclusion of more strictly medical and surgical, or professional, subjects. During the next decade, or from the year 1845 to 1854, we find along with Zoology and Botany a sub-section of Physiology, and in several years of the same time along with the latter a separate department of Ethnology. In the eleven years which extended from 1855 to 1865, the branch of Ethnology was associated with Geography in Section F. More recently, or since the arrangement which was commenced in 1866, the section Biology has included, with some slight variation, the whole of its subjects in three departments. Under one of these are brought all investigations in Anatomy and Physiology of a general kind, thus embracing the whole range of these sciences when without special application. A second of these departments has been occupied with the extensive subjects of Botany and Zoology; while the third has been devoted to the subject of Anthropology, in which all researches having a special reference to the structure and functions or life-history of man have been received and discussed. Such I understand to be the arrangement under which we shall meet on this occasion. At the conclusion of my re-

marks, therefore, the department of Anatomy and Physiology will remain with me in this room; while that of Zoology and Botany, on the one hand, and of Anthropology on the other, will adjourn to the apartments which have been provided for them respectively.

*Anthropology*

With regard to the position of Anthropology, as including Ethnology, and comprehending the whole natural history of man, there may be still some differences of opinion, according to the point of view from which its phenomena are regarded: as by some they may be viewed chiefly in relation to the bodily structure and functions of individuals or numbers of men; or as by others they may be considered more directly with reference to their national character and history, and the affinities of languages and customs; or by a third set of inquirers, as bearing more immediately upon the origin of man and his relation to animals. As the first and third of these sets of topics entirely belong to Biology, and as those parts of the second set which do not properly fall under that branch may with propriety find a place under Geography or Statistics, I feel inclined to adhere to the distinct recognition of a department of Anthropology, in its present form; and I think that the suitableness of this arrangement is apparent, from the nature and number of the appropriate reports and communications which have been received under the last distribution of the subjects.

*Condition of Biological Research*

The beneficial influence of the British Association in promoting biological research is shown by the fact that the number of the communications to the sections received annually has been nearly doubled in the course of the last twenty years, and this influence has doubtless been materially assisted by the contributions in money made by the Association in aid of various biological investigations; for it appears that out of the whole sum of nearly 34,500*l.* contributed by the Association to the promotion of scientific research, about 2,800*l.* has been devoted to biological purposes, to which it would be fair to add a part at least of the grants for Palæontological researches, many of which must be acknowledged to stand in close relation to Biology.

The enormous extent of knowledge and research in the various departments of Biology has become a serious impediment to its more complete study, and leads to the danger of confined views on the part of those whose attention, from necessity or taste, is too exclusively directed to the details of one department, or even, as often happens, to a subdivision of it. It would seem, indeed, as if our predecessors in the last generation possessed this superior advantage in the then existing narrow boundaries of knowledge, that it was possible for them to overtake the contemplation of a wider field, and to follow out researches in a greater number of the sciences. To such combinations of varied knowledge, united with their transcendent powers of sound generalisation and accurate observation, must be ascribed the wide-spread and enduring influence of the works of such men as Haller, Linnæus, and Cuvier, Von Baer, and Joannes Müller. There are doubtless brilliant instances in our own time of men endowed with similar powers; but the difficulty of bringing these powers into effectual operation in a wide range is now so great, that, while the amount of research in special biological subjects is enormous, it must be reserved for comparatively few to be the authors of great systems, or of enduring broad and general views which embrace the whole range of biological science. It is incumbent, therefore, on all those who are desirous of promoting the advance of biological knowledge, to combat the confined views which are apt to be engendered by the too great restriction of study to one department. However much subdivision of labour may now be necessary in the original investigation and elaboration of new facts in our science (and the necessity for such subdivision will necessarily increase as knowledge extends), there must be secured at first, by a wider study of the general principles and some of the details of collateral branches of knowledge, that power of justly comparing and correlating facts which will mature the judgment and exclude partial views. To refer only to one bright example; I may say that it can scarcely be doubted that it is the unequalled variety and extent of knowledge, combined with the faculty of bringing the most varied facts together in new combinations, which has enabled Mr. Darwin (whatever may be thought otherwise of his system) to give the greatest impulse which has been felt in our own times to the progress of biological views and thought; and it is most satisfactory to observe the effect which this influence is already producing on the scientific mind of this country, in opposing the tendency perceptible in recent times to the too restricted study of special departments of natural history. I need scarcely remind you that for the proper investigation and judgment of problems in physiology, a full knowledge of anatomy in general, and much of comparative anatomy, of histology and embryology, of organic chemistry and of physics, is indispensable as a preliminary to all successful physiological observation and experiment. The anatomist, again, who would profess to describe rationally and correctly the structure of the human body, must have acquired a knowledge of the principles of morphology derived from the study of comparative anatomy and development, and he must have mastered the intricacies of histological research. The comparative anatomist must be an accomplished embryologist in the whole range of the animal kingdom, or in any single division of it which he professes to cultivate. The zoologist and the botanist must equally found their descriptions and systematic distinctions on morphological, histological, and embryological data. And thus the whole of these departments of biological science are so interwoven and united that the scientific investigation of no one can now be regarded as altogether separate from that of the others. It has been the work of the last forty years to bring that intimate connection of the biological sciences more and more fully into prominent view, and to infuse its spirit into all scientific investigation. But while in all the departments of Biology prodigious advance has been made, there are two more especially which merit particular mention, as having almost taken their origin within the period I now refer to, as having made the most rapid progress in themselves, and as having influenced most powerfully and widely the progress of discovery, and the views of biologists in other departments — I mean histology and embryology.

