THURSDAY, FEBRUARY 24, 1881

PROFESSOR MAX MUELLER AT UNIVERSITY COLLEGE

UNIVERSITY COLLEGE, London, is to be congratulated on the fresh step which was celebrated on Wednesday last week. The new wing which was then formally opened, and which will be largely devoted to scientific teaching, and let us hope research as well, will give the College more elbow-room in its career. Of course the "toasting" and speechifying at the dinner were largely collegiate, the speakers generally expressing their approval of the principles upon which University College and similar institutions have been founded. We have repeatedly called attention not only to the admirable educational work which University College has done since its foundation, but to the influence it has had on the higher teaching all over the country. Not only has it been in a sense the parent of not a few similar institutions, the number of which is almost every year on the increase, but it has undoubtedly had much to do with rousing from the lethargy of generations the two oldest and wealthiest universities of the country. Much as has been done recently in the way of reforming these two great educational centres, the work has been little more than begun. The advocates of university reform may therefore congratulate themselves that Prof. Max Müller was called upon to reply to the toast of "British Universities." His reply was not likely to be, and certainly was not, compounded of the common-places usually uttered on such occasions. Prof. Max Müller has reason to be grateful to Oxford, and his gratitude he expressed in terms of genuine tenderness. "At the same time," he went on to say, "Oxford, or at all events my friends at Oxford, have no feelings but those of sincere rejoicing at the springing up, and growing, and spreading of what may be called the young universities, the universities of the future. We watch them rising in every part of England as we watch the rising of new planets. We greet them as on a stormy night we greet new lighthouses coming into sight and shooting their rays of electric light through the darkness—yes, the darkness of this so-called enlightened century, the darkness visible, and best visible to those who have spent their lives in the study of even the smallest subject, and know how every one of them still bristles with problems that cannot be solved without a large collection of new facts, and without bringing to bear on them more powerful batteries of thought than are yet at our command."

Prof. Müller was so far loyal to his *Alma Mater* as to admit that the Oxford of the past has done good work; but the Oxford of the present is doing better work, and we trust with him that the Oxford of the future will do infinitely better work still. How the desirable end is to be accomplished is a problem that all true friends of learning in the country are anxious to have solved, and to attempt to solve which the recent Universities Commissioners were appointed. We do not mean at present to criticise the work which these Commissioners have been attempting to do; how far short that work is of anything like a high standard of reform may best be seen by comparing what is known of their recommendations with the aspirations expressed in Prof. Max Müller's admirable speech.

"To compare the work that Oxford or Cambridge could do, and ought to do, with that of any other university, whether British or Continental, is simply absurd. Oxford, with its excellent material, the well-fed and well-bred youth of these islands; Oxford, with its many students who have not to work for their bread; Oxford, with its rich colleges and libraries and fellowships, can do for the advancement of learning fifty times over what Giessen or even Leipsic can do. Oxford and Cambridge could beggar the whole world and make the old universities the home of all English genius, all English learning, all English art, all English virtue."

Alas, how far are we from realising what Prof. Müller modestly called his "German dreams"! But that these "dreams" are perfectly realisable Prof. Müller went on to show by facts and figures based on the report of the Commissioners themselves. Why, in accordance with his suggestion, should a certain number of prize fellowships at Oxford not be thrown open to the whole of England? Prof. Müller's suggested scheme is as wide and liberal as the most advanced friends of education could wish, including the practical endowment of research in all departments of literature, science, and art.

"Prize Fellowships," he went on to say, "are in future to be tenable for five or seven years only. This is quite right. But if after five or seven years a young man has developed a taste for scientific work and wishes to continue it, then let him have a second Fellowship, again with duties attached to it, and let that man, with the proceeds of two Fellowships, do the work and fill the place which the Extraordinary Professors fill in Continental universities. Lastly, if after another five years the few who remain true to a scientific life can show that they have done good work and are able and willing to do still better work, let them have a third Fellowship and become permanent Professors in the University on an income of about 1000*l.* a year for life. I must not enter into fuller detail," Prof. Müller went on, "I only wanted to sketch out to you how the national funds of national universities could be made to subserve truly national interests: how Prize Fellowships could be made a blessing both to the giver and the receiver, and how England could stamp out of the ground an army of, call them soldiers, or missionaries, or colonists, or men—true men of science, such as the past has never dreamt of. All this could be done to-morrow, and no one would suffer from it. I know I shall be told—in fact I have been told—that such changes are far too great; that the fathers who send their boys to Oxford and Cambridge would not approve them, and—this is always the last trump—that public opinion is against them. With regard to public opinion, if public opinion—if Parliament—is against us we must bow and wait. As to the fathers of boys—*ces pères de famille*—I am one of them myself, and I do not think we are always the most disinterested judges. As to changes, great or small, Nature teaches us that nothing can live which cannot grow and change, and history confirms her lesson that nothing is so fatal to institutions as a faith in their finality."

The scheme is one which, in its essential points,

has received the approval of the *Times*. "In fact," that journal concludes, in a leading article on the speech, "if the objects proposed by Prof. Müller for attainment are desirable in themselves, there ought to be no difficulty in obtaining funds for the purpose. In view of what the Commissioners have sanctioned in principle for one College at least in Oxford, it can hardly be said that the objects aimed at are either very visionary or very far in advance of public opinion. If Prize Fellowships may legitimately be used for the purpose of giving some men a start in ordinary life, it is difficult to see why they should not also be used, within reasonable limits, for giving others a modest provision for the pursuit of a learned career."

Why not? every one is likely to repeat except those who imagine they have a vested interest in being supported in idleness on what is really the property of the nation. By so doing, the university would once more make an approach to what it was intended to be, a really national institution. The change would incommode none but idlers, and those who have at heart the real advancement of science and learning must be convinced that the present isolation of both universities can lead to nothing but stagnation. Oxford especially, with its silent and all but deserted laboratories, could only gain by an accession of activity from the outside. Only thus indeed, only by having regular additions of fresh energy, can the place be kept sweet and wholesome; and if once this principle be accepted, as indeed it must be, and the sooner the better, there need be little difficulty in regulating its application. At present it would be difficult to calculate how much of the best intellectual energy of the country is wasted or misapplied, simply because there is no channel open by which it may be guided into the course in which it could do the best work.

There were several other subjects touched upon by the speakers at the University College dinner, to which we have not space to refer. Prof. Morley's tribute to the memory and the work of Mr. Carlyle was well-timed and appropriate, coming as it did just when the country was awed by its recent loss. Mr. Carlyle often said hard things of science, as he did of everything else under the sun. All the same, his methods and his philosophy were as scientific as they could well be, being simply his peculiar applications of the doctrine of the reign of inevitable law everywhere. Apart from this, and while we might disagree with everything he said and positively taught, it must be admitted that the inspiration of his teaching gave fresh energy and earnestness to scientific research, as it did to every other sphere of intellectual activity.

ATLAS OF HISTOLOGY

Atlas of Histology. By E. Klein, M.D., F.R.S., and E. Noble Smith, L.R.C.P., M.R.C.S. (London: Smith, Elder, and Co., 1880.)

MODERN histology is not yet fifty years old, but fifty years old in the nineteenth century means a great deal, and it is rather a matter of surprise that no English work entirely devoted to histology should have yet appeared than that we should be welcoming the largest and in some respects the most important illustrated work on that subject in this or any language.

That modern histology is most faithfully represented in the book before us becomes abundantly evident on looking at the figures and their description. We find the tissues and organs of the body delineated under every aspect and after every possible method of treatment; hardened with chromic acid, osmic acid, picric acid; stained with hæmatoxylin, carmine, aniline blue; submitted to the action of gold and silver salts and otherwise prepared *lege artis*. Of the value of these in elucidating structure there can be no question whatever, but at the same time we think it would have been well in a comprehensive work of this description had more space been given to the representation of the tissues in their living condition and unaltered by the action of reagents: the almost complete absence of allusion to and representation of the fresh tissues being a defect in the book.

Dr. Klein, in selecting the subjects for illustration, and Mr. Noble Smith in executing them, alike deserve high praise. Many of the figures are evidently as near an approach to facsimile of the preparations as can well be attained, and it need hardly be said that the preparations themselves, made as they are by so skilful a histologist, are as good in all probability of their kind as it is possible to make them.

In looking through the plates one is especially struck with the excellent manner in which the minute anatomy of the various organs is detailed, indeed the part of the work which relates to the structure of the viscera is in all respects better than that in which the simple tissues are dealt with. The illustrations of the latter are comparatively meagre, and in many cases too small, considering the size and aim of the work. This is very marked in the figures of the blood and in those of cartilage and osseous tissue, as well as in the illustrations of the structure of voluntary muscle. On the other hand, the development of bone is well and carefully represented, especially so far as the more intimate processes are concerned; but we miss the general features of bone-formation, such as the first calcification of the primitive cartilage bone, the periosteal irruption, and so on. The nervous tissue is also abundantly and beautifully illustrated, and here we are glad to observe that Dr. Klein has availed himself of the magnificent representations given by Key and Retzius in their monograph on the nervous system; representations that could scarcely have been improved upon, and to compete with which would have involved needless labour.

That the lymphatic system should occupy an important part of the work was to be expected from the fact that we already owe to Dr. Klein two monographs wholly devoted to that system, and from them, as well as from the plates in the "Handbook for the Physiological Laboratory," some delineations are here republished. With the exception of these and one or two other less important instances the figures throughout the book are new, and will no doubt for many years furnish a stock to which both teachers and authors may come for diagrams and illustrations.

As before remarked, the representations of the minute structure of the viscera are particularly good, and will prove useful in replacing many of the coarse and semi-diagrammatic figures which at present occupy a prominent place in the text-books of histology and physiology. We

may signalise those of the stomach and those of the kidney—the structure of the last-named organ being illustrated with particular minuteness. One is glad to think that one's examinations are over on finding that there are now no less than sixteen several named parts to be remembered in describing the course of a uriniferous tubule!

We have hitherto been writing as if the book before us were an Atlas of Plates and their description, and nothing more. This is emphatically not the case however, for the plates are accompanied by a text written by Dr. Klein, which forms a complete and independent compendium of the present state of histology, giving in plain terms and as briefly as is consistent with clearness, an account of the minute structure of each tissue and organ. In this account credit is given wherever possible to those to whom the discovery of new facts is due, but it is, we think, to be regretted that the references to the works in which the facts were published has not been added; such a notice of the literature of each subject would have been of much value.

At the end of the book a description of the appearances which are presented by nuclei in process of division will be found, embodying the results of the recent researches of Strasburger, Flemming, Mayzel, Klein, and others; results which have not unnaturally created a feeling of wonderment that in objects which have long engaged the special attention of histologists, changes of so marked a character should occur, and until now have wholly escaped observation.

We see that endothelium is still described as a tissue distinct from and indeed in contradistinction to epithelium, but it seems to be upon its last legs, for it now has to depend for existence upon a negative definition, and no longer presumes to base its claims to the place upon its developmental history.

There is a general tendency throughout the text to teach the subject somewhat dogmatically, and this, with the absence of detailed reference to literature, detracts from its value as a work of reference, while perhaps increasing its value as a text-book for students. Taking the work however as a whole it is not too much to say that it is in every way worthy of the high reputation of its principal author, and that its appearance, supplying as it does a want that has been long felt, will be welcomed by histologists both at home and abroad.

OUR BOOK SHELF

Urania: an International Journal of Astronomy. Edited by Ralph Copeland, Ph.D., and J. L. E. Dreyer, M.A.

THE first number of what is intended to be a high-class astronomical periodical, with the above title, has just appeared, and forms twenty-four pages demy quarto. It is proposed to issue it in numbers of from sixteen to twenty-four pages, whenever sufficient material offers, with shorter numbers when subjects of immediate interest require it. Papers will be accepted and printed in French, German, and Italian. This first number is well supported. It contains an article on the solution of Lambert's equation by Prof. Klinkerfues, and auxiliary tables for the calculation of occultations of stars by the moon, by Dr. C. Borgen. The Earl of Crawford and Balcarres contributes observations of comets 1880 *b*, *c*, and *d* made at Dunecht; the Earl of Rosse has a paper on determinations of lunar radiant heat during an eclipse; and Dr. R. S. Ball communicates an investigation of the parallax of the star Groombridge 1618, which is No. 89 in Argelander's list of stars with large proper motions, the observations having been made at Dunsink in 1878-79: a parallax to the amount of a third of a second is indicated by the measures both of distance and position, so that, as Dr. Ball remarks, there is reason to consider Groombridge 1618 entitled to a place amongst the sun's nearest neighbours. Dr. Copeland has a note upon a nebula detected at Dunecht on the method of sweeping suggested by Prof. Pickering of Harvard College, U.S., which is termed "a new planetary nebula." The nebula however is not new; it was discovered several years since by Mr. S. C. Burnham with a refractor of 6-inches aperture, and was notified at the end of his third catalogue of new double-stars: it is referred to also in the notes to his observations of double-stars in 1877-78, in the *Memoirs* of the Royal Astronomical Society, vol. xliv.: he found it to be double, the distance between the centres of the two parts and a star of 9m. (which appears to be *Durch.* + 47°, No. 3289), being 27″·3 at the epoch 1878·47. The double nucleus has also been remarked at Dunecht, and the measures of position and distance made there have a particular interest when compared with Mr. Burnham's in 1878; thus we have—

Burnham, 1878·476	...	Position, 88°·5	...	Distance,	2″·57
Dunecht, 1880·913	...	,, 71°·9	...	,,	8″·00

Such differences surely indicate rapid motion. Dr. Copeland does not allude to the star of about ninth magnitude distant less than half a minute of arc in 1878. This journal may be obtained by applying to Mr. J. L. E. Dreyer, Observatory, Dunsink, Co. Dublin.

