THURSDAY, JUNE 25, 1896.

CLOSELY ALLIED "SPECIES."

Monographie der Gattung Euphrasia. Von Dr. R. von Wettstein. 4to. Pp. 316. With 14 plates and 4 maps. (Leipzig: Wilhelm Engelmann, 1896.)

EUPHRASIA is one of those genera exhibiting a very limited range of variation, as compared with *Ranunculus*, *Senecio*, *Solanum* or *Euphorbia*; yet abounding in closely allied forms, concerning the rank of which there is great diversity of opinion amongst botanists. Bentham and Hooker in their various works, including a monograph of the genus by the former, estimate the number of species at about a score, whilst the author of the monograph under consideration defines nearly a hundred. Whatever our opinion may be respecting the utility of this extreme subdivision, most of us will agree that a profound study of the manner and extent of this limited kind of variation should furnish some interesting results. Moreover the genus *Euphrasia* is admirably suited for this purpose, because it is possible to have the entire plant in all cases.

First, with regard to the utility or convenience of naming such closely allied forms, whether they be ranked as species or varieties. Names are given, of course, as a means to an end. The botanist names his species and the florist his varieties, and there seems no reason why a specialist should not carry his naming as far as his studies lead him. Few may care to attempt to follow him, and he may be impossible to follow, as some of the hieraciologists of the present day are; but no harm is done, no confusion arises. The generally-accepted application of the name *Euphrasia officinalis* is not destroyed by giving names to the various forms it presents. But when the author claims for them that they are "good species," because they are constant under cultivation, or because they have a wide range, or for some other reason we reach a debatable point.

Euphrasia is a genus of small, slender annual and perennial herbs, parasitic on the roots of other plants, chiefly on grasses and sedges, according to Wettstein and other investigators. Bentham divided the species into three sections, which are practically adopted by Wettstein; and these sections inhabit as many widely separated geographical areas. First there is the *officinalis* group, which is confined to the northern hemisphere. Then there is a group restricted to Australia and New Zealand, with the exception of a single species inhabiting Mount Kinabalu, in North Borneo. The third group inhabits western South America, from about 15° S. lat. to Cape Horn. The Bornean species, and another in the Andes of Peru, are the only ones found within the tropics. The total absence of the genus in Africa, the African islands, the mountains of South India and Malaya, with the one exception noted, is a remarkable fact, especially as the genus reaches the north shores of the Mediterranean from end to end, and the Azores, where there is a very distinct endemic species. In eastern North America the genus extends as far south as the north shores of the lakes; it is absent from the centre, and its southern limit in the west is the northern part of the Rocky Mountains. But by some mischance Dr. Wettstein has located the White Mountains of New Hampshire somewhere in Utah! At least he gives the White Mountains as the locality of the species in the text, whilst on his map it occupies the isolated position indicated.

The geography is weak in other places, more especially in the arrangement of the localities in Central Asia. Indeed the author has by no means made the most of the geographical aspects of the question. He has one map showing the general distribution of the genus, and three others showing the areas of the principal northern species; but the explanatory text is altogether insufficient, considering the small scale of the maps. It is interesting to note that many of these critical species have a wide area, and few are really very local. *E. stricta* has two pages of synonyms and seven pages of localities, from which it would appear that the author has examined some thousands of specimens. *E. rostkoviana*, a very common and widely-spread species in Europe, has also been found in Canada, whither it may possibly have been taken with grass-seed.

Without sharing the author's views on species, concerning which he is very confident, I would strongly recommend his monograph for study. It has been considered worthy of a De Candollean prize.

W. BOTTING HEMSLEY.

THE AUTOBIOGRAPHY OF PROFESSOR W. C. WILLIAMSON.

The Reminiscences of a Yorkshire Naturalist. By the late William Crawford Williamson, LL.D., F.R.S. Edited by his Wife. Pp. xii + 228. (London: George Redway, 1896.)

IN the "Reminiscences of a Yorkshire Naturalist," Prof. Williamson has left an autobiographical sketch, containing much that is of general scientific interest, and many delightful records of his own personal history. This simple story of a student's life, which Mrs. Williamson has done wisely to publish in its original form, takes us back to a period which, to the present generation of students, suggests the dawn of modern science.

These reminiscences link, in a picturesque and striking manner, the past with the present. In speaking of his boyhood spent by the Scarborough cliffs, Williamson describes how he examined, with a pocket-lens, the little cups at the tips of *Polytrichum* stems, and wondered whether the reproductive organs, which so many botanists were in search of, were enclosed within these cups. His graphic description of the Father of English geology, recalls the infancy of geological science. As a boy he remembered William Smith, with "the drab knee-breeches and grey worsted stockings, the deep waistcoat with its pockets well furnished with snuff, . . . and the dark coat with its rounded outline and somewhat quakerish cut." It was during his apprenticeship to Mr. Weddell, a Scarborough medical practitioner, that he first contributed to palæo-botanical literature; many of the plates in Lindley and Hutton's "Fossil Flora" were drawn by the young

naturalist at one end of his master's kitchen table, "whilst the housekeeper was occupied at the other end with the several processes of providing the day's dinner." At the age of seventeen, Williamson wrote an important memoir on a tumulus near Gristhorpe Bay, which called forth a letter from Prof. Buckland praising the article, and prophesying that the author's name would "figure in the annals of British science." Passing from these early days of youthful enthusiasm and the pursuit of natural history in all its branches, and over many years of activity in zoological and medical work, we come to the latter part of Williamson's career. The memoirs on the Coal-measure plants, published in the *Philosophical Transactions*, between the years 1870 and 1893, furnish a splendid record of original work, which will always rank among the most important additions to botanical knowledge during the later decades of the present century. It would be difficult to find a more striking illustration of the continuance of vigorous industry, and the power of adaptability to modern methods, than is afforded by the palæobotanical writings of a man whose early days were spent before modern science began.

Did space permit, one might quote numerous passages in which recollections are given of the "sober-minded quaker John Dalton," and of the first meeting with Joule, "a young and extremely unassuming man." The autobiography gives us an epitome of the advance of scientific thought during the present century, with the added charm and freshness of a personal history of the almost ideal scientific career of a genuine naturalist. "Writing these reminiscences of his life's work, was one of the pleasures of Dr. Williamson's later years"; and we are grateful to Mrs. Williamson for giving us the opportunity of sharing the enjoyment of so fascinating a retrospect.

It is a matter of regret that Dr. Williamson's name does not appear in the title of the book; it would have afforded a better index to the interesting contents.

A. C. S.

OUR BOOK SHELF.

Die Protrophie, eine neue lebensgemeinschaft in ihren auffälligsten erscheinungen. Von Arthur Minks. (Berlin: Friedländer and Sohn, 1896.)

DR. MINKS is already well known as the author of several treatises on the biology and morphology of Lichens, in each of which the ideas set forth are quite original, and at the same time directly opposed to modern views regarding the structure presented by this group of plants. The present contribution must be considered as part iii. of "Contributions to a knowledge of the structure and life of Lichens," of which the previous parts appeared in an Austrian scientific publication (*K. K. zool.-bot. Gesell. zu Wien*). The present, preceded by a digest of the leading ideas embodied (*Oester. Bot. Zeitschr.*, 1896, p. 50) appears as an independent publication. The previous parts contain, amongst other new views, the ptatement that many species considered as valid by slichenologists, are the outcome of parasitism between two or more originally distinct species, the product being a pseudo-species, differing in structure and general appearance from the species concerned in its production. In the book under consideration, the contents of which could not be understood without a knowledge of the author's previous views and theories, we are introduced to a second method which, as before, results in the wholesale production of what may be termed pseudo-species, due to the intermingling and gradual changing of the layers of the thallus. This change is said to be due to "Protrophie"; a statement which must be accepted in good faith. The definition given would be next to meaningless in English, hence it is offered in the original language.

"Ich erachte es für statthaft, die Unselbstständigkeit, die nur den Anfang des Lebens betrifft, daher auch nur für diese Zeit der schützenden und unterstützenden Flechte zur Einleitung und Sicherung von dessen hauptsächlicher Dauer in aller Selbstständigkeit bedarf, unter Protrophie zu begreifen und die dazu bestimmten Flechten als Lichenes protrophici zu bezeichnen."

The most remarkable circumstance in connection with these supposed discoveries is the fact that the author was enabled to utilise herbarium specimens for his researches, and had not to resort to the more laborious and exact method of pure cultures. G. MASSEE.

Mathematical Papers read at the International Mathematical Congress held in connection with the World's Columbian Exposition, Chicago, 1893. (New York: Macmillan and Co.)

THIS book, which is an excellent specimen of mathematical printing, constitutes vol. i. of "Papers published by the American Mathematical Society." The 400 pages contain thirty-nine papers. German and American mathematicians are the largest contributors; there are a few pages from France, Italy, Austria and Russia also, but the mathematicians of England are not represented. Papers of great interest are given by Dr. Schönflies, "Gruppentheorie und Krystallographie"; by Dr. Heinrich Burkhardt, "Ueber einige mathematische Resultate neuerer astronomischer Unsuchungen, insbesondere über irreguläre Integrale linearer Differentialgleichungen"; by M. Maurice d'Ocagne, "Nomographie: sur les équations représentables par trois systèmes rectiligues de points isoplèthes"; by E. H. Moore, "A doubly infinite system of simple groups." Prof. Felix Klein, of Göttingen, whose work at the Congress has been already published in a separate volume, is only represented here by two short communications, one on "The Present State of Mathematics," the other on "The Development of the Theory of Groups during the last Twenty Years." They are of the nature of lightning sketches by a master hand.

The book is an evidence of the formation, gradual but sure, of an American school of mathematicians which, at first mainly inspired by Cayley and Sylvester, appears now to be coming under the influence, principally, of modern German methods.

Modern Optical Instruments and their Construction. By Henry Orford. Pp. 100. (London: Whittaker and Co., 1896.)

WHEN a book bearing the title "Modern Optical Instruments" is found to contain nothing about the telescope, merely a reference to the microscope, and but two pages on the spectroscope, it is the duty of a reviewer to declare that the volume is not what it pretends to be. The contents belong almost entirely to ophthalmoscopy; that is to say, to the determination of optical defects by means of the opthalmoscope, and the amelioration of them by means of spectacles. There are, in addition, brief chapters on stereoscopic projection and the optical lantern. As a short work on these matters, the book is not altogether bad (though the illustrations are very coarse), and opticians may find interest in parts of it. But to say the book is "a description of a few of what may safely be termed the more popular optical instruments in use," and to give it the title it has, is to court adverse criticism.

The book as published contains two-thirds text and one-third advertisement.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Cattle Plague in Africa.

THE following extract from a report addressed by Captain F. Lugard, C.B., managing director and leader of the expedition sent out by the British West Charterland to work its mining rights in Ngamiland, referring, as it does, to the outbreak of cattle disease which now paralyses transport throughout South Africa, may be of interest to the readers of NATURE.

There can now be little doubt that the present epidemic, known under the common name of "rinderpest," is the same as that with which we have been familiar in Central Africa for the past six years, and for the inroad of which into South Africa we ought long ago to have been prepared.

Commencing, so far as we know, in Somaliland in 1889, where the disease killed off a large part of the cattle, it passed through Masailand in the autumn of 1890. It was there that Captain Lugard, then an officer of the Imperial British East Africa Company, first came in contact with it. In 1891 he again found it sweeping off the cattle in the countries to the north and west of Uganda, of which province he was the Administrator. In 1892 it invaded North Nyasaland, and the Government were then duly warned of the double danger to be apprehended from the free export of hides of diseased animals, thousands of which were taken to America and to Europe, and through the advance of the epidemic into South Africa, should it cross the Zambesi and enter Bechuanaland.

The great peculiarity of the present disease is that it attacks not only domestic cattle, but also certain classes of wild animals, chiefly the buffalo, giraffe, warthog, the eland, and several other species of antelope. The elephant, the rhinoceros, and most of the smaller antelopes seem not to be affected, but in countries where it has appeared the destruction of cattle has been general.

The only accurate account of its previous ravages with which I am acquainted is to be found in Captain Lugard's work on "The Rise of our East African Empire," to which I would refer those who may wish to follow the course of the present epidemic from Somaliland South to Nyasaland.

Captain Lugard, writing from Gaberones, in Bechuanaland, May 13, says: "The results of the 'rinderpest' are here terribly *en évidence*. Near villages, literally hundreds and thousands of dead carcases lie about; they are found under almost every bush, and the stench is indescribable. I noticed that these carcases are being skinned by the natives, which means that the hides will be smuggled into the colony, and perhaps exported. I pointed this out yesterday to the magistrate here, and suggested that parties of police should burn the bodies in field cinerators, as fuel is abundant. He told me traders were buying up the hides, and he would recommend their confiscation and destruction by Government." He adds further on: "The magistrate told me that between here (Gaberones) and Buluwayo there are at least 4000 wagons stranded along the road (mostly loaded), of which the ox teams are dead. A famine threatens the country, for the ox is not only the food, but the money of the natives, with which they buy grain, &c. It is also their agricultural agent, for they no longer use the hoe; hence agriculture is at a standstill. The sole counterbalancing good is that it will compel the natives to work on the railway, which will now become a 'famine relief' work."

As little is known of the nature of the disease—some who have seen it in Central Africa classing it as a form of anthrax, others as a sort of pleuropneumonia—I annex an account of the chief symptoms as seen in the present epidemic in South Africa.

As regards the export of hides of diseased animals, to which Captain Lugard refers, which has gone on freely, and, to a large extent, from the Somali ports and from Zanzibar, I may remark that all hides before shipment are there dipped in a solution of arsenic and soda, which may, to a considerable extent, destroy any poisonous germs they contain.

The whole matter is now likely to be thoroughly worked out, but it cannot but be regretted that an inquiry was not instituted several years ago, when so many favourable opportunities of doing so were presented both on the Zanzibar coast and in Nyasaland.

JOHN KIRK.

Sevenoaks, June 10.

"*Zambesi Cattle Fever or Rinderpest.*

"This is a feverish disease of typical rapid course, which spreads by contagion and chiefly attacks cattle. Sheep, goats, and game are less liable; human beings, horses, mules, and donkeys do not get it. A healthy animal which has come into contact with a sick one usually shows the first symptoms of the disease seven days after; occasionally the period is considerably longer.

"General symptoms are fever, weariness, uneasiness, rough coat, failing appetite, increase of pulse and breathing, convulsive trembling of skin, rapid emaciation, and decline of strength.

"Special symptoms: One of the first and most constant is a frequent short cough, and thin slimy, afterwards mattery, discharge from the inflamed and swollen mucous membranes of the nose, eyes, and even mouth On the third (rarely so soon as the second) day diarrhœa sets in. The colour of the fœces depends upon the character and degree of the inflammation of the bowels. At the beginning they are still green, but quickly become discoloured. Some animals evacuate grey-brown, some a gelatine-like yellowish brown, and some clay-like fœtid excrement; the dark colour is due to the presence of blood. From the fourth or fifth day the fœces flow off involuntarily, and the anus appears red and swollen. Sometimes small ulcers and sores are visible on the mucous membrane of the lips, gums, and cheeks, and on those parts of the skin which can be licked.

"Diseased animals rarely succumb, earlier or later, than from the fourth to the seventh day after the first symptoms have become manifest.

"Experience has always shown that medical treatment is of no avail, but merely tends to spread the malady. It is therefore wisest and cheapest to destroy all animals affected at the earliest possible moment, and all carcases, unskinned and complete, should be burnt carefully or deeply buried.

"The disease does not originate through influences, such as cold and fog, dew or rain, but is solely due to a vegetable parasite, which is able to spread easily and rapidly.

(Signed) "OTTO HENNING,
"Government Veterinary Surgeon."

"The foregoing is published for general information. It is hoped that all will realise this great danger and the serious losses which the spread of the pest would produce, and that all will assist the authorities in extirpating it.

(Signed) "F. J. NEWTON,
"Mafeking, March 16." "Resident Commissioner.

The Electrical Resistance of Alloys.

IN reference to Lord Rayleigh's very interesting note in your issue of June 18, we have, for several months, had preliminary experiments in progress, with the object of educing practical proof of the effects of thermo-electric currents upon the conductivity of alloys; but, owing to the stress of routine work in our respective departments, the research was not sufficiently advanced for publication. We had hoped, however, to be able to read a short note immediately after the long vacation.

About two years ago, one of us, who has been engaged in observing the microscopic structure of alloys, was first led to the conviction that the peculiar formation (so often met with) of metallic crystals enmeshed in a network of other metallic material must inevitably cause the production of thermo-electric currents when a current was passed through the alloy-mass. This, he believed, might account for the disproportionate effect of traces of impurities upon the conductivity of pure metals, and for the production of a curve (with percentages of impurity and electrical resistance as coordinates) which, steep at first, tended to become flatter as the percentage of impurity was increased. Prof. Dewar's experiments on the conductivity of pure metals, and of alloys at low temperatures, appeared to give additional proof of the correctness of this surmise, as Lord Rayleigh has pointed out. The pure metals, being perfectly homogeneous, may have no resistance at the absolute zero of temperature; but if other substances be added, so that there is produced the complex structure which the microscope shows the

mixture to possess, there would obviously be interference produced by the thermo-electric currents set up owing to the juxtaposition of these masses of unlike metals. It would be particularly interesting to observe whether pure entectic alloys or chemical compounds of metals, which alone appear to form really homogeneous masses of mixed metals, would behave like pure metals, or like other alloys in regard to conductivity at low temperatures.

In order to detect the presence of opposing E.M.F.s, we first tried the experiment of passing a fairly intense current through a bar of alloy, breaking contact by means of a simple switch, and immediately making connection with a galvanometer, the interval of time elapsing between the reversal of connections being but a small fraction of a second. We have hitherto, however, failed to obtain any indication in this manner, a fact which we ascribe to the rapidity with which the temperature of the mass is equalised, owing to the minute size of its constituent particles, and to the appreciable time that must elapse between the break of the current and the contact with the galvanometer. Even when the time was reduced to 1/100th of a second or less by the use of a Morse key, and when the process was repeated five times a second, no consistent indication of a residual E.M.F. could be detected with a D'Arsonval galvanometer giving a deflection of 0·5 mm. per micro-volt. The ordinary thermo-electric effects had of course to be eliminated, and were very troublesome.

The next experiment was to balance the resistance of two pieces of wire of equal diameter—one of copper, the other of alloy—against each other, using equal ratio arms on a Wheatstone bridge, and then by means of a secohmmeter to try if the resistance of the alloy diminished when the current was rapidly reversed. In all cases there was found to be a distinct reduction of the resistance of the alloy relatively to the copper, the above-mentioned galvanometer giving deflections of from 10 to 15 mm., with 60 reversals per second. In one case the alloy was copper = 75 per cent. : gold = 25 per cent., the wire being 0·7 mm. in diameter and 820 mm. long, whilst the copper wire was 0·7 mm. in diameter and 4100 mm. long ; the current used was about 1·5 amp., and the resistance of each wire was about 0·18 ohms. A deflection of 15 mm. on the galvanometer scale, corresponding to 30 micro-volts, would be caused by an unbalanced E.M.F. in one of the wire = 105 micro-volts, or, say, 1/2600th of the total E.M.F.

The time actually occupied in the reversal of the current was estimated as varying between 1/500th and 1/1000th of a second, which was the time available for equalisation of temperature before the current was started in the opposite direction. Any residual E.M.F. would then *assist* the current at "make," and so reduce the apparent resistance. In any case, at the first instant of starting the current, the opposing E.M.F. would be absent, but the time required for its appearance would be very small compared with the time between reversals (1/60th of a second). Increased effect should therefore be sought by increasing the number of reversals per second rather than by shortening the time between stopping and re-starting the current.

Care was, of course, taken to ensure equal capacities and inductances in each pair of arms of the bridge ; and an experiment was made to see if the observed effect was due to the current in the copper wire becoming concentrated near the surface. A copper wire 1000 mm. long and 0·35 mm. in diameter was balanced against another copper wire 4000 mm. long and 0·7 mm. in diameter ; but no variation of resistance was observed. At this point the investigation was allowed to rest, pending the construction of special apparatus and the arrival of the summer vacation.