*Histology*

I need scarcely remind those present that it was only within a few years before the foundation of the British Association that the suggestions of Lister in regard to the construction of achromatic lenses brought the compound microscope into such a state of improvement as caused it to be restored, as I might say, to the place which the more imperfect instrument had lost in the previous century. The result of this restoration became apparent in the foundation of a new era in the knowledge of the minute characters of textural structure, under the joint guidance of Robert Brown and Ehrenberg, with contributions from many other observers, so as at last to have entitled this branch of inquiry to its designation, by Prof. Huxley, of the "exhaustive investigation of structural elements." All who hear me are fully aware of the influence which, from 1839 onwards, the researches of Schwann and Schleiden exerted on the progress of Histology and the views of anatomists and physiologists as to the structure and development of the textures both of plants and animals, and the prodigious increase which followed in varied microscopic observations. It is not for me here even to allude to the steps of that rapid progress by which a new branch of anatomical science has been created; nor can I venture to enter upon any of the interesting questions presented by this department of microscopic anatomy; nor attempt to discuss any of those difficult problems possessing so much interest at the present moment, such as the nature of the organised cell, or the properties of protoplasm. I would only remark that it is now very generally admitted that the cell wall (as Schwann indeed himself pointed out) is not a constant constituent of the cell, nor a source of new production, though still capable of considerable structural change after the time of its first formation. The nucleus has also lost some of the importance attached to it by Schwann and his earlier followers, as an essential constituent of the cell, while the protoplasm of the cell remains in undisputed possession of the field as the more immediate seat of the phenomena of growth and organisation, and of the contractile property which forms so remarkable a feature of their substance. I cordially agree with much of what Prof. Huxley has written on this subject in 1853 and 1869. The term "physical basis of life" may perhaps be in some respect objectionable, but I look upon the recognition of protoplasm which he has enforced, as a most important step in the recent progress of histology; adopting this general term to indicate that part of the tissue of plants and animals which is the constant seat of the growing and moving phenomena; but not implying identity of nature and properties in all the variety of circumstance in which this substance may occur. To Haeckel the fuller history of protoplasm in its lowest forms is due. To Dr. Beale we owe the minutest investigation of the properties by the use of magnifying powers beyond any that had previously

been known, and the successful employment of reagents which appear to mark out its distinction from the other elements of the textures. I may remark, however, in passing, that I am inclined to regard contractile protoplasm, whether vegetable or animal, as in no instance entirely amorphous or homogeneous, but rather as always presenting some minute molecular structure which distinguishes it from parts of glassy clearness. Admitting that the form it assumes is not necessarily that of a regular cell, and may be various and irregular in a few exceptional instances, I am not on that account disposed to give up definite structure as one of the universal characteristics of organisation in living bodies. I would also suggest that the terms formative and nonformative, or some such other, would be preferable to those of "living and dead," employed by Dr. Beale, to distinguish the protoplasm from the cell-wall or its derivatives, as the latter terms are liable to introduce confusion.

*Embryology.*

To the discoveries in embryology and development I might have been tempted to refer more at large, as being those which have had, of all modern research, the greatest effect in extending and modifying biological views, but I am warned from entering upon a subject in which I might trepass too much on your patience. The merits of Wolff as the great first pioneer in the accurate observation of the phenomena of development were clearly pointed out by Prof. Huxley in his presidential address of last year. Under the influence of Döllinger's teaching, Pander, and afterwards Purkinge, Von Baer, and Rathke, established the foundations of the modern history of embryology. It was only in the year 1827 that the ovum of mammals was discovered by Von Baer; the segmentation of the yelk, first observed by Prevost and Dumas in the frog's ovum in 1824, was ascertained to be general in succeeding years, so that the whole of the interesting and important additions which have followed, and have made the history of embryological development a complete science, have been included within the eventful period of the life of this Association. I need not say how distinguished the Germans have been by their contributions to the history of animal development. The names of Valentin, R. Wagner, Bischoff, Reichert, Kölliker, and Remak are sufficient to indicate the most important of the earlier steps in recent progress, without attempting to enumerate a host of others who have assisted in the great work thus founded. I am aware that the mere name of development suggests to some ideas of a disturbing kind as being associated with the theory of evolution recently promulgated. To one accustomed during the whole of his career to trace the steps by which every living being, including man himself, passes from the condition of an almost imperceptible germ, through a long series of changes of form and structure into their perfect state, the name of development is suggestive rather of that which seems to be the common history of all living beings; and it is not wonderful therefore that such a one should regard with approval the more extended view which supposes a process of development to belong to the whole of nature. How far that principle may be carried, to what point the origin of man or any animal can by facts or reasoning be traced in the long unchronicled history of the world, and whether living beings may arise independently of parents or germs of previously existing organisms, or may spring from the direct combination of the elements of dead matter, are questions still to be solved, and upon which we may expect this section to guide the hesitating opinion of the time. I cannot better express the state of opinion in which I find myself in regard to the last of these problems than by quoting the words of Professor Huxley from his address of last year, p. lxxxiii.:—

"But though I cannot express this conviction of mine too strongly (viz., that the evidence of the most careful experiments is opposed to the occurrence of spontaneous generation), I must carefully guard myself against the supposition that I intend to suggest that no such thing as abiogenesis ever has taken place in the past, or ever will take place in the future. With organic chemistry, molecular physics, and physiology yet in their infancy, and every day making prodigious strides, I think it would be the height of presumption for any man to say that the conditions under which matter assumes the properties we call 'vital,' may not some day be artificially brought together. And again, if it were given me to look beyond the abyss of geologically recorded time, to the still more remote period when the earth was passing through physical and chemical conditions which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from not living matter." I will quote further a few wise words from the discourse to which many of you must have listened last evening with admiration. Sir William Thomson said—"The essence of science, as is well illustrated by astronomy and cosmical physics, consists in inferring antecedent conditions, and anticipating future evolutions, from phenomena which have actually come under observation. In biology, the difficulties of successfully acting up to this ideal are prodigious. Our code of biological law is an expression of our ignorance as well as of our knowledge." And again, "Search for spontaneous generation out of inorganic materials; let any one not satisfied with the purely negative testimony, of which we have now so much against it, throw himself into the inquiry. Such investigations as those of Pasteur, Pouchet, and Bastian are among the most interesting and momentous in the whole range of natural history; and their results, whether positive or negative, must richly reward the most careful and laborious experimenting."