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. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Infusible Ice

PROF. CARNELLEY'S directions in NATURE, vol. xxiii. p. 341, just received, for producing the hitherto fabulous commodity, "hot ice," have succeeded so much beyond our expectations for a first experiment in our College laboratory to-day, that the ease and simple means with which the experiment was performed, and the unaccountable and unaccustomed appearances which it presented, recommend it very strongly, as Prof. Carnelley remarks in his paper, and as I hope that the following description may also serve to prove, to other observers' trials and repetitions.

A 30 oz. flask of stout glass (made nearly as strong as the Carré decanters, for vacuum experiments) was tightly fitted, by forcing a two-inch plug of large solid india-rubber tube placed round a tube into its mouth and firmly fixing it there with wire, with a delivery-tube of three-eighths of an inch large glass barometer-tube about two feet long. This tube was bent into an S-shape, and at the extreme end of the small U-part, which turned up, it was drawn out to a nearly capillary neck and bent over to communicate by india-rubber tubing through another similar flask surrounded by cold water to act as a condenser, with a Swan's aspirator giving a vacuum of twenty-eight inches by the action of the town water-supply. About 15 oz. of distilled water previously introduced was now boiled in the flask *in vacuo*, and distilled over, at a very gentle heat, into the second flask. After two or three hours' boiling the quantity of water in the flask was reduced to about 3 oz., and the capillary end of the tube was then sealed with a blowpipe. The flask thus exhausted makes an excellent water hammer and cryophorus, ringing with sharp raps when the water is shaken to and fro in it or in its tube. The least warmth of the flask, or cold applied to the U-part of the tube, suffices to collect there, by distillation, a quantity of beautifully clear water completely freed from air.

To obtain the rapid evaporation and superheated state of ice, the U part of the tube was placed in a freezing-mixture of ice and salt till the condensed water coated the tube internally with a hollow sleeve of ice extending in the long and short parts of the U to a total length of about eight inches, and the flask itself was thereupon placed in a sawdust-bedded tin pail containing a large freezing-mixture of 5 lbs. of salt and 10 lbs. of pounded ice. Hydrochloric acid was at the same time added to the frigorific mixture round the U-tube, lowering the temperature of that part of the cryophorus to − 29° C. (− 20° F.), which had the effect of cracking the ice-sleeve (apparently by contraction) in all directions, giving rise at first, from its appearance, to the apprehension that the glass tube was completely splintered! Now came the critical operation. Would the hard frozen ice-coat bear the application of the heat ordeal without melting?

The freezing mixture round the U-tube was replaced by cold water in a water-bath, which was heated rapidly with a Bunsen-flame. About two inches of the ice-sleeve in the long part of the tube stood above the surface of the water; the rest soon melted, while the temperature of the water in the bath rose to 70° C., and a thick rime of white frost from the condensed vapours of this water formed round the tube containing the projecting part of the ice-tongue, which must have been intensely cold, since the rime almost touched the surface of the warm water. Below the surface of the water the tube appeared always to contain some snowy-looking solid, along with what resembled water proceeding from its liquefaction. When the temperature of the bath reached 70° C. the projecting ice-tongue was still unmelted; it had replenished itself by condensing and freezing the vapours rising up to it from below, and formed a snowy plug in the tube an inch or more long.

The water-bath was then removed in order to heat this snow-plug with a Bunsen-flame, and to our extreme surprise a similar snow-lining was found still to remain coating, quite dry, the whole long part and much of the short part of the U-bend. The flame was applied, and the whole tube was heated violently without for some time appearing to have the least effect upon the white crust within, notwithstanding the tube was too hot to be touched! A small flake weighing at most a few tenths of a grain, at the bottom of the U, withstood the strongest heat there for several minutes, wasting insensibly away, and unchanged in shape, until it vanished with perhaps a moment's collection to a drop as it disappeared. As it slowly grew thinner the white coating in the tube seemed in general to be no more affected by the heat than white feathers would have been; but in particular parts there often occurred partial liquefaction or pasty fusion allowing pieces of the film to turn over by their weight and roll or slip down the glass while still adhering to it, quite in the manner of drops. That the liquid itself, completely freed from air, refuses to boil, and may be described in that respect as practically oily, was evident enough in the preparation of the flask, when except by sudden bumps the distillation of vapour, however much it was urged by heat, and seen to be passing copiously through the bent worm-tube, proceeded almost entirely from the surface of the water in the flask.

In these drops at least, adhering to the heated glass, it seems difficult to believe that the solid ice which makes them angular, jagged in form, and pasty, can be anything but superheated; and it seems also scarcely credible that the latent heat of sublimation of the insignificant weight of a few grains of ice-crust in the tube resisting its strong heat for many minutes can reach the large amount of its gain of heat in that time by conduction and radiation from the surrounding tube, if the ice-film is at no higher temperature than its natural melting-point. These are questions however which the calorimetric methods devised and pursued by Prof. Carnelley are best designed to answer, and to which replies without such positive determinations can only be urged at present as probable conjectures, or as clear preceptions and presentiments, on the other hand, of the action and operation of some hitherto undiscovered thermal laws.

Whether by direct sublimation, or by evaporation accompanied by liquefaction, the slender snowdrift with its enlargement at the top was gradually reduced in thickness, and subdivided into remaining parts along its length, which all adhered to the tube until they wasted away, and the largest top piece never fell by withdrawal of support below, but, like the rest, it clung like a thin scale to the last to its original place on one side of the tube. This power of adhesion of hermetically volatilised ice to hot bodies with which it is in contact forms, as Prof. Carnelley observes, one of its most marked, although not at all one of its most prognosticable, properties, and it certainly prompts, if it does not unequivocally substantiate, the supposition that the ice in such close contact with extremely hot bodies must be superheated, or at a temperature sensibly higher than its natural melting-point.

The perfect success of the experiment and the beautiful appearance of the ineffaceable white snow-lining of the tube afforded us unqualified pleasure and surprise, and the simple preparation and preservation of the cryophoric apparatus needed for its exhibition will, I have no doubt, cause the experiment to be often reproduced and shown wherever freezing-mixtures and the cryophorus, and Boutigny's and Leidenfrost's phenomena, and Prof. Carnelley's theory and researches, are subjects of lecture-demonstrations.

A. S. HERSCHEL

College of Physical Science, Newcastle-on-Tyne, February 15

Dust, Fogs, and Clouds

I NEED not say that the information contained in M. H. J. H. Groneman's letter in NATURE, vol. xxiii. p. 337, was a most unexpected surprise. Nothing whatever seems to have been known in England about the results obtained by Messrs. Coulier and Mascart; and my astonishment was not diminished when I considered that their important investigation had borne no fruit, never having been practically applied by meteorologists or others.

I have just seen the article by M. Coulier in the *Journal de Pharmacie et de Chimie*, and will (with your permission) make a few remarks on his paper and on my own. M. Coulier was led to the discovery of the important part played by dust in the condensation of vapour, by making experiments on the well-known cloudy condensation produced by expanding saturated air. Instead of the ordinary air-pump arrangement M. Coulier's apparatus consisted of a glass flask, in which was placed some water. This flask was connected by a tube to a hollow india-rubber ball. He first compressed the india-rubber ball, thus compressing the air in the flask. The pressure was then removed from the ball, when the air in the flask expanded, and the condensation became visible.

In making repeated experiments with this apparatus M. Coulier noticed that the action of the air was capricious. After the air had remained in the flask some days he found it quite inactive. He also found it inactive after shaking it up with the water in the flask, and that on expelling some of the inactive air and replacing it with the air of the room the cloudiness again appeared. He then found that if he filtered the air before admitting it to the flask it did not give any cloudiness when expanded, and he explains with perfect clearness that the dust in the air formed the nuclei on which the vapour condensed.

Having explained the manner in which M. Coulier approached the subject I shall now give the history of the corresponding part in my work and show the direction from which I approached it. I had been studying the action of "free surfaces" in water and other forms of matter, when changing from one state to another. I knew that water could be cooled below the freezing-point; I was almost certain ice could be heated above the melting-point, and I had shown that water could be heated far above the boiling point; that the material of which the vessel holding the water was composed had no influence on the result—and all that was necessary to prevent the change of state taking place, at the freezing and boiling points, was an absence of "free surfaces" at which the change could begin. Arrived at this point, the presumption was very strong that vapour could be cooled below the "condensing point" without changing to water, if no "free surfaces" were present. I first intended to experiment with steam at the pressure of the atmosphere, but found difficulties in operating at so high a temperature. I then made arrangements to conduct the experiments at a lower temperature, and for convenience experimented on steam mixed with air. I then saw that dust in the air would form "free surfaces" on which the vapour would condense. I therefore attached a cotton-wool filter to the apparatus, and filtered the air before it entered the receiver. When this was done I found that the steam on entering the receiver was perfectly invisible, and gave rise to no cloudy condensation, the air remaining supersaturated. The experiment was immediately afterwards repeated somewhat in the same way as was done by M. Coulier, the air being supersaturated by expanding it by means of an air-pump.

Though the two investigations approached the subject from very different points, they seem afterwards to have flowed in almost parallel directions. Starting from his first experiments,

M. Coulier made experiments with the products of combustion from flames in which the combustion was as perfect as possible. He found these gases much more active than the air of the room. This he attributed to particles of unconsumed carbon. He also found the air after rain and storms to be less active, and the air in summer less active than in winter. After extending the experiments to alcohol and benzine, the paper concludes with some remarks on the peculiar action of ozone.

Up to this point the two investigations run perfectly parallel, and the strange likeness between the two sets of experiments is not the least interesting point connected with them. After going over this first paper by M. Coulier, I found he had communicated a second paper, which will also be found in the same volume of the *Journal de Pharmacie et de Chimie*, at page 254. This second paper is almost entirely occupied with a description of some experiments in which inactive air was heated and rendered active.

In the first experiment described in M. Coulier's second paper a platinum wire was heated in the purified air of the flask, after which the air was active. In the second experiment pure air in which hydrogen was burned became active. In the third experiment pure air which was passed through a glass tube surrounded with tinsel ("clinquant"), and moderately heated, was made active. Fourth experiment, oxygen, nitrogen, and hydrogen became active after they had been heated in a tube. After describing some effects in ventilation when *highly* heated air is used, he says, "In the preceding note (the first paper) I believed I could attribute the activity of the air to the presence of solid bodies, and it seemed to me that the only solid body that could escape from a carbon flame could be nothing but carbon itself. It was the remarkable experiment, so easily made, of filtering air through cotton-wool, that led me to form this hypothesis, which the experiments above related invalidate (à faire cette hypothèse, que les expériences relatées plus haut infirment)." He concludes by saying, "The explanation of these phenomena remains still to be found."

Experiments exactly corresponding to some of those described in M. Coulier's second paper will be found in mine. Wishing to test the effect of combustion on air, I first made experiments to test the effect of heat on the apparatus to be used in collecting the hot gases. For this purpose I passed filtered air through a heated glass tube, after which I found it was remarkably active. It was found however that this activity is not due, as M. Coulier seemed to suppose, to the heating of the air, but to impurities driven off the surface of the tube by the heat. This was proved by showing that the air remained inactive when the hot tube through which it was passed was thoroughly cleansed.

In making experiments on the effect of burning gas I arranged a platinum wire, connected with a battery, to enable me to light the gas in the pure air of the receiver. On testing the action of the heated wire alone, it was found that simply heating the wire gave rise to cloudiness. It was however found that by highly heating the wire its activity was destroyed, all impurities being driven off.

These experiments explain M. Coulier's first and third experiments. The fourth experiment is also to be explained by the nuclei driven off the tube by the heat. These nuclei may be driven off in the solid state, or as gases which condense without nuclei when *highly* supersaturated on being cooled to the temperature of the flask. The nuclei are in some cases formed by chemical union of the gases driven off by the heat, and in other ways unnecessary to enter upon here. As to the second experiment, more information is required as to arrangement of apparatus, &c., before any opinion can be formed as to the origin of the nuclei.

It now appears to me that this second paper explains why the first results of M. Coulier, though repeated and confirmed by M. Mascart, have not received that general acceptance we should have expected. In his second paper he describes a number of results which he did not succeed in fitting into his hypothesis. They even seemed to him to shake his first conclusions, and the uncertain sound given by his second paper seems to have blighted any fruit his first paper was likely to have produced. There can however be no doubt that M. Coulier was the first to show the important part played by dust in the cloudy condensation of the vapour in air, and his first paper clearly explains its action. It seems highly probable that if it had not been followed by his second paper, or if he had succeeded in getting the key to the explanation of his experiments, and his conclusions had confirmed instead of weakening the teaching of his first paper, his result would long ere now have been applied to explain the different causes and the different forms of cloudy condensation in our atmosphere, as well as other physical phenomena.

Darroch, Falkirk, February 15 JOHN AITKEN

Geological Climates

I DESIRE to express my thanks to Dr. John Rae for the valuable contribution of "facts" which he has added to this interesting question, of which I hope to make use in due time.

I wish also to answer the question asked by Prof. Woeikoff in his letter of February 17. My authority for January, July, and mean temperatures in the northern hemisphere and in the southern is the most recent and accurate available, viz., United States Coast Survey, "Meteorological Researches for the use of the Coast Pilot," Part 1, by William Ferrel (Washington, 1877). Mr. Ferrel gives the January and July temperatures for every ten degrees of longitude and latitude, up to 80° N. and 60° S. as follows, so far as regards the annual means :—

Lat. N.		Annual.		Lat. S.		Annual.
°		°		°		°
0	...	80·1 F.	...	0	...	80·1 F.
10	...	81·0 ,,	...	10	...	78·7 ,,
20	...	77·6 ,,	...	20	...	74·7 ,,
30	...	67·6 ,,	...	30	...	66·7 ,,
40	...	56·5 ,,	...	40	...	57·9 ,,
50	...	43·4 ,,	...	50	...	47·8 ,,
60	...	29·3 ,,	...	60	...	35·3 ,,
70	...	14·4 ,,	...	70	...	—
80	...	4·5 ,,	...	80	...	—

This table fully justifies what I said of the southern hemisphere as compared with the northern, and is, of course, explained by the existence of three great gulf streams in the south, which raise the mean temperature, producing insular climates with a small range from July to January.