WALTER G. MCMILLAN.
ROBERT H. HOUSMAN.

Departments of Metallurgy and of Physics,
Mason College, Birmingham, June 22.

Are Röntgen Rays Polarised?

MR. L. CASELLA has made for me a Crookes' tube having as the anode a platinum window sealed into the end of the tube opposite the kathode, which is the ordinary aluminium disc. Owing to the glass sealing, only a small portion of the platinum, about 3 mm. in diameter, is free to act. The light from all but this portion was screened off by thick glass discs and a brass disc, these having each an aperture in the centre. The result, with the fluorescent screen, was at first poor, because the vacuum was too low ; but as that got higher it improved, and I was able to electrograph a part of the hand, by the rays given off by this small platinum window, in 15 seconds, the plate being 2½″ from the window. An ordinary focus tube takes 30 seconds to produce the same effect under similar conditions, but gives better definition. With the platinum window tube, though the bones are defined on the fluorescent screen, there seems to be too much white light, and the difference between bones and flesh is less marked. The tilted platinum of a focus tube, apparently, reflects most of the kathode rays, but transmits some. Compare the behaviour of the platinum in both tubes with the action of light on glass. With both glass and platinum, part of the rays are transmitted and part reflected, the proportion varying with the angle of incidence ; but, with both, those rays which are perpendicular are apparently transmitted. If the glass be tilted at the proper angle, the reflected rays and a small part of the transmitted rays are polarised. Suppose the plate of glass in the position of the platinum window, and the source of light a luminous point within the tube ; although most of the transmitted light would be radiated direct from the luminous point, part would be rays which had been polarised by reflection from the walls of the tube. The analogy would still hold good, for we know that, as far as X-rays are concerned, glass behaves very similarly to platinum, for these rays are under suitable conditions given off by both.

These considerations and the appearance of microscopic preparations containing bone undecalcified when examined by low powers and ordinary light under Nicol prisms, lead me to hazard the suggestion that a bare possibility exists of X-rays being polarised kathode rays. Were this so, the two kinds of X-ray described by several observers would be explained, and we should also understand why those who have tried to polarise these X-rays should have failed, the rays being already polarised. If this view is correct, extinction of the X-rays should be caused by reflection from a second platinum surface at the proper angle. Whether this would succeed at atmospheric pressure, I know not ; the experiment should be tried in vacuo, and a tube constructed specially for the purpose. The window tube has, at all events, proved that a quantity of kathode rays, with some X-rays, may be transmitted through moderately thin platinum under these conditions.

J. WILLIAM GIFFORD.

Chard, June 9.

A Curious Bird's Nest.

A CURIOUS bird's nest, or rather its adjuncts, has lately been presented to the Warwick Museum. It was found in a curved iron pipe intended to deliver water from a well at the baths, and appears not to have been used for some time. The entire length of the pipe was four feet, and the diameter five inches. The bird had built its nest in the centre, and had not only surrounded it with moss and other materials, but had extended them for some length on each side, the total amounting to two feet two inches. The singular thing is that the bird should have taken so much trouble to do this, and it really might seem as if, like the bower birds, it had done it in sport ; for it was not necessary (though the sharp little bird may have thought so) for the preservation of the nest to extend it so far on each side with moss, feathers, and other things. The eight small eggs in the nest appear to have belonged to the blue titmouse.

June 22. P. B. BRODIE.

"Hydrodictyon reticulatum."

IT may interest readers of NATURE who collect fresh-water Algæ, to know how easy of cultivation is this beautiful species. It occurs frequently, though by no means every year, in one of the tanks in the Royal Gardens, Kew. Last summer, about this time, I gathered it there in considerable quantities. After preparing specimens for demonstration, I placed the remainder in a glass dish, where it remained in my study, entirely neglected, except for an occasional renewal of the water, until a week or two ago, when I found it still in beautiful condition, with both large and small nets. It is to be found again this year in its original habitat, with nets of an unusually large, almost gigantic, size.

ALFRED W. BENNETT.

London, June 20.

"The Old Light and the New."

YOUR reviewer expressed an opinion, and makes two statements, and the six lines comprise his review of my book. The opinion, being on a matter of business, may be right or may be wrong. The statements are supposed to relate to fact; but they must be the outcome of hasty reading, for the "large portion of the book, dealing with theories of the natural colours of bodies," cannot surely be spoken of as "padding" in a work whose sub-title is "The Chemistry of Colour," and one of whose objects is to show that the Röntgen rays and matter yield "invisible" colour which conforms to the same laws as "visible" colour. Nor do I think it correct to call information on the X-rays "sketchy" because it happens to be concise.

WILLIAM ACKROYD.

IN my brief criticism of Mr. Ackroyd's book, I did not intend to suggest that the *whole* of the section on natural colours was "padding." My meaning would, perhaps, have been clearer had I written, "a large portion of that part of the book which deals with theories of the natural colour of bodies is nothing more than padding." The forty pages which comprise the chapter on "The Chemistry of Colour," contain the substance of a lecture delivered before the Society of Dyers and Colourists, and is so full of tabular details, while the remainder of the book is of a very elementary character, that it certainly gives the impression of having been included more to increase the bulk than on account of suitability. YOUR REVIEWER.

"The Reminiscences of a Yorkshire Naturalist."

THE brevity of the reference, on page 205 of "The Reminiscences of a Yorkshire Naturalist," by Dr. W. C. Williamson, to the memoir in the *Annales des Sciences Naturelles*, may give rise to misconception. Prof. Hartog's share in this work was by no means that of a mere translator, although his exceptional ability as a French scholar was of essential service. His collaboration extended to the substance as well as the form of the memoir, and he was always fully recognised by Dr. Williamson as its joint author. A. C. WILLIAMSON.

Post-Graduate Study in London.

COULD you inform a graduate in science of London University whether there is any place in London where he could attend post-graduate and research courses of study in botany? He is engaged as science master in a large public day-school, but is anxious to study botany in his spare time. Any information will greatly oblige. "PUTHOS."

June 14.

LORD KELVIN'S JUBILEE.

OUR summary in last week's issue of the proceedings at Lord Kelvin's jubilee celebration gives only a faint idea of the completeness and success with which every part of the festival was carried out, or of the enthusiasm which characterised what was the world's tribute of admiration to the achievements and personal qualities of a truly great man. The list of delegates and visitors which we give on pp. 174–5 will convey some idea of the unanimity with which science and learning throughout the world have done honour to one who, besides advancing pure science in a remarkable degree by his own abstract researches, has not disdained to apply his great knowledge of scientific principles to the construction of apparatus and appliances which have promoted peace and good will among men and aided commerce by placing continents in telegraphic communication, by improving and facilitating navigation, and last but not least, diminished the perils to which those who sail the seas are exposed. A great physical mathematician, a physicist to whom physical principles are intuitive, an engineer whom engineers have united to honour as one of the greatest of themselves, Lord Kelvin has many scientific interests, and there is no department of science which is not the larger and richer for his work.

The opening meeting of the celebration was the conversazione on Monday evening at the University. The guests were received by the Senatus Academicus, and the members of the Corporation of the City of Glasgow headed by Lord Provost Sir James Bell, in the Randolph Hall, which forms a "Fore Hall" or vestibule for the magnificent Bute Hall in which the high ceremonies of the University are held. In the Bute Hall, a little beyond the entrance and to the left, chairs were set for Lord and Lady Kelvin, who stood receiving the individual congratulations of the multitude of distinguished visitors. After thus paying their respects to the hero of the occasion, the guests passed on to meet one another, to renew acquaintanceships, to look at the treasures of the museum, and to inspect the splendid collection of instruments, diplomas, and medals which had been arranged to illustrate Lord Kelvin's researches and inventions, and the honours he has received. In this exhibition were many things of great interest, and we will not attempt even their enumeration. To give an adequate account of the instruments alone would require several numbers of NATURE, while the diplomas, mostly in Latin and of extraordinary distinction, represented the honour in which Lord Kelvin is held by the learned societies at home and abroad. Beginning with the certificate of the Bishop of Ely approving the appointment of William Thomson, B.A., as a Fellow of Peterhouse, they ended with the credentials of Sir William Thomson or Lord Kelvin's election as member of every one of the most distinguished scientific societies of the world, and included the letters of the Perpetual Secretary announcing, first, Lord Kelvin's election as Corresponding Member, next, as Foreign Associate of the Institute of France, and the announcement of his appointment as *Grand Officier* of the Legion of Honour.

The part played by the telegraph in the conversazione formed an exceedingly interesting part of the proceedings. The chief Cable Companies—the Anglo-American, the Commercial, the Eastern, and the Brazilian Submarine—sent congratulations, and instruments were arranged in the Library Hall whereby messages could be received from all parts of the world during the soirée. The Anglo-American Company's message may here be quoted, as it gives in a few words that credit for rendering by his instruments submarine telegraphy practically possible, which is Lord Kelvin's due, and that by a large portion of the commercial public that carries on business by means of cable communication is either unknown or apparently forgotten.

In 1858 Professor William Thomson took out his first patent for a system of working long cables, and for instruments (including the mirror-galvanometer) calculated for producing a high rate of transmission. In the Atlantic expedition of 1858 Professor William Thomson, at that time one of the directors of the Atlantic Telegraph Co., at the request of his brother directors, took upon himself the duties of electrician on board H.M.S. *Agamemnon*, which had been placed at the disposal of the company for the laying of the first Atlantic cable; and when the cable had been laid, it was Professor William Thomson's inventions and genius which caused a sufficient number of messages to be transmitted to demonstrate the practicability of Atlantic telegraphy, thus contributing most materially to the present success.

Our readers will remember that the theoretical solution of the problem of telegraph signalling by Lord Kelvin consisted in showing that the "retardation" of a signal increases in direct proportion to the square of the length of the cable supposed of a given pattern; and that therefore it was only possible by using receiving instruments for surpassing in delicacy the most sensitive of land instruments that intelligible signals could be obtained at all. There can be no manner of doubt that it was the tremendous battery power used to actuate the primitive receiving instruments that ruined the cable first laid, and brought temporary disaster to the promoters. The mirror-galvanometer with its needle and mirror of a grain or two hung by a single fibre of silk, and its long mass-

less index of a ray of light, first overcame the difficulty and reduced the battery power required to something like a fiftieth or a hundredth part of that originally employed. Then came the beautiful siphon-recorder with its pen of lightest capillary tubing, through which the ink was forced by electrical action, so that it wrote its message on a ribbon of paper without actually touching the paper-surface, thus avoiding in the most ingeniously simple manner what for long-cable signalling would have been most detrimental, the friction of the glass on the ribbon. The recorder-siphon once deflected registered successive signals in the same direction by small ripples drawn on the moving paper as from a new zero, and thus the reduction to zero between two of these signals of the current deflecting the coil, was rendered unnecessary. The shifting zero of the siphon-recorder was made still more definite in whatever position it took up by means of curb-sending, which brought out clearly the individual ripples of the last three signals of the letter *b*, the four successive signals in the same direction which form the letter *h*, and so on.

Returning, however, to the conversazione and the part played by the telegraphic instruments, we have first to mention the message of congratulation which was sent by the Jubilee Committee to Lord Kelvin, present in the same room, round a circuit as long as about three-quarters of the earth's circumference. The Anglo-American Company sent the message to Heart's Content, thence to New York, thence round by Chicago and San Francisco back to New York, thence again to Heart's Content and Glasgow. The message was as follows :—

By the Atlantic cable which represents your unrivalled combination of scientific genius and practical skill, the Glasgow Jubilee Committee send you their warmest congratulations.

The interval between sending and receiving was seven and a half minutes, and Lord Kelvin replied :—

The Cable Companies have beaten Ariel by half a minute. Warmest thanks to the Glasgow University Jubilee Committee.

The reply took only four minutes.

From Simla the Viceroy of India telegraphed :—

I offer congratulations and desire to join with the University of Glasgow in celebrating your fifty years of service. We in India, thanks to your labours, constantly feel closer to friends at home.

From the capital of the Orange Free State the following message was received :—

The President of the Orange Free State, in the name of many Free Staters who have either directly or indirectly profited by Lord Kelvin's magnificent services to science, desires to offer his hearty congratulations to Lord Kelvin on the celebration of his professorial jubilee.

Congratulatory telegrams were also received from Earl Grey (Buluwayo), Sir James Sievewright (Cape Colony), the Earl of Glasgow (Wellington, New Zealand), the Postmaster-General of New Zealand, Sir John Robinson (Prime Minister of Natal), the Governor of Hong Kong, Lord Hampden (Sydney), the Universities of Adelaide, Madras, New Zealand, Calcutta, Santiago, the Johns Hopkins University of Baltimore, and Chicago, from the Indian Telegraph Department, the College of Science, Poona, and old students and friends in Japan, and almost all parts of the world.

Lord Kelvin telegraphed his thanks to General Eckert, the President of the Western Union Telegraph Company, New York, in the following terms :—

Pray accept my sincere thanks to yourself and staff for your great kindness and assistance. The messages you have transmitted to me have given very great pleasure to the whole assembly.

The following is a list of the delegates and other distinguished visitors who, besides the Lord Provost, Magistrates, and Town Council, the members of the Senatus Academicus, and the local guests invited, were announced as present at the reception and throughout the celebration :—

REPRESENTATIVES OF UNIVERSITIES, SOCIETIES, INSTITUTIONS, &c.

AUSTRO-HUNGARY.—Prof. Dr. Izidor Fröhlich, Academy of Sciences, Buda-Pest.

BELGIUM.—Senator Montefiore Levi, of Brussels.

DENMARK.—Prof. C. Christiansen, Royal Danish Society of Science, Copenhagen.

FRANCE.—Prof. Aug. Angellier, Academy of Lille; Prof. Pinloche, Academy of Lille; Prof. Lippmann, University of France, Paris; Prof. Henri Moissan, University of France, Paris; Prof. Picard, University of France, Paris; Prof. Bonet Maury, University of Paris; Prof. Eleuthère Mascart, Collège de France, Paris; Prof. Violle, Ecole Normale Supérieure, Paris.

GERMANY.—Prof. Heinrich du Bois, University of Berlin; Prof. Georg Quincke, University of Heidelberg; Prof. Woldemar Voigt, Royal Society of Science, Göttingen.

HOLLAND.—Dr. Elie van Rijckevorrel, Batavian Society of Experimental Philosophy, Rotterdam.

ITALY.—General Annibale Ferrero, Italian Ambassador, London, representing Royal Institute of Science and Letters, Milan; Royal Academy of Science, Letters, and Arts, Modena; Italian Society of Science, Rome. Prof. Peter G. Tait, M.A., D.Sc., Edinburgh, representing University of Rome. Prof. J. J. Thomson, M.A., F.R.S., Cambridge, representing Royal Academy of Turin.

MEXICO.—George J. Symons. F.R.S., representing the Antonio Alzate, Scientific Society.

RUSSIA.—Prof. Nicholas Oumov, representing University of Moscow; Imperial Society of Friends of Natural Science, Anthropology, and Ethnography, Moscow; and Imperial Society of Naturalists, Moscow.

SWEDEN.—Prof. Per Theodor Cleve, University of Upsala.

SWITZERLAND.—Mons. Lucien de Candolle, Société des Arts, Geneva.

UNITED STATES OF AMERICA.—Prof. Joseph S. Ames, Ph.D., Johns Hopkins University, Baltimore; James C. Thomas, M.D., Johns Hopkins University, Baltimore; Prof. Cushney, University of Michigan; Prof. Robert M. Wenley, M.A., D.Phil., University of Michigan; Prof. G. F. Barker, M.D., University of Pennsylvania, Philadelphia; Mr. Samuel Dickson, University of Pennsylvania, Philadelphia; Prof. Woodrow Wilson, Princeton University, New Jersey; Prof. Van Amringe, Columbia College, New York; Mr. T. C. Martin, National Electric Light Association, New York; Right Hon. Lord Rayleigh, F.R.S., representing American Academy of Arts and Sciences, Boston; General Wistar, Academy of Natural Sciences, Philadelphia; Dr. J. Cheston Morris, Philosophical Society, Philadelphia.

GREAT BRITAIN AND IRELAND, THE COLONIES, AND INDIA.

CANADA.—Sir D. A. Smith, K.C.M.G., LL.D., M'Gill University, Montreal; Principal Peterson, M'Gill University, Montreal; Mr. James Ross, Canadian Society of Civil Engineers, Montreal.

INDIA.—Mr. Justice Jardine, I.C.S., Bombay University; Ghanasham N. Nadkarin, LL.B., Bombay University; Prof. J. H. Gilliland, M.A., Calcutta University.

NEW SOUTH WALES.—Prof. Liversidge, M.A., F.R.S., University of Sydney.

UNITED KINGDOM.

I. UNIVERSITIES.

ENGLAND.

Cambridge University.—Prof. A. R. Forsyth, D.Sc., F.R.S.; Prof. Sir George G. Stokes, LL.D., F.R.S.; Prof. J. J. Thomson, M.A., F.R.S.

Durham University.—Rev. Principal Gurney, D.C.L.; Dr. Merz.

London University.—Prof. Carey Foster, F.R.S.; Sir Henry E. Roscoe, F.R.S.

Manchester—Victoria University.—Prof. Oliver J. Lodge, D.Sc., F.R.S.; Principal A. W. Ward, Litt.D., LL.D.

Oxford University.—Prof. Clifton, F.R.S.; D. B. Monro, M.A.; Provost of Oriel College; Prof. Burdon Sanderson, F.R.S.

IRELAND.

Dublin—Trinity College.—Right Hon. the Earl of Rosse, LL.D., D.C.L., F.R.S. Chancellor of the University of Dublin.

Royal University of Ireland.—Right Rev. Monsignor Molloy, D.D., D.Sc. ; William A. M'Keown, M.D.

SCOTLAND.

Aberdeen University.—Prof. Finlay, M.D. ; Prof. Niven, F.R.S. ; Prof. Pirie.

Edinburgh University.—Prof. A. Crum Brown, F.R.S. ; Prof. Sir William Turner, F.R.S. ; Prof. Peter G. Tait, M.A., D.Sc.

St. Andrew's University.—Prof. Scott Lang ; Prof. Pettigrew, M.D., LL.D., F.R.S.

WALES.

University of Wales.—Prof. Andrew Gray, LL.D. F.R.S. ; Principal J. Viriamu Jones, F.R.S., Vice-Chancellor of the University of Wales.

II.—COLLEGES.

ENGLAND.

Birmingham—Mason College.—Principal Heath, D.Sc., F.R.S.

Leeds—Yorkshire College.—Prof. Stroud, D.Sc.

Liverpool—University College.—Prof. M'Cunn, M.A.

London—King's College.—Prof. W. G. Adams, D.Sc., F.R.S.

London—University College.—Prof. Ramsay, F.R.S.

London—City and Guilds Central Technical College.—Prof. W. E. Ayrton, F.R.S.

London—City and Guilds Technical College, Finsbury.—Prof. S. P. Thompson, D.Sc., F.R.S.

Manchester—Owens College.—Prof. Osborne Reynolds, LL.D., F.R.S.

Newcastle-on-Tyne—Durham College of Medicine and Science.—Prof. George H. Philipson, M.D.

IRELAND.

Belfast—Queen's College.—Rev. Thomas Hamilton, D.D., LL.D. ; Prof. Purser, LL.D.

Cork—Queen's College.—Prof. W. Bergin, M.A.

Galway—Queen's College.—Sir Thomas Moffett, LL.D.

SCOTLAND.

Dundee.—University College.—Prof. Steggall, M.A.

Glasgow—Faculty of Physicians and Surgeons.—Bruce Goff, M.D., F.F.P.S.

Glasgow and West of Scotland Technical College.—Henry Dyer, D.Sc.

Glasgow School Board.—Sir John N. Cuthbertson, LL.D. ; Rev. William Boyd, LL.D.