*Organic Chemistry and Vital Force*

The consideration of the finest discoverable structures of the organised parts of living bodies is intimately bound up with that of their chemical composition and properties. The progress which has been made in organic chemistry belongs not only to the knowledge of the composition of the constituents of organised bodies, but also to the manner in which that composition is chemically viewed. Its peculiar feature, especially as related to biological investigation, consists in the results of the introduction of the synthetic method of research, which has enabled the chemist to imitate or to form artificially a greater and greater number of the organic compounds. In 1828 the first of these substances was formed by Wöhler, by a synthetic process, as cyanate of ammonia, or urea. But still, at that time, though a few no doubt entertained juster views, the opinion generally prevailed among chemists and physiologists that there was some great and fundamental difference in the chemical phenomena and laws of organic and inorganic nature. Now, however, this supposed barrier has been in a great measure broken down and removed, and chemists, with almost one accord, regard the laws of combination of the elements as essentially the same in both classes of bodies, whatever differences may exist in actual composition, or in the reactions of organic bodies in the more complex and often obscure conditions of vitality, as compared with the simpler, and, on the whole, better known phenomena of a chemical nature observed in the mineral kingdom. Thus, by the synthetic method, there have been formed among the simpler organic compounds a great number of alcohols, hydrocarbons, and fatty acids. But the most remarkable example of the synthetic formation of an organic compound is that of the alkaloid conia, as recently obtained by Hugo Schiff by certain reactions from butyric aldehyde, itself an artificial product. The substance so formed, and its compounds, possess all the properties of the natural conia—chemical, physical, and physiological—being equally poisonous with it. The colouring-matter of madder, or alizarine, is another organic compound which has been formed by artificial processes. It is true that the organised or containing solid, either of vegetable or animal bodies, has not as yet yielded to the ingenuity of chemical artifice; nor, indeed, is the actual composition of one of the most important of these, albumen and its allies, fully known. But as chemists have only recently begun to discover the track by which they may be led to the synthesis of organic compounds, it is warrantable to hope that ere long cellulose and lignine may be formed; and, great as the difficulties with regard to the albumenoid compounds may at present appear, the synthetic formation of these is by no means to be despaired of, but, on the contrary, may with confidence be expected to crown their efforts. From all recent research, therefore, it appears to result that the general nature of the properties belonging to the products of animal and vegetable life, can no longer be regarded as different from those of minerals, in so far at least as they are the subject of chemical and physical investigation. The union of elements and their separation, whether occurring in an animal, a vegetable, or a mineral body, must be looked upon as dependent on innate powers or properties belonging to the elements themselves; and the phenomena of change of composition of organic bodies occurring in the living state are not the less chemical because they are different from those observed in inorganic nature. All chemical actions are liable to vary according to the conditions in which they occur, and many instances might be adduced of most remarkable variations of this kind, observed in the chemistry of dead bodies from very slight changes of electrical, calorific, mechanical, and other conditions. But because the conditions of action or change are infinitely more complex and far

less known in living bodies, it is not nececsary to look upon the phenomena as essentially of a different kind, to have recourse to the hypothesis of vital affinities, and still less to shelter ourselves under the slim curtain of ignorance implied in the explanation of the most varied chemical changes by the influence of a vital principle.

*Zoology and Botany*

On the subjects of zoological and botanical classification and anthropology, it would be out of place for me now to make any observations at length. I will only remark, in regard to the first, that the period under review has witnessed a very great modification in the aspect in which the affinities of the bodies belonging to these two great kingdoms of nature are viewed by naturalists, and the principles on which groups of bodies of each are associated together in systematic classification; for, in the first place, the older view has been abandoned that the complication of structure rises in a continually increasing and continuous gradation from one kingdom to the other, or extends in one line, as it were, from group to group in either of the kingdoms separately. Evolution into a gradually increasing complexity of structure and function no doubt exists in both, so that types or general plans of formation must be acknowledged to pervade, presenting typical resemblances of construction of the deepest interest; but in the progress of morphological research, it has become more and more apparent that the different groups form radiations, which touch one another at certain points of greatest resemblance, rather than one continuous line, or a number of lines which partially pass each other. The simpler bodies of the two kingdoms of nature exhibit a gradually increasing resemblance to each other, until at last the differences between them wholly disappear, and we reach a point of contact of which the properties become almost indistinguishable, as in the remarkable Protista of Haeckel and others. I fully agree, however, with the view by Professor Wyville Thomson in his recent extraordinary lecture, that it is not necessary on this account to recognise an intermediate kingdom of nature. Each kingdom presents, as it were, a radiating expansion into groups for itself, so that the relations of the two kingdoms might be represented by the divergence of lines spreading in two different directions from a common point. Recent observations on the chorda dorsalis (or supposed notochord) of some Ascidians tend to revive the discussion at one time prevalent, but long in abeyance, as to the possibility of tracing a homology between the vertebrate and invertebrate animals; and, should this correspondence be confirmed and extended, it may be expected to modify greatly our present views of zoological affinities and classification. It will also be an additional proof of the importance of minute and embryological research in systematic determinations. The recognition of homological resemblance of animals, to which in this country the researches of Owen and Huxley have contributed so largely, form one of the most interesting subjects of contemplation in the study of comparative anatomy and zoology in our time; but I must refrain from touching on so seductive and difficult a subject.

*Natural Science in Schools*

There is another topic to which I can refer with pleasure as connected with the cultivation of biological knowledge in this country, and that is the introduction of instruction in natural science into the system of education of our schools. As to the feasibility of this in the primary schools, I believe most of those who are intimately acquainted with their management have expressed their decidedly favourable opinion—it being found that a portion of the time now allotted to the three great requisites of a primary education might with advantage be set apart, for the purpose of instructing the pupils in subjects of common interest, calculated to awaken in their minds a desire for knowledge of the various objects presented by the field of nature around them. As to the benefit which may result from this measure to the persons so instructed, it is scarcely necessary for me to say anything in this place. It is so obvious that any varied knowledge, however easily acquired or elementary, which tends to enlarge the range of observation and thought, must have some effect in removing its recipients from grosser influences, and may even supply information which may prove useful in social economy and in the occupations of labour. Nor need I point out how much more extended the advantages of such instruction may prove if introduced into the system of our secondary schools, and more freely combined than heretofore with the too exclusively literary and philosophical study which has so long prevailed in the approved British education. Without disparagement to those modes of study as in themselves necessary and useful, and excellent means of disciplining the mind to learning, I cannot but hold it as certain that the mind which is entirely without scientific cultivation is but half prepared for the common purposes of modern life, and is entirely unqualified for forming a judgment on some of the most difficult and yet most common and important questions of the day, affecting the interests of the whole community. I refer with pleasure to the published Essay of Dr. Lankester on this subject, and to the arguments addressed two days ago by Dr. Bennett to the medical graduates of the University, in favour of the establishment of physiology as a subject of general education in this country, with reference to sanitary conditions. It is gratifying, therefore, to perceive that the suggestions made some years ago in regard to this subject by the British Association, through its committee, have already borne good fruit, and that the attention of those who preside over education in this country, as well as of the public themselves, is more earnestly directed to the object of securing for the lowest as well as the highest classes of the community that wholesome combination of knowledge derived from education, which will duly cultivate all the faculties of the mind, and thus fit a greater and greater number for applying themselves with increased ability and knowledge to the purposes of their living and its improved condition. If the law of the Survival of the Fittest be applicable to the mental as well as to the physical improvement of our race (and who can doubt that in some measure it must be so), we are bound by motives of interest and duty to secure for all classes of the people that kind of education which will lead to the development of the highest and most varied mental power. And no one who has been observant of the recent progress of the useful arts, and its influence upon the moral, social, and political condition of our population, can doubt that that education must include instruction in the phenomena of external nature, including, more especially, the laws and conditions of life and health; and that it ought to be, at the same time, such as will adapt the mind to the ready acquisition and just comprehension of varied knowledge. It is obvious, too, that while this more immediately useful or beneficial effect on the common mind may be produced by the diffusion of natural knowledge among the people, biological science will share in the gain accruing to all branches of natural science, by the greater favour which will be accorded to its cultivators, and the increased freedom from prejudice with which their statements are received and considered by learned as well as by unscientific persons.