Mr. Ferrel adds, at the close of his discussion (p. 22) :—

"From Dove's Charts of Isothermal Lines, which do not extend beyond the middle latitudes in the southern hemisphere, it has been inferred that the southern hemisphere is colder than the northern, and this has been the accepted view ever since his charts were first published, in the year 1852; but from the results obtained above it is seen that the mean temperature of the southern hemisphere is the greater of the two."

I was well aware that the east coast of Asia is colder, latitude for latitude, than the east coast of North America, but this has nothing to do with reducing the temperatures of the east coast of America, by means of alterations in the ocean currents of the North Atlantic, which I deny to be possible.

SAMUEL HAUGHTON

Trinity College, Dublin, February 19

Climate of Vancouver Island

AS questions connected with the climate of Vancouver Island and the influence on it of ocean currents have lately been the subject of several communications in the pages of NATURE, it may be worth while to draw attention to the fact that Esquimalt, at the southern extremity of the island, together with several places on the mainland of British Columbia, have now been for a number of years occupied as regular stations of the Canadian Meteorological Service, and that trustworthy meteorological results are to be found in the annual reports to Government.

When writing a report on British Columbia for the Canadian Pacific Railway Survey in 1877, I applied to Prof. Kingston, then in charge of the Meteorological Department, for some information on climate, and received from him an abstract, which was published at the time ("Can. Pacific Ry. Report, 1877," p. 246), by which it appears that the mean summer temperature of Esquimalt is 57°·82 F., mean winter temperature 34°·45, mean annual temperature 47°·97. This does not include however the additional results of the last few years.

Much information on the climate of the northern part of the north-west coast may also be found in the *Alaska Coast Pilot*, 1869, and the *U.S. Pacific Coast Pilot*, Appendix 1, 1879. In the latter, series of monthly and mean annual isothermal lines are given for the air and sea surface, which—though the observations at command are by no means complete—are doubtless nearly correct. A partial abstract of these, with some discussion

of the climatic features of British Columbia, may be found in an appendix written by me for the Canadian Pacific Railway Report of 1880, p. 107.

The mean temperature of Tongass at the southern extremity of Alaska, from two years' observations, is stated as 46°·5.

Observations have been maintained at Sitka with little interruption for a period of forty-five years. The latitude of this place is 57° 3′, or about one degree north of Glasgow. The mean temperatures are as follows:—spring 41°·2, summer 54°·6, autumn 44°·9, winter 32°·5, and for the year 43°·3.

According to the *Pacific Pilot* above quoted, that portion of the Kuro-siwo, having a temperature of 55° F. or more, approaches the coast in the vicinity of Vancouver Island. Temperatures not much lower than this however prevail much further north. The average temperature of the surface of the sea during the summer months in the vicinity of the Queen Charlotte Islands as determined by me in 1878 ("Report of Progress, Geological Survey of Canada, 1878-79") is 53°·8. Observations by the U.S. Coast Survey in 1867, in the latter part of July and early in August between Victoria and Sitka, gave a mean surface-temperature of 52°·1.

GEORGE M. DAWSON

Geological Survey of Canada, February 1

"The New Cure for Smoke"

IT was not my intention to trouble you further on this subject at present, but as Dr. Siemens has been good enough to notice the result of my trials with the coke-gas grate, and has asked a question with reference to the grate used by me, it is due to that gentleman that I should at once explain that the grate in which the trials were made is of modern construction and permanently fitted with side-cheeks and back of fire-clay lumps, and that when in use with the coke and gas the back was fitted with a copper plate, and in all other respects the grate was arranged in the manner described and illustrated in NATURE, vol. xxiii. p. 26.

J. A. C. HAY

On the Space Protected by Lightning-Conductors

THE very interesting article by Mr. W. H. Preece on the "Space Protected by a Lightning-Conductor" (*Phil. Mag.* 5th series, vol. x. p. 427 *et seq.*, December, 1880) revives this important practical question. The old rule, first enunciated by M. Charles, which makes the radius of the protected circular area around the base of the rod equal to twice its vertical height, has never been satisfactorily verified either on theoretical or experimental grounds. This rule was adopted in the Report of the Commission of the French Academy of Sciences drawn up by M. Gay-Lussac in 1823 (*Ann. de Chim. et de Phys.* 2nd series, t. 26, p. 258), and also in two other reports drawn up by M. Pouillet, one in 1854 (*Comptes rendus*, t. 39, p. 1142), and the other in 1867 (*Comptes rendus*, t. 64, p. 102). But still more recently the Committee appointed by the Préfet de la Seine to superintend the construction of lightning-conductors in the City of Paris, in their Report in February, 1876, *reduced* the radius of the protected area to 1·45 times the height of the rod. I am ignorant on what grounds the Commission adopted this precise number.

In this state of the problem Mr. Preece's paper was both apposite and welcome. The rule which he deduces certainly has the merit of *definiteness;* but it seems to me that it fails to be *practically satisfactory*. For it is very evident that his investigation is exclusively applicable to "*Blunt-Conductors*," since the "*Power of Points*" is entirely left out of consideration. His deductions might apply to the *blunt*-conductors which crowned the Royal Palace of George III., but are scarcely applicable to the *pointed* rods now employed! His investigation assumes that the *distance* of the earth-connected objects from the electrified cloud is the *only element* which determines the *direction* of the discharge. It seems to me that the well-established "power of points" to discharge, or rather to *neutralise* the electricity of charged conductors, is an essential element in the problem of the protected space.

It is a well-known fact that when an electrified cloud approaches a *pointed* lightning-conductor which is in good conducting connection with the earth, the sharp point becomes charged by induction with opposite electricity of *high tension* long before the distance between them approximates that required for a *disruptive* discharge; so that electricity of the opposite kind from that of the cloud *escapes* from the point in the form of a *connective discharge* or electrical *glow*, and *neutralises* that of the cloud, and thus silently *disarming* it, *averts* the disruptive stroke of lightning. This *neutralisation*, due to the power of points, constituting the *preventive action* of lightning-conductors, is justly regarded as the *most important* function of such rods; although, under certain extraordinary circumstances, they may be forced to carry disruptive discharges. Under any circumstances, however, it is obvious that *pointed* conductors must *enlarge* the protected area as compared with *blunt* conductors.

It is very difficult, if not impossible, to estimate in a precise manner how this *power of points* would *modify* and *distort* the *equipotential surfaces* in the intervening electric field. The problem is evidently one of great complexity. The following circumstances must obviously influence, to a greater or less extent, the *magnitude* and *direction* of the resultant electromotive force, which determines the path of discharge, *convective* or *disruptive*, viz.: (1) *Distance* of thunder-cloud from the point of the conductor; (2) variable *dielectric properties* of the intervening air; (3) *size* of the cloud; (4) the variable *tension* of its electric charge, especially under the neutralising action of the pointed rod; and (5) the *velocity* with which the thunder-cloud approaches the point of the conductor. The *last* consideration is very important, and at the same time most difficult to formulate; for the *convective neutralisation* is a *gradual* process requiring *time*. It is evident that a heavily-charged thunder-cloud *rapidly* driven towards the point of the conductor might give rise to a *disruptive* spark, while, if *slowly* approaching the same, it would have been *silently neutralised*, and the stroke averted. In fact the strength and direction of the resultant force is influenced by so many variable conditions that it would tax the resources of a powerful calculus to indicate a formula which would satisfy, even approximately, the demands of practice in the construction of lightning-conductors.

Nevertheless, it is quite certain that Mr. Preece's rule, which makes the radius of the protected circular area equal to the *height* of the rod for *blunt* conductors, is perfectly *safe* for *pointed* rods; for there can be no question as to the fact that the "power of points" *enlarges* the protected area.

The late Prof. Henry frequently witnessed the efficacy of convective discharges from the point of the lightning conductor attached to the high tower of the Smithsonian Institution. During violent thunder-storms at night, at every flash of lightning he observed that "a jet of light, at least five or six feet in length, issued from the point of the rod with a hissing noise."

It is proper to add that while the circumstances influencing *disruptive* discharges of electricity have been experimentally investigated by a number of physicists, the laws of *convective* discharges from points do not seem to have received attention from any experimenter. Thus I have not been able to find a satisfactory answer to the following elementary inquiry, viz.—Under given conditions, at what *distance* will a pointed conductor connected with the earth *begin* to neutralise the electricity of an insulated conductor by the convective discharge of the opposite kind of electricity from the point?

In short, the whole subject of the "power of points," although one of the best-established and most conspicuous phenomena in electricity, is sadly in need of experimental investigation. This class of electrical phenomena is pretty much in the same condition in which Franklin left it more than a century ago.

Berkeley, California, January 1 JOHN LE CONTE

[Mr. Preece has shown by considering the area between the conductor and the charged cloud as an electric field mapped out in equipotential surfaces and lines of force, that "a lightning-rod protects a conic space whose height is the length of the rod, whose base is a circle having its radius equal to the height of the rod, and whose side is the quadrant of a circle whose radius is equal to the height of the rod."—*Phil. Mag.*, December, 1880.—ED.]

Localisation of Sound

MY friend the Rev. H. J. Marston, Second Master of the School for Blind Sons of Gentlemen at Worcester, has communicated to me some very singular instances of the power of localising sound possessed by blind boys.

One of the games in which his pupils most delight is that of *bowls*. A bell is rung over the nine-pins just as the player is ready to throw the bowl, when, totally blind as he is, he delivers it with considerable accuracy of aim. Mr. Marston vouches for the fact that it is no uncommon feat for a boy to strike down a single pin at a distance of forty feet three times in succession.

It is significant that this game cannot be played by the blind boys in windy weather. And yet the allowance for windage on a heavy bowl can be no very large quantity.

The boys also play football with great zeal and considerable skill. Bells are rung at the goals throughout the game, and the ball contains two little bells. With these guides the boys manage both to follow the ball and to direct it to the goals.

Clifton College, February 15 H. B. JUPP

Migration of the Wagtail

THE inclosed extract from the New York *Evening Post*, a newspaper of high standing for accuracy and intelligence, contains statements which are not, I think, generally known in regard to the migration of the water-wagtail, and your insertion of the same may be the means of drawing from other correspondents some evidence in confirmation or disproof. Though riding is not quite unknown among animals other than men, yet such purposeful riding as is here described is, to say the least, very extraordinary. E. W. CLAYPOLE

Antioch College, Yellow Springs, Ohio, Dec. 12, 1880

The Singular Methods of Travel the Wagtail adopts to Cross the Mediterranean Sea.—In the autumn of 1878 I spent several weeks on the Island of Crete. On several occasions the papas—village priest—a friendly Greek with whom I spent the greater part of my time—frequently directed my attention to the twittering and singing of small birds which he distinctly heard when a flock of sand-cranes passed by on their southward journey. I told my friend that I could not see any small birds, and suggested that the noise came from the wings of the large ones. This he denied, saying, "No, no! I know it is the chirping of small birds. They are on the backs of the cranes. I have seen them frequently fly up and alight again, and are always with them when they stop to rest and feed." I was still sceptical, for with the aid of a field-glass I failed to discover the "small birds" spoken of. I inquired of several others, and found the existence of these little feathered companions to be a matter of general belief among both old and young. I suggested that possibly the small birds might go out from the shore a short distance and come in with the cranes. "No, no," was the general answer, "they come over from Europe with them." I certainly heard the chirping and twittering of birds upon several different occasions, both inland and out upon the sea. But in spite of the positive statements of the natives I could not believe their theory until convinced one day while fishing about fifteen miles from the shore, when a flock of cranes passed quite near the yacht. The fishermen, hearing the "small birds," drew my attention to their chirping. Presently one cried out "There's one," but I failed to catch sight of it. Whereupon one of them discharged his flint-lock. Three small birds rose up from the flock and soon disappeared among the cranes.

I subsequently inquired of several scientific men, among whom were two ornithologists, as to the probability of such a state of affairs. They all agreed that it could not be, and I, too, was forced to cling to my original judgment, and let the matter go. Recently however while reading the *Gartenlaube* my attention was attracted to an article bearing directly upon the subject. The writer, Adolf Ebeling, tells the same story, and adds the statements of some ornithologists of distinction, which makes the whole matter so striking and interesting that I quote the paragraph from his book :—

"Shortly after my arrival in Cairo I greeted various old German friends among the birds that I observed in the palm-garden of our hotel. First, naturally, was the sparrow, the impudent proletariat—I had almost said social democrat, because the whole world to-day has that bad word in the mouth. He appeared to me to be more shameless than ever in the land of the Pharaohs, for he flew without embarrassment on the breakfast table, and picked off the crumbs and bits from every unwatched place. But the mark of honour we paid to the wagtails, and in truth chiefly because we did not then know that the wagtails were birds of passage. We had thought that they passed the winter in Southern Europe, or at farthest as many of them do, in Sicily and the Grecian Islands. That they came to Africa, and especially to Nubia and Abyssinia, was then unknown to us. This appeared to us singularly strange, nay, almost incredible, particularly on account of the peculiar flight of the wagtail, which it is well known always darts intermittingly through the air in longer or shorter curves, and apparently, every few moments, interrupts its flight to sit again and 'wag its tail.' But there was the fact, and could not be denied. Everywhere in the gardens of Cairo you could see them under the palms that border the banks of the Nile; on the great avenues that lead to the pyramids; nay, even on the pyramids themselves in the middle of the desert. And there it was that I first heard of this singular phenomenon.