WALES.

Aberystwith—University College.—R. D. Roberts, M.A., D.Sc.

Bangor—University College.—Prof. Andrew Gray, LL.D., F.R.S.

Cardiff—University College.—Prof. A. C. Elliott, D.Sc.

III.—SOCIETIES, INSTITUTIONS, &c.

ENGLAND.

Royal Society.—Prof. Sir Joseph Lister, M.B., P.R.S. ; Sir John Evans, K.C.B., F.R.S.

Cambridge—Philosophical Society.—Prof. J. J. Thomson, F.R.S.

London—Society of Arts.—Sir Frederick Abel, F.R.S.

Astronomical Society.—A. A. Common, LL.D., F.R.S.

British Association for Advancement of Science.—Prof. A. W. Rücker, F.R.S.

Chemical Society.—Prof. John M. Thomson.

Institution of Civil Engineers.—Sir Benjamin Baker, F.R.S., K.C.M.G.

Society of Engineers.—Henry O'Connor.

Institution of Electrical Engineers.—John Hopkinson, F.R.S.

Royal Geographical Society.—Dr. John Murray, F.R.S.

Geological Society.—Dr. Henry Hicks, F.R.S.

Mathematical Society.—Major P. A. MacMahon, R.A., F.R.S.

Physical Society.—Captain W. de W. Abney, F.R.S.

Manchester Literary and Philosophical Society.—Prof. Schuster, F.R.S.

IRELAND.

Royal Irish Academy.—Right Hon. the Earl of Rosse, LL.D., D.C.L., F.R.S.

SCOTLAND.

Edinburgh—Educational Institute of Scotland.—John Dunlop, Esq.

Edinburgh—Royal Society.—Hon. Lord M'Laren.

Glasgow—Geological Society.—Sir Archibald Geikie, LL.D. F.R.S. ; J. Barclay Murdoch, Esq.

Glasgow—Institution of Engineers and Shipbuilders.—John Inglis, Esq.

Glasgow—Philosophical Society.—Ebenezer Duncan, M.D.

Other distinguished Visitors.—Professor Cleveland Abbe, Weather Bureau, Washington ; John Aitken, F.R.S., Darroch, Falkirk ; Prof. Roberts-Austen, C.B., F.R.S., London ; Prof. Bayley Balfour, M.D., F.R.S., Edinburgh University ; Rev. A. K. H. Boyd, D.D., St. Andrews ; A. Hargreaves Brown, M.P., 12 Grosvenor Gardens, London, S.W. ; Alexander Buchan, LL.D., 42 Heriot Row, Edinburgh ; Professor G. H. Darwin, LL.D., F.R.S., Newnham Grange, Cambridge ; Prof. James Dewar, LL.D., F.R.S., Peterhouse, Cambridge ; Lowes Dickenson, Esq., 1 All Souls' Place, London, W. ; J. D. H. Dickson, M.A., Peterhouse, Cambridge ; John M. Dodds, M.A., Peterhouse, Cambridge ; Prof. J. A. Ewing, LL.D., F.R.S., Cambridge ; Prof. Fitzgerald, Sc.D., Dublin ; J. E. Foster, M.A., Cambridge ; Prof. Michael Foster, LL.D., F.R.S., Cambridge ; Prof. Frankland, F.R.S., Mason College, Birmingham ; Ex-Prof. Frederick Fuller, London ; David Gill, C.B., LL.D., F.R.S., Astronomer Royal, Cape Town ; Dr. Gladstone, F.R.S., London ; J. G. Gordon, Esq., London ; Prof. Herkomer, R.A., Bushey, Herts. ; Sir Joseph D. Hooker, M.D., K.C.B., F.R.S., Sunningdale, Berks ; John K. Ingram, LL.D., Dublin ; Prof. Alex. B. W. Kennedy, LL.D., F.R.S., London ; Hon. Lord Kinnear ; Hon. Lord Kyllachy ; Count Lovatelli, Italian Embassy, London ; Rt. Hon. Prof. Max Müller, LL.D., Oxford ; Frank M'Clean, LL.D., F.R.S., Tunbridge Wells ; John M'Intyre, M.D., Odiham, Hants ; Prof. Simon Newcomb, of Johns Hopkins University, Baltimore, and Nautical Almanac Office, Washington ; Prof. Perry, F.R.S., London ; Rev. Dr. Porter, Master of Peterhouse, Cambridge ; W. H. Preece, C.B., F.R.S., General Post Office, London ; Emanuel Ristori, London ; Edward J. Routh, D.Sc., LL.D., F.R.S., Peterhouse, Cambridge ; Sir William Russell, Adare, Ireland ; Right. Hon. Lord Shand, LL.D., London ; Alex. Siemens, London ; Major-General Sir R. M. Smith, K.C.M.G., Edinburgh ; Prof, J. J. Sylvester, M.A., D.C.L., F.R.S., Oxford ; James Thomson, M.A., C.E., Newcastle-on-Tyne ; Prof. W. A. Tilden, Sc.D., F.R.S., London ; Admiral Wharton, R.N., C.B., F.R.S., Admiralty, London.

The only noticeable want in the above list is that of any high Officer of State of our own country. The presence of some member of the Government would have added a touch of State official recognition which it would have done honour to the Government to bestow ; but very possibly, like Lord Salisbury and Sir John Gorst, other ministers were unable to leave their posts.

The suite of rooms, unique in extent and convenience for such an assembly, beautiful in themselves because of their architecture and fittings, were further decorated with flowers and plants, and were illuminated by several arc-lamps which shed a bright but mellow light upon the scene. The effect was indescribably brilliant—the splendour of the ladies' dresses, the uniforms, and the municipal and academic robes of the men, mixed with the sober evening attire to which many adhered, rendered the appearance of the rooms during the evening exceedingly picturesque and bright. The east quadrangle was also lighted with the electric light, and formed a most attractive refuge from the hotter atmosphere inside. The band of the Gordon Highlanders discoursed sweet music at intervals from a band stand erected in the centre of the quadrangle, alternating with the pipers of the same regiment, who played a selection of Highland airs in excellent style.

On Tuesday a congregation of the University was held for the presentation of addresses to Lord Kelvin, and the conferring of honorary degrees on Lord Kelvin himself and the principal foreign visitors representative of science. The delegates of the various universities, colleges, societies, and institutions were accommodated

with seats in front of the principal floor-space of the hall, while the chair of the Vice-Chancellor, with chairs for officials, was placed in the centre of a semicircle of professional stalls occupied by the members of the Senatus Academicus, distinguished strangers, and representatives of the Corporation present. For the delegates who were to receive degrees, chairs were set in front of the circle occupied by the Senate. The rest of the hall and the galleries were occupied by students and spectators.

Punctually at 10 a.m. the Senatus with Lord Kelvin at its head, marched in procession up the hall, while the whole assemblage rose and cheered him to the echo. In the absence of Principal Caird, who unfortunately is not yet sufficiently recovered in health to take part in such a ceremony, the chair was taken by Prof. William Gairdner, F.R.S., who, next to Lord Kelvin, is the senior Professor now at Glasgow. After prayer, offered in Latin according to a form which has been long in use at Glasgow, Professor Stewart, Clerk of Senate, read the following letter of congratulation from H.R.H. the Prince of Wales.

Marlborough House,
Pall Mall, S.W.,
June 10, 1896.

DEAR LORD KELVIN,—The Prince of Wales desires me to offer you his warmest congratulations upon your having attained the fiftieth year of the tenure of your professorship in the University of Glasgow.

His Royal Highness is in most cordial sympathy with the eminent representatives of universities, learned societies, and other public bodies in different parts of this Empire and in foreign States who, to do you honour, have assembled in the University which has for a long series of years, eventful through the rapid advance of science and its applications, enjoyed the high prestige derived from your close association with its work, and from the invaluable and brilliant contributions to science resulting from the researches carried on by you during the last half-century within its walls.

The Prince of Wales remembers with much satisfaction that he had the gratification seventeen years ago to present you with the medal instituted by the Society of Arts as a memorial of the Prince Consort, and awarded to men who have rendered pre-eminent service in promoting arts, manufactures, and science.

The work which you had at that time accomplished was but an earnest of the important researches to which you have since then devoted yourself so indefatigably, and he cherishes the sincere hope that you may long continue to enjoy the happiness derived from the most gratifying evidence that the high value of the services rendered by you through science to mankind is universally recognised and appreciated.

I remain,
Dear Lord Kelvin,
Yours truly,
FRANCIS KNOLLYS.

P.S.—His Royal Highness desires me to repeat what he has already stated to the University authorities, how greatly he regrets that long-formed engagements in the South prevent him from having the pleasure of being present on the occasion of this interesting celebration.—F. K.

Professor Story then called forward the delegates very nearly in the order in which they are given in the foregoing list. These advanced to the daïs, and presented the messages with which they were charged to Lord Kelvin; and after shaking hands with him, retired to their places. Most of the delegates presented elaborate addresses, beautifully engrossed, and signed by the authorities of the bodies represented. These were not, however, in general read, though a good many delegates made a few pointed remarks when placing the addresses before Lord Kelvin on the table. The delegates of the Institute of France were the bearers to Lord Kelvin of the Arago medal, which has only been three times before bestowed on any one. It is interesting to note in this connection that the Freedom of the City of Glasgow was in 1834 conferred on Arago himself "in testimony of admiration of his high talents and eminent scientific attainments, and particularly of his successful exertions to extend the boundaries of astronomical science."

The medal was presented to Lord Kelvin by Professor E. Mascart, of the Collège de France.

General Ferrero, the Italian Ambassador, attended on behalf of the Royal Institute of Science and Letters of Milan, the Royal Academy of Science, Letters, and Arts of Modena, and the Italian Society of Science, Rome.

The presentation of the addresses of the Royal Society, the University of Cambridge, the students of the four Scottish Universities, the students of the University of Glasgow, and the Senatus of the University of Glasgow excited much interest.

The address of the University of Cambridge, written by the Public Orator, Dr. Sandys, on behalf of the University, was as follows:—

Baroni Kelvin
Regiae Societatis nuper Praesidi
Philosophiae Naturalis inter Glasguenses
per annos quinquaginta Professori
S. P. D.
Universitas Cantabrigiensis.

DUM tot tantaeque Universitates praeceptori tam illustri annos quinquaginta Professoris in munere feliciter exactos certatim gratulantur, Universitati nostrae imprimis consentaneum est ob rem tam laetam tamque honorificam suum gaudium confiteri, suam superbiam testificari. Etenim nostra inter nemora (iuvat recordari) quinquagesimo primo abhinc anno studiorum mathematicorum e certamine primo lauream prope primam reportasti, studiorum eorundem in certamine altero victor renuntiatus. Nostris umbraculis egressus, et aliis ex aliis honores serie perpetua propter insignia merita adeptus, physicorum praesertim studiorum provinciam et inventis tuis et exemplo tuo praeclare illustrasti. Tu trans maria magna navigantibus securitatem novam dedisti, septentrionum regionem accuratius indicasti, vada periculosa etiam in ipso transcursu metiri docuisti; tu oceani denique Atlantici litus utrumque vinculo novo coniunxisti. Haec et alia inventa egregia dum contemplamur, non sine superbia recordamur plusquam quinquaginta per annos ipsum inventorem etiam nostra cum Universitate vinculo artissimo fuisse coniunctum. Alumno igitur nostro insigni, non modo annos quinquaginta Professoris in munere prospere peractos, sed etiam vitae annum septuagesimum primum feliciter expletum libenter gratulati, etiam in posterum plurimos per annos omnia fausta ex animo exoptamus. Vale.

Datum Cantabrigiae
mensis Iunii die xi°
A. S. MDCCCXCVI.

L.S.

The following address of the Senatus of the University of Glasgow was read by Professor Stewart, D.D.:—

MY LORD,—The rejoicings which have been arranged to celebrate the close of your fiftieth session betoken the admiration and affection with which you are regarded by your colleagues in the Senate, but it is none the less fitting that on this auspicious occasion these feelings should find articulate expression in an address of congratulation. The fifty years during which you have occupied the Chair of Natural Philosophy in this University have to an extent, unparalleled in the history of the world, been marked by brilliant discoveries in every department of physical science, and by the prompt adaptation of many of these discoveries to meet the practical needs of mankind. We recognise with admiration that in both these respects you have been a leader of the age in which we live. Your mathematical and experimental genius has unveiled the secrets of nature; your marvellous gift of utilising such discoveries has ministered in many ways to the happiness and dignity of human life. Your name and your work have been an inspiration to the physicists of the world; new departments of technical industry have sprung into existence under your hand, and even the unlettered have learned to value the gifts which science bestows. The justice of the tributes which have been paid to you by universities and scientific societies at home and abroad, and by the Governments of this and other lands, we are proud to acknowledge. But only your colleagues in university work are in a position to

appreciate the versatility of faculty, the exhaustless energy, and the tenacity of purpose which have enabled you to grapple successfully with problems the most varied, and to reveal to us on every side the reign of order and law. In the midst of all you have endeared yourself to us by the graces of your personal character, notably by that simplicity which, unmarred by honours or success, remains the permanent possession of transcendent genius, and by that humility of spirit which, the clearer the vision of truth becomes, bows with the lowlier reverence before the mystery of the universe.

My Lord, the contemplation of a past so rich in achievements and honours encourages your colleagues to look forward to the future in the hope that you may have health and strength to win new triumphs in years to come, and long to remain among us the ornament and the glory of our ancient University.

WILLIAM STEWART.
Clerk of Session.

The address from the Royal Society was presented by the President, Sir Joseph Lister, Bart., and the Treasurer, Sir John Evans, K.C.B. It ran as follows :—

The Royal Society.

DEAR LORD KELVIN,—The President, Council, and Fellows of the Royal Society desire, on the happy occasion of the jubilee of your Professoriate in the University of Glasgow, not only to be represented, as they are, by their highest officers, the President and Treasurer, but also to assure you, by some direct words, of the warm sympathy of the whole Society.

There is no need to dwell on the many ways in which you have contributed to that improvement of natural knowledge to secure which the Society was founded, or on the many valuable communications with which you have enriched the Society's records. Since you first joined the Society, and the jubilee of that event is not far off, the Society has always known how much your belonging to it has added to its strength ; but it has been especially during the recent five years, which went too swiftly by, while you filled in so admirable a manner the chair of President, that the Society has felt how close are the ties which bind it to you and you to it.

We ask you to receive our heartiest congratulations on the present glad event, and our warmest wishes for your welfare in the years yet to come.

(Signed) JOSEPH LISTER, Pres. R.S.

When the presentation of addresses had been completed, Professor Moody Stuart, Dean of the Faculty of Law, amid great and prolonged applause presented Lord Kelvin for the degree of Doctor of Laws. "As a memorial," he said, "of this day, the Senate desire to confer on Lord Kelvin the highest honour they have to bestow, by placing his illustrious name on the roll of Doctors of Laws of the University."

The ceremony of capping was performed by Professor Gairdner, amid a renewed outburst of cheering.

Lord Kelvin thereafter took the chair as Senior Professor in the University, and proceeded to confer the remainder of the honorary degrees.

Prof. Moody Stuart, in presenting the recipients, said :—The Senate desire to commemorate this occasion by conferring the honorary degree of Doctor of Laws on some of the distinguished men of science from the continent of Europe, from the United States of America, and from the British Colonies, who have honoured the University by their presence to-day. In the name of the Faculty of Law, and by authority of the Senate, I have now the honour of presenting them for this degree.

Prof. Cleveland Abbe, head of the Meteorological Office, Washington, distinguished for his important contributions to astronomical and meteorological science.

Prof. Christian Christiansen, Copenhagen, author of many important papers on physical science, and of a most beautiful experimental illustration of differences of refractivity at different temperatures.

Prof. Per Theodore Cleve, of Upsala, long esteemed as one of the most notable workers in chemical and mineralogical science. His name has become known to a wider public in connection with the discovery of helium in the mineral Cleveite named after him.

His Excellency General Annibale Ferrero, Ambassador to this country from His Majesty the King of Italy. General Ferrero is specially eminent in mathematical and geodetical science, and, notwithstanding the engrossing duties of his high office, continues to take his part in the scientific work to which his life has been devoted.

Prof. Izidor Fröhlich, of the University of Buda-Pesth and Academy of Sciences, Buda-Pesth, who has published a large number of important papers on physical optics and on electricity.

Prof. Gabriel Lippmann, of the Sorbonne, Paris, inventor of the capillary electrometer and discoverer of the principles of true colour photography.

Prof. Archibald Liversidge, of the University of Sydney, New South Wales, Dean of Faculties in that university, distinguished as a traveller, a chemist, and a geologist.

Prof. Eleuthère Mascart, official head of meteorology in France, a physicist of great reputation, and author of a very important treatise on electricity.

Prof. Henri Moissan, of the University of France, one of the most originative and practical of modern chemists.

Prof. Simon Newcomb, of Johns Hopkins University, Baltimore, whose numerous researches have contributed largely to the progress of gravitational astronomy, the most notable being his work on the satellites of Saturn and his researches on the motion of the moon. He was awarded the Copley Medal of the Royal Society of London in 1890.

Prof. Nikolai Aleksejevich Oumov, of the University of Moscow, who has gained great distinction by his researches on energy and on electro-dynamic induction.

Prof. Émile Picard, of the University of France, who holds a leading position among the great French mathematicians.

Prof. Georg Quincke, of the University of Heidelberg, one of the most famous experimental physicists in Germany, author of numerous important experimental investigations, among others on capillarity and in optics.

Prof. Woldemar Voigt, of the University of Göttingen, well known as the author of numerous papers on the mathematical theory of light and on the electricity of crystals.

Lord KELVIN then said—The University of Glasgow is honoured by the presence to-day of many distinguished visitors from foreign countries, from America, from India, from Australia, and from all parts of the United Kingdom. Names of men renowned for their scientific work in distant countries have been added to our list of honorary graduates. That I have had the honour of conferring these degrees in the name of the University is a subject of keenest regret to all here present, because it is due to the absence of Principal Caird on account of illness. We hope that the beginning of next session will see him at home in the University with thoroughly recovered health. In his absence the duty of conferring degrees has fallen, according to University law, on me as senior Professor present. I am also one of the recipients of the degree, and, in the name of all who have to-day been created Doctors of Laws of the University of Glasgow, I thank the Senate for the honour which we have thus received on the occasion of the jubilee of my professorship. For myself, I can find no words to express my feelings on this occasion. My fifty happy years of life and work as Professor of Natural Philosophy here, among my students and my colleagues of the University and my many kind friends in the great City of Glasgow, call for gratitude ; I cannot think of them without heartfelt gratitude. But now you heap coals of fire on my head. You reward me for having enjoyed for fifty years the privilege of spending my time in the work most congenial to me and in the happiest of surroundings. You could not do more for me if I had spent my life in hardships and dangers, fighting for my country, or struggling to do good among the masses of our population, or working for the benefit of the people in public duty voluntarily accepted. I have had the honour to receive here to-day a gracious message from His Royal Highness the Prince of Wales, and addresses from sister-universities in all parts of the world ; from learned societies, academies, associations, and institutions for the advancement of pure and applied science ; from municipal corporations and other public bodies ; from submarine telegraph companies, and from their officers, my old comrades in their work ; from students, professors, and scientific workers of England, Scotland, and Ireland and other countries, including my revered and loved St. Peter's College, Cambridge, and my twenty Baltimore coefficients of 1884. The term coefficients is abused by mathematicians. They use it for one of the two factors of the result. To me the professor and his class of students are coefficients, fellow-workers, each con-

tributing to whatever can possibly be done by their daily meetings together. I dislike the term lecture applied here. I prefer the French expression—"conference." I feel that every meeting of a professor with his students is rather a conference than a pumping in of doctrine from the professor, perhaps ill-understood and not well received by his students. The Scottish universities have enabled us to carry out this French idea of conference. In many of our classes the professor is accustomed to converse with his students sometimes in the form of *viva voce* examination and oftener, I hope, in the manner of the interchange of thoughts, the professor discovering whether or not the student is following his lecture, and being thus really helped in his treatment of the subject. I have had addresses also from my old Japanese students of Glasgow University, now professors in the University of Tōkiō, or occupying posts in the Civil Service and Engineering Service of Japan, for which I thank them heartily. I wish particularly also to thank my Baltimore coefficients for their address. They have been useful to myself in my own keen endeavour—unsuccessful, I must say—nevertheless keen—to know something about the true dynamics of light and ether and crystals. The addresses which I have received to-day contain liberal and friendly appreciation of all my published mathematical and physical papers, beginning in 1840, and ending—not yet I hope. The small proportion of that long series of writings which has led to some definite advancement of science is amply credited for its results. The larger part, for which so much cannot be said, is treated with unfailing and sympathetic kindness as a record of persevering endeavour to see below the surface of matter. It has been carried on in the faith that the time is to come when much that is now dark in physical science shall be seen bright and clear, if not by ourselves, by our successors in the work. I am much gratified by the generous manner in which these addresses have referred to the practical applications of science in my work for submarine telegraphy; my contributions to the advancement of theoretical and practical knowledge of the tides; my improvements in the oldest and next oldest of scientific aids to navigation, the sounding plummet and the mariner's compass; and my electric measuring instruments for scientific laboratories, for the observation of atmospheric electricity, and for electrical engineering. I now ask the distinguished men who have honoured me by presenting to me these addresses to accept for themselves personally, and for the societies represented by them, my warmest thanks for the great treasure which I have thus received—good will, kindness, friendship, sympathy, encouragement for more work—a treasure of which no words can adequately describe the value. I cordially thank the French Academy of Sciences for their great kindness in sending me by the hands of my loved and highly esteemed colleague Prof. Mascart the Arago Medal of the Institute of France. I thank all present in this great assembly for their kindness, which touches me deeply; and I thank the City and University of Glasgow for the crowning honour of my life which they have conferred on me by holding a commemoration of the Jubilee of my Professorship.