*Spiritualism*

I cannot conclude these observations without adverting to one aspect in which it might be thought that the appreciation of biological science has taken a retrograde rather than an advanced position. In this, I do not mean to refer to the special cultivators of Biology in its scientific acceptation, but to the fact that there appears to have taken place of late a considerable increase in the number of persons who believe, or who imagine that they believe, in the class of phenomena which are now called spiritual, but which have been known since the exhibitions of Mesmer, and, indeed, long before his time, under the most varied forms, as liable to occur in persons of an imaginative turn of mind and peculiar nervous susceptibility. It is still more to be regretted that many persons devote a large share of their time to the practice—for it does not deserve the name of study or investigation—of the alleged phenomena, and that a few men of acknowledged reputation in some departments of science have lent their names, and surrendered their judgment, to the countenance and attempted authentication of the foolish dreams of the practitioners of spiritualism, and similar chimerical hypotheses. The natural tendency to a belief in the marvellous is sufficient to explain the ready acceptance of such views by the ignorant; and it is not improbable that a higher species of similar credulity may frequently act with persons of greater cultivation, should their scientific information and training have been of a partial kind. It must be admitted, further, that extremely curious and rare, and to those who are not acquainted with nervous phenomena, apparently marvellous phenomena, present themselves in peculiar states of the nervous system—some of which states may be induced through the mind, and may be made more and more liable to recur, and are greatly exaggerated by frequent repetition. But making the fullest allowance for all these conditions, it is still surprising that persons, otherwise appearing to be within the bounds of sanity, should entertain a confirmed belief in the possibility of phenomena, which, while they are at variance with the best established

physical laws, have never been brought under proof by the evidences of the senses, and are opposed to the dictates of sound judgment. It is so far satisfactory in the interests of true biological science that no man of note can be named from the long list of thoroughly well-informed anatomists and physiologists, who has not treated the belief in the separate existence of powers of animal magnetism and spiritualism as wild speculations, devoid of all foundation in the carefully tested observation of facts. It has been the habit of the votaries of the systems to which I have referred to assert that scientific men have neglected or declined to investigate the phenomena with attention and candour; but nothing can be farther from the truth than this statement. Not to mention the admirable reports of the early French academicians, giving the account of the negative result of an examination of the earlier mesmeric phenomena by men in every way qualified to pronounce judgment on their nature, I am aware that from time to time men of eminence, and fully competent, by their knowledge of biological phenomena, and their skill and accuracy in conducting scientific investigation, have made the most patient and careful examination of the evidence placed before them by the professional believers and practitioners of so-called magnetic, phreno-magnetic, electro-biological, and spiritualistic phenomena; and the result has been uniformly the same in all cases, when they were permitted to secure conditions by which the reality of the phenomena, or the justice of their interpretation, could be tested—viz., either that the experiments signally failed to educe the results professed, or that the experimenters were detected in the most shameless and determined impostures. I have myself been fully convinced of this by repeated examinations. But were any guarantee required for the care, soundness, and efficiency of the judgment of men of science on these phenomena and views, I have only to mention, in the first place, the revered name of Faraday, and in the next that of my life-long friend Dr. Sharpey, whose ability and candour none will dispute, and who, I am happy to think, is here among us, ready, from his past experience of such exhibitions, to bear his testimony against all classes of *levitation*, or the like, which may be the last wonder of the day among the mesmeric or spiritual pseudo-physiologists. The phenomena to which I have at present referred are in great part dependent upon natural principles of the human mind, placed, as it would appear, in dangerous alliance with certain tendencies of the nervous system. They ought not to be worked upon without the greatest caution, and they can only be fully understood by the accomplished physiologist who is also conversant with healthy and morbid psychology. The experience of the last hundred years tends to show that while there are always to be found persons peculiarly liable to exhibit the phenomena in question, there will also exist a certain number of minds prone to adopt a belief in the marvellous and striking in preference to that which is easily understood and patent to the senses; but it may be confidently expected that the diffusion of a fuller and more accurate knowledge of vital phenomena among the non-scientific classes of the community may lead to a juster appreciation of the phenomena in question, and a reduction of the number among them who are believers in scientific impossibilities.

## SECTION E.

### GEOGRAPHY

OPENING ADDRESS BY THE PRESIDENT, COL. H. YULE, C.B.

THE first natural duty in circumstances like the present is to pay a tribute, however inadequate, to the memory of the eminent geographer whom we expected to fill this chair. The long list of his works has been rehearsed in so many of the notices that have honoured his memory, as well as in the address of the Vice-President of the Geographical Society, when presenting the medal which he had won by so many years of faithful labour in the cause of Geography, that I need not now repeat them. Indeed, when contemplating the catalogue of such an amount of work achieved, an amateur geographer like myself stands abashed; but feels at the same time that his own limited experience and desultory studies serve at least to furnish him with some just scale by which to estimate the vast labours involved in the accomplishment of such a life's work as Dr. Keith Johnston's.