"One evening we were sitting at the foot of the pyramid of Cheops, sipping our cup of fragrant Mocha and in jolly conversation, rolling up clouds of blue smoke from our Korani cigarettes. We were waiting for the sinking of the sun to make our return to Cairo. The deep silence of the surrounding desert possessed something uncommonly solemn, only now and then disturbed by the cry of the hoarse fishhawks far above us. Still higher the pelicans were grandly circling. Their flight, though heavy when seen from anear, possesses a majesty in the distance attained by no other bird. Right before us several wagtails were hopping around and 'tilting.' They were quite tame, and flew restlessly hither and thither. On this occasion I remarked, 'I could not quite understand how these birds could make the long passage of the Mediterranean.' Sheik Ibrahim heard this from our interpreter. The old Bedouin turned to me with a mixture of French and Arabic as follows, which the interpreter aided us to fully comprehend :—

"'Do you not know, Hadretch (noble sir), that these small birds are borne over the sea by the larger ones?'

"I laughed, as did our friends; for at first we thought we had misunderstood him; but no: the old man continued quite naturally :—

"'Every child among us knows that. These little birds are much too weak to make the long sea journey with their own strength. This they know very well, and therefore wait for the storks and cranes and other large birds, and settle themselves upon their backs. In this way they allow themselves to be borne over the sea. The large birds submit to it willingly; for they like their little guests, who by their merry twitterings help to kill the time on the long voyage.'

"It appeared incredible to us. We called to a pair of brown Bedouin boys, pointed out the wagtails to them, and inquired :—

"'Do you know whence come these small birds?'

"'Certainly,' they answered. 'The Abu Saad (the stork) carried them over the sea.'

"At supper, in the Hôtel du Nil, I related the curious story to all present, but naturally enough found only unbelieving ears.

"The only one who did not laugh was the Privy Councillor Heuglin, the famous African traveller, and, excepting Brehm, the most celebrated ornithologist of our time for the birds of Africa. I turned to him after the meal, and inquired of his faith. The good royal councillor smiled in his caustic way, and with a merry twinkle remarked: 'Let the others laugh: they know nothing about it. I do not laugh, for the thing is known to me. I should have recently made mention of it in my work if I had had any strong personal proof to justify it. We must be much more careful in such things than a mere story-teller or novel-writer; we must have a proof for everything. I consider the case probable, but as yet cannot give any warrant for it.'

"My discovery, if I may so call it, I had kept to myself, even after Heuglin had thus expressed himself, and would even now maintain silence on the subject had I not recently discovered a new authority for it."

I read lately in the second edition of Petermann's great book of travels the following :—

"Prof. Roth of Munich related to me in Jerusalem that the well-known Swedish traveller, Hedenborg, made the following interesting observation on the Island of Rhodes, where he stopped. In the autumn tide, when the storks come in flocks over the sea to Rhodes, he often heard the songs of birds without being able to discover them. Once he followed a flock of storks, and as they lighted he saw small birds fly up from their backs, which in this manner had been borne over the sea. The distance prevented him from observing to which species of singing birds they belonged."

Thus wrote the famous geographer Petermann. Prof. Roth and Hedenborg and Heuglin are entirely reliable authors. This was a matter of great curiosity to me, and after I found others had made similar observations and expressed them in print, I thought they would be of no less curiosity and interest on this side of the Atlantic, and equally deserving of public notice. I hope that connoisseurs, amateurs, and experts may be excited by this to extend their observation in this line also. The instinct of animals is still, in spite of all our observations and experience,

almost a sealed book to us. By a little attention we might hear of still more curious things in this field. PHONE

New York, November 20, 1880

Subsidence of Land caused by Natural Brine-Springs

A THEORY has been put forward to account for the subsidence of land in the salt districts of Cheshire. It is said that, supposing the manufacturers of salt ceased to pump up the brine, it would run away to the sea, and subsidence would go on at as rapid a rate as now. Can any of the readers of NATURE tell me of any *facts* to substantiate such a theory, or refer me to any district where such rapid subsidence is going on, owing to the escape of natural brine-springs to the sea? Any reference to works giving information on this point will be thankfully received. THOS. WARD

Northwich, February 15

Chlorophyll

THE following experiment may be interesting in its bearing on the relation between chlorophyll-development and light.

If cress seed are grown for a few days in the dark on damp cotton-wool, and then, beneath the surface of water, introduced into an inverted glass jar filled with water, they may be exposed to daylight for an indefinite time without chlorophyll being developed. But the plants are not dead; for if, after a few days' exposure, the cotton-wool on which they have been grown is cut in two beneath the surface of the water, and one half, with its plants, is restored to the inverted jar of water, while the other is placed under an inverted glass jar containing air only, and then these two jars be exposed to full daylight, the plants beneath the jar containing air rapidly become green, while the others never do so.

Light therefore cannot always cause the development of chlorophyll in the etiolated leaves of living plants.

Liverpool, January 24 WILLIAM CARTER

[This is an interesting observation, but seems to need some further investigation. As shown by Sachs ("Text-book," pp. 665, 666) the formation of chlorophyll has a complicated dependence upon light. If the temperature be sufficiently high it is formed in the cotyledons of conifers and the leaves of ferns even in complete darkness. The seedlings of angiosperms require exposure to light for the production of chlorophyll, but it does not take place at low temperatures. All the visible parts of the spectrum possess the power of turning etiolated grains of chlorophyll green, although the yellow and adjoining rays are most effective. The failure of the seedlings immersed in water to become green can hardly therefore be attributed to the absorption of the heat rays. Is it possible that their water-bath keeps their temperature too low?]

Squirrels Crossing Water

IN NATURE, vol. xxiii. p. 340, I read that Mr. Godwin-Austen never had heard of a squirrel taking to the water. As here are perhaps more readers of NATURE in Mr. Godwin-Austen's case, I take this opportunity to transcribe what Bachman related to us about that matter in the year 1839.

The northern grey and black squirrel *Sciurus leucotis*, has occasionally excited the wonder of the populace by its wandering habits and its singular and long migrations. Like the lemming, *Lemnus norvegicus*, of the Eastern Continent, it is stimulated, either from a scarcity of food or from some other inexplicable instinct, to leave its native haunts and seek for adventures or for food in some distant and, to him, unexplored portion of our land. The newspapers from the West contain frequent details of these migrations; they appear to have been more frequent in former years than at the present time. The farmers in the Western wilds regard them with sensations which may be compared to the anxious apprehensions of the Eastern nations of the flight of the devouring locust. At such periods, which usually occur in autumn, the squirrels congregate in different districts of the far North-West, and in irregular troops bend their way instinctively in an eastern direction. Mountains and cleared fields, the head-waters of lakes and broad rivers, present no unconquerable impediments. Onward they come, devouring on their way everything that is suited to a squirrel's taste, laying waste the corn and wheat-fields of the farmer; and as their numbers are thinned by the gun, the dog, and the club, others are ready to fall in the rear and fill up the ranks, till they occasion infinite mischief and call forth no empty threats of revenge. It is often inquired how these little creatures, that on common occasions have such an instinctive dread of water, are enabled to cross broad and rapid rivers, like the Ohio and Hudson, for instance. It is usually asserted, and believed by many, that they carry to the shore a suitable piece of bark, and seizing the opportunity of a favourable breeze, seat themselves upon this substitute for a boat, hoist their broad tails as a sail, and float safely to the opposite shore. This, together with many other traits of intelligence ascribed to this species, I suspect to be apocryphal. That they do migrate at irregular and occasionally at distant periods is a fact sufficiently established; but in the only instance in which I had an opportunity of witnessing the migrations of the squirrel, it appeared to me that he was not only an unskilful sailor, but a clumsy swimmer. It was (as far as my recollection serves me of the period of early life) in the autumn of 1808 or 1809, troops of squirrels suddenly and unexpectedly made their appearance in the neighbourhood, but among the grey ones were varieties not previously seen in those parts; some were broadly striped, with yellow on the sides, and a few with a black stripe on each side, bordered with yellow or brown, resembling the stripes of the little chipping squirrel (*Tamias lysteri*). They swam the Hudson in various places between Waterford and Saratoga; those which I observed crossing the river were swimming deep and awkwardly, their bodies and tails wholly submerged; several that had been drowned were carried downward by the stream, and those which were so fortunate as to reach the opposite bank were so wet and fatigued that the boys stationed there with clubs found no difficulty in securing them alive or in killing them. Their migrations on that occasion did not, as far as I could learn, extend farther eastwardly than the mountains of Vermont; many remained in the county of Rensellaer, and it was remarked that for several years afterwards the squirrels were far more numerous than before. It is doubtful whether any ever return westwardly; but finding forests and food suited to their tastes and habits, they take up their permanent residence in their newly-explored country; there they remain and propagate their species until they are gradually thinned off by the effects of improvement and the dexterity of the sportsmen around them. (The *Magazine of Natural History*, vol. iii., new series, 1839.)

Leyden, February 16 F. A. JENTINK

Flying-Fish

WITH reference to the letter of Mr. Pascoe in NATURE, vol. xxiii. p. 312, allow me to offer a suggestion as to the mechanical means by which the flying-fish moves when out of the water. During a voyage to India and back I took a great interest in observing the movements of these beautiful creatures by means of a powerful opera-glass; and soon came to the conclusion that a slight but rapid tremor of the pectoral fins could be seen for a few moments after the fish left the water. In very calm weather I noticed a series of little ripples on each side of the fish as it skimmed along the surface before rising for its flight, evidently caused by the wing-points tipping the water. My idea is that the flying-fish springs from the sea, and by beating the surface rapidly with its pectoral fins obtains an impetus which carries it along for some distance in the air. It then descends to the surface, and in the same manner acquires a fresh accession of speed. This process however is never repeated more than twice, though the fish does sometimes resume its flight after a moment of immersion. R. E. TAYLOR

THE TRANSIT OF VENUS

THE President of the Royal Society presents his compliments to the Editor of NATURE, and will be much obliged to him if he will, at as early a date as may be convenient, be so good as to give publicity to the enclosed minute of the Transit of Venus Committee.

The Royal Society, Burlington House,
London, W., February 21

"THE Committee appointed by the Royal Society, at the request of the Government, to make arrangements for observing the Transit of Venus in 1882, would be glad to be informed whether astronomers have at their disposal, and are willing to lend, for use in the observations, 4-inch, 5-inch, or 6-inch refracting telescopes, and 10-inch or 12-inch reflectors, with equatorial mountings; also portable transits or altazimuths.

"The instruments would be returned, in perfect order, as soon as possible after the transit, and, in any case, before the end of 1883.

"All communications should be addressed to the Secretary, Transit Committee, Royal Society, Burlington House."

The Committee, we are informed, is constituted as follows :—The President of the Royal Society is the chairman, the other members being Prof. J. C. Adams, the Astronomer-Royal, the Earl of Crawford and Balcarres, Mr. De la Rue, Mr. Hind, Dr. Huggins, Vice-Admiral Sir G. H. Richards, Prof. H. J. S. Smith, Prof. Stokes, and Mr. E. J. Stone.

DR. J. J. BIGSBY

YET another of the links that have bound the geologists of the present time in association with the early leaders of their science has been severed by the removal of the kindly and venerable form of Dr. Bigsby. Upwards of sixty years ago he began his geological career in North America, devoting himself mainly to the investigation of the structure of the older Palæozoic rocks of Canada and of the adjoining tracts of the States. As secretary to the Boundary Commission under the Treaty of Ghent he had opportunities of investigating the region from Quebec to Lake Superior, and published numerous descriptions, of which the exactness has been amply verified by the subsequent researches of the Geological Survey of Canada. It is chiefly as an admirable pioneer in Canadian geology that his name will be inscribed in the records of scientific progress. But he has other claims to grateful remembrance. Since he returned to spend his later years in this country he has devoted himself with the most untiring patience to the compilation of his "Thesaurus Siluricus" and "Thesaurus Devonicus"—works in which the geological and geographical range of the organisms of the earlier half of Palæozoic time is clearly shown in a series of valuable tables.

Still more recently, in 1877, he presented to the Geological Society a bronze medal which, with a sum of money derived from the interest of a fund also given by him, is to be awarded every two years as an incentive to geological study. The terms according to which he directed that the prize should be given are that the medal and interest from the fund should be awarded "as an acknowledgment of eminent services in any department of geology, irrespective of the receiver's country; but he must not be older than forty-five years at his last birthday, thus probably not too old for further work, and not too young to have done much." The founder lived to see two fitting awards of his prize go to the eminent palæontologists of the United States, Professors O. C. Marsh and E. D. Cope. He died just before the third presentation was made, last week, to Dr. Charles Barrois of Lille.

ON TIDAL FRICTION IN CONNECTION WITH THE HISTORY OF THE SOLAR SYSTEM[1]

THIS paper forms one of a series on the subject of tidal friction which have been read from time to time before the Royal Society and reported in NATURE.

The first part of the paper contains the investigation of the changes produced by tidal friction in the system formed by a planet with any number of satellites revolving about it in circular orbits. As the results cannot be conveniently stated without the aid of mathematical notation, they are here passed over.

The previous papers treated of the effects which tidal friction must have had on the motions of the earth and moon, on the supposition that time enough has elapsed for this cause to have its full effect. It then appeared that we are thus able to co-ordinate together the various elements of the motions of these two bodies in a manner too remarkable to be the product of chance.

The second part of the present paper contains a discussion of the part which the same agency may have played in the evolution of the solar system as a whole and of its several parts.

It is first proved that the rate of expansion of the planetary orbits, due to the reaction of the frictional tides raised by the planets in the sun must be very slow compared with that due to the reaction of the tides raised by the sun in the planets. Thus it would be much more nearly correct to treat the sun as a rigid body, and to suppose the planets alone to be subject to frictional tides, than the converse. It did not, however, seem expedient to attempt to give any numerical solution of the problem thus suggested which should apply to the solar system as a whole.

The effect of tidal friction is to convert the rotational momentum of the tidally disturbed body into orbital momentum of the tide-raising body. Hence a numerical evaluation of the angular momentum of the various parts of the solar system will afford the means of forming some idea of the amount of change in the orbits of the several planets and satellites, which may have been produced by tidal friction. Such an evaluation is accordingly made in this paper, with as much accuracy as the data permit.