A more dignified and imposing ceremony than that which was now closed with the benediction pronounced by Prof. Stewart, was never witnessed at the University of Glasgow. Anything more striking and impressive of an academic nature it is hardly possible to conceive. The demeanour of the students and general public was respectful, and at the same time displayed the most enthusiastic regard for the hero of the occasion, and all the arrangements worked without the slightest hitch or fault.

In the evening at seven o'clock a grand banquet was given in the St. Andrews Halls to about six hundred gentlemen, including all the delegates and other distinguished strangers present at the celebration. On the platform of the hall three principal tables were arranged, at which were seated the Lord Provost, with Lord Kelvin and other gentlemen, who were afterwards to speak, or who, for various reasons, it was proper should be so honoured.

The Lord Provost occupied the chair at the first table, and was supported on the right by Lord Kelvin, His Excellency General Annibale Ferrero, the Italian Ambassador, the Right Hon. Lord Rayleigh, D.C.L., LL.D., F.R.S., Prof. Newcomb (Washington), Lord Overtoun, the Lord Justice General of Scotland, Prof. Picard (Paris), Lord Shand, General Sir Archibald Alison, Bart.; and on the left by the Earl of Rosse, K.P. (Chancellor of the University of Dublin), Sir Joseph Lister, Bart. (President of the Royal Society), Lord Napier and Ettrick, Prof. Quincke (Heidelberg), Dr. Gill (Astronomer-Royal, Cape of Good Hope), Signor Montefiore Levi (Brussels), Prof. Abbe (Washington), James A. Campbell, LL.D., M.P.

On the main floor of the hall were arranged fourteen tables, accommodating about forty guests each. The length of each table ran at right angles to the platform, so that each person could regard the after-dinner speakers comfortably without changing his position.

After dinner the front seats of the galleries round the hall were occupied by ladies, who had previously been received on entrance by Lady Bell and Mrs. Caird.

The Lord Provost began by saying—I have been entrusted with a message from Her Majesty the Queen, and, as is customary, I would ask you to stand while Her Majesty's message is being read. It is as follows:—

The Queen commands me to beg that you will kindly express to Lord Kelvin her Majesty's sincere congratulations on the occasion of the jubilee of his professorship in the Glasgow University. Her Majesty trusts that many years of health and prosperity may be in store for him and Lady Kelvin. The Queen is particularly gratified at the presence of so many eminent representatives from all countries of the world who have come to do honour to your distinguished guest.—(Signed) Arthur Bigge, on behalf of her Majesty.

This message was received with great applause by the company, and the knowledge that Her Majesty had joined her congratulations to those of the whole scientific world gave great and evident pleasure.

After the toasts of Her Majesty the Queen, the Prince and Princess of Wales, and the other members of the Royal Family had been duly honoured, the Lord Justice General of Scotland proposed that of the Houses of Parliament, coupling it with the names of Lord Rayleigh and Dr. James A. Campbell, member of Parliament for the Glasgow and Aberdeen Universities.

In concluding his reply on behalf of the House of Lords, Lord Rayleigh said:—

I suppose there are not very many here present who have followed more closely than I have done the writings with which our guest has furthered science for many years. It would be a commonplace to say that much which now passes as current science has its origin in those writings. But what gives to me more to think about, what is to me a matter of deeply-felt gratitude, is the twenty or twenty-five years' friendship with him that it has been my own privilege to enjoy—a friendship enlivened by many discussions, some perhaps not without a spice of controversy; but it would be difficult to convey the deep debt of gratitude due for all I have learned from him, in his writings or in his stimulating conversation. I feel, however, if I were to enlarge upon this subject, I should be very soon called to order, because I should be trenching on a toast which is soon to be proposed; but I feel I cannot abstain from saying a few words as a result of the very heartfelt feelings which I have on this subject.

The Lord Provost, in a most excellent and appreciative speech, next proposed the toast of the evening. He began by reading cable messages from the University of Toronto and the students of the University of Moscow. The latter ran as follows:—

To the celebrated Lord Kelvin, famous, learned, we send our congratulations, the Moscow University Students.

Telegrams of regret for absence were read from Lord Salisbury, Sir John Gorst, and others. The Lord Provost also read the following letter from the Principal of the University, unhappily laid aside by illness:—

The University, Glasgow, June 10, 1896.

My dear Sir James,—Will you allow me to express to you and to any others who may chance to notice my absence, my great disappointment and regret that I am not permitted to be

present next week at the banquet at which you are to preside, or at any of the other functions in connection with Lord Kelvin's jubilee. It would have been a great gratification to me to take part in the universal tribute of admiration and respect that is to be paid to the great man of science, and to give public expression to the esteem and affection which for many a long year I have felt for him as my colleague and friend. Acting under medical advice, however, I am reluctantly constrained, owing to a recent illness, from which I have not yet completely recovered, to refrain from taking part in the approaching ceremonials.—Very truly yours, (Signed) J. CAIRD.

The Lord Provost then proceeded, and, after a very interesting, but necessarily brief, sketch of Lord Kelvin's career, he concluded with the following graceful words :—

This life of unwearied industry, of universal honour, has left Lord Kelvin with a lovable nature that charms all with whom he comes in contact. Unaffected, ever wishful to get the opinions of others, courteous and kind, well might Prof. Huxley, after a memorable controversy, introduce Lord Kelvin as his successor in the presidency of the British Association with these words :—"Gentler knight never broke lance." Lord Kelvin, indeed, inspires love and reverence in all. His home life is love and melody. His helpmate is worthy of him, and greater cannot be said. Those who have the great privilege of their friendship, will in their hearts with fervent prayer add to the toast the wish that Lord and Lady Kelvin may long be spared to one another. I give you "Lord Kelvin, and hearty congratulations on the attainment of his jubilee."

The toast was pledged with great enthusiasm, and, on the call of the Lord Provost, cheers were raised for Lady Kelvin, the entire company rising and waving handkerchiefs. The cheering was again renewed when the organist played "See the Conquering Hero," followed by "For He's a Jolly Good Fellow," in which the company joined *con amore*.

On rising to respond, Lord Kelvin was greeted with enthusiastic applause. He said—

My Lord Provost, your Excellency, my Lords, and gentlemen,—First of all, I desire to express the deep and heartfelt gratitude with which I have heard the most kind and gracious message from Her Majesty the Queen, which has been read to us by the Lord Provost. But I cannot find words for thanks. I can only, on the part of Lady Kelvin and myself, tender an expression of our loving loyalty to the Queen. My Lord Provost, my Lords, and gentlemen, I thank you with my whole heart for your kindness to me this evening. You have come here to commemorate the jubilee of my University professorship, and I am deeply sensible of the warm sympathy with which you have received the kind expressions of the Lord Provost regarding myself in his review of my fifty years' service, and his most friendly appreciation of practical results which have come from my scientific work. I might perhaps rightly feel pride in knowing that the University and City of Glasgow have joined in conferring on me the great honour of holding this jubilee, and that so many friends and so many distinguished men, friends and comrades—day-labourers in science, have come from near and far to assist in its celebration, and that congratulations and good wishes have poured in on me by letter and telegram from all parts of the world. I do feel profoundly grateful. But when I think how infinitely little is all that I have done, I cannot feel pride ; I only see the great kindness of my scientific comrades, and of all my friends, in crediting me for so much. One word characterises the most strenuous of the efforts for the advancement of science that I have made perseveringly during fifty-five years ; that word is failure. I know no more of electric and magnetic force or of the relation between ether, electricity, and ponderable matter, or of chemical affinity, than I knew and tried to teach to my students of natural philosophy fifty years ago in my first session as Professor. Something of sadness must come of failure ; but in the pursuit of science, inborn necessity to make the effort brings with it much of the *certaminis gaudia*—and saves the naturalist from being wholly miserable, perhaps even allows him to be fairly happy, in his daily work. And what splendid compensations for philosophical failures we have had in the admirable discoveries by observation and experiment on the properties of matter, and in the exquisitely beneficent applications of science to the use of mankind with which these fifty years have so abounded ! You, my Lord Provost, have remarked that I have had the good fortune to remain for fifty years in one post. I cordially reply that for me they have been happy years. I cannot forget that the happiness of Glasgow University both for students and professors is largely due to the friendly and genial City of Glasgow in the midst of which it lives. To live among friends is the primary essential of happiness ; and that, my memory tells me, we inhabitants of the University have enjoyed since I first came to live in it in 1832, sixty-four years ago ! And when friendly neighbours confer material benefits, such as the citizens of Glasgow have conferred on their University in so largely helping to give it its present beautiful site and buildings, the debt of happiness due to them is notably increased. I do not forget the charms of the old college in the High Street and Vennel, not very far from the comforts of the Saltmarket, which was my home from 1832 till 1870. Indeed, I remember well when, in 1839, the old Natural Philosophy class-room and apparatus-room (no physical laboratory then) was almost an earthly paradise to my youthful mind. And the old College Green, with the ideal memories of Osbaldistone and Rashleigh and their duel, and Rob Roy intervening to prevent bloodshed, created for it by Sir Walter Scott, was attractive and refreshing to the end. But density of smoke and of crowded population in the adjoining lanes increased, and pleasantness, healthiness, and convenience of the old College both for students and professors diminished year by year. If, my Lord Provost, your predecessors of the Town Council, and the citizens of Glasgow, and wellwishers to the city and its university all over the world, and the Government, and the great railway company that has taken the old college for a passenger and goods station, had left us undisturbed on our ancient site, and had not given us our new college, I do not believe that attractions elsewhere would have taken me away from the old college—but I do say that the fifty years of professorship which I have enjoyed would have been less bright and happy, and I believe also less effective in respect to scientific work, than they have been with the great advantages with which the University of Glasgow has been endowed since its migration from the High Street. My Lord Provost, I ask you to communicate to your colleagues of the Town Council my warmest thanks for their great kindness to me in joining with the University to celebrate this jubilee. Your Excellency, my Lords, and gentlemen, I thank you all for the kind manner in which you have received the toast of my health proposed by the Lord Provost, and for your presence this evening to express your good wishes for myself.

Prof. W. T. Gairdner, F.R.S., in an interesting speech, proposed the representatives present from other Universities and learned bodies, coupling it with the names of His Excellency General Annibale Ferrero, Ambassador for Italy, Sir Joseph Lister, President of the Royal Society, and Prof. Simon Newcomb, Washington. These gentlemen replied as follows.

His Excellency General Annibale Ferrero, Ambassador for Italy, who, in acknowledging the compliment, spoke in French, said—My Lords, Ladies, and Gentlemen, when the honour was done me of asking me to speak in the name of so many illustrious men, I thought that it would be great hardihood on my part to accept a duty which would have better suited men whose name had already a place in the history of science. However, I thought that I had the honour of representing a country from which there have come great predecessors of Lord Kelvin, such as Galileo, Volta, and Galvani. In coming here to represent the scientific bodies of our respective countries we have merely the desire to render homage to the man of genius whose jubilee is being celebrated by the University of Glasgow, which has the honour of possessing him. But our presence is also intended to show that the whole scientific world desires to take part in recognising the services which Lord Kelvin has rendered to the human race. The light which shines to-day upon the University of Glasgow is like that of the sun. It does not belong to one country but extends to all nations. We owe special thanks to Prof. Gairdner for the way in which he has proposed the toast of the representatives of other institutions and learned bodies. We also owe a tribute of gratitude to the Corporation of Glasgow for the cordial and dignified welcome which has been accorded us. We have taken part in this jubilee celebration with the most lively feeling of admiration for the great man who is its object. The noble ceremony which we witnessed to-day in the University raised our spirits and touched our hearts. I cannot

better express our common thought than by saying that we have taken part in the apotheosis of science. I conclude by expressing the kindest wishes to the University of Glasgow, and our gratitude to Providence for having confided to us an incalculable treasure in the person of Lord Kelvin. May he be long spared to humanity.

Sir Joseph Lister said—My Lord Provost, my Lords and gentlemen, I have to thank Prof. Gairdner, my old friend, for the kind words in which he has referred to myself in the close of his speech, and this most distinguished company for the manner in which they have been received. It has been to myself a matter of unalloyed satisfaction to attend this grand celebration. A jubilee is sometimes attended with melancholy when it is felt that the man in whose honour it is held is failing in body and in mind, and that his life's work is over. No such cloud hangs over us to-day. It is true, as you are all aware, that some months ago Lord Kelvin experienced some indisposition. There was felt anxiety in some quarters, whether it might be prudent for him to undergo the fatigue and excitement necessarily attendant upon an occasion like this. Lord Kelvin came to London some weeks since, and he did me, as an old colleague, the honour of asking my advice. I looked into his case as carefully as I could, and it seemed to me that his ailment had been in its origin purely local, implying nothing of constitutional defect, and giving no reason to apprehend any ultimate impairment of bodily or mental vigour. A certain amount of care had been required at the outset, and this had been taken under the direction of the eminent men whose advice he had had in Glasgow; and I agreed with them in the opinion that the care might be gradually relaxed; and finally I took upon myself the somewhat serious responsibility of giving to Lord Kelvin *carte blanche* to behave as any ordinary mortal might do. Now, gentlemen, I venture to think that what we have seen and heard of Lord Kelvin in the course of the last two days justifies my boldness, and that we may confidently look forward to the fulfilment of the hope which he expressed this morning, that he may yet for many years to come pursue with unabated energy those magnificent researches which have already done so much to benefit humanity. There is another aspect of this occasion with regard to which I should like to say a word. It has been to me a matter of very great pleasure to witness the splendid vitality and vigour of the school in which I had once the honour of being a teacher, in palatial buildings, which may well excite the envy of us Londoners—a true teaching university in the full tide of prosperity and usefulness. I have also been exceedingly pleased to observe the friendly co-operation between the university and the municipality, of which this magnificent banquet is of itself sufficient evidence. The electrical illumination of the college buildings, which so largely promoted the success of last night's entertainment, was due to the liberality of the municipality, guided by the wise and bold policy of the Lord Provost. I visited to-day the Botanic Garden—that indispensable adjunct of an efficient university. In former days these gardens produced a painful impression upon those who visited them. They gave too clear an evidence that science was confined and cribbed for want of pecuniary means. Now all this is altered. The beautiful site has been extended and embellished, magnificent new houses have been erected, and everything bears the stamp on the one hand of scientific wisdom in their management, and on the other hand of ample resources. Now, all this is due to the beneficent rule of the municipality of Glasgow. I feel, therefore, that whether I look at this great celebration with regard to its essential object—the homage of the scientific world to our illustrious friend—or to the evidence which it has afforded of the prosperity of the University and the wise liberality of this great city, it has given me unmixed pleasure; and it has been a high privilege to have been permitted to take part in it.

Exhibition of diplomas and instruments, showing telegraph receiving and sending instruments, used for receiving and replying to congratulatory messages.

Prof. Simon Newcomb, Washington, U.S., replied for the Americans. He remarked—I feel that an apology is due to you in accepting the invitation to speak this evening, and thereby imperilling a certain reputation which I believe my country has for grace in after-dinner speeches. The fact is, that until it was too late I was really not aware America would have so many representatives here better able than I am to do justice to the occasion. But there is yet another reason why I was extremely unwilling to voice the sentiments which I know are entertained by all Americans on the present occasion. If among the friends of Lord Kelvin, who for twenty-five years have been in more or less intimate association with him, that one was to be selected of whom during that period he had most kindly spoken, and

awarded a praise that was perhaps the least deserved, I think it would have been the humble individual who now has the honour of addressing you. As Americans, you are aware how very close is our association with the great man of science whose jubilee we now celebrate. He first became known to us through his work in connection with the Atlantic cable of 1858, a cable which, those of you who now can remember it, ceased after a week or two of rather intermittent activity. It is quite true that on that occasion his fame was temporarily eclipsed by that of the operator who sent the messages from the end in Newfoundland. The name of this operator ran from city to city throughout the country. It had never been heard of before; it filled the land for those few brief days, and when the cable ceased to send the current, it disappeared almost for ever. For an explanation we had to refer to one of our most eminent men of science, who has lived, I think, wherever the English language is spoken—the author of the "Autocrat of the Breakfast Table"—and who published a theory or explanation of the whole phenomenon. This man was a living product of the galvanic action of the cable, and when the current ceased to pass, there was nothing left in the room he occupied but a cloud of organic elements such as man is made of. On the subsequent occasion of laying the cable in 1866, our guest again became well known to us for his work in promoting that object. Also, in our naval service, to which I have the honour to belong, we are in many ways most indebted to him. I do not think the name of any man is more familiar to the officers of our navy anywhere than that of Lord Kelvin, first, by his work on magnetism, and for the navigation of ships, and by his deep-sea sounding apparatus, as well as by many others of his inventions which relate to navigation. There are certain features of his work which, as one so long intimately associated with him, it may not be amiss that I recall. The first, and perhaps most unique, feature is the combination of abstract results with practical application. It has been the general—I do not know but that it has been the almost universal—rule that the men who have by their studies and thought promoted our knowledge of nature have not been those who have applied that knowledge to the direct benefit of mankind by inventing means for its application. I am not sure but that Lord Kelvin is the single, solitary exception to this rule. The ground covered by his work is certainly remarkable in its extent. The first knowledge I had of him—probably the first that those who cultivate mathematics know of him—is in connection with a journal published back in the forties, and known under different names at different times as the *Cambridge, London, and Dublin Mathematical Journal*. For a period, I believe, he was associated in the editorship of that journal. Now, it is worthy of remark in this connection, that at the present time sets of this journal can command a price that is almost fabulous in the public market from the mathematicians of the day. Then at this point he diverged from the doctrine which was said to have been laid down by one of the most eminent workers in the words, "I thank Heaven that I cultivate a science which cannot be prostituted to any useful purpose." In passing from the field of mathematics we come next to pure philosophy by saying that the theory of energy in its present form is, I think, very largely due to his work. This is, perhaps, the most far-reaching generalisation as to the laws of action that the world has seen; it enables us to see the beginning of the universe and to look forward towards its end. We all read discussions as to the age of the earth and the question whether the geologist has an indefinite bank of time on which he can draw cheques without limit. Yet another question of geology was that of the rigidity of the earth, in which I think his view is almost universally accepted. In this wide range of activity I think we may say that he has made few mistakes—perhaps we may say that he is almost unique in not having made any. I beg leave, on behalf of the foreign representatives, to thank you, my Lord Provost and the citizens of Glasgow for the very cordial reception we have met in coming here to present our congratulations to Lord Kelvin on this memorable occasion. We shall ever remember that reception, and I beg leave on behalf of all to again express the hope that our honoured guest of this evening may live for many years.