I shall in this address attempt no general view of the geographical desiderata of the time, and of recent geographical progress in discovery and literature throughout the world. Living habitually far from new books and meetings of societies, I am not sufficient for these things, nor, if I were, could I easily vary from the comprehensive epitome of the year's geography, which but two months ago was issued, though, as we know with sorrow, not delivered, by him who has been so long the Dean of the Faculty of Geographers in Britain, and whose name is identified throughout the Continent with English geography. Sir Roderick Murchison has desired me to take occasion to express his deep regret at his inability to be present at this meeting. It is, he said, one of the most painfully-felt disappointments that his illness has occasioned. For he had looked forward with strong interest to taking part once more in a meeting of the Association at the chief city of his native country—with which city, I may remind you, he the other day bound his name and memory by strong and enduring ties in the foundation of a Chair of Geology in this University. Instead, then, of attempting a review which in my case would be crude, and therefore both dull and uninstructive, I propose to turn to one particular region of the old world with which my own studies have sometimes been concerned, and to say something of its characteristics, and of the progress of knowledge, as well as of present questions regarding it.

There are, however, one or two points on which I must first touch lightly. Of Livingstone, all that there is to tell has already been told to the world by Sir Roderick Murchison. We know the task that Livingstone had laid out for himself in dispersing the darkness that still hangs over some of the greatest features of Central African hydrography, by determining the ultimate course of the great body of drainage which he has followed northward from 12° south latitude—whether towards the Congo and the Atlantic, or towards Baker's Lake and so to the Nile; as well as the kindred question of the discharge of Lake Tanganyika; but of his progress in the solution of those questions we know nothing. I can but add that Sir Roderick himself has lost none of his confidence in the accomplishment of the task, and in the return of the great traveller at no distant period. That confidence of his has been so often before justified by the arrival of fresh news of Livingstone, however meagre, that we may well retain strong hope, even if it be not granted to all of us to rise from hope into confidence. We trust, then, that Livingstone will never have a place among the martyrs of geography.

One addition, however, has been made during the past year to that long list, in the name of the undaunted George Hayward, formerly a lieutenant in the 72nd Regiment, who had for some years resolutely devoted himself to geographical discovery. After having proved his powers in a journey to Yarkand and Kashghar, which obtained for him last year one of the medals of the Geographical Society, he had started again, with aid from that Society, to attempt an examination of the famous plateau of Pamir, hoping to succeed in crossing it, and to descend upon the Russian territory at Samarkand. In the Darkot Pass above Yassin, he was foully murdered by the emissaries of the chief of that district, Mir Wali by name. Public suspicion in India first turned upon the Maharajah of Kashmir, on whose alleged oppressions Hayward, in a private letter, had made severe remarks, which were rashly published by the editor of a local newspaper. The latest intelligence seems to exonerate the Maharajah, and to throw the guilt of complicity rather on the Mahomedan Chief of Chitral. If he be the guilty man, it may be difficult to punish him, so inaccessible is his position at present; for, to apply the old saw of the Campbells, "It is a far cry to Chitral." I may observe, however, that some sixteen or seventeen years ago, a similar murder took place on the persons of two poor French priests at the other extremity of India, and within the Thibetan boundary on the Upper Brahmapootra, and the apprehension of the criminal must have seemed almost as hopeless as in this case. Yet eventually he fell into the hands of our officers of the province of Assam, and paid the due penalty of his crime.

The geographical field on which, with your permission, I propose to expatiate for a little, is that of India beyond the Ganges. I mean in the largest sense of the expression, and inclusive, at least, in some points of view, of the Indian Islands. India, indeed, in old times was a somewhat vague term, or at least it had always a vague as well as an exacter interpretation. In the latter, it had the same application that we give it now when we speak with precision; it meant that vast semi-peninsular region roughly limited by the valleys of the Indus and the Ganges, which embraces many nations and many tongues and many climates, but yet all pervaded by a certain almost intangible character, which gives it a kind of unity recognised by all. In its vaguer sense, India meant simply the Far East. The traces of such use still survive in such expressions as the East Indies or the Indian Archipelago. Though this vague and large application of the name probably arose only from the vagueness of knowledge, it coincides roughly with a fact, and that is the extraordinary expansion of Hindoo

influence which can be traced in the vestiges of religion, manners, architecture, language, and nomenclature over nearly all the regions of the East to which the name has been applied. Another name has been applied to the continental part of this region—Indo-China. This, too, expresses the fact that on this area the influences of India and of China have interpenetrated. But the influence of China has, except on the eastern coast, been entirely political, and has not, like India, affected manners, arts, and religion.

The address concluded with a long and interesting account of the land trade which has been maintained for many centuries between Western China and the Valley of the Iriwadi.

## SECTION F.

### ECONOMIC SCIENCE AND STATISTICS

### OPENING ADDRESS BY THE PRESIDENT, LORD NEAVES

The greater part of this address deals with subjects beyond our scope; we may, however, make the following extracts:—

Economic science is sometimes spoken of as having a very modern date; but I think that this is an error. More or less the subject has entered into all the codes or systems of law that have been established from the earliest times. Alongside of political philosophy, which may be considered as peculiarly the science of government, great attention has always been bestowed upon matters which form an important part of political economy, or economic science—such as taxation, trade, commerce, wealth, and population. Those writers also who have presented us with ideal or imaginary states or Utopias are full of discussions and speculations of the same kind. The rival "Republics" of Plato and Aristotle afford abundant illustrations of this statement. It is peculiarly interesting to see this fact brought out so vividly in the admirable introduction to the "Republic" of Plato, prefixed to that treatise in Prof. Jowett's translation of that great philosopher; and if we had a similar translation and exposition of Aristotle's kindred work, which I think we might have from the hand of one of our own vice-presidents, to whom we owe so excellent an exposition of the "Ethics," we should see in a remarkable manner how many of the most interesting questions of the present day were considered and dealt with by those wonderful men according to the varying lights and tendencies which characterised their several minds. It is true that in more recent times a great advance has been made in economic science, and the chief feature and excellency of that change is the tendency to leave things as much as possible to their natural operation, and to the inherent laws of nature and society. It is to the credit of Scotland that she has produced the two greatest leaders in this altered movement—David Hume and Adam Smith—who are still high authorities on the whole subject, and whose principles have been made the basis of our recent legislation. The subject of Statistics is added to the title of this section as an auxiliary to the main subject of Economic Science.