From the numerical values so found it is concluded that the orbits of the planets round the sun can hardly have undergone a sensible enlargement from the effects of tidal friction since those bodies first attained a separate existence.

Turning to the several sub-systems, it appears that, although it is possible that the orbits of the satellites of Mars, Jupiter, and Saturn about their planets may have been considerably enlarged, yet it is certainly not possible to trace the satellites back to an origin almost in contact with the present surfaces of their planets, in the same manner as was done for the case of the moon in the previous papers.

The numerical values above referred to exhibit so marked a contrast between the case of the earth with the moon, and that of the other planets with their satellites, that it might *à priori* be concluded as probable that the modes of evolution have differed considerably. The conclusion above stated concerning the satellites of the other planets cannot therefore be regarded as unfavourable to the acceptance of the views maintained in the previous papers. It must, however, be supposed that some important cause of change other than tidal friction has been concerned in the evolution of the solar system and the planetary sub-systems. According to the nubular hypothesis of Laplace, that cause has been the condensation of the heavenly bodies. Accepting that hypothesis, the author then proceeds to consider the manner in which contraction and tidal friction are likely to have worked together.

A numerical comparison shows that, notwithstanding the greater age which the nebular theory assigns to the exterior planets, yet the effects of solar tidal friction in reducing planetary rotation must in all probability be considerably less for the remote than for the nearer planets. It is, however, remarkable that the number expressive of the rate of retardation of the Martian rotation by solar tidal friction is nearly the same as the similar number for the earth, notwithstanding the greater distance of Mars from the sun. This result is worthy of notice in connection with the fact that the inner satellite of Mars revolves with a periodic time much shorter than that of the planet's rotation; for (as suggested in a previous paper) solar tidal friction will have been com-

[1] An account of a paper entitled "On the Tidal Friction of a Planet attended by several Satellites, and on the Evolution of the Solar System," by G. H. Darwin, F.R.S., read before the Royal Society on January 20, 1881.

petent to reduce the planetary rotation without directly affecting the satellite's orbital motion.

It is then shown to be probable that solar tidal friction was a more important cause of change when the planets were less condensed than it is at present. Thus we are not to accept the present rate of action of solar tidal friction as indicating that which has held true in all past time.

It is also shown that if a planetary mass generates a large satellite, the planetary rotation is reduced after the change more rapidly than before; nevertheless the genesis of such a satellite is preservative of the moment of momentum which is internal to the planetary subsystem. This conclusion is illustrated by the comparatively slow rotation of the earth, and by the large amount of angular momentum residing in the system of moon and earth.

An examination of the manner in which the difference of distances of the various planets from the sun will have affected the action of tidal friction leads to a cause for the observed distribution of satellites in the solar system.

According to the nebular hypothesis a planetary mass contracts, and rotates quicker as it contracts. The rapidity of the revolution causes its form to become unstable, or perhaps, as seems more probable, an equatorial belt gradually detaches itself; it is immaterial which of these really takes place. In either case the separation of that part of the mass which before the change had the greatest angular momentum permits the central portion to resume a planetary shape. The contraction and increase of rotation proceed continually until another portion is detached, and so on. There thus recur at intervals a series of epochs of instability or of abnormal change.

Now tidal friction must diminish the rate of increase of rotation due to contraction, and therefore if tidal friction and contraction are at work together the epochs of instability must recur more rarely than if contraction acted alone.

If the tidal retardation is sufficiently great, the increase of rotation due to contraction will be so far counteracted as never to permit an epoch of instability to occur.

Now the rate of solar tidal friction decreases rapidly as we recede from the sun, and therefore these considerations accord with what we observe in the solar system. For Mercury and Venus have no satellites, and there is a progressive increase in the number of satellites as we recede from the sun.

Whether this be the true cause of the observed distribution of satellites amongst the planets or not, it is remarkable that the same cause also affords an explanation of that difference between the earth with the moon and the other planets with their satellites, which has permitted tidal friction to be the principal agent of change with the former, but not with the latter.

In the case of the contracting terrestrial mass we may suppose that there was for a long time nearly a balance between the retardation due to solar tidal friction and the acceleration due to contraction, and that it was not until the planetary mass had contracted to nearly its present dimensions that an epoch of instability could occur.

If the contraction of the planetary mass be almost completed before the genesis of the satellite, tidal friction, due jointly to the satellite and the sun, will thereafter be the great cause of change in the system, and thus the hypothesis that it is the sole cause of change will give an approximately accurate explanation of the motion of the planet and satellite at any subsequent time. It is shown in the previous papers of this series that this condition is fulfilled with the earth and moon.

The paper ends with a short recapitulation of those facts in the solar system which are susceptible of explanation by the theory of the activity of tidal friction. This series of investigations affords no grounds for the rejection of the nebular hypothesis, but while it presents evidence in favour of the main outlines of that theory, it introduces modifications of considerable importance.

Tidal friction is a cause of change of which Laplace's theory took no account, and although the activity of that cause is to be regarded as mainly belonging to a later period than the events described in the nebular hypothesis, yet its influence has been of great, and in one instance of even paramount, importance in determining the present condition of the planets and their satellites.

G. H. D.

INDIGO

IN July, 1878, an account was given in this journal of the synthesis of indigo-blue from phenylacetic acid, accomplished by Prof. Baeyer of Munich (NATURE, xviii. 251). The process there described did not permit of the successful production of indigo-blue on a manufacturing scale at reasonable cost. Since that time Prof. Baeyer has continued to work at the problem, and he has so far succeeded that he has now taken out a patent for the artificial manufacture and application of indigo-blue.

In a paper in the last number of the *Berliner Berichte* Baeyer gives an interesting *résumé* of the steps whereby progress has been slowly made, since 1865, in solving the problem of the synthesis of indigo.

Following up the work sketched in the article already referred to, Baeyer attempted to prepare *orthonitrophenyl acetic aldehyde*, expecting that this substance would yield indol, which may be regarded as the parent substance of the indigo group of compounds. But as the work proceeded Baeyer became more and more convinced that the hypothesis which had guided his earlier work was that which should still regulate his experiments. In 1869 he had written, "In order to prepare indol synthetically it is necessary—in accordance with the formula already given—to introduce a pair of carbon atoms and one nitrogen atom into benzene, and to link these together. The necessary conditions are found in *nitro-cinnamic acid*, if one supposes carbon dioxide and the oxygen of the nitro-group to be removed. And indeed it has been shown that nitro-cinnamic acid yields indol by fusion with potash." The steps in the preparation of indigo-blue, according to Baeyer's patent, are these:—

1. *Cinnamic acid* (or *phenyl acrylic acid*)—

$$C_6H_5 . C_2H_2 . CO_2H.$$

2. *Orthonitrocinnamic acid*—

$$C_6H_4\begin{cases}NO_2\\C_2H_2 . CO_2H.\end{cases}$$

3. *Orthonitrocinnamic acid dibromide*—

$$C_6H_4\begin{cases}NO_2\\C_2H_2Br_2 . CO_2H\end{cases};$$

prepared by acting on No. 2 with gaseous bromine and crystallising from benzene.

The dibromide in alcoholic solution is then treated with alcoholic potash, in the proportion of 1 : 2 molecules; and after dilution with water

4. *Orthonitromonobromcinnamic acid*—

$$C_6H_4\begin{cases}NO_2\\C_2HBr . CO_2H,\end{cases}$$

is precipitated. By again treating this acid with three molecules of alcoholic potash

5. *Orthonitrophenylpropiolic acid*—

$$C_6H_4\begin{cases}NO_2\\C_2 . CO_2H\end{cases}$$

is produced. When an aqueous solution of this acid is warmed with such feeble reducing agents as grape- or milk-sugar, in presence of caustic or carbonated alkali, indigo-blue separates in crystals. It is not however

necessary to prepare pure orthonitrophenylpropiolic acid; if orthonitrocinnamic acid (No. 2 above) be treated with bromine, then with alcoholic potash, and lastly with grape-sugar, without separating the various products indigo-blue is produced. Orthonitrocinnamic acid may be prepared, without difficulty, from oil of bitter almonds.

Artificial indigo may be directly printed on cloth by mixing orthonitrophenylpropiolic acid—or *orthonitrophenyloxyacrylic acid* described below—with soda and grape- or milk-sugar, and after proper thickening, soaking the cloth in the mixture, and heating: or the material may be simply soaked in orthonitrophenyloxyacrylic acid and heated.

Orthonitrophenyloxyacrylic acid is prepared by the action of alcoholic potash on an alcoholic solution of orthonitrophenylchlorolactic acid (itself prepared by the action of chlorine on orthonitrocinnamic acid), in accordance with the equation—

$$C_6H_4\begin{cases}NO_2\\C_2H_3OCl.CO_2H\end{cases} + 2KOH =$$

$$C_6H_4\begin{cases}NO_2\\C_2H_2O.CO_2K\end{cases} + KCl + H_2O.$$

By boiling an aqueous solution of orthonitrocinnamic acid dibromide (No. 3 above) with sodium carbonate, indigo blue separates out. M. M. P. M.

MICROSCOPIC STRUCTURE OF MALLEABLE METALS

THE following observations on the minute structure of metals, which have been hammered into thin leaves, are instructive. Notwithstanding the great opacity of metals, it is quite possible to procure, by chemical means, metallic leaves sufficiently thin to examine beneath the microscope by transmitted light. Silver leaf, for instance, when mounted upon a glass slip and immersed for a short time in a solution of potassium cyanide, perchloride of iron, or iron-alum, becomes reduced in thickness to any required extent. The structure of silver leaf may also be conveniently examined by converting it into a transparent salt by the action upon it of chlorine, iodine, or bromine. Similar suitable means may also be found for rendering more or less transparent most of the other metals which can be obtained in leaf.

An examination of such metallic sections will show two principal types of structure, one being essentially granular, and the other fibrous.

The granular metals, of which tin may be taken as an example, present the appearance of exceedingly minute grains, each one being perfectly isolated from its neighbours by still smaller interspaces. The cohesion of such leaves is very small.

The fibrous metals, on the other hand, such as silver and gold, have a very marked structure. Silver, especially, has the appearance of a mass of fine, elongated fibres, which are matted and interlaced in a manner which very much resembles hair. In gold this fibrous structure, although present, is far less marked. The influence of extreme pressure upon gold and silver seems to be, therefore, to develop a definite internal structure. Gold and silver in fact appear to behave in some respects like plastic bodies. When forced to spread out in the direction of least resistance their molecules do not move uniformly, but neighbouring molecules, having different velocities, glide over one another, causing a pronounced arrangement of particles in straight lines.

This development of a fibrous structure, by means of pressure, in a homogeneous substance like silver, is an interesting lesson in experimental geology, which may serve to illustrate the probable origin of the fibrous structure of the comparatively homogeneous limestones of the Pyrenees, Scotland, and the Tyrol.

J. VINCENT ELSDEN

ISLAND LIFE[1]

II.

IN the second half of his volume Mr. Wallace proceeds to apply to the elucidation of the history of the characteristic assemblages of plants and animals in islands, the principles laid down with so much explicitness in the first half. He points out that for the purposes of the naturalist a fundamental difference exists between islands that have once formed part of continents and those which have not. Continental islands are those which, by geological revolutions at more or less remote periods, have been severed from the continental masses in their neighbourhood. They are recognisably portions of the continental ridges of the earth's surface. This relation is usually made strikingly apparent by the chart of soundings between them and the nearest mainland (Fig. 2). Further, in geological structure they resemble parts of the continents, like which they contain both old and new formations, with or without volcanic accumulations. In some cases the evidence of recent severance from the adjacent continent is abundant. In others it is less distinct; for example, where the islands are separated from the nearest land by a depression of a thousand fathoms or more, and where their fauna, though abundant, is of a fragmentary nature, almost all the species being distinct, many of them forming distinct and peculiar genera or families, while many of the characteristic continental orders or families are entirely absent, and in their place come animals to which the nearest allies are to be found only in remote parts of the world. Oceanic islands, on the other hand, exhibit no geological connection with any continental area, but owe their birth either to upheaval of the ocean floor or to the piling up of lavas and tuffs round submarine vents of eruption. Their geological structure is of the simplest kind. As Mr. Darwin long ago showed, they consist of volcanic rocks or of coral reefs, or of volcanic and coralline formations combined. Ancient formations, so characteristic of continental islands, are wholly wanting. These islands lie far removed from a continent, and rise from water of profound depth. Their fauna is in curious keeping with this isolation, for it contains no indigenous land-mammals or amphibians, but abounds in birds and insects, and usually possesses some reptiles. These animals or their ancestors must have reached the islands by crossing the ocean.