Prof. Story, at the suggestion of the Lord Provost, very gracefully proposed the health of Lady Kelvin, which was received with great applause. Lady Kelvin, who occupied a seat in the balcony, bowed her acknowledgments, and Lord Kelvin, replying for her, said—

Prof. Story has said well that I owe a great deal to Lady Kelvin, but he does not know how much I owe. No person in the world except myself knows how much of any results for science that it has been possible for me to arrive at are due to her co-operation. I thank you warmly for the very kind manner in which you, Prof. Story, have proposed this toast, and with which the company have received it.

After the toasts of the University and City of Glasgow, proposed by the Earl of Rosse, D.C.L., F.R.S., and the Lord Provost, proposed by Sir Henry Roscoe, F.R.S., had been duly honoured and replied to, the company joined in singing "God Save the Queen," and afterwards, on the request of Lord Kelvin, in singing "Auld Lang Syne."

Thus closed the celebration proper, a celebration almost unique in the experience of every one present for its grand simplicity, splendid enthusiasm, and entire success in every detail of arrangement. For the latter characteristic the Jubilee Committee deserve the highest credit, and its Secretaries, and others, among whom are the Rev. Professor Stewart, D.D., Clerk of Senate, Mr. Allen Baird, and members of the Senatus, who had charge of the University arrangements, may well be proud of the result of their labours.

Nothing in Lord Kelvin's reply to the toast of his health at the banquet was more characteristic of the man than his humble confession of failure to penetrate the mystery of the constitution of matter and of ether. It is no doubt true, as Lord Kelvin remarked, that the nature of electric and magnetic force, and the relation between ether, electricity, and ponderable matter, are still unknown to us; but Lord Kelvin's researches have been the means of enabling himself and others to unravel many of their phenomena, to connect these phenomena by general laws, and to marshal the forces of science for still further assaults on the unknown. The *certaminis gaudia* is not after all in this case mere joy of conflict, but the pleasure of obtaining by strenuous endeavour some view first of the very innermost secrets of nature, and what is of very great consequence and may in time include everything, an accurate conception of her method of working, and of the dynamical laws which govern her operations.

A number of delegates and others left Glasgow on Wednesday morning, but many remained and accepted the invitation of the Senatus to a special excursion on the Firth of Clyde. A special train was run from St. Enoch's station to Greenock, where the steamer *Glen Sannox* awaited the party. The morning was wet, but the ample saloon accommodation of the splendid steamer, with an awning erected on deck, provided sufficient shelter. The steamer headed down the Clyde instead of proceeding up Loch Long, where it was likely to be raining still more heavily, and proceeded past Largs, saluting Nether Hall, Lord Kelvin's country house at Largs, in passing, thence between the Cumbraes to the mouth of Loch Fyne, then round the Kyles of Bute, and back to Greenock in time to allow Glasgow to be reached before the departure of the limited mail train in the evening. Luncheon and tea were served on board. The weather cleared about midday, and the excursion proved most enjoyable to all, and there were many who ventured to go. Lord and Lady Kelvin with their party were present, and, it was gratifying to observe, seemed to be in excellent health and spirits in spite of the excitement and fatigues of the previous days.

A. GRAY.

INTERNATIONAL CATALOGUE OF SCIENCE.

THE approaching International Conference arranged by the Royal Society to consider proposals for an International Catalogue of Scientific Literature will be formally opened at the apartments of the Society in Burlington House on the morning of Tuesday, July 14. A reception of the delegates will be held by the

President of the Royal Society on the previous evening at Burlington House, and they will be entertained at dinner by the Society on the evening of the 14th at the Hôtel Métropole. On the 15th the delegates will be received by the Lord Mayor at the Mansion House, and on the afternoon of the 16th they will be entertained by Dr. Ludwig Mond, F.R.S., at a garden party at his house in Avenue Road. The total number of delegates appointed to attend the Conference amounts to forty, including representatives of the principal colonies of the Empire and the principal Governments of the world.

The following is a list of the delegates appointed to attend the Conference.

AUSTRIA.—Prof. Dr. Edmund Weiss; Prof. Dr. Ernst Mach.

BELGIUM.—Chevalier Descamps-David (President Institut International de Bibliographie); M. de Wulf (Member Institut International de Bibliographie); M. Paul Otlet (Member Institut International de Bibliographie).

BRAZIL.—Dr. João Ribeiro (Professor "Gymnasio Nacional").

DENMARK.—Prof. Christiansen (Universitet, Copenhagen).

FRANCE.—Prof. A. Milne-Edwards (Membre de l'Institut, &c.); Prof. G. Darboux (Membre de l'Institut, &c.); Prof. Troost (Membre de l'Institut, &c.); Dr. J. Deniker (Librarian, Muséum d'Histoire Naturelle, Paris).

GERMANY.—(Names not yet received).

GREECE.—M. Avierinos M. Averoff (Greek Consul at Edinburgh).

HUNGARY.—Prof. August Heller (Librarian, Ungarische Akademie, Buda-Pesth); Dr. Theodore Duka (London).

ITALY.—General Annibale Ferrero (Italian Ambassador in London).

JAPAN.—Hantaro Nagaoka (Assistant Professor, Science College, Tōkiō); Gakutaro Ozawa (Assistant Professor, Medical College, Tōkiō).

MEXICO.—Señor Don Francisco del Paso y Ironcoso.

NETHERLANDS.—Prof. D. J. Korteweg (Universiteit, Amsterdam).

NORWAY.—(Names not yet received).

PORTUGAL.—The Portuguese Minister in London (Señhor D'Antas).

RUSSIA.—Privy Councillor Stasow (First Librarian, Imper. Publičnaja Biblioteka, St. Petersburg).

SWEDEN.—Dr. E. W. Dahlgren (Librarian, Kongl. Svenska Vetenskaps Akademie, Stockholm).

SWITZERLAND.—The Swiss Minister in London (M. Bourcart); Prof. Dr. F. A. Forel (Président du Comité Central de la Société Helvétique des Sciences Naturelles).

UNITED KINGDOM.—Representing the Government: Right Hon. Sir John E. Gorst, M.P. (Vice-President of the Committee of Council on Education). Representing the Royal Society of London: Prof. Michael Foster, Sec. R.S., Prof. H. E. Armstrong, F.R.S., Mr. J. Norman Lockyer, C.B., F.R.S., Dr. Ludwig Mond, F.R.S., Prof. A. W. Rücker, F.R.S.

UNITED STATES.—Dr. John S. Billings (U.S. Army); Prof. Simon Newcomb, For. Mem. R.S. (U.S. Nautical Almanac Office).

CANADA.—The High Commissioner for Canada (the Hon. Sir Donald A. Smith, G.C.M.G.).

CAPE COLONY.—Mr. Roland Trimen, F.R.S.

INDIA.—General Sir Richard Strachey, F.R.S.

NATAL.—The Agent-General for Natal (Walter Peace, C.M.G.).

NEW SOUTH WALES.—(Appointment awaiting confirmation).

NEW ZEALAND.—The Agent-General for New Zealand (the Hon. W. P. Reeves).

QUEENSLAND.—The Agent-General for Queensland.

NOTES.

WE are asked to state that a zoologist with experience of deep-sea dredging is required for the Belgian Antarctic expedition. Intending applicants should communicate with Lieut. de Gerlache, Commander of the expedition, at Sandefiord, Norway.

PROF. DR. G. NEUMAYER, the Director of the Deutsche Seewarte, reached his seventieth birthday on Sunday last. We join with German scientific papers in congratulating Prof. Neumayer upon his numerous contributions to natural knowledge, and in the hope that science may have the benefit of his assistance for many years to come.

DR. D. GILL, F.R.S., has been elected a Correspondant of the Paris Academy of Sciences.

WE regret to announce that Sir Joseph Prestwich died on Tuesday morning, after a short illness. By his death science has lost a devoted student, whose numerous papers in the various departments of theoretical, observational, and practical geology testify to a career of earnest and careful work. He was born in in 1812, and became a Fellow of the Royal Society in 1853.

MR. J. H. MAIDEN has been appointed Government Botanist and Director of the Botanic Gardens at Sydney, in succession to Mr. Charles Moore, who has recently retired after a service, in these capacities, of nearly half a century.

MAJOR ARTHUR GRIFFITHS, one of her Majesty's Inspectors of Prisons, has been appointed by the Home Secretary to represent her Majesty's Government at the International Congress of Criminal Anthropology to be held at Geneva in August next.

WITH reference to the tornado at St. Louis on May 27, we learn from *Science* that, with commendable promptness, the Washington Weather Bureau issued, on May 29, a special storm-bulletin showing the weather conditions over the United States on May 26–28. The Chicago 8h. a.m. forecast on May 27 predicted severe thunderstorms for Illinois and adjoining States during the latter part of the day, and a special warning was issued from Washington at 10h. 10m. on that morning.

THE Northern Province of Japan has recently been visited by a series of destructive earthquakes. Within twenty hours, on the 15th and 16th insts., no less than 150 shocks were felt. Nearly the whole of the town of Kamaishi has been destroyed, with the reported loss of one thousand lives. Three of the shocks appear to have been of exceptional severity, for, according to information we have received from Prof. Vicentini, they were registered by his microseismograph at Padua. The first pulsations began there at 10h. 45m. a.m. (Greenwich mean time) on the 15th, and lasted till 0h. 10m. p.m.; the second continued from 7h. 28m. to 8h. 30m. p.m.; the third and strongest began at 11h. 14m. p.m., and ended at 0h. 2m. a.m. on the 16th inst. The great sea-wave, which accompanied the earthquake, extended over seventy miles of the north-east coast of Japan, destroying many towns, and drowning, it is feared, about ten housand persons.

A DEVOTED student of natural history, whose name is known to most zoologists, and whose observations have greatly enriched ornithology, has just passed away in the person of Lord Lilford. Numerous notes by him on British birds, and on the ornithology of Spain and of the shores of the Mediterranean, have appeared in the *Zoologist* and the *Ibis*, the journal of the British Ornithologists' Union, of which he was President. Last year he published an excellent volume on the birds of his native county, Northamptonshire, with beautiful illustrations, and the thirty-second part of his "Coloured Figures of the Birds of the British Islands," which was issued only in April last, almost

completes that work. Lord Lilford will be remembered and regretted by naturalists all over the world.

M. TONY NOËL has (says the *British Medical Journal*) just finished a statue of Pasteur, to be placed in the market-place of Alais, where the illustrious investigator made his researches in the diseases of silkworms. The statue is declared by the relatives and friends of M. Pasteur to be an excellent likeness, and artistically it is a very successful piece of work. Pasteur is represented erect, gazing fixedly at a sprig of mulberry covered with cocoons which he holds in his left hand. At his feet is a young girl in a graceful attitude handing him other cocoons. Near at hand are a microscope and a box of scientific instruments. M. Berthelot, who in company with M. Roux carefully inspected the statue, is said to have exclaimed: "Je revois Pasteur tel qu'il était il-y-a vingt-cinq ans."

WE regret to announce the death, on the 14th inst., of Dr. H. B. Pollard, lecturer on biology and comparative anatomy at Charing Cross Hospital. Elected a scholar of Christ Church, Oxford, in 1885, Dr. Pollard graduated B.M. with first class honours in morphology in 1890, and concurrently gained similar distinction in the London intermediate and final B.Sc. examinations. He subsequently studied for two years under Prof. Wiedersheim at Freiburg, and in 1892 was appointed to the Oxford table at Dr. Döhrn's laboratory at Naples. In 1893 he was elected Berkeley Fellow of the Owens College, Manchester, and in 1895 lecturer at Charing Cross Hospital. He was granted the degree of D.Sc. by London University for a thesis on Polypterus. Dr. Pollard made a special study of fish, and in a series of papers contributed to German scientific periodicals, he originated a theory of their development which has received considerable attention from biologists. He was writing a text-book on the subject at the time of his death, which took place at Dover, in his twenty-eighth year. He was apparently stunned by a fall while bathing and drowned.

FOR the opening of museums and art galleries on Sundays we are undoubtedly very largely indebted to the zeal of Mr. Mark Judge, the Honorary Secretary of the Sunday Society. For some years the Society cried aloud in the wilderness, but few of the multitude paid heed, though such men as Darwin, Huxley, Romanes, Spottiswoode and Tyndall, only to mention a few of the supporters who are gone, became apostles of the movement. From the time when the Society was founded, thirty years ago, Mr. Judge has advanced its objects with the pertinacity which comes from conviction, and has thus educated public opinion on the subject of Sunday reform. The objects have now been attained, and there is a feeling that the services rendered by Mr. Judge in support of them should be publicly recognised. A Committee has therefore been formed to appeal, for subscriptions for a testimonial to Mr. Judge. It is hoped that a ready response will be made to the appeal, as a token of gratitude for the boon of Sunday opening. The Chairman of the Testimonial Committee is the Rev. S. A. Barnett, and the Hon. Sec. and Treasurer, Prof. Corfield, to whom subscriptions may be sent at 19 Savile Row, W.

WE learn from *Science* that the party from Cornell University which will embark with Lieut. Peary on the *Kite* is as follows. R. S. Tarr, professor of dynamic geology and physical geography; A. C. Gill, professor of mineralogy and petrography; J. A. Bonstell, assistant in geology; T. L. Watson, fellow in geology; E. M. Kindle, scholar in palæontology; and J. O. Martin, special student in entomology. It is the purpose of the party to make as thorough a geological study as is possible in five or six weeks, of the region near the Devil's Thumb, at the south end of Melville Bay, and in addition to this to make collections of flora and fauna. Another party will also sail with Lieutenant Peary, under the leadership of A. E. Burton, professor of civil engineering in the Massachusetts Institute of Technology. This party will land at the great Umanak Fiord; they will make pendulum observations, natural history collections, and study the glacial phenomena. Lieut. Peary himself will proceed north as far as Cape Sabine at the entrance of Smith Sound. He will also endeavour to explore Jones Sound. He will be accompanied by Mr. Albert Operti, the artist, who will take casts of the Cape York natives for the purpose of making models for the American Museum of Natural History, New York.

IN connection with the note in NATURE of June 18 (p. 158), with reference to the instruction in meteorology in the University of Odessa, our attention has been drawn to a circular relating to meteorological observations in schools, recently prepared for the Connecticut State Board of Education by Mr. R. De C. Ward, Instructor in Meteorology in Harvard University, and published by the Connecticut Board. The *Document* (No. 10, 1896) points out that the time has come when meteorology should be systematically taught in schools, and it indicates the lines along which the elementary study of the subject should proceed in order to be most thorough and useful. In addition to the registration of observations without the use of instruments, including current weather and the state of the sky, it is not proposed to attempt anything more than records of temperature, direction and force of wind, and rainfall during the early years of the grammar-school course. Such elementary work cannot fail to attract both teachers and scholars, and to lay a foundation on which, in after years, a more advanced study of meteorology (including the practical use of daily weather maps) may be built up.

THE Hawke's Bay Philosophical Institute, New Zealand, is fortunate in having such a generous and broad-minded friend as the Rev. William Colenso, F.R.S., as their President. At the opening of the Institute's session in May, after delivering an animated address, Mr. Colenso put before the meeting a scheme for the foundation of a museum to take the place of the present museum at Napier. He offered to give towards the realisation of his scheme the sum of £1000 and a freehold site, and to supplement this with a second donation of £500 so soon as £500 was given by some one else. The total amount required to establish the museum is about £4000. Referring to the conditions of gift, Mr. Colenso said: "The museum must be a building which will be open every day of the week and Sunday afternoons too. I find that this is the case in Auckland, where large numbers visit the museum on Sunday afternoons. And what better use can a man give to his time than in the observance of the wonderful works of his Maker? There is another proviso, and that is that the building must only be used for the purposes of a museum and library. There must be no concerts, no Liedertafels, no spouting, no mutual admiration societies, no globe-trotters, no tourists, and no parsons. I will not give a penny for persons of that kind. I have received a letter asking for assistance for a museum in my native town in England. There the money has to be raised by a certain time. So in Napier it must be raised by December 31. The deed would be vested in five trustees, who should be generous and businesslike men, with a keen interest in the project. The museum proposed would be a museum for the East Coast, not only for Hawke's Bay proper, or for the old provincial district, but for Poverty Bay and Gisborne and the country stretching up to the East Cape." There should be no difficulty in raising the money required for the consummation of the scheme which Mr. Colenso has in mind, and towards which he is willing to contribute so liberally.

DR. BRUNI, of Naples, has recently contributed an important paper to the *Annales de l'Institut Pasteur*, corroborating earlier investigations on the association of the typhoid bacillus with cases of osteomyelitis. The bacteriological study of this disease has recently been actively pursued, and a French physician not long ago published statistics of ninety cases in which he found the *Staphylococcus aureus* seventy times, and the typhoid bacillus four times. Particular interest attaches to the connection of Eberth's bacillus with osteomyelitis, since Orloff, Fränkel, and others have shown that this organism is frequently found in osseous tissue, whilst of especial importance is the discovery made by Chantemesse and Widal, that it has a particular predilection for the marrow of bones. Osteomyelitis may declare itself not only during the course of typhoid fever, or during the period of convalescence, but also a long time after the recovery has been completed. That a connection was possible between typhoid fever and subsequent manifestations of osteomyelitis was first indicated by Keen in 1878; but for the more precise information which is now at our disposal on this subject, we are indebted to Chantemesse and Widal. Dr. Bruni describes a most interesting case of osteomyelitis in which the typhoid bacillus was found in the marrow of the left tibia, six years after the patient had recovered from an acute attack of typhoid fever. Most careful tests were made, including Pfeiffer's ingenious serum reaction, to correctly diagnose the bacillus found as that of typhoid, and there appears to be no doubt that Dr. Bruni has furnished fresh evidence of the new *rôle* which may be assumed by this much-dreaded microbe.

DURING last year M. Flammarion made some interesting experiments as to the effect of lights of different colours upon vegetable growth (*Bull. Soc. Ast. France*, June). On July 4, eight identical sensitive plants, which had been sown at the same time, were selected for experiment. These were placed two by two in similarly constructed glass boxes, of which the sides were of different colours, one being red, one green, one blue, and another of ordinary clear class. All were exposed to precisely the same meteorological conditions throughout. The rates of growth were as follows:

	Red. m.	Green. m.	Blue. m.	White. m.
Sept. 6	0·220	0·090	0·027	0·045
,, 27	0.345	0·150	0·027	0 080
Oct. 22	0·420	0·152	0·027	0·100

Thus, while the plants exposed to blue light made no progress whatever, those exposed to red increased their height fifteen times. The latter, moreover, acquired an extraordinary degree of sensitiveness. Similar results, but not so strongly marked, were obtained with geraniums and other plants. The fact that the plants exposed to white light grew less rapidly than those which were under red glass, although receiving the same amount of red radiations, seems to suggest that the presence of blue light in the former case not only did not accelerate the growth of the plants, but actually retarded it.

IN vol. viii. of the *Proc. Roy. Soc. Victoria* (Melbourne), recently published, Mr. R. Etheridge, jun., describes some Trilobite remains from Heathcote, on the western side of Mount Ida, which are of extreme interest as an addition to the scanty Cambrian fauna of the Antipodes. Although occurring only as casts, the characters of the head and pygidium appear to be clearly shown, so much so that Mr. C. D. Walcott, from an examination of careful drawings, unhesitatingly referred them to the Middle Cambrian. As the result of a critical comparison, Mr. Etheridge is unable to identify them with any known genus, and has named the specimens *Dinesus ida*. Along with this trilobite occurs a brachiopod, which seems very similar to *Lakhmina*, a form described from the Cambrian of the Salt Range, India. It is to be hoped that this scanty fauna, which is the only unquestionable *Middle* Cambrian fauna yet found in Australia, and which seems to have no close relation to any of the other Cambrian faunas of that country, may soon be added to, for it is certain that the trilobites are a most promising group for the determination of the geographical life-provinces which may have existed in these remote times. In the same volume there is a revision of (with additions to) the fauna of the Table Cape Beds, Tasmania, by Mr. Pritchard, who regards it as Eocene.