The subjects to which statistics may be extended seem to be innumerable, and new ones are cropping up every day. In the pages of NATURE there lately appeared a letter of a somewhat curious kind, which may perhaps engage the attention of our fellow-associate member Mr. Tyler. The suggestion in that letter was that the degree of civilisation existing in any country is connected with the quantity of soap there consumed. The writer gave as a formula the equation of

$$x = \frac{S}{P}$$

$x$ being the amount of civilisation inquired for, S being the soap consumed, and P the population consuming it. So that the amount of civilisation depended on the proportion of S, the numerator, to P, the denominator. If S is large in proportion to P, then the civilisation is great, and *vice versâ*. How the civilisation of Scotland in the olden times would come out according to this test I shall not inquire; but if there is any truth in the proposition, it gives additional relevancy and interest to the question which is sometimes vulgarly put by some people to their friends as to how they are provided with that commodity. I have not yet seen any tables framed upon this principle, but I have no doubt that the Registrar-General will keep it in view. An inquiry of a more serious nature, and indeed peculiarly important and impressive, is connected with one of the most remarkable phenomena in human nature—I mean the occasional appearance in the world of men of great genius. From time to time men have arisen whose mental powers have far transcended the ordinary average of human intellect, and who have thereby been enabled, within the space of a single life, and by the effort of a single mind, to give an impulse to science and discovery which they could not have received through long generations of average mediocrity. Whether this singular boon and blessing to mankind can be traced to any law is a natural but mysterious inquiry. Some persons have considered the production of exceptional genius as quite an insulated fact; and Savage Landor declared that no great man had ever a great son, unless Philip and Alexander of Macedon constituted an exception. Mr. Galton, however, in his interesting work on "Hereditary Genius," has endeavoured to prove that genius runs in families, or, at least, that men of genius have generally sprung from a stock where great mental power is conspicuous; and he adheres to the view commonly taken as to the importance of the maternal character and influence in the formation of genius. I do not venture to give any opinion upon Mr. Galton's theory, but his book contains an important collection of facts bearing on the subject, and a great deal of very curious collateral speculation. Mr. Galton attributes great power in many ways to the principle of *heredity*, as it seems now to be called. He does not indeed go so far as the Irish statist, who, as mentioned by Sydney Smith, announced as a fact that *sterility was often hereditary;* but he states that comparative infertility is transmitted in families; and adduces as a remarkable example, a fact not generally known, if it be a fact, that in the case that frequently happens of Peers marrying heiresses, the family is apt to die out very soon, the heiress being naturally, in the general case, an only child, and bequeathing to her descendants a tendency to produce small families, who do not afford the usual chance of a numerous supply of descendants. Whatever may be said of some of his other opinions, I hesitate to concur with Mr. Galton in his proposition that as it is easy "to obtain by careful selection a breed of dogs or horses, gifted with peculiar powers of running, or of doing anything else, so it would be quite practicable to produce a highly-gifted race of men by judicious marriages during several consecutive generations." I doubt greatly the practicability of such a plan; and suspect there are some elements in human nature that would counteract it. Persons of proud family descent have often a horror of mesalliances; but I scarcely think it would be possible to inspire people of genius with the same *esprit de corps* or desire to wed with those on a par with them. Men of genius don't seem to me apt to fall in love with women as clever as themselves, and I rather suspect the tendency is to look for some difference of character, an instinct of which it is the object, or at least the result, to keep up the average of talent rather than to multiply the highest forms of mental power. At any rate we may here ask poor Polly's question, "Can love be controlled by advice?" and however we may in other respects agree with Horace's maxim, "Fortes creantur fortibus et bonis," I question whether a high mental stature could be maintained by coupling male and female genius together, or whether the experiment might not fail as signally as it is said sometimes to have done with Frederick William's attempts to breed Grenadiers. I strenuously advise, however, that a marriage with a fool of either sex should be always considered as a mesalliance, and I would particularly warn the ladies against such a step, taken, sometimes it is said, in the hope that their sway may in that way be more easily maintained. A fool is as difficult to be governed as a mule, and the couplet, I believe, is strictly true, that says—

Wise men alone, who long for quiet lives,
Wise men alone are governed by their wives.

## SCIENTIFIC INTELLIGENCE FROM AMERICA *

THE geological expedition under Prof. Hayden, at last advices, had reached Fort Hall, in Utah, on June 21, after a march from Ogden, during which much of interest was obtained by the party. The heat was very great, reaching from 95° to 105° in the shade during the day, with a difference of 25° to 35° between the wet and dry bulb thermometers. The party expected to pass Fort Ellis by the middle of July, on its way to the basin of the Yellow Stone Lake, where it will probably spend the greater part of the season. Mr. Thomas Moran, of Philadelphia, and Mr. Bierstadt, were to join the expedition before long for the purpose of making sketches for paintings.—In the August number of the *American Journal of Science*, will be found a con-

* Contributed by the Editor of *Harper's Weekly*.