Mr. Wallace first attacks the problems presented by the Oceanic Islands (Fig. 1). He describes the characters of the flora and fauna of the Azores, Bermuda, the Galapagos, St. Helena, and the Sandwich Islands, and endeavours in each case to show how the resemblances and differences between them and the plants and animals of the continents may be accounted for. The contrast offered by two groups of islands on either side of the American continent—the Bermudas and Galapagos—brings vividly before the mind the nature of the difficulties with which the author grapples, and the methods by which he seeks to solve them. In the case of the Bermuda group a series of coral islets having a total area of no more than fifty square miles rises from the very deepest depression in the Atlantic basin in 32° N. lat. at a distance of 700 miles from North Carolina. The chief elements in the fauna of these islands are birds and land-shells. Upwards of 180 species of birds have been observed, more than half of which belong to wading and swimming orders, while eighty-five are land-birds, of which twenty species are frequent visitors. Only ten species live as permanent residents on the island, and these are all common North American birds. No bird, and indeed no vertebrate animal, save a species of lizard, is peculiar to Bermuda. The feathered population of the islands is de-

[1] "Island Life; or, the Phenomena and Causes of Insular Faunas and Floras," &c. By Alfred Russel Wallace. (London: Macmillan and Co., 1880.) Continued from p. 359

rived from the North American continent, whence every year, especially during the autumnal storms, numbers of birds are blown out to sea. Most of these no doubt perish, but some succeed in reaching Bermuda. Hence from this constant introduction of fresh individuals there has been no development even of any distinct variety in the avian fauna. The land-shells include twenty species, of which at least four, or about a fourth of the whole, are peculiar. The proportion of peculiar land-shells among the Azores is about a half of the whole number of resident species. It is obvious that these organisms have comparatively feeble and uncertain means of transport as compared with birds. They may be carried only at widely separated and irregular intervals, enclosed in drift-wood from some other island or continent. Hence the conditions for their gradual change under the new circumstances of their insular home are exceptionally favourable. The flora of Bermuda contains a majority of tropical and West Indian plants, and includes a number of species identical with

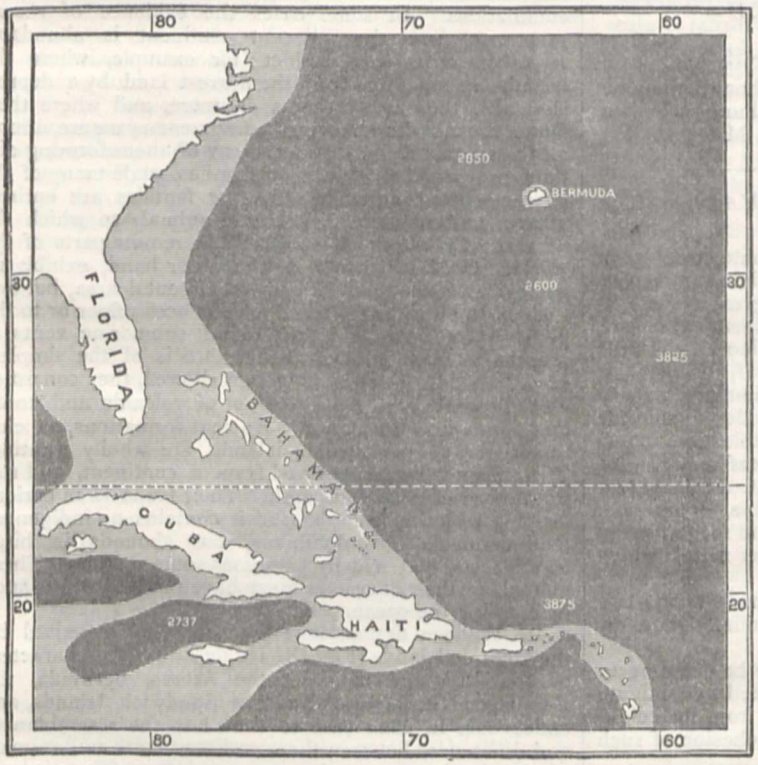

FIG. 1.—Map of Bermuda and the American Coast. The darker tint indicates sea more than 1000 fathoms deep, the lighter shows sea less than 1000 fathoms. The figures mark the depth in fathoms.

those in the Southern States of the American Union. The origin of this vegetation is thus easily traced, first, to the operation of marine currents, whereby plants of the West Indian Islands have been actually observed to be washed ashore on Bermuda and to germinate there; next, of cyclones by which fine seeds transported in the higher parts of the atmosphere may doubtless be easily carried from the American continent; and thirdly, of birds, which among their feathers and in the mud adhering to their feet are known to transport living seeds to enormous distances.

The Galapagos, though less distant from the west side of the American continent than the Bermudas are from the east side, rise nevertheless out of a profoundly deep ocean. The whole group of seventeen islands ranges over an area of 300 miles in length by 200 in breadth, being of volcanic origin, and still containing in the western islands numerous active volcanoes. Between the fauna of the Galapagos however and that of the nearest part of South America a remarkable difference obtains. As usual, no indigenous mammalia or amphibia occur in these islands; but a few species of reptiles abound—land-tortoises, lizards, and snakes, that find their nearest allies on the American continent, whence doubtless their ancestors at some remote period were derived. Out of a total of fifty-seven species of birds no fewer than thirty-eight are peculiar. In particular the land-birds number thirty-one species, which are all, with but one exception, confined to the Galapagos, and more than half of them are so peculiar as to be ranked in distinct genera, though all are undoubtedly allied to birds inhabiting Tropical America. Mr. Wallace points out that every gradation can be traced, from perfect identity with continental species to marked generic divergence, and that "this diversity bears a distinct relation to the probabilities of and facilities for migration to the islands." A species which is widely diffused and essentially migratory will, by frequent arrival of fresh individuals from the parent stock and intercrossing, continue unchanged, while others, in proportion to the rarity of their re-introduction, will be subject to all the variation which change of habitat and prolonged isolation may induce. The flora of these islands includes 174 peculiar flowering-plants, and 158 common to other regions. Among the latter occur forms found both in North and South America, with some that range into the West Indies. Sir Joseph Hooker has observed that the peculiar plants of the Galapagos are allied to forms now found in temperate America, or in the high Andes, while the non-peculiar species are such as live in tropical latitudes near the sea-level. These facts in zoological and botanical distribution the author seeks to explain by the meteorological conditions and geological history of the region. The Galapagos Islands lie in a tract of almost perpetual calms. The storms that annually transport a fresh immigration of birds and seeds to the Bermudas are there unknown; consequently the fauna and flora present a far greater contrast to those of the continent than is the case of Bermuda. The presence of West Indian species is regarded as pointing to the former submergence of the Isthmus of Panama and the consequent drifting of those forms from the north-east, perhaps by a deflected branch of the Gulf Stream. Again, the affinity of a portion of the Galapagos flora to plants of northern or sub-alpine types is looked upon as an indication of that ancient southward migration of northern forms consequent upon the extension of the snow and ice of the Glacial Period.

As examples of Continental Islands the author describes the British Isles, Borneo, Java, Japan, Formosa, and the Madagascar group. The difference between the plants and animals of continental islands and those of the neighbouring continents varies extensively, one main effective element in the case being the length of time during which insular relations have been established. Taking Britain as perhaps the most typical illustration of a large and recently separated continental island (Fig. 2), Mr. Wallace points out how many are the proofs of comparatively recent subsidence, which he regards as the cause of the severance of Britain from the continent. Undoubtedly subsidence was one, probably the principal,

operation whereby the British Islands were isolated. We must not forget however that denudation also played its part. The excavation of the Strait of Dover, for example, may have been in large measure effected by streams diverging from the watershed and partly by the littoral erosion of the waves as they advanced upon the slowly foundering land. The recent date of the separation of Britain is shown by the identity of the fauna as a whole with that of France and Germany. But as compared with the continent, the British Isles are remarkably poor in species. In Germany, for example, there are nearly ninety species of land mammals; even Scandinavia possesses about sixty; but Britain can boast only forty—a number which in Ireland is reduced to twenty-two. Still more remarkable is the contrast presented by the reptiles and amphibia; for while Belgium possesses twenty-two species, Britain can show no more than thirteen, and Ireland has only four. This progressive diminution of the fauna westward is even illustrated by animals possessing the power of flight, though, as might be supposed, it is in these cases less strongly marked. The twelve bats of Britain are reduced to seven in Ireland, the 130 land-birds to about 110. In Britain 1425 species of flowering plants and ferns are known, but in Ireland only 970, or two-thirds of the British flora. The reason assigned by Mr. Wallace for this poverty of species is the extensive submergence of the British Islands during the later stages of the Glacial Period. He believes that the interval between the subsequent elevation and the final separation of Britain from the continent cannot have been of long duration. It was indeed sufficiently prolonged to allow of the migration westwards of a considerable part of the Post-glacial fauna and flora, but the insular condition was established before more than a part had succeeded in reaching Britain, where both the soil and climate would have been eminently favourable for the reception of the rest. The time that has elapsed since our area ceased to be continental has been long enough for the production of a few peculiar varieties. No distinct species or variety of mammal, reptile, or amphibian has arisen. But we possess three peculiar birds—the coal-tit, long-tailed tit, and grouse—fifteen peculiar species of fresh-water fishes, sixty-nine lepidopterous insects, seventy-two beetles, four caddis-flies, and four terrestrial and fluviatile shells believed to be peculiar. In the flora the chief contrasts are exhibited by the mosses and hepaticæ, of which respectively seventeen and nine forms appear to be peculiar. This mode of considering the British fauna and flora brings out in clear relief the relations between them and those of the continent, and their bearings upon the question of the origin of peculiar forms. Not only do the British Islands as a whole contain species or varieties that do not appear on the mainland of Europe, but some of our outlying islands, such as the Shetland Isles, the Isle of Man, and Lundy Island, possess each its local forms that are not met with on the main island.

As "anomalous islands" the author classes together Celebes and New Zealand, the former because it belongs to no one of the six zoological regions of the globe, and cannot be certainly affirmed to have been united to a continent, the latter because in some respects it may be regarded as an oceanic, in others as a continental island. Celebes is supposed by Mr. Wallace to be probably a fragment of Miocene Asia, preserving down to the present time a few remnants of its Tertiary fauna, together with an intermixture of more modern types that have been introduced by ordinary means of dispersal. Three interesting chapters are devoted to New Zealand, and in these is discussed the important question of the origin of the European element in the floras of the temperate southern latitudes.

Enough has been said here to show the nature and value of this new contribution to scientific literature. Even where Mr. Wallace's conclusions may be disputed, they are always of the most suggestive kind. His volume, as he acknowledges, is the development and application of a theory; but it is not written in the spirit of a mere partisan. Its facts are of course marshalled in such form as most effectively to sustain the theory; yet with a transparent directness and honesty of purpose that runs through the whole book, and gives it one of its great charms. The writer does not consciously shut his eyes to any of the difficulties of his case. Candidly admitting them, he presents such explanation as seems to him to offer the most likely pathway to their ultimate solution.

FIG. 2.—Map of the shallow bank connecting the British Isles with the Continent. The dark tint marks sea of more than, the paler tint shows sea of less than, 1000 fathoms in depth. The figures show the depth in fathoms. The narrow channel between Norway and Denmark is 2580 feet deep.

He deserves the thanks alike of geologists and of biologists for a treatise, the appearance of which marks another epoch in the history of the doctrine of Evolution.

ARCH. GEIKIE

HONOUR TO MR. DARWIN

THE following address to Mr. Darwin, from New Zealand, speaks for itself:—

To Charles Darwin, Esq.

SIR,—We, the members of the Council of the Otago Institute, beg to offer you our congratulations on this, the

twenty-first anniversary of the publication of your great work, the "Origin of Species."

However limited the field of our own labours may be, we cannot but be sensible of the influence which that work has had throughout the whole domain of Natural Science, and especially upon Biology, which, as one great comprehensive Science, may be said to owe its very existence to the fact that you made belief in Evolution possible by your theory of Natural Selection.

We are glad to think that you have lived to see the almost universal acceptance of the great doctrine which it has been the work of your life to establish; it is hardly an exaggeration to say that every important Botanical or Zoological discovery of the last twenty-one years, particularly in the departments of Embryology and Palæontology, has tended to fill up some gap in the evidence you had originally collected, and to make Evolution no longer a theory, but an established doctrine of Science.

We hope that you may long live to continue your labours and to see the further spread of their influence upon all scientific thought and upon all higher scientific work.

We are, sir, your obedient servants,

THOS. MORGAN HOCKER	*President*
F. W. HUTTON	*Vice-Presidents*
GEORGE H. F. ULRICH	*Vice-Presidents*
GEORGE M. THOMSON	*Hon. Sec.*
HENRY SKEY	*Hon. Treasurer*
ROBERT GILLIES	*Members of Council*
C. W. BLAIR	*Members of Council*
ALEXANDER MONTGOMERY	*Members of Council*
T. JEFFERY PARKER	*Members of Council*
W. MACDONALD	*Members of Council*
DONALD PETRIE	*Members of Council*

Dunedin, New Zealand, October 1, 1880.

DEGREES TO WOMEN

WE trust the Grace which is to-day to be submitted to the Cambridge Senate, advocating the admission of women to receive University degrees, will meet with the approval of that body. In fact, as the *Times* put it yesterday, the point was ruled ten years ago. "Cambridge, in conniving at its public examiners examining Girton and Newnham students precisely as if they were Trinity or Johnian scholars, gave in spirit what is now demanded. It seems ungenerous, and not very rational, for a university to let its authorities proclaim a man in the Senate House eighth wrangler, and inform Girton College that the real eighth wrangler was a woman. Even a country clerical passman would not venture to withdraw the existing licence; all that remains is for the Senate to ratify with a good grace the principle upon which its officials have long and openly been acting."

The following paper, which has been issued from Cambridge in view of to-day's discussion, puts the case as fairly as it can be put:—

Reasons why the university should be one of the leading centres of female education.