THE *Agricultural Gazette* of Cape Colony publishes a letter sent by Sir Ferdinand von Mueller to Sir Hercules Robinson, the Governor of the Colony, and appealing for a reserve-ground for the preservation of rare Cape plants. As the veteran botanist of Victoria points out, the vegetation of South Africa is the richest in the world, not only as to number of species, but also as containing an astounding variety of plants of special and peculiar type, aggregated chiefly in the south-western provinces and occurring nowhere else. Hundreds of these are quite local and restricted to very circumscribed areas. They are sure to be swept out of existence altogether, unless special provision is made for their preservation; and it is on that account that the appeal is made for a wild-garden or reserve for the conservation of Cape plants in areas where they can be maintained for the knowledge of generations to come. It may be said that botanic gardens exist already in several parts of the colony; but in a report upon Baron von Mueller's proposal, Prof. Mac Owan remarks: "These places can only exist by making themselves into a lounge or pleasaunce of idle hours for the population living close by. I speak as one who knows, for it was my lot to run one of these for fourteen of the hardest and most unsatisfactory years of my working life. The conditions of support compelled the place to grovel down into a nursery-garden on commercial lines, in order to get money enough to keep it presentable for the daily stroller. Nor did I ever dare to plant up any single portion of it with typical representatives of our Flora. The public would have taken the alarm at once. They care nothing for the special prehistoric flora of the land they live in, compared with the newest hideous abortion in chrysanthemums. . . . So that some of the gardens which we complaisantly call botanic, have it in them to stand between the living and the dead, and stop the slow and sure extinction of the most ancient and interesting part of our Cape Flora. This state of things, brought home to me yearly as I traverse the same solitudes each season, and note the increasing scarcity of rare plants, has been much in mind; but I do not see any other way of dealing with the matter, than by the reserve, now recommended, of chosen localities for all time and inalienable." But much as this is to be desired, Prof. Mac Owan has to confess that the idea is not likely of even approximate fulfilment.

UNDER the editorship of Dr. Götz Martius, Professor of Philosophy in the University of Bonn, the first part of a new journal has appeared, entitled *Beiträge zur Psychologie und Philosophie*. The present number is devoted to considerations bearing on colour-vision, and contains three papers by Dr. Martius on the brightness of negative after-images, on a new method of determining the brightness of colours, and on the conception of specific brightness of colour-sensation. In addition to these, Herr Friedrich Kretzmann contributes a note on the brightness of complementary mixtures.

IN *L'Elettricista*, Prof. A. Róiti describes a new tube for the production of Röntgen rays, in which the bottom end is covered with a cap of aluminium instead of glass, thus allowing freer passage of these rays. According to the figure given, it appears that this cap is used as the anode, the kathode being a concave speculum of aluminium facing it. By polishing with emery

the end of the tube over which the cap fits, the whole is made perfectly air-tight so that good vacua can be obtained. For taking photographs of bones, &c., none of the other tubes that the author had constructed or purchased approached anywhere near the present one in respect of intensity and sharpness of definition.

IN the *Journal of Physiology*, Dr. Lazarus Barlow has pointed out that before the laws of osmosis, deduced from the final osmotic pressure, freezing point, &c., can be applied to the explanation of biological problems, it is necessary to determine whether the initial rates of osmosis of substances bear constant ratios to their final osmotic pressures, and whether the presence of proteid substances in the solutions affects the initial rate of osmosis. The author has found that the initial rates of osmosis cannot be determined from observations of the freezing points of solutions, and that proteid substances, even when present only in minute quantities, markedly diminish the rate of osmosis. In a subsequent paper, Dr. Barlow applies these conclusions to the consideration of lymph-formation, and describes observations of the specific gravity of the blood, of voluntary muscle, and of lymph, which have an important bearing on the question. In his conclusion the author summarises the evidence in favour of the occurrence of osmosis and increased filtration as the effective factors in causing the increased outflow of lymph that is seen after the injection of a crystalloid into the blood, as well as the evidence against the view that osmosis and increased filtration alone account for the observed phenomena.

A VALUABLE little pamphlet on "Coal Mining," full of information on many questions of practical importance in the working and use of coal, has been received from Mr. W. Galloway. The pamphlet is an excerpt from the "Handbook of the Cardiff Exhibition," and may be obtained from the office of the *Western Mail*, Cardiff.

DURING the spring and summer, Herr P. Sintenis has been carrying out a botanical exploration of the mountains of the Peloponnesus. After visiting Volo in Thessaly, he proposes to investigate the almost unknown flora of the south-western portion of the Pindu Chain.

AT the time of his death Mr. Seebohm had almost completed an exhaustive monograph on the "Family of Thrushes" We learn that Dr. Bowdler Sharpe has undertaken to finish the work, and that it will shortly be published by Messrs. Henry Sotheran and Co. It will be illustrated with nearly 150 coloured plates, and the edition will be limited to 250 copies.

A SHORT account of the proceedings of the Sixth International Geographical Congress, held in London last July, appeared in these columns at the close of the Congress. The official Report, containing the addresses delivered and papers read before the Congress, together with a brief historical statement, has now been published. When it is remembered that the papers are in several languages, and that authors are often procrastinators in the matter of reading and returning proofs, the appearance of the Report within a year of the Congress is commendable. Most of the papers are of international interest, and all of them are of geographical value. The two Secretaries of the Congress, and Dr. Mill, who has done the editorial work in connection with the Report, are to be congratulated upon having brought their difficult tasks to a satisfactory conclusion.

THE second edition of the valuable "Statistical Atlas of India" has been published by the Government of India, and is obtainable from Mr. Edward Stanford. The Atlas originally appeared in 1886, but since then another census of India has been taken, and new information has been obtained, so that a revision of the maps was necessary. The maps and diagrams in the Atlas give a good general idea of the character, inhabitants, and resources of India, and illustrate the commercial, financial, and educational condition of the country. Explanatory chapters are contributed by persons having special knowledge of the subjects of them; thus, Sir E. C. Buck writes on physical configuration, irrigation, famine, revenue and rent systems; Dr. W. King, on the geology of India; and Mr. J. Eliot, on the rainfall and climate. Mr. George Watt deals with crops and economic minerals; Mr. B. Ribbentrop with forests; Mr. J. E. O'Conor with prices, foreign trade, finance and taxation; and Veterinary-Lieutenant H. T. Pease with horses and live-stock. The Atlas is an excellent piece of work, which conveys by concise text and clear illustration, an abundance of information concerning our great Indian Empire.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*, ♂) from South Africa, presented by Mr. Vernon E. Barratt; a Black-eared Marmoset (*Hapale penicillata*) from South-east Brazil, presented by Mr. S. Osborn; two Golden Eagles (*Aquila chrysaëtus*), two Peregrine Falcons (*Falco peregrinus*) from the Isle of Mull, presented by the Maclaine of Lochbuie; two Wood Owls (*Syrnium aluco*), a Short-eared Owl (*Asio brachyotus*), British, presented by Mr. A. Farquahar Wilson; a Ring-necked Parrakeet (*Palæornis torquatus*) from India, presented by Miss Smith; a Black-headed Conure (*Conurus nanday*) from Paraguay, presented by Mrs. Baird; two Peafowls (*Pavo cristatus, albino*) from the Transvaal, presented by Mr. F. A. Noyce; a Mona Monkey (*Cercopithecus mona*), two West-African Love-Birds (*Agapornis pullaria*) from West Africa, a Crab-eating Raccoon (*Procyon cancrivorus*) from South America, deposited; an Australian Fruit Bat (*Pteropus poliocephalus*) from Australia, purchased; a Burrhel Wild Sheep (*Ovis burrhel*), a Thar (*Capra jemlaica*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

RETURN OF COMET BROOKS (1889 V.).—A telegram from Kiel announces that Brooks's periodic comet was observed by Javelle at Nice on June 20. At 14h. 17·4m. mean time it was in R.A. 22h. 25m. 30s., Decl. 18° 33′ 59″ S. The comet is now in the southern part of Aquarius, and rises about midnight. It is interesting to note that the observed place of the comet shows a very close agreement with Dr. Bauschinger's search ephemeris printed in NATURE (vol. liv. p. 84).

VISIBILITY OF SOLAR PROMINENCES.—Prof. Hale has brought together some facts which emphasise the importance of the work which may be done by observers of solar prominences at the time of a total solar eclipse without going to view the eclipse itself (*Astrophys. Jour.*, May). It is pointed out that in 1870 Tacchini concluded that the dimensions of prominences spectroscopically observed in full sunshine, and measured in Hα light, were considerably smaller than those measured telescopically during an eclipse. In 1883 the same observer discovered the "white prominences," and found that these were not visible in the spectroscope immediately after the eclipse. Similar results were obtained in 1886, and it was further ascertained that the spectrum of a white prominence consisted principally of the H and K lines, the hydrogen lines being extremely feeble.

The results obtained during the eclipse of 1893 furnish valuable data as to the relative efficiency of the different methods of registering the forms of the prominences, as the spectroheliograph at Chicago was employed on that occasion, and a complete set of eye observations was secured by Fenyi at Kalocsa. A comparison is drawn between these non-eclipse observations and the forms of the prominences as photographed nearly at the same time by Prof. Schaeberle, in Chili, and by Mr. Fowler with the prismatic camera in Africa. It turns out that one of

the largest prominences depicted in all the photographs was not seen at all at Kalocsa. The results with the spectroheliograph were not of the best, owing to haze; but from all available facts, it seems to be established that the white prominences are spectroscopically invisible because they shine chiefly by H and K light. Nevertheless, light of the same refrangibility in the electric arc undoubtedly appears violet; but it may be, as Prof. Hale suggests, that the violet tinge is overlooked in the presence of the more conspicuous colours during an eclipse. The best results obtainable with the spectroheliograph, when K light is utilised, compare very favourably in sharpness of definition, as well as in the rendering of faint details, with the best photographs taken during an eclipse.

SHOOTING-STAR RADIANTS.—In connection with a table of radiant points observed at Hong Kong, Dr. Doberck refers to several interesting points relating to the phenomena of shooting-stars (*Ast. Nach.*, 3360). It is pointed out that the long continuance of some of the radiants is accounted for by parabolic motion, while others can possibly be explained by hyperbolic motion. In explanation of some of the radiants having somewhat similar elements, it is suggested that they were possibly associated with different tails of the same comet.

Owing to the fact that the meteorites are heated to incandescence nearer the earth in the evening than in the morning, there is a small decrease in the average magnitude of shooting-stars during the night; before 9 p.m. the average brightness is mag. 2·7, while of those seen later it is 3·2. Again, on account of the earth's movement, the duration decreases from 0·9 sec. between 6 and 8 p.m. to 0·5 sec. between 8 and 11 p.m., and to 0·3 sec. between 11 p.m. and 4 a.m. Up to 11 p.m. the mean length of path is 15°, and afterwards 13°. The average duration, length, angular velocity per second, and the numbers of shooting-stars observed, classified according to magnitude, are shown in the following table:—

Mag.	Duration.	Length.	Velocity.	Number.
	s.	°	°	
1	0·9	19	21	60
2	0·4	14	35	79
3	0·3	13	43	130
4	0·3	12	40	128
5	0·2	12	60	97

The majority of the shooting-stars below third magnitude were probably hidden by haze and artificial light.

KEPLER AND HIS WORK.—In a little pamphlet entitled "Kepler's Lehre von der Gravitation" (Halle, Max Niemeyer), Dr. Ernst Goldbeck gives an interesting and appreciative account of Kepler and his work. The point principally elaborated is a main difference between Kepler's methods and those pursued by Ptolemy and the older astronomers. These latter were content to solve the problem of celestial mechanics on purely mathematical lines. They were instructed in the shape of the orbits and their dependence on time; they could foretell the place of an object at a definite epoch, and this satisfied their astronomical needs. Kepler, however, the forerunner of the modern school, is concerned in the character and the operation of the force, on which these motions depend. The points surveyed by the author as affecting the development of Kepler's views in his approach to a gravitational theory of the earth are: (1) The transference of the centre of the solar system from the earth to the sun, and the consequent disturbance of Aristotle's views. (2) The impetus given to mechanical inquiry by Gilbert's magnetical investigations. (3) The discovery of the coincidence of tidal phenomena with the position of the moon, and consequently the suggested attraction. (4) The telescopic examination of the moon by Galileo, and the confirmation of the suspected identity of its general character with that of the earth. Kepler's work on Mars, and his endeavours to trace the nature of the connection between the sun and the planets, are graphically described, and the whole pamphlet well repays careful study.

SCIENCE AND SOCIETY AT THE CENTRAL TECHNICAL COLLEGE.

THE object of the conversazione at the Central Technical College, Exhibition Road, on Friday, June 12, was to enable the scientific public to witness the ordinary working life of the students there. Consequently, while in deference to the lady visitors, the staircases and corridors were rendered attractive with arches of palms, arm-chairs, arc lights, and Hungarian airs, neither the blossoms, the banners, nor the band, were allowed to intrude on the apparatus and machinery, which were left as in every-day use.

Laboratory sinks remained sinks, and were not converted into make-believe flower-boxes; while no green baize covers hid the traces of oil and tools on the workshop benches, nor made them resemble extemporised billiard tables.

The Lord Chancellor, as Chairman of Council, and Lady Halsbury, received the visitors, and conspicuous amongst the 1700 were the Masters of many of the City Companies wearing their chains of office.

Exactly twelve years ago to-day (June 25, 1896) the Central Technical College was opened by the Prince of Wales, who expressed the opinion, "that the opportunities for advanced instruction, which will be afforded in the well-arranged laboratories and workshops, will enable the managers and superintendents of our manufacturing works to obtain more readily than hitherto the higher technical instruction which is so essential to the development of our trade and commerce." And, on the same occasion, the late Lord Selborne—the then Lord Chancellor—stated that "in the several laboratories with which this College is provided, new and increased facilities will be afforded for the prosecution of original research, having for its object the more thorough training of the students, and the elucidation of the theory of industrial processes."

An examination of the laboratories and workshops by the visitors at the conversazione, made it clear that the aims initially laid down for the working of the Central Technical College have been steadily kept in view. The Department of Mechanics and Mathematics showed the apparatus which had been developed for familiarising students with the laws of motion and force. Electric clocks transmit time-signals to quick-running Morse instruments for chronographically marking the instants of various experimental events. To measure "g" the falling body is started electrically, its moment of arrival noted electrically, and the interval measured with a vibrating tuning-fork; while for slower motions, such as that of a body rolling down an inclined plane, the electric current that liberates the ball starts a stream of water flowing from a water-clock, which again is instantly stopped on the ball touching an electric trigger placed at any desired point of its path. Apparatus for measuring centrifugal forces, studying impact, finding moments of inertia, timing the vibrations of pendulums, measuring the extensions of wire, &c., make us wish that, when, as boys thirty or forty years ago, we laboured through "little Newth," acquired a particle of Tait and Steele, and struggled with the rigidity of Routh's Dynamics, some Maxwellian demon had opened the door of Prof. Henrici's laboratory, and shown us so vivid a realisation of the principles of what, in the misleading jargon of that day, was called "statics and dynamics," with its "accelerating forces" and "moving forces."

In the same department were seen calculating machines and quadric surfaces, planimeters and plaster of Paris models, integraphs for solving differential equations, and integrators for evaluating areas; while the smooth working of the latest form of Prof. Henrici's harmonic analyser, by means of which ten coefficients in a Fourier's series can be determined by going only once over a curve, led the engineer to speculate on the time when all calculations, however complex, would be done by turning a handle, and when the brain would be left quite free to think and originate.

So much attention has of late been given by School Boards and County Councils to the establishment of manual training classes, that the collection of exercises in wood-working in the Carpenter's Shop of the Engineering Department, could not fail to attract attention. But more attractive still was the laboratory for testing materials, where the deliberate motion of the lever of the 100-ton machine, stretching steel plates until they broke, and automatically writing the history of the experiment with Prof. Unwin's stress-strain-recorder, was as fascinating to the lady-visitors as to the engineers who accompanied them. And how complete is the investigation that the students can make on the properties of the materials used by the engineer and builder, could be gathered from seeing the smaller machines which were bending thick beams of wood, stretching wires, and breaking blocks of cement, as well as from examining those specially designed for testing lubricants, gauges, and the elastic constants of materials, such as the screw and mirror extensometers and compressometers designed by Prof. Unwin.

The desire of every lad to make something is gratified and educationally directed in the Engineering Workshop, which is liberally fitted with milling, planing, shaping, and slotting machines, and four of the lathes, we were told, had been made by the students themselves, while one weighing three tons, and having a 10-foot gap bed, we saw in process of construction.

The economy of a De Lavel steam turbine, running at 32,000 revolutions a minute, and of a Tower spherical engine, were being tested in the Steam Laboratory, while a 40-horse power condensing engine, specially designed to illustrate the effect of varying the conditions of working, has fitted to it a very satisfactory hand-brake, indicator gear, and arrangements for measuring the circulating water, the condensed steam, the jacket and receiver drainage, &c. And, as a memento of the improvements that can be effected in prime movers by experimental inquiry, there stands the very engine used by the late Mr. Willans in his classical investigations on steam engine economy, cut through so as to expose a sectional view of the cylinders, pistons, and valves.

Adjoining the Steam Laboratory is the boiler-room, where in addition to the Lancashire and Cornish boilers, used for generating steam for the engines, is a Babcock and Wilcox boiler, used exclusively for boiler and fuel tests, with its accompaniments of feed-water measuring tanks, coal-weighing apparatus, dasymeter for determining the percentage of carbonic acid in the furnace gases, &c.

In the laboratories of the Physical Department are many instruments and pieces of apparatus that have been developed there, and specimens of which are now to be found in other colleges, electrical works, and electric lighting stations. In the dynamo room are speed cones by means of which the speed of any dynamo can be varied between wide limits, and, what is equally important for experimental purposes, can be kept at a constant value independently of variations in the speed of the engine, or in the amount of slip of a belt when it is transmitting different amounts of power. Doubts were originally expressed as to the possibility of such cones being used to transmit even 10-horse power satisfactorily, but their successful working having been proved, sets of them were reproduced for University College, Nottingham, the McGill University, Montreal, &c. This room contains many different types of dynamos, and, as space is limited, one is driven with a weighted pulley hanging in a very short belt passing over the fly-wheel of the engine, the dynamo itself being balanced on trunions, so that it turns on an axis at right angles to that round which the armature rotates.

The "injector" for producing any desired shape of wave, and so enabling one alternating current dynamo to serve the purpose of many, was shown in use, and the vibrating wire curve tracer, described at the last meeting of the British Association, was writing out the wave-forms so produced. The permeability of iron rods was being examined with the small dynamo recently shown at the Royal Society's soirée, and the regulation of transformers differentially tested with an electrostatic voltmeter, with which a pressure of one volt can be measured without any independent electrification.

Those interested in the bills sent in by Electric Light Companies had an opportunity of seeing American, English, French and German electric supply meters being tested at various temperatures in the Magnetic Research Laboratory, as well as experiments on the slow rise of temperature in underground electric mains.

The Electrical Research Laboratories contain various forms of electrostatic voltmeters, some of which were being tried, while others were in use for measuring the electric pressure at which cables and insulating oils break down by sparking. A Lorenz apparatus for the determination of the ohm, which had been constructed regardless of cost for the M'Gill University, and sent to the college to be tested, attracted much attention. It is certainly unique in its details, and eminently characteristic of the transatlantic millionaire who stipulates that the wealth which he showers on the laboratory named after him shall be used to purchase only the "very best apparatus." How many an English professor would delight in having such a condition imposed by a benefactor determined that the laboratory founded by him should be the most costly in the world.