tinuation of the important communications by Prof. Marsh, of Yale College, in regard to the results of his expedition to the Rocky Mountains during the past year. In addition to a number of new fossil mammals allied to the woodchuck, the gopher, the squirrel, the dog, and the fox, he presents a notice of sundry new species of birds from the Tertiaries of the West. Among these is an extinct species of eagle of large size, a turkey, and an owl.—In the search for new regions of exploration and discovery, it is not a little surprising to be assured that, taking the West Indies as a group, we know almost as little of their natural history as we do of that of Central Africa, especially of the islands east and south of the Greater Antilles. Thanks to the labours of Dr. Gundlach, and Prof. Poey in Cuba, of Dr. Bryant in the Bahamas, of Mr. March and Mr. Gosse in Jamaica, of Mr. A. E. Younglove in Hayti, of Dr. Bryant, Mr. Swift, and Mr. Latimer in Porto Rico, of Mr. Swift in St. Thomas, of Mr. Galody in Antigua, of Mr. Julien in Sombrero, and of Mr. Newton in Santa Cruz, we have a fair knowledge of the birds of the islands mentioned; but of Anguilla, St. Martin, Barbuda, Nevis, Montserrat, and Grenada we know nothing; and of St. Bartholomew, St. John, Saba, and Barbadoes, next to nothing. Dominica, Martinique, and Guadaloupe have been more or less explored by English and French naturalists, although with no very complete result. We are glad to see that the Zoological Society of London is printing a paper by Dr. Sclater upon a collection of the birds of Santa Lucia, sent to the Society by Mr. De Voeux, in which twenty-five species are enumerated, and among them three entirely peculiar to the island, one of them, a species of oriole, being hitherto undescribed. To such of our readers as have a spirit of enterprise, and are desirous of visiting a region which is sure to reward them with rich and undescribed treasures in natural history, we earnestly recommend the smaller West India islands, to which a trip can be made, especially in the winter season, with little or no risk to life or health, and with ample promise of satisfactory results.—We have before us the annual report of the trustees of the Museum of Comparative Zoology in Cambridge, for the year 1870, containing interesting communications from Prof. Agassiz, as the director, and his corps of able assistants. We are glad to learn that the temporary indisposition of the director (now happily past) has not crippled the efficiency of the establishment, and that so much progress has been made in arranging the immense stock of specimens that has been gathered within the walls of the museum from all quarters of the globe. The addition of a number of trained European naturalists, as Dr. Steindachner, Dr. Maack, Dr. Hagen, &c., has given great strength to the scientific corps, and has enabled Prof. Agassiz to do much toward realising the magnificent plan that he has proposed, for the permanent arrangement and utilisation of the collection.—We have referred, in a previous article upon American explorations into the fauna of the deep seas, to the proposed work, during the current season, of Mr. J. F. Whiteaves, the accomplished secretary and curator of the Natural History Society of Montreal; and we now give a more detailed account of his expected movements. This gentleman has been in America for several years, bringing with him an excellent record as a zoological investigator. Soon after his arrival in this country, he associated himself with the Montreal Society of Natural History, and has since that time been working sedulously in its interest. In 1867 he spent a fortnight in Gaspé Bay, where he prosecuted an extended system of dredging, and revisited the same region in 1869, extending his labours to the Gulf, between Cape Rozier lighthouse and Shiphead. Large numbers of marine invertebrates were collected by him, among them two species of shell new to America; but no dredging was prosecuted at a greater depth than sixty fathoms. The object of his expedition of the present year is to carry on work in deeper water, and for this purpose he expected to start in the schooner *La Canadienne* on the 5th of July, to cruise along the north shores of the Gulf as far as Anticosti, or beyond. He goes prepared to prosecute his labours in the deep sea (two to three hundred fathoms) on each side of that island; and from his experience in such researches, and the information derived from the later American and English deep-sea explorations, we have reason to hope for many important discoveries.—The cultivation of the natural and physical sciences has not been prosecuted with much success, as far as the announcement of new facts is concerned, by the Spanish-American races of the New World, although in nearly every State there is a society devoted more or less to such objects. Of late years, however, an increasing degree of vitality has manifested itself in these organisations, and there is reason to believe that in time they may be of considerable value. The most prominent institutions of the kind at present are in Mexico, namely, the Geographical and Statistical Society and the Society of Natural History; both of them publishing Transactions which embody much information in their pages. The Royal Economical Society of Havana has published a bulletin of its proceedings, although devoted more to historical than scientific subjects. The most active society in Havana, however, is the "Royal Academy of Medical and Physical and Natural Sciences." Of this Dr. Gutiërrez is President; Don Francisco de Sauvalle, Vice-President; Dr. Antonio Mestre, Secretary-General; Don José F. de Castro, Corresponding Secretary; Dr. Felipe Rodriguez, Assistant-Secretary; Dr. Ramon L. Miranda, Treasurer; and Dr. Juan Calixto Oxamend, Librarian—all holding their offices until 1873. Institutions in Brazil, Buenos Ayres, and Chili also exhibit a commendable degree of activity.

Prof. C. F. Hartt, of Cornell University, has lately issued a circular announcing his intention of starting on a fourth expedition of scientific research to Brazil. This gentleman has been long and favourably known for his efforts in regard to the exploration of that portion of South America, having made his first journey in 1865 as one of the *attachés* of the Thayer expedition under Prof. Agassiz. In 1867 he made a second journey alone to the Brazilian coast, taking Bahia as his centre, and covering an extensive area around that point, including a trip to the Abrolhos Islands. These two expeditions included a large part of the coast from Rio to Pernambuco, a district of about one thousand miles. A third visit was made in 1870 to the valley of the Amazon, to clear up certain points at issue between himself and Prof. Agassiz in regard to the geology of that country. The funds for this expedition were furnished in part by a friend of science, whose name he is not permitted to give, with a contribution by Colonel Edward Morgan of one thousand dollars, and by Prof. Goldwin Smith of five hundred, besides small sums from other parties. Assistance was rendered by the Brazilian authorities in furnishing a small steamer with a suitable amount of coal. The collections made on this expedition were very extensive, and embraced objects of all kinds, including ethnology and anthropology. The fourth expedition, now contemplated, is intended to complete the survey of the eastern part of the Amazonian Valley, especially in its zoological relationships, and further to investigate the Indian mounds of Marajo, and to collect data in reference to the languages of the people of the country. The sum estimated as necessary for this expedition is four thousand dollars, of which five hundred have already been contributed by Harvard University; and we trust that the friends of science who may have the means at their command will not fail to respond to the appeal of Prof. Hartt by furnishing pecuniary assistance, either without conditions or with the understanding that a certain portion of the collection is to be supplied to the contributors in return. It is understood that Messrs. Osgood and Co., of Boston, have engaged a series of articles upon the expedition, to be published in *Every Saturday*, and afterwards to be collected in book form.

The Hydrographic Office of the Bureau of Navigation of the United States has lately published a monogram upon the Marshall group of islands in the North Pacific. This group consists of two chains of islands, lying nearly parallel with each other, and running north-west and south-west from lat. 11° 50′ N. to 4° 30′ N., and from long. 167° E. to 173° E., covering an area of over 350 by 400 miles in extent, and very little known to navigators, the information hitherto on record being considered very unreliable. The eastern chain is known as the Radack, and the western as the Ralick, each numbering from fifteen to eighteen groups of low coralline islands, the greater number of which are fully formed atolls—that is lagoons of greater or less extent—with deep water and anchorages, surrounded by a chain of reefs, connecting islands, with one or more passages through the reefs into the lagoons, most of which are navigable for large vessels, besides which there are numerous boat passages. The earliest discovery of this archipelago is said to have been by Laévédra, in 1529; and the next visit made to them was by Anson, in 1742. Since then the islands have been touched at by different navigators at various times, although until the appearance of the report just referred to but little definite information had been brought together of the archipelago as a group. A missionary establishment was started on one of these islands in 1857, which continues to be successful to the present time. The inhabitants numbered, at the latest accounts, 10,000. They are expert navigators, and perform journeys throughout the group. They are dark, with straight hair, and are said to be intelligent and hospitable.—Mr.