1. Because no line can be drawn separating main subjects of study or whole branches of learning into those suitable for men and unsuitable for women, or *vice versâ*. No true classification of human knowledge will admit of the distinction, "Propria quæ maribus tribuntur, mascula dicas." 2. Because the University as a chief inheritor and transmitter of learning from generation to generation has no right to dissociate itself from any great movement connected with the advancement of learning. The participation of women in the general and particularly in the higher studies of their time must be a great fact and factor in the future of education. 3. Because whatever educational resources may be found elsewhere, those of Cambridge and Oxford are peculiar; and though as long as there was no public demand for these resources except from male students they were properly applied only to male education, now that a demand has sprung up and persistently declared itself on the part of the other sex, the university will incur the reproach of inhospitable partiality if it bars its doors, like a monastery, to female applicants for admission. 4. Because one of the legitimate wants and aspirations of the University—leisure for continued study and research—is likely to be promoted by increasing the amount of remunerative educational work done in the university. The more work, the more workers, and the more remuneration; and out of work, workers, and earnings, the legitimate and sure outcome will be leisure for the worthiest work and workers. 5. Because the education of women in England must, from irresistible national feelings and convictions, be religious and Christian; and if female education is centred in the university a stimulus will be given to the best religious influences in study and life; and from these the English universities have never for any long period been dissociated. 6. Because any mischievous consequences that might be feared, whether to the university or to the students, by the admission of women can be guarded against by suitable regulations, and still more by responsible authorities; whereas the diversion of the interests and influences that are gathering round the question of women's education from the university to other centres would be an irretrievable step, isolating the university for the future from a movement of great force and promise. J. L. BRERETON

February 16

NOTES

AT the anniversary meeting of the Royal Astronomical Society, on the 11th inst., Mr. Hind, president, in the chair, the gold medal was presented to Prof. Axel Möller, Director of the Observatory at Lund, in Sweden, for his investigations on the motion of Faye's comet. Prof. Möller's researches commenced in 1860, soon after attention had been directed to this comet by the offer of a prize for the accurate determination of its orbit by the Society of Natural Sciences of Dantzic, and they have been continued to the present time, the comet's track at each of the three subsequent returns in 1865-66, 1873, and 1880-81, having been predicted with a precision which has excited in no small degree the admiration of astronomers; indeed, at the re-appearance in 1873, M. Stephan's first observation at the Observatory of Marseilles, showed that the error of predicted place was less than *six seconds of arc*, and after the last revolution, when the perturbations from the action of the planets were greater than in any previous revolution since the comet was first detected by M. Faye in 1843, the agreement between observation and calculation was still very close. One important result of these investigations has been a striking confirmation, from the motion of Faye's comet, of the value for the mass of Jupiter deduced by Bessel from the elongations of the satellites, the two values according within the limits of their probable errors. Prof. Möller also carried back the accurate computation of the perturbations to December, 1838, so as to ascertain the effect of a pretty near approach to Jupiter in March, 1841, upon the previous orbit, and having done this he examined the probable circumstances of a very near approach of the two bodies near the passage of the node in 1816, to which attention had been drawn by Valz soon after the comet's orbit was fairly determined. Thus Möller's laborious investigations extend over a period of forty-three years, during which he has followed the motion of the comet with all the refinements of which the actual state of the science admits. It will be generally accorded that the medal has been well earned in Prof. Möller's case. The last occasion on which it was awarded for investigations of a similar kind was as far back as 1837, when the Astronomer-Royal presented the medal to Rosenberger for his researches on the motion of Halley's comet.

AT the anniversary of the Geological Society on Friday the medals were awarded as follows:—The Wollaston medal to Prof. P. Martin Duncan, M.B., F.R.S., F.G.S.; the Murchison medal to Prof. Archibald Geikie, F.R.S., F.G.S.; the Lyell medal to Principal Dawson, LL.D., F.R.S., F.G.S., of McGill College, Montreal; and the Bigsby medal to Dr. Charles Barrois of Lille. The Wollaston Fund was awarded to Dr. R. H.

Traquair, F.G.S., of Edinburgh; the Murchison fund to Frank Rutley, F.G.S.; the Lyell Fund in equal parts to G. R. Vines of Sheffield, and to Dr. Anton Fritsch of Prague.

In addition to the amount reported last week, we have received two guineas from Mr. William Black for the John Duncan Fund, making the total received through NATURE £67 4*s.* 3*d.*

The first of Prof. Flower's nine lectures on the Anatomy, Physiology, and Zoology of the Cetacea, in the theatre of the College of Surgeons, will be given on Monday next. The Comparative Anatomy of Man, which formed the subject of the last four courses of lectures, is far from being exhausted, especially as the acquisition of the Barnard Davis collection has more than doubled the materials at the disposal of the lecturer for its illustration. But the work of removing, cleaning, arranging, and cataloguing the numerous specimens of this collection has absorbed so much time, that little has been left as yet for their scientific examination. As any attempt at exposition of the variations of the osteological structure of man, from which the evidence afforded by the newly-acquired specimens is omitted, would be very incomplete, it has been thought advisable to postpone the continuation of the subject to a future time. The anatomy of the group selected for consideration this year is of great interest, and particularly well illustrated in the Museum, (as it is a subject to which John Hunter devoted much attention, and upon which he published a valuable memoir in the *Philosophical Transactions* for 1787, entitled "Observations on the Structure and Œconomy of Whales"):—General characters of the Cetacea; Division into two distinct groups—*Mystacoceti* or whalebone-whales, and *Odontoceti* or tooth whales; Anatomy of the lesser rorqual (*Balænoptera rostrata*) as a type of the *Mystacoceti;* Other whalebone-whales—rorquals (*Balænoptera*), humpbacks (*Megaptera*), and right whales (*Balæna*); Anatomy of the porpoise (*Phocæna communis*) as a type of the *Odontoceti;* Other toothed whales—*Delphinidæ*, dolphins, beluga, narwhal, platanista, &c.; *Physeteridæ*—sperm-whale and its allies; Extinct Cetacea—position of the order in the animal kingdom, and relation to other groups.

We regret that the Lords should have thrown out the Bill on Tuesday for the Opening of Museums and similar places on Sundays. The smallness of the majority leads us to hope that this forward and really beneficial step will be taken ere very long. As the *Times* very well puts it:—"The gravity of the question is that London has in its midst people to whom anything of the nature of intellectual toil—and prolonged sight-seeing is of that character—is essentially irksome. But they are human beings, and not lost to all salutary influences. It would be folly to despair of making the Sunday more tolerable than it is to them. Our climate does not often admit of men and women sitting out of doors talking or listening to elevating music. Some substitute must be found to put us on equality with the people of more sunny lands. It is the task of true friends of the working classes to suggest means by which, without any revolution in national ideas as to the sacredness of Sunday, they may be enabled to taste those simple and primitive pleasures—for example, the pleasure of pure repose of mind and body, or that of hearing music—which all, even the untutored, can enjoy. The movement is directed towards the cure of a real social evil, and those who oppose it are bound to suggest a more effectual remedy."

By an oversight, for which the American authorities must be held partly responsible, we did not observe that the volume on "Odontornithes," by Prof. Marsh, briefly alluded to in NATURE of last week, was the same work which had already been reviewed in our columns as far back as September 16 of last year (vol. xxii. p. 457). The monograph now sent to us bears no reference to the previous issue of the same work. It is announced as a portion of the Survey of the Fortieth Parallel under Mr. Clarence King; but no number is assigned to it as a volume of that splendid series of quartos. We hope that this new issue of the work will secure for it a still wider circle of readers, as it certainly adds additional lustre to the Survey of the Fortieth Parallel.

The Hunterian Oration this year was so far original that the orator, Mr. Luther Holden, gave the results of some original research he has been making into the early life of John Hunter. It is usually said that Hunter, up to the time of his coming to London, led a completely idle life, giving no promise whatever of future eminence. Dr. Holden however thinks he has proved that Hunter, instead of being apprenticed to a cabinet-maker, entered Glasgow University when he was seventeen years old, and had the advantage of a regular training under the eye of Cullen. Whatever may be thought of the evidence Mr. Holden adduced, he has certainly opened fresh ground, quite deserving to be worked out by future orators.

The freedom of the Cutlers' Company was conferred upon Sir Henry Bessemer last week. At the dinner which followed he stated that a young and rising American "city" had been named after him.

Can any reader send us information concerning the fate of the instruments which belonged to the late Dr. Dick of Broughty Ferry, Scotland, the author of a number of theologico-scientific works ("Philosophy of a Future State," &c.), rather remarkable for their advanced views, considering the time at which they were published—about forty years ago? He is said to have left, among other things, a large telescope, the subsequent history and present possessor of which we are anxious to trace.

The Commissariat-General of the Paris International Exhibition of Electricity are anxious that all requests for space be sent in as soon as possible, and not later than March 31.

The following are prize-subjects lately proposed by the Society of Arts and Sciences at Utrecht:—Researches on the development of one or several invertebrate species of animals whose history is not yet known; exact anatomical description of the larva and nymph of the common cockchafer (*Melolontha vulgaris*); means of purifying the rivers of Holland so as to render them potable, and expense of application on a large scale; results of experiments in recent times as to the movement of liquids and the resistance they offer to moving bodies; study of the theories of electric phenomena in muscles and nerves; critical *aperçu* of the methods for determining the place occupied in bodies of the aromatic series by substituted atoms and groups of atoms (according to Kekulé and Ladenburg's theory regarding benzol); quantities of heat liberated or absorbed in the allotropic change of two or several simple substances; heat given by the moon in different phases. Papers may be written in French, Dutch, German, English, or Latin, and must be sent to the Secretary, Baron R. Melvil, of Lynden, before December 1, 1881. The prize is a diploma of honour and 300 Dutch florins.

A classified list of the books published in Germany during 1880, just issued by Hinrichs of Leipzig, shows the number of publications to be steadily increasing. We find a total of 14,941 new works against 14,179 in 1879. The largest number belongs to the class of school-books and other works for the young, viz., 2446 (against 2175 in 1879). We give the further classes in a descending scale, adding the numbers for 1879:—Law, politics, statistics, conveyancing, 1557 (1683); theology, 1390 (1304); Belles Lettres, 1209 (1170); medicine, 790 (732); natural history, chemistry, pharmacy, 787 (841); historical works, 752

(680); popular works, almanacs, 657 (642); fine arts, stenography, 627 (584); commerce, 583 (577); classical and oriental languages, archæology, mythology, 533 (481); modern languages, old German literature, 506 (485); agriculture, 433 (421); miscellaneous writings, 423 (378); architecture, railways, engineering, mines, and navigation, 403 (384); bibliography, encyclopædias, 377 (278); geography, travels, 356 (306); war, 353 (337); maps, 301 (300); mathematics, astronomy, 201 (158); philosophy, 125 (139); forests and game, 112 (103); freemasonry, 20 (21).

MESSRS. MACMILLAN AND CO. have in preparation, and will publish this year, "A Course of Instruction in Zootomy (Vertebrata)," by T. Jeffery Parker, B.Sc. Lond., Professor of Biology in the University of Otago. The work will consist of full directions for the dissection of the Lamprey, Skate, Cod, Lizard, Pigeon, and Rabbit, and will be illustrated by numerous woodcuts from the author's original drawings.

THE death is announced of Count Alexander Erdödy, a Member of the Pesth Academy of Sciences, vice-president of the Society for Plastic Art, and a liberal patron of science and art. His death occurred on January 24 at Vep (Hungary); he was eighty years of age. We regret also to announce the death of Herr Gabriel Koch, a Frankfort tradesman and an eminent lepidopterist, whose "Schmetterlingsbuch" has a wide reputation in Germany. He died at Frankfort-on-Main on January 22, aged eighty. On February 2 died Prof. Gorini at Lodi, well known by his works on volcanic phenomena. He was a teacher at the Lodi High School, and one of the warmest advocates of cremation in Italy.

EARTHQUAKES continue at Berne. A new shock, directed from east to west, was felt in the north of the town on February 8, at 5.25 p.m. Shocks of earthquake are reported from Braila on February 11 at 7h. 15m. a.m., and from Galatz at the same time.

IT was not difficult to foresee that the warm weather which prevails now in the Alpine region, together with immense quantities of snow fallen during the previous days, would occasion several avalanches. On February 13 a terrible one descended from the slopes of Mont Pourri, and covered with a mass of snow, thirty feet deep, the village of Brévières, in the Tignes commune. Thirty-two persons were buried under the snow, and no less than three hundred peasants from the neighbourhood were engaged in sinking pits to reach the buried houses. Of the buried, twenty-five were found alive, four were dead, and three are not yet discovered. Two days later, another avalanche descended from the same mountain, and covered a space 10,000 metres wide, with a mass of snow fifteen to twenty metres deep. The pressure of air displaced by the avalanche was so great that all the windows of the village were broken within a few seconds. The quantity of snow fallen during the previous days was so great that all communication was broken up between Brévières village and the bottom of the valley; a peasant from Tignes took thirteen hours to reach the next town, Bourg-Saint-Maurice, travelling in the snow more than one metre deep.

THE provincial governments of Navarre and Logroño (Spain) have received the royal sanction to the necessary outlay for constructing and maintaining meteorological stations in these provinces.

OUR ASTRONOMICAL COLUMN

ENCKE'S COMET IN 1881.—So far as can be judged without the calculation of the perturbations since 1878 this comet will again arrive at perihelion about November 8 in the present year. In 1848, when the comet passed this point of its orbit on November 26, it was detected with the 15-inch refractor at Cambridge, U.S., on August 27, as "a misty patch of light, faint and without concentration: its light coarsely granulated, so that were it not for its motion it might be mistaken for a group of stars of the 21st magnitude" (Bond). The theoretical intensity of light at this time was 0·21, and we find that, assuming the perihelion passage to occur on November 8, the comet should have this degree of brightness soon after the middle of August next, so that it may be anticipated observations will be practicable with the waning moon about the 20th of that month. The last perihelion passage took place on July 26, 1878, the period of revolution at that time being 1200·58 days according to the late Dr. von Asten. The aphelion distance is 4·0879, the perihelion distance 0·3335, and the minor semi-axis 1·1675 (the earth's mean distance from the sun = 1). The approach to the orbit of the planet Mercury is still very close (0·031) in about 126°·5 heliocentric longitude. The nearest approximation of the two bodies that has occurred since the discovery of the comet's periodicity took place on November 22, 1848, when their distance was only 0·038. It is known that from his investigations on the motion of Encke's comet, von Asten inferred a much smaller value for the mass of Mercury than had been previously assigned, viz. $\frac{1}{7636440}$.

CINCINNATI MEASURES OF DOUBLE STARS.—Mr. Ormond Stone has issued an important series of measures of double stars made at the Observatory of Cincinnati, which is under his superintendence, between January 1, 1878, and September 1, 1879. The number of stars measured is 1054, of which 622 are south, and 432 north of the celestial equator: 560 belong to Struve's catalogue, 171 were discovered by the Herschels, 162 by Mr. Burnham, and 85 were found with the Cincinnati refractor, which has an aperture of eleven inches. The measures of the southern stars have a special interest, as there are comparatively few previous ones upon record. In his introduction Mr. Stone points out the most notable differences between the Cincinnati measures of angle and distance, and those of Struve, Sir John Herschel, and others; we shall refer to several of these cases in a future column. The volume is published by the Board of Directors of the University of Cincinnati, and will be a necessary addition to the libraries of those who are making the double stars their special study. Mr. Stone acknowledges his obligation to the Manual of Double Stars lately published by Messrs. Crossley, Gledhill, and Wilson, and M. Flammarion's "Catalogue des Étoiles Doubles et Multiples en Mouvement relatif certain."