In another room was a secohmmeter spinning out coefficients of self-induction, a new addition to the Wheatstone's bridge for facilitating the measurement of very small resistances, and an artificial submarine cable, electrically as long as those under the Atlantic, with which the retardation in the passage of the telegraphic signals was demonstrated to the visitors.

In the Arc Lamp Laboratories the photometry of the arc, and the steady feeding of the carbons with various types of lamps, were shown, also the details of the experimental lamp used in the recently published researches was explained. The observer sees close to him the arc itself and its image enlarged ten times, also the spots of light indicating the current flowing and the potential difference maintained between the carbons; while in front of him are handles for regulating the current, the position of each carbon, &c. Mark Tapley would doubtless have said that there was no credit in making discoveries under *such* circumstances.

On a screen on a wall the voltmeter and ammeter spots of another arc were seen dancing up and down, and proving that when an alternating current is superimposed on a direct current arc the oscillations of potential difference and current are in the same direction when the carbons are cored, but in opposite directions when they are solid.

Gas-burners and glow-lamp testing, polarimetry, and spectrophotometry are carried out in the Senior Optical Laboratory, and the curves of results obtained by the students showed the most economical gas pressure to use with each type of burner; why it pays the gas companies to make the gas flare and the private consumer to use governed burners, and how much dearer, as far as mere light is concerned, is glow-lamp lighting than gas lighting with the Welsbach burners.

A range of rooms on the first floor is devoted to the Junior Physical Laboratories, and in them students, who frequently have never worked in a laboratory before, learn the principles of electricity, heat, light, magnetism and sound by performing an organised series of quantitative physical exercises.

In both the Physical and Chemical Departments there were several exhibits of "seeing with X-rays," the potassium-platino cyanide screens, which have been so successfully constructed by Mr. Jackson, being lent for the occasion. The majority of the exhibits, however, in the Chemical Department were connected with the educational methods employed, and with the results which have been obtained from the researches carried out by the advanced students and the staff. Prof. Armstrong has long advocated that every student of chemistry should be early infused with the spirit of scientific inquiry; and that this principle has been practised in his laboratories, and not merely preached in his lecture-room, was proved by the large number of specimens of new series of compounds which were exhibited as the outcome of the work in his department. Sulphuric derivatives of camphor prepared for the first time in a pure state, hundreds of specimens of derivatives of naphthalene—the hydrocarbon from which so many modern dye-stuffs are made—obtained experimentally, and the apparatus for many researches in course of progress, attracted attention.

In the Junior Chemical Laboratory were exhibited the apparatus and experiments used in connection with the courses to teachers that have been given at the College. This apparatus is suitable for the use of teachers giving elementary instruction in technical schools, as well as for carrying out the experiments recommended in the syllabus of elementary science (chemistry and physics) issued by the Incorporated Association of Headmasters.

For the last ten years Dr. Armstrong has made strenuous efforts to obtain adequate recognition for that hitherto much neglected, but all important branch of physical chemistry, crystallography, and in consequence the crystallographic branch of the department has gradually extended in size, until at present the laboratory devoted to that subject rivals the best on the continent for completeness of equipment. Numerous measurements and drawings of crystals that had been made by the students were exhibited, and demonstrations of the methods employed in the optical examination of crystals were given in the adjoining lecture theatre during the evening, apparatus that had been specially devised to facilitate the accurate examination of doubly refracting substances being employed for the purpose.

In the Woodcarving Department, under the direction of Miss Rowe, there was an exhibition of carving in a variety of styles by present and past students, some of the latter being now the instructors in this and in other schools of art woodcarving. A renaissance panel illustrative of the arts of sculpture, architecture, and literature, an Italian bracket, and a pediment for a bookcase, a low relief renaissance frieze, &c., showed boldness and finish, while the practical demonstrations of the different

methods of working in high and low relief attracted much attention.

What is the outcome of it all, thought the visitor, as he left with his mind whirling with slotting machines, scalar quantities, secohmmeters, and sugar analysis? Has original research been prosecuted as foreshadowed by Lord Selborne? Where are the some 200 students that have been awarded the diploma of Associateship of the Institute, and all the other special students who have passed through courses at the Central Technical College? The seventy papers communicated by the students, and the staff, to the proceedings of various scientific societies answer the first question, while the reports issued yearly by the Dean give information on the second point; some of the past students are the Principals, and some have charge of departments at technical schools; some are the chief engineers and some assistant engineers at electric light central stations in England; some hold postsin chemical works, and some are railway engineers, and others telegraph engineers in India, but practically all appear to be employed. And what is a little remarkable—in view of the vast number of people who have been attracted to follow engineering pursuits during the past few years—we understand that nearly all the students who have passed through the Central Technical College are in receipt of pay for the services they are rendering, and are not paying premiums to employers for the privilege of being allowed to do hard work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered by the Public Orator, Dr. Sandys, in presenting for the honorary degree of Doctor in Science Prof. Newcomb, of Johns Hopkins University, Superintendent of the American Nautical Almanac.

Si Thales ille Milesius, "rerum naturae certissimus explorator et astrorum peritissimus contemplator," sapiens propterea nominatus est, quod solem lunae oppositu solere deficere primus omnium vidisse fertur, etiam hunc virum sapientiae laude non indignum arbitramur, qui solis et lunae defectus omnes antiquitus observatos cum astronomiae legibus hodiernis accuratissime comparavit. Idem quanto ingenii acumine aliorum de lunae motu placita correxit; quam admirabili studiorum caelestium cognatione cum Neptuni inventore nostro consociatus est; quam infinita denique cura fratribus nostris transmarinis trans aequora navigantibus siderum cursus litterarum monumentis mandatos explicavit. Talium virorum de genere humano merita dum contemplamur, non iam miramur ipsum Vergilium a Musis esse precatum, ut sibi ante omnia

> "caelique vias et sidera monstrent,
> defectus solis varios lunaeque labores."

Duco ad vos astronomum illustrem, SIMONEM NEWCOMB.

At the annual election, on June 22, at St. John's College, the Hutchinson Studentship was awarded to A. S. Hemmy, double first in Natural Sciences, for research in Physical Chemistry. Foundation Scholarships, varying in value from £100 to £50 a year, were given to the following Science Students:—K. C. Browning, D. J. Morgan, J. S. White, N. B. Harman, J. H. Howitt; and Exhibitions in Natural Science to J. A. Glover, R. F. C. Ward, A. C. Ingram, Jehu, and Yapp. In Mechanical Sciences and Engineering, Foundation Scholarships were for the first time awarded to W. S. La Trobe (£80) and A. Chapple (£50). It is noteworthy that Messrs. Hemmy, La Trobe, and Chapple, who have thus carried off the chief scientific honours, are all colonial graduates, from the Universities of Melbourne, New Zealand, and Adelaide, respectively. Mr. J. E. de Villiers, of this College, who takes the highest honours in Law, being senior in his Tripos Part I., is a graduate of the Cape of Good Hope.

The Harkness Scholarship in Geology and Palæontology is awarded to J. H. Gray, Scholar of King's College.

In Part I. of the Natural Sciences Tripos, thirty men are placed in the first class; in Part II. eleven men attain this distinction. No woman gains a first class in either part.

SESQUICENTENNIAL gifts continue to pour in upon Princeton University. An unnamed benefactor has given funds for a new library building.

THE following are among recent appointments:—Dr. Theodor Des Coudres to be Extraordinary Professor of Physics in Göttingen University, and Dr. Otto Bürger to be Extraordinary Professor of Zoology; Mr. A. A. Heller to be Instructor in Plant Taxonomy at the University of Minnesota, and Curator of the University Herbarium.

THE fitness of Convocation of the University of London to deal with such subjects as a Teaching University may be estimated from the result of the meeting held on Tuesday. The chief business was the election of a Fellow of the University, and the following gentlemen had been nominated:—Sir Joseph Lister, Mr. Walter Rivington, and Mr. Richard Mosey Stephenson. The election was one in which voting papers were permissible, and the result of the counting of the votes was that Mr. Rivington obtained 963, and Sir Joseph Lister only 846 votes.

THE report of the Technical Education Committee which was adopted at the meeting of the Devonshire County Council, held at Exeter on the 11th inst., shows that the work done on the agricultural side of Ashburton Grammar School is of so satisfactory a nature that an additional grant has been awarded to the school; also that 175 continuation schools have been maintained throughout the year. At the same meeting the following resolution was passed by a substantial majority:—"That this Council, while offering at present no opinion as to the advisability or otherwise of placing secondary education under the control of the local education authority, strongly deprecates the proposal to transfer to them any duties connected with elementary education."

A SPECIAL Committee, appointed by the West Riding County Council to watch the Education Bill, have passed the following resolution:—"That in view of the amendment to the Education Bill, 1896, whereby every non-county borough with a population of 20,000 is to appoint an Education Committee, amendments should be introduced by way of limiting the duties of the education authority of such a borough to such defined matters as may be least hurtful to the administrative county, and the cause of education."

A MEETING of the Executive Council of the County Councils Association was held on Friday morning last, at the Guildhall, Westminster. Lord Thring having briefly explained the circumstances under which the meeting had been convened, it was proposed by Lord E. Fitzmaurice, and seconded by Sir J. E. Dorington, Bart., M.P., and resolved:—"That this Council, considering the changes which have been introduced into the constitution of the education authority by the exclusion from the administrative county of non-county boroughs with a population of 20,000, is of opinion that the above change strikes a serious blow at the administration of the Technical Education Acts, and of county administration generally." It was also resolved that the Parliamentary Committee be authorised to arrange for the presentation of the foregoing resolution to the Right Hon. A. J. Balfour, M.P., and His Grace the Duke of Devonshire.

THE Education Bill has been abandoned by the Government, and the eleven days of Parliamentary time spent in discussing it have been sacrificed. It is proposed to bring up the subject afresh next January, but there is little possibility that the measure which will then be brought forward will be of the very contentious character of the one just withdrawn.

THE National Home Reading Union aims mainly to make high-class reading attractive, and to give advice with regard to courses of reading in romance, travel, biography, economics, ancient and modern history, English and foreign literatures, science and art. Once a year it is the custom of the Union to hold a summer assembly at some interesting centre, when lectures are given in connection with the courses of study which have been pursued during the past winter. This year Chester has been chosen, and the assembly takes place there between June 27 and July 6. But not only will the subjects recently studied claim attention, for there will be several lectures on the botany, geology, and architecture of the district, besides a lecture by Mr. St. John Hope on "The Arrangements of Mediæval Monasteries," with special reference to Chester. A number of interesting excursions and social gatherings have been arranged, including a visit to Northwich to descend a salt mine.

THE Technical Education Board of the London County Council next month will appoint not more than five Senior County Scholars. Each scholarship will be tenable for three years, and of the annual value of £60, together with free instruction in a college of university rank, provided that the fees

do not exceed £30 a year. In the case of scholars proceeding to the old universities a contribution of £30 per annum is made by the Board towards the college and university tuition fees. Candidates must be resident within the administrative County of London, and must send in applications to the Secretary of the Board, at 13 Spring Gardens, on or before Monday, June 29, on forms which can be obtained on application. Last year the Board awarded several exhibitions of smaller value to specially deserving candidates in addition to appointing five County Scholars. Hitherto the selection of the scholars has been based upon the record of their past achievements and testimonials received from their teachers or others qualified to judge of their capabilities. These scholarships are restricted to candidates whose parents are in receipt of not more than £400 per annum.

THE Hartley Institution at Southampton has not developed so much as it might have done since it was established, owing to a divided management and limited finances, but it has now entered upon a brighter part of its career, and we confidently expect to learn of rapid and vigorous growth in the near future. The Secretary of the Institution has retired on a pension, and the Town Council of Southampton have decided to grant a farthing rate for one year to the Hartley Council. The action of the Borough Council in giving rate aid in support of technical and scientific education, in addition to the whole of the residue under the Customs and Excise Act, shows that the friends of educational advancement upon the Council are strong enough to make headway in spite of contrary breezes. Dr. R. W. Stewart, the Principal, is now free to develop his well-laid schemes for extending and improving the work of the Hartley Institution, and there is every reason for believing that under his whole management, and with the increased resources now available, the Institution will extend in the right direction, while at the same time the position of Southampton as an educational centre will be advanced. The objects of the proposed reorganisation are, first, the extension of the evening technical classes, and, second, a complete change in the work of the day classes. The extension of the evening classes will take place mainly in improving and extending the trade and commercial classes, and in providing classes for teachers. It was to make these changes that a farthing rate was solicited. The help was asked not to relieve the Hartley Council of any present financial embarrassment, but to enable them to carry out a scheme of educational reform which must ultimately be of the greatest benefit to the town and neighbourhood. A few of the reasons which showed the necessity for reorganising the educational work of the Institution may be specified. The Institution is already provided with buildings, and during the last five years the accommodation and equipment had been greatly improved by the provision of new lecture-rooms, a chemical laboratory, a physical laboratory, and engineering and other workshops. All this would be practically wasted and lost to the town unless supplemented by the appointment of a properly qualified teaching staff, able to utilise and develop the resources of the Institution to the utmost. The income of the Institution—about £2750—was not quite enough to meet the general working expenses and to provide a staff of this kind; but with the grant now made by the Town Council a much more efficient return will be obtained. The development of the Institution on the lines suggested will enable students to obtain an education of university rank, and to proceed to a degree in arts, or science, or law, at the University of London, by attending a three years' course at the day classes of the Institution in their own town. Lecturers are to be appointed in mathematics, biology and geology, English and classics, French and German, at a salary of £150 per annum each. This is something for Southampton to be proud of, and we trust that the policy which has inaugurated the new epoch in the educational history of the town will permanently represent the feeling of the Borough Council.

SCIENTIFIC SERIALS.

American Journal of Science, June.—On the colour relations of atoms, ions, and molecules, by M. Carey Lea. Part II. If a coloured substance be formed by the union of a colourless kation with a colourless anion, the colour belongs to the molecule only. Consequently, if we find a solvent which, like water, is capable of separating the ions, the resultant solution when dilute must be colourless, no matter how intense the colour of the compound. Experiments confirm this law without exception. Antimony pentasulphide, a strongly coloured compound, is a case in point. When dissolved in an alkaline sulphide, the ions of antimony and sulphur, themselves colourless, separate sufficiently to no longer change each other's vibration periods. They still, however, remain within the sphere of mutual influence. The union of coloured and colourless ions gives rise to the most surprising changes of colour. Two similar coloured ions may unite to form a colourless element. Two similar colourless ions may unite to form a strongly-coloured element. No black ion is known. There is absolutely no relation traceable between the colour of an ion and that of the element which it aids to form.—The gravimetric determination of selenium, by A. W. Peirce. The usual method used in the gravimetric determination of selenious acid, that of precipitating the selenium with sulphurous acid in presence of hydrochloric acid, is slow and incomplete. The author substitutes potassium iodide for the sulphurous acid. To avoid obtaining the selenium in the pasty condition when large quantities are present, the potassium iodide should be considerably in excess of the amount necessary for precipitation.—The extinct *Felidæ* of North America, by G. I. Adams. This is an attempt to give a general account of this family, to summarise the literature on the subject, and to work out a comprehensive classification. The paper is accompanied by three admirable plates.—The age of the igneous rocks of the Yellowstone National Park, by Arnold Hague. The pouring out of igneous rocks began with the post-Laramie uplift, or closely followed it, and from the time of the first appearance of these rocks, volcanic eruptions continued throughout Tertiary time.—Researches on the Röntgen rays, by Alfred M. Mayer. Herapathite, an iodosulphate of quinine, the most powerfully polarising substance known, is incapable of polarising X-rays. The actinic effect of X-rays varies inversely as the square of the distance of the sensitive plate from the radiant source.—On the *Pithecanthropus erectus*, from the Tertiary of Java, by O. C. Marsh. It may be taken as established that the remains of this "missing link" at present known are of Pliocene age. The tooth, skull, and femur found belonged to the same individual. This individual was not human, but represented a form intermediate between man and the higher apes.

Wiedemann's Annalen der Physik und Chemie, No. 5.—Anomalous electric dispersion of liquids, by P. Drude. Short electric waves (of 70 cm. wave-length in air) are more strongly damped in alcohol, and especially in glycerine, than in water or in aqueous solutions. Theoretically, the damping should increase with the conductivity. But these badly conducting bodies are found to damp electric waves as effectually as a 5 per cent. solution of copper sulphate, which is 6000 times more conducting. This is not the only anomaly exhibited by ethyl and amyl alcohol, glycerine, and acetic acid. They also show anomalous dispersion for rapid electric oscillations, *i.e.* a decrease of the electric index of refraction with increasing frequency. Further, the specific inductive capacities are greater than the squares of the electric indices of refraction. Water, methyl alcohol, and benzol show no such anomalies, and ether only shows anomalous absorption.—Thermo-couples of amalgams and electrolytes, by A. Hagenbach. These were prepared by connecting two beakers filled with an amalgam by means of an M-shaped siphon filled with an aqueous solution of a salt of the same metal, the ends of the siphon being closed by a membrane. The amalgams were enclosed in water baths, and could be heated simultaneously or alternately. The only metals suitable for accurate measurements were cadmium and lead. Theory demands that as the salt solutions are diluted the thermo-electric forces shall increase. This law was found to fail with the divalent elements named. A couple, consisting of cadmium amalgam and cadmium chloride or nitrate, showed a steady diminution of the thermo-electric force as dilution increased from 0·1 to 0·0001 of the normal.—Contributions to the knowledge of fluorescence, by G. C. Schmidt. The author maintains that all bodies are capable of fluorescence if dissolved in suitable solvents. The most favourable form in which a substance may occur is that of a "solid solution." Aniline dyes may be made to fluoresce by solution in sugar, gelatine, hippuric acid, quinine bisulphate, and other substances. The colour of fluorescence is often nearly independent of the solvent.—Theoretical investigations concerning light, by P. Glan. The author calculates the absorption of various substances for a certain kind of ultra-violet light from their thermal conductivities and refractive indices, and shows that muscle, horn, wood, bone, cork, paper,

ebonite, shellac, lampblack, water, and carbon bisulphide must behave towards these rays in the same manner as they have been found to behave towards Röntgen rays.—A new form of mercurial air-pump, and the preservation of the vacuum in Röntgen tubes, by R. W. Wood. The author describes a simple pump consisting of a system of tubes and bulbs containing the vacuum tube in one branch. It is completely closed, and the vacuum is restored at will by simply oscillating the whole apparatus.

Bulletin de la Société des Naturalistes de Moscou, 1895, No. 2.—Contributions to the knowledge of the molecular forces, as a foundation to thermodynamics, by J. Weinberg; fourth part, dealing with capillarity and adhesion.—The development of the occipital region of the lower verterbrates, in connection with the question of metamery of the head, by A. Sewertsoff. An elaborate and suggestive work, in German, with two plates.—On the rotation of the earth, supposed to be fluid in its interior, by Th. Sloudsky, in French.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 4.—"Observations on Atmospheric Electricity at the Kew Observatory." By Dr. C. Chree.

The primary object of the investigation was to arrive at a more exact interpretation of the records obtained with the Kew electrograph, and to devise improvements in the conditions under which it works. The electrograph curves are intended to give the value of the potential at the point in the air where a water jet issuing from a long pipe breaks into drops. The proximity of a tall building has naturally, however, a large influence on the potential, so that no direct estimate could be made of the true potential gradient, *i.e.* the increase in potential per unit of height in the open.

Some preliminary experiments were made, which may be regarded as verifying Prof. Exner's experimental conclusion that a building under normal conditions reduces the potential in its neighbourhood, as if it formed an integral part of the earth's surface. Subsequently four series of observations were made. The respective seasons were November–December, 1894, March–April, June–July, and October–November, 1895. The observations were taken with a portable electrometer of known scale value, at one or two approximately constant hours, at five or six stations on or near the Observatory.