Alphonse L. Pinart, the French naturalist, who is engaged in a scientific exploration of Alaska, announces his arrival at Unalaska on May 24, and his intended departure at an early day for Nusgajak. We hope to lay before our readers, from time to time, the important features of the progress of this expedition.—A correspondent of the *Weekly* writes to report the occurrence of a lunar rainbow at his residence, Oxford Depôt, New York, on the 2nd July last. At nine o'clock in the evening of that day a heavy rain-storm came up from the west, and when the sky was about half obscured a very distinct and beautiful rainbow made its appearance, having an arc estimated at 90°. The top of the bow was a deep blue, the lower side red; and between the two colours appeared a distinct hazy green. The moon was just rising at the time, and the perfect bow was visible for about five minutes, and partially distinguishable for a quarter of an hour.

## SOCIETIES AND ACADEMIES

### PARIS

Academie des Sciences, July 24.—No elections took place, but the members were rather numerous, as a secret committee is to take place at the close of the public sitting to discuss the merits of candidates. The secret committee was rather long, and a lively conversation took place. M. Lacaze-Duthiers was presented at the head of the list. After him came M. Gervais, and on the third line MM. Dareste and Alphonse Milne-Edwards. Each of these four gentlemen has respectable qualifications. M. A. Milne-Edwards is the son of M. Milne-Edwards, the great naturalist, who is chief of the section where the vacancy is to be filled up. —In the public sitting, M. Chasles gave a new series of theorems, which are to be demonstrated; but as they belong to a certain family of properties, and arranged *seriatim*, the very enunciation of them is more than half of the work to be done. These theorems are sixty in number, and are styled "Properties of geometrical curves relating to their harmonic axes," but none of them are of primary importance.—An observation was sent to M. Leverrier with respect to the great bolide of the 18th July, which was seen at La Guerche (Cher). Its course was from $\epsilon$ Cygni to $\alpha$ Pegasi. No track but a great quantity of light, first white and afterwards red; local time 11h. 5m., duration 3″. —Details were given by M. Sainte-Claire Deville of a bolide seen on the night of 17th and 18th March. A bolide was seen also in Italy by P. Denza at Moncalieri, but the accounts do not agree. It is supposed that P. Denza saw another bolide, which is not much to be wondered at, as the 18th of March is considered to be favourable for the appearance of large meteors, and P. Denza says he saw many of them on that very night when there was no moon.—P. Secchi sends a new letter "On solar protuberances and the relations between faculæ and spots; the communication cannot be condensed.—M. Delaunay presented a new volume of the "Annales de l'Observatoire National," the twenty-third of the collection, and full of observations. — The Academy appointed a committee for the Bordin prize, which will be given for the best memoir on the Comparison of the Natural Productions of South Africa, South America, and South Australia, as well as intermediate lands. The programme was very cleverly drawn up, and answers most admirably to the controversies on the "Origin of Species." The election was contested, and MM. Milne-Edwards, Brongniart, Elie de Beaumont, Quatrefages, and Decaisnes, were appointed. The report will be written with great care.— An invitation was addressed to the Academy by the International Congress, which will meet at Antwerp on the 22nd August; no formal answer is given to it.—M. Berthelot, who for some time had not published any report in the *Comptes Rendus*, attempted to give a very clever explanation of the immense explosive force of some organised compounds derived from nitric acid. He says that there is an intimate union between nitric acid and the organic matter upon which the acid has acted. But the action takes place with scarcely any heat being produced. The heat is kept in reserve within the molecules of the explosive body for future action. His theoretic views are supported by calorimetrical experiments. Thus an equivalent of nitric acid being employed in the manufacture of nitro-benzine, gives only 4,300 calorics, and in the fabrication of nitric ether 6,000 calorics. Nitric ether being inexplosible, the greater explosibility of nitro-benzine can be explained by the 1,700 calorics.—M. Milne Edwards presented, in the name of M. Joly, a paper on a transformation which *Palingeura virgo* undergoes before its final metamorphosis. These intermediate and imperfect metamorphoses are less scarce and exceptional than was supposed— M. Ledillat, who is a very learned Arabic scholar, as well as a very good astronomer, sent a paper to support his previous assumption relative to the immense number of Arabic words which are to be found in the French language. His views will be supported by every Frenchman acquainted with the Arabic language, and there are a good many owing to the occupation of Algiers, and all these Arabic etymologies were omitted systematically by M. Littré in his great Etymological Dictionary.— An electro-magnetic machine on a new plan for exciting continuous currents was exhibited on the 17th by M. Gramme, who was highly praised by M. Jamin. M. Bazin raised a claim for the priority of the invention, and a paper placed by him in the hands of the perpetual secretary in the sitting of the 10th July was opened. The description given by him is similar. But the construction of M. Gramme's machine was certainly in full operation by that time.—We learn with much concern that M. Saigey, a very clever philosopher and mathematician, who had contributed many very valuable papers to the *Comptes rendus*, and to several scientific periodicals, and who was the author of many interesting books on scientific matters, died from actual want during the Communist insurrection. He was found dead in his room on the 19th of May, after having been left unassisted during more than three days. M. Saigey was a genuine free thinker and a Republican by heart. He was expelled from the Normal School when twenty-four years old, under the Bourbons, in consequence of his liberal opinions. He remained true to his colours during his whole life, had never a single appointment from the State, and died of starvation when seventy-four years old.

July 31.—M. Faye in the chair.—M. Lacazes-Duthiers was elected a member by a large majority to fill the room of M. Longet. The new academician is a very accurate observer, who inaugurated his scientific career by discovering the extraordinary reproductive system of corals by the inspection of corals living on the Algerine sea coasts. Every year he has spent his summers at some sea-side station in order to enlarge his knowledge of inferior organisms. He will be a very useful member.—The election for a free member will take place on August 7. M. Belgrand, a meteorologist and an engineer, will very likely be returned. Some opposition is expected, although according to every probability it will not be successful.—A letter from M. Janssen was read with respect to the observation of the next total eclipse, but the discussion was postponed till after the next meeting of the Section of Astronomy, which intends to propose an expedition.

## BOOKS RECEIVED

ENGLISH.—Handbook of British Fungi, 2 vols.: M. C Cooke (Macmillan and Co.). - Sir Isaac Newton's Principia, edited by Sir W. Thomson and H. Blackburn (Glasgow: J. Maclehose).—A Digest of Facts relating to the Treatment and Utilisation of Sewage, 2nd edition. W. H. Corfield (Macmillan and Co.).—The Estuary of the Firth and Adjoining Districts Viewed Geologically: D. M. Home (Edinburgh: Edmonston and Douglas).

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