The results were consistent with the view that such general phenomena as diurnal or annual variation of potential got out with the same instrument at the several stations would show a good agreement.

A comparison was also made between the potentials deduced from the electrograph curves and the readings of the portable electrometer.

The values of the several meteorological elements, at the times of the observations with the portable electrometer, were derived from the Observatory records.

They afforded the opportunity of carrying out a searching investigation into possible connections of the several meteorological elements and the potential gradient. Attention was particularly directed to data bearing on Exner's theory, which connects potential gradient with density of aqueous vapour through a definite formula, departures from which are to be regarded as abnormal and due to disturbing causes. Special attention was also devoted to the possible influence of bright sunshine in reducing the potential gradient, in consequence of the theory proposed by Elster and Geitel.

The results of the investigation seem far from favourable to Exner's hypothesis. They afford a certain amount of general support to Elster and Geitel's theory, inasmuch as on an average potential seemed lower after long previous sunshine. The evidence, however, in favour of a connection between high potential and low temperature, high barometric pressure, low wind velocity, and anti-cyclonic conditions generally, seems about equally strong with that in favour of Elster and Geitel's theory. In each case notable exceptions appeared to any general rule.

Chemical Society, May 28.—Mr. A. G. V. Harcourt, President, in the chair.—Prof. P. P. Bedson delivered the Lothar Meyer Memorial Lecture. The lecturer reviewed Meyer's contributions to our knowledge of the gases contained in the blood and of the periodic law, and gave an account of the work done by the late German chemist towards promoting the systematic arrangement of inorganic chemistry, pointing out how great had been Meyer's influence on the promotion and advancement of chemical theory during the past thirty years.

June 4.—Mr. A. G. V. Harcourt, President, in the chair.—It was announced that an address is to be presented to Prof. Cannizzaro on the occasion of his seventieth birthday in July next; an address is also being presented to Lord Kelvin on the completion of his fiftieth year as Professor of Natural Philosophy in Glasgow University. The following papers were read:—On magnetic rotatory power, especially of aromatic compounds, by W. H. Perkin. The author describes apparatus used for determining magnetic rotations, and having determined the influence of temperature and dissolution on this property, gives the results of the examination of a large number of compounds of different types. Great differences exist between the magnetic rotations of aromatic and fatty compounds, the nuclei contained in a substance considerably influencing its rotation; frequently the compounds behave as composite molecules, the fatty and cyclic part separately influencing the magnetic rotation; the presence of a carbonyl group connecting the nucleal and fatty groups seems to act as a screen, preventing them from influencing each other. The influence of the nucleus on the rotation is reduced by the presence of electro-negative groups, and increased by that of electro-positive ones; this great liability of the magnetic rotation of the nucleus to change, is connected with the fact of its unsaturatedness, for saturated cyclic compounds behave like ordinary open chains. The so-called values given for atomic refractions or magnetic rotations are not true physical constants, but are merely the average influences which elements or radicles exert in different compounds; this, however, does not detract from their usefulness in determining constitution.—Mononitroguaiacol, by R. Meldola. One mononitro-derivative, probably the para-compound, is obtained by nitrating acetylguaiacol; benzoylguaiacol yields two mononitro-derivatives, probably the ortho- and para-, on nitration. Mononitroguaiacol may be prepared by hydrolysing its acetyl-derivative.

Linnean Society, June 4.—Anniversary Meeting.—Mr. C. B. Clarke, F.R.S., President, in the chair.—The Gold Medal of the Society was formally awarded to Prof. G. J. Allman, F.R.S., for distinguished researches in zoology, and, in consequence of his inability to receive it in person, was delivered on his behalf to Sir Joseph D. Hooker, K.C.S.I., who made a suitable acknowledgment. The Treasurer then presented his annual statement of accounts. The Secretary reported the deaths, withdrawals, and elections during the past year. The report of the Librarian having been read, the President opened the chief business of the evening, when the Fellows present proceeded to ballot for the President, Officers, and Council for the ensuing year. Scrutineers having been appointed, and the votes counted, the result was declared to be as follows:—President, Dr. Albert Günther, F.R.S.; Treasurer, Mr. Frank Crisp; Secretaries, Mr. B. Daydon Jackson and Prof. G. B. Howes. The retiring President, Mr. C. B. Clarke, then delivered the annual presidential address, which on the motion of Mr. W. Carruthers, seconded by Mr. W. P. Hiern, it was resolved should be printed and circulated.

Mathematical Society, June 11.—Major MacMahon, R.A., F.R.S., President in the chair.—The Chairman announced that the Council had awarded the De Morgan Memorial Medal to Mr. S. Roberts, F.R.S. He also read an address which the Council had requested him to present to Lord Kelvin on the occasion of the jubilee celebration on the 16th instant. The address, which was illuminated, was placed for inspection on the table. The following communications were made:—Waves in canals, by H. M. Macdonald; on the *a*, *b*, *c* form of the binary quintic, by J. Hammond; construction for the four normals to a central conic drawn through a given point, by Prof. Mathews; on a two-fold generalisation of Stieltjes' theorem, by Dr. Taber; notes on magic squares, by Rev. A. H. Frost.

Entomological Society, June 3.—Dr. D. Sharp, F.R.S., Vice-President, in the chair.—Mr. Gervase F. Mathew exhibited the new species of Leucania, *L. flavicolor*, recently described by Mr. Barrett (*Ent. Monthly Mag.*, 2nd series, vol. vii. p. 99), and also the varieties of *L. pallens* noticed by Mr. Barrett in the same article (*l. c.*, p. 100). Mr. Tutt having carefully examined the specimens of *Leucania flavicolor*, said that he considered it

as highly probable that it was a remarkable form of *Leucania pallens*, but that more material was required before a final opinion could be formed. The remarkable transverse (elbowed) line of dots crossing the forewings was exactly parallel with that of *Leucania straminea* and *L. impura* ab. *punctalinea*, and for an aberration of this character to occur in *L. pallens* was as probable as in *L. impura*, the typical form of which is but sparingly dotted in the direction of the elbowed line. The hindwings showed almost identically the same characters in the dark shading, traces of dots in nervures, &c., as the red aberrations of *L. pallens* exhibited by Mr. Mathew. He considered that until the matter of its specific distinctness was finally settled, Mr. Barrett had erred on the right side in giving it a distinctive name, even if the name subsequently fell as an aberration of *L. pallens*.—Mr. Waterhouse exhibited several branches of oaks from the New Forest entirely denuded of foliage, and stated that throughout large tracts of the forest the oaks had been stripped of their leaves in the same fashion by Lepidopterous larvæ, especially *Cheimatobia brumata*, *Hybernia defoliaria*, and *Tortrix viridana*. Certain trees, however, though situated among the denuded trees, had quite escaped. Dr. Sharp suggested that they belonged to a different species; but Mr. Waterhouse said that he had carefully examined them, and that this was not the case. Mr. McLachlan said that the immunity of the trees referred to was probably due to irregularity in coming into leaf.—Mr. Tutt exhibited living pupæ of *Enodia hyperanthus* and *Epinephele ianira*, and pointed out how different the pupæ of these two species were in general appearance, structure, and cremastral attachment from each other. He pointed out that these two species had for a long time been erroneously placed in the same genus, but that, in all stages, they were widely separated, and that not only should they be placed in different genera, but that they appeared to belong to different tribes—*Enodia hyperanthus* being in the *Cœnonymphidi* and *Epinephele ianira* in the *Epinephelidi* (*vide Entom. Record*, vii. p. 301).—Mr. Blandford exhibited and described series of tropical American butterflies from the Godman-Salvin collection, arranged to show the existence and geographical distribution of homœochromatic groups.—Dr. Chapman communicated a paper on the phylogeny and evolution of the Lepidoptera from a pupal and oval standpoint.

Geological Society, June 10.—Dr. Henry Hicks, F.R.S., President, in the chair.—On foliated granites and the relations to the crystalline schists in Eastern Sutherland, by J. Horne and E. Greenly. The crystalline schists of Eastern Sutherland are traversed by great numbers of granitic intrusions, chiefly in the form of lenticular sills. These generally lie parallel to the foliation-planes of the schists, but transgressive junctions are also frequent. Thin seams of granite also occur in such abundance as to constitute with the schists a banded gneissic series; but these seams can often be seen to transgress the schistose folia, and even often to proceed from large masses of granite. The granites contain numerous inclusions of the schists which they traverse, such inclusions retaining, usually, the dip and strike of the surrounding rocks. There are no chilled edges; and, moreover, the component crystals of schist and granite mutually interlock along the line of junction. The authors gave an account of the foliation of the granite. In some rare cases a foliation parallel to that of the schists traverses granite-veins. It is generally, however, parallel at once to the sides of the sill and to the foliation of the schists; and many of the structures are the remains of biotite folia belonging to schists whose quartzo-felspathic elements have been incorporated with those of the granite. But many sills or veins, traversing the schists at various angles, are foliated parallel to the line of junction, and so discordantly to the structures in the schists; and foliated granites may even be observed to cut each other's foliation. These can hardly be anything but original igneous structures; but, if coexistent with the last-named, would be indistinguishable from it. The country-rocks are various types of biotite-schist or gneiss, with quartz-schists at Kildonan, and a scapolite-limestone at Armadale. They are almost all holocrystalline, but it is certain that sedimentary rocks enter into the complex. The whole series is powerfully folded. The granites increase in size and numbers north-westward from Kildonan; the intimate intrusive relations above described becoming more highly developed in the same direction. The schists, at the same time, become more and more highly crystalline, sillimanite also appearing in them. About Kinbrace they are coarse sillimanite-biotite-gneisses, with large striated felspars. Igneous contact was not held to be the sole origin of metamorphism, though the cause which brought about the introduction of the granites had evidently also produced these high types of crystallisation. The evidence of powerful movement which the schists everywhere present suggested that such movement was the initial cause of the whole series of phenomena. Movement recurred throughout, though all cataclastic structures (if such existed) had been wholly effaced by crystallisation; introduction of granite being the final stage in the production of the complex, and a high temperature (as shown by the absence of chilled edges) being maintained to the very end. With regard to the granites, the authors found it difficult to believe that they are wholly foreign matter, but remark that it is necessary to observe the utmost caution with reference to it.—The geology of the eastern corner of Anglesey, by E. Greenly.—Seismic phenomena in the British Empire, by M. F. de Montessus de Ballore, Captain of Fortress Artillery at Belle-Ile-en-Mer. The author gave a brief outline of a plan that he has elaborated for studying seismology. He has separated his work into four parts: (1) The formation of an earthquake catalogue. (2) Refutation of the empirical laws previously ennuciated. (3) Description of the globe from a seismological point of view. (4) Investigation of the characters which differentiate stable from unstable regions. He gave a method by which the relative *seismicity* (or instability as regards earthquakes) of regions may be obtained and registered, and indicated some of the results which he had derived from his study, including the intimate relationship between instability and surface-relief, and the independence of seismic and volcanic phenomena. The main part of the paper was a section of the third division of the author's work, and dealt in detail with the earthquakes of the British Empire. In this part of the paper, the recorded earthquakes of the British Isles, India, Australia and New Zealand, British Africa, Canada, and various scattered possessions were described.

EDINBURGH.

Royal Society, June 15.—Prof. Geikie in the chair.—Mr. A. T. Masterman read a note on the structure of *Actinotrocha* considered in relation to the chordate affinities of *Phoronis*. In this paper, the author demonstrated the presence of a paired notochord in *Actinotrocha* which atrophies before the adult stage is reached, probably at the metamorphosis. He also showed the presence of five body-cavities in the larval stage. For these and other reasons he claimed for *Phoronis* a place among the Chordata, and proposed to place it in a separate division of this group—the Diplochordata. The relationship of *Phoronis* to *Balanoglossus* may be compared to that of the *Tunicata* to *Amphioxus*.—Prof. Tait read a paper on Clerk-Maxwell's law of distribution of velocities in a group of equal colliding spheres. He adverted to the extraordinary denunciation by M. Bertrand of Clerk-Maxwell's proof of the fundamental law of the kinetic theory of gases. He showed that Maxwell's proof involved none of the absurdities alleged by M. Bertrand, and that the gist of the matter was this:—There is a *unique* solution of the problem: Maxwell's is *a* solution, because it is not interfered with by collisions; therefore it is *the* solution.—Prof. Chrystal gave a summary of a paper on the p discriminant of a differential equation of the first order, in which he applied Newton's method of approximation (first employed in the theory of differential equations by Briot and Bouquet) to prove some leading theorems regarding the p discriminant locus, most of which had previously been established by Darboux by other methods. He showed that the p discriminant locus (A), $\phi(x, y, p) = 0$, $\phi_p(x, y, p) = 0$ is, in general, a cusp-locus for the family of integral curves. He also established that the locus, $\phi(x, y, p) = 0$, $\phi_x(x, y, p) + p\phi_y(x, y, p) = 0$, is in general an inflexion-locus (B), and that $\phi(x, y, p) = 0$, $p\phi_x(x, y, p) - \phi_y(x, y, p) = 0$ is a locus of inflexions on the orthogonal trajectories of the integral family (C). Any point of intersection of A and B, is, in general, a point at which two integral curves touch each other, and also touch A. The necessary and, in general, sufficient condition for an envelope singular solution is that A and B have a branch in common. The necessary and, in general, sufficient condition that two integral curves touch, and do not touch A, is that A, B, C have a point in common. The necessary and, in general, sufficient condition for a tac-locus is that A, B, C have a branch in common; the characteristic of this branch appears as a squared factor in the p discriminant. Prof. Chrystal then proceeded to refute a proposition of Cayley's, "that a differential equation of the first

order, which has no singular solution, cannot have an algebraic integral." He showed that Cayley's proof that every algebraic family has a proper envelope, on which this conclusion regarding differential equations depends, fails to take account of the fact that the residual points of intersection, $m + n$ in number, may be concentrated in isolated points, usually tac-points; and produced examples of cubic and quartic families which, in point of fact, have no proper envelope.—Prof. Ewart gave a summary of a paper by Mr. Frank J. Cole, on the cranial nerves of *Chimæra monstrosa*, with a discussion of the lateral line system, and of the comparative anatomy of the chorda tympani nerve.

PARIS.

Academy of Sciences, June 15.—M. A. Cornu in the chair.—Formula for the mean local pressures in a fluid moving irregularly or in vortices, by M. J. Boussinesq.—On the variations observed in the composition of apatites, by M. Adolphe Carnot. In Canadian apatites some of the calcium fluoride would appear to be replaced by calcium carbonate without change of crystalline form. In some apatites from the Tyrol, which presented the crystalline properties of normal apatite, the amount of calcium fluoride is reduced to about one-tenth of that usually present.—On the presence of *Campodea staphylinus* (Westwood) and *Sabacon paradoxus* in the cave of Dargilan (Lozère), by M. Lannelongue.—Remarks on the preceding communication, by M. E. Blanchard.—On the value as food of bread from different specimens of screened flour, by M. A. Girard. From a comparative study of the amounts of phosphorus in various samples of bread, the conclusion is drawn that there is no real justification for the use of brown bread in preference to white, when the digestive organs are in a healthy state.—Observations and remarks on the bactericidal power of blood serum, and on the bactericidal substance contained in it, by M. S. Arloing. The experimental results obtained do not appear to sustain the idea of a specific substance in the serum of bactericidal properties. It was found that solutions of many salts could replace the solution of common salt as a diluent of the serum without appreciably affecting its action upon bacteria.—Measurement of the work expended in driving a bicycle, by M. Bouny. The work done was measured by a pedal of special construction containing two dynamometers, arranged so as to register the force exerted in two directions at right angles to each other, and also so as to take into account the effect produced by the deviations of the pedal from the horizontal plane. The work done by the pressure on the pedal is given as a function of the speed. To double the velocity (17 to 33 kilometres per hour) more than trebled the work required to be done.—Remarks on the preceding communication, by M. Marey.—On apsidal surfaces, by M. A. Mannhein.—On the theorem stated by M. P. H. Schoute in the *Comptes rendus* of May 18, by M. D. J. Korteweg. A simplification of one part of the demonstration of this theorem.—On the note of M. P. H. Schoute, entitled "The area of parabolas of higher order," by M. G. Mannoury.—On the method of least squares, by M. Jules Andrade.—On multiple resonance of electric oscillations, by M. Nils Strindberg. An experimental study of the theory of MM. Poincaré and V. Bjerknes on the phenomena of multiple resonance, discovered by MM. Sarasin and De la Rive. By the use of a new form of electro-dynamometer based upon the Joule effect, it has been found possible to determine completely the form of the curves of interference. Qualitatively, the results obtained verify the above theory.—Non-isotropic magnetisation of crystallised magnetite, by M. Pierre Weiss. From the fact that magnetite crystallises in the cubic system, complete symmetry of magnetic properties in all directions might be expected. The experiments detailed, however, show that this is not the case.—On the surfusion of water, by M. J. Passy. It is possible to produce a precipitate in surfused solutions without causing crystallisation to begin.—On the diurnal variation in rain, by M. A. Angot. In summer the maximum amount of rain at Paris falls between 3 p.m. and 6 p.m. In winter the maximum, which is not so well marked, appears to be between 6 a.m. and 9 a.m. In March, April, October, and November there is no appreciable daily variation.—Dissociation spectra of fused salts. Alkali metals: sodium, potassium, lithium, by M. A. de Gramont.—On the reproduction of colours in chromotypography, and on a simple system of colour notation, by M. Steinheil.—On a reaction of cuprous compounds serving as a characteristic test for nitrites, by M. Paul Sabatier. A solution containing a nitrite, treated with concentrated sulphuric acid and a little cuprous oxide, gives a characteristic violet colouration.—On the zirconotungstic compounds, by M. L. A. Hallopeau.—Synthesis of natural methylheptenone, by MM. Ph. Barbier and L. Bouveault.—Contribution to the study of the anterior region of the digestive apparatus of the higher Stenoglossia, by M. A. Amaudrut.—Artificial reproduction of a chlorocarbonate of sodium and magnesium, and a double carbonate of the same bases. Artificial reproduction of darapskite and hydrargylite, by M. A. de Schulten.—On the rare minerals of the glacier of Meije, by M. A. Lacroix. The minerals include anatase, brookite and turnerite.—Chalk containing hippurites of the eastern province, by M. H. Douville.—On the presence of a genus allied to *Caprina* in the limestone at Chateauneuf-du-Rhône (Drôme), by M. V. Paquier.—On the relations between thermal sensibility and temperature, by M. C. Henry.—Action of the porcelain filter upon snake venom; separation of the toxic substances and vaccinal substances, by M. C. Phisalix.—On some derivatives of diphenylethylene diamine, by M. C. Gassmann.—Studies on peridinitronaphthalene, by the same.—On a method of observing sun-spots, by M. Bougon.

BOOKS AND SERIALS RECEIVED.

BOOKS.—Report of the Sixth International Geographical Congress held in London, 1895 (Murray).—Statistical Atlas of India, 2nd edition (Stanford).—Rivers and Canals: L. F. Vernon-Harcourt, 2 Vols., 2nd edition (Clarendon Press).—Domestic Science Readers: V. T. Murché, Book 3 (Macmillan).—The Story of Electricity: J. Munro (Newnes).—Hegel's Philosophy of Right: translated by Dr. S. W. Dyde (Bell).—Das Süsswasserplankton: Dr. C. Apstein (Kiel, Lipsius).—Voxometric Revelation: J. Abner for A. A. North (Authors' and Printers' Joint Interest Publishing Company).—Text-Book of Zoology: Dr. J. E. Boas, translated by J. W. Kirkaldy and E. C. Pollard (Low).

SERIALS.—Economic Journal, June (Macmillan).—Royal Natural History, Part 32 (Warne).—Madras Government Museum, Bulletin No. 4 (Madras).—Journal of the Institution of Electrical Engineers, June (Spon).—Lloyd's Natural History. British Birds. Part 2 (Lloyd).—Himmel und Erde, June (Berlin).

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