THE MINOR PLANETS IN 1881.—The usual supplement to the *Berliner astronomisches Jahrbuch* (1883), containing its specialty, elements and ephemerides of the small planets for the present year, has been issued. We have in it approximate ephemerides for every twentieth day throughout the year of 210 planets, the latest being No. 217, and accurate opposition ephemerides of 58. Three planets are omitted for want of proper data for computation, viz. No. 99 *Dike*, No. 155 *Scylla*, and No. 206 *Hersilia*. A glance at this long series of ephemerides shows how wide a range over the heavens the apparent tracks of these small bodies present: thus we find *Euphrosyne* in opposition in 52½° south declination, in the constellation Indus, and *Niobe* in the vicinity of ζ Persei, with 43° north declination. A favourable opportunity for repeating observations for determination of the solar parallax would have been afforded if, in the first place, the actual position of No. 132 *Æthra* were pretty accurately known, and if Mr. Gill were able to utilise his heliometer at the Cape of Good Hope: this planet on February 28 being distant from the earth less than 0·84 of the earth's mean distance from the sun, with 47° south declination and rather greater brightness than a star of the ninth magnitude.

CHEMICAL NOTES

HAUTEFEUILLE AND CHAPPUIS state (*Comptes rendus*) that when a high tension spark is passed through a mixture of nitrogen and oxygen, ozone and "pernitric acid" are produced, but the latter compound is readily decomposed with production of a less oxygenated body and oxygen. When the electric discharge is passed through air in presence of water vapour very noticeable quantities of nitric acid are formed. The same observers have examined the absorption-spectrum of ozone and have recognised certain bands which they state are also found in the solar

spectrum. They think that the blue colour of the sky may probably be partly due to the presence of ozone.

BRAME (in *Comptes rendus*) recommends the use of baryta in place of sodium carbonate and charcoal, in the ordinary dry test for arsenic. If arsenious oxide is heated with baryta a mirror is obtained consisting partly of metallic arsenic, and partly of barium arsenate: the test does not succeed so well with arsenious sulphide.

A CONSIDERABLE deposit of crystallised (octahedral) sulphur has been found under the soil of Paris, where organic refuse matter has long accumulated. The sulphur appears to be a product of the deoxidising action of the carbon compounds present in the refuse on the calcium sulphate of the soil.

M. LOUGHININ continues, in the *Journal* of the Russian Chemical Society, his interesting researches on the quantities of heat produced by burning alcohols of the allyl series; he publishes in the *Journal* the figures corresponding to two new bodies of this series ($C_6H_{12}O$ and $C_{10}H_{20}O$), which figures, together with those he has already published in the *Comptes rendus* (vol. xci.), allow him to draw a complete table of the calories disengaged by the whole of the alcohols of this series.

THE first number of the *Gazetta Chimica Italiana* for the present year is devoted, with the exception of a paper by M. Fileti on gas analysis, to papers on organic chemistry: these include work on Camphor Derivatives by Schiff; on Picrotoxin by Paterno and Oglialoro; and on Synthesis of Aromatic Aldehydes by the use of Chromyl Dichloride, by Paterno and Scichiloni.

IN the course of a paper on the Photo-chemistry of Silver Chloride, Eder states (in *Wien. Akad. Ber.*) that this substance is more sensitive to light when substances which absorb chlorine are present, than when in the pure state. To develop the latent image he recommends especially ammonium ferrocitrate, and hydroquinone along with ammonium carbonate.

BY the action of potassium dichromate and sulphuric acid on caffeine, Hinteregger has obtained as much as 40 per cent. of dimethyl parabanic acid, and 39 per cent. of the monomethyl acid from theobromine.

IN continuation of his investigations into the action of hydrochloric acid on metallic chlorides, Ditte describes (*Compt. rend.*) several new hydrated salts which crystallise from aqueous solutions when these are saturated with hydrochloric acid. In the absence of hydrochloric acid hydrated salts with more water of crystallisation are always produced. The following table contains the principal results obtained by Ditte:—

Aqueous solution.			Solution saturated with HCl at 12°.		
Grams of salt dissolved per litre.		Crystals which form	Grams of salt dissolved per litre.		Crystals which form
700	...	$CaCl_2.6H_2O$	270	...	$CaCl_2.2H_2O$
500	...	$SrCl_2.6H_2O$	20	...	$SrCl_2.2H_2O$
720	...	$MgCl_2.6H_2O$	65	...	$MgCl_2.2H_2O$
415	...	$CoCl_2.6H_2O$	205	...	$2CoCl_2.3H_2O$ and $CoCl.H_2O$
600	...	$NiCl_2.6H_2O$			
870	...	$MnCl_2.4H_2O$	40	...	$NiCl_2.H_2O$
630	...	$CuCl_2.2H_2O$	190	...	$MnCl_2.H_2O$
			290	...	$CuCl_2.H_2O$

M. POUCHET describes in *Compt. rend.* a method for destroying organic matter before testing for mineral poisons in contents of a stomach, &c.; the method is based on the oxidising action of potassium-hydrogen sulphate followed by addition of sulphuric acid.

PHYSICAL NOTES

IN a little mathematical note in the *Comptes rendus* M. Thollon investigates the general equation for the passage of light through a prism, and thence deduces the proposition that for every prism there is an angle of minimum resolving power. Differentiating the general equation with respect to the index of refraction, he obtains, first, a differential equation expressing the dependence of the angular distance between two rays upon the dispersive index. A separate differentiation with respect to the angle of incidence yields a second differential equation expressing the dependence of the apparent width of the slit as seen through the prism upon the angular aperture of the slit, as viewed from the prism through the collimator. Hence a relation can be obtained between the angular distance between two rays and their apparent breadth. Further examination of the equations shows that for a certain incidence there will be a minimum of resolution (*i.e.* an incidence at which the rays are least well defined), and that for another incidence there will be a minimum of dispersion; these two incidences being symmetrically related to the angle of incidence corresponding to minimum deviation. M. Thollon states that these deductions may be readily verified by the following experiment:—A dense flint glass prism is adjusted in the position of minimum deviation for the rays D upon its supporting table in the spectroscope, lit by a sodium flame. The slit is then narrowed or widened until the two yellow rays are just in mutual contact. On then turning the prism around its axis so as to increase the angle of incidence the two rays are seen to separate and to become perfectly distinct, *the angular distance between them diminishing all the while.* But if the prism be turned in the opposite direction, so as to decrease the angle of incidence, the yellow band is seen to become wider, but without being resolved into two rays. Perhaps this research may explain why the so-called "half prism" spectroscope failed to realise all the hopes of its inventor.

RECENT observations by Hrn. Wüllner and Grotrian (*Wied. Ann.* No. 12) seem to prove that the specific volume of vapours is independent of the size of the space in which it is determined. They also confirm Herr Herwig's result, that vapours always undergo precipitation before reaching the so-called maximum tension. Further, the tension at which condensation begins is found to have a relation to the maximum tension, which depends on the nature of the liquid, but is nearly independent of the temperature. Experiments made in order to find in what measure vapour must be compressed so as to present maximum tension, gave the unexpected result, that there is in general no maximum tension in the sense hitherto accepted; but that the tension of saturated vapours, even when they are in contact with a large and excessive quantity of liquid, is perceptibly increased by compression.

THE varieties of the electric discharge in gases are fully investigated by Herr Lehmann in a recent paper (*Wied. Ann* No. 12). The chief conclusion is that there are four well-characterised modes of discharge to be distinguished, viz. glow, brush, band, and spark discharge; and these may all be obtained in air of ordinary (as well as of less) density, and also in other gases, with inserted resistances and breaks, and with sharp and rounded form of electrodes, at great or small distances. The principal characteristics are these:—1. Glow-discharge; positive glow, negative light pencil, consisting of two parts separated by a dark space. 2. Brush-discharge; positive brush, consisting of stem and branches; negative light-pencil. 3. Band-discharge; positive light with two places of intermittence, sometimes stratified, and separated from the negative glow by a dark space. 4. Spark-discharge: band of light connecting both electrodes; with two places of intermittence, brushes of metallic vapour at both ends, the positive longer, the negative thicker; sometimes oblique dark spaces.

THE influence of traction and vibrations of a metallic wire on its electric conductivity is the subject of a paper by Dr. De Marchi in the *Reale Ist. Lomb. Rend.* (vol. xiii. fasc. xix.). The results he arrives at are summed up thus: 1. Any traction of a metallic wire increases in general its resistance; when the traction is very slight however there is diminution instead of increase; with increase of traction the case comes under the general law. 2. In general the increments are proportional to the increments of traction, up to a certain limit, beyond which the variations of resistance are manifested in sudden bounds, indicating an instantaneous and profound perturbation of the molecular state of the wire. 3. The law of increments of resistance is apparently independent of that of the elongations. 4. Any vibration of a wire is accompanied by a variation of resistance generally very perceptible. In most cases there is decrease of resistance if the vibration be sonorous, and more so if harmonic; increase, if the vibration be silent. This last law however requires confirmation.

IT is known that M. Plateau distinguishes between an internal and a surface viscosity of liquids, a distinction which Signor Marangoni does not consider warranted. Herr Oberbeck (*Wied. Ann.* No. 12) has approached the question experimentally thus: A brass cross is hung bifilarly with two platinum wires by one arm; its horizontal arms carry weights whose positions can be varied by screwing, so as to vary the swing; it carries a mirror reflecting a scale, and to the lower arm is attached a thin plate

or cylinder of brass to swing in the liquid at various depths. The whole can be raised or lowered with a micrometer screw, and it is thrown into slight oscillation by means of a magnet. A rectangular glass vessel is used for the liquid. The author finds that with distilled water the resistance increases suddenly and to a quite considerable extent whenever the upper edge of the plate comes into the free surface, and he does not doubt this is due to increased friction in the surface layer. The increase of resistance from the last previous position of the plate was 60·9 per cent., and with four aqueous salt solutions there was also an increase, varying between 75·1 to 54·1 per cent. Precautions adopted to prevent the presence of foreign particles on the surface (filtration, covering with moist filter-paper, &c.) had hardly any influence on the values. Long-standing of the liquid increased the surface-resistance, and stirring then diminished it; still it was always considerable at first. With M. Plateau, Herr Oberbeck found a decrease of resistance at the surface in some liquids; this was comparatively small (alcohol 11·9 per cent., oil of turpentine 12·6, sulphide of carbon 26·3, &c.). A small addition of alcohol to water lessens its surface-resistance property in a marked degree, and with further addition the mixture behaves like pure alcohol.

IN a paper on dew and fog (*Zeits. für Meteor.* Bd. xv. p. 381) Herr Dines, from observations of the former with watch-glasses exposed on different substances at night, estimates the annual dew formation to be about 35·5 mm. (on grass, 26 mm.); at the best 38 mm. The average nightly dew (in 198 observations) was hardly 0·1 mm.; in a few cases 0·3 mm.; average on grass 0·07 mm. Morning fog along a river course arises when the water is warmer than the air over it. The evaporation goes on more quickly than the vapour can be carried away; hence the latter is condensed and spreads as fog (similarly with fogs over the Gulf Stream). The evening fog on moist low-lying meadows is due to the fact that the grass surface cooled by radiation cools the lowest air-layers, so causing condensation of the aqueous vapour. The fine drops of dew, Herr Dines estimates, are about 0·001 mm. in diameter; while the finest rain-drops have a diameter of 0·3 to 0·33 mm. The particles of fog vary in diameter from 0·016 to 0·127 mm.

THE colour-changes presented in the microscope by various substances (chiefly mineral) of uneven surface, when immersed successively in liquids of different refracting power, have been made by Herr Maschke (*Wied. Ann.* No. 12) the basis of a method of distinguishing substances. Such changes may be had, *e.g.* with small glass particles, observed in water, in oil of almonds, and in mixtures of the latter with oil of cassia. The dark and the bright parts of the image show different series of colours. That the effects are simply due to prismatic action of the object appears from the fact that they may be got without the microscope, by looking *e.g.* through a tube at a piece of rock-crystal in water, &c. For mineral objects Herr Maschke used five liquids; amylic alcohol and glycerine, besides the three just named. By various mixtures of these a series of liquids is obtained, giving any desired index of refraction from 1·333 to 1·606. (Coloration begins when the refraction of the liquid is near that of the object; when the former greatly exceeds the latter a certain stability of colour appears.) The method is not applicable to bodies opaque in the microscope, or having too strong colours of their own; nor yet to bodies having a greater index of refraction than oil of cassia. It may, too, prove difficult sometimes to find a liquid sufficiently indifferent to the object. Herr Maschke indicates how the refractive indices of substances may be compared by his method, and (a more difficult task) numerically determined. He also gives a number of his own determinations.

AN interesting study, by Herr Holtz, of the electric discharge in insulating liquids appears in *Wiedemann's Annalen*, No. 12. Among other results the length of spark is found hardly at all dependent on quantity or on retardation of the discharge. Naturally it differs in different liquids, but only in one liquid (sulphuric ether) did it increase with velocity of rotation of the disk (this appears to be due rather to the mode of preparation than to the nature of the liquid). As in air, with dissimilar electrodes, the spark-length is conditioned by the polarity of the electrodes. The thickness, sound, and luminous force of the spark depend chiefly on the electric quantity and the retardation. The spark is thinner than in air, but brighter (brightest in sulphide of carbon, least bright in olive-oil and ether). It is more crooked than in air. Throughout its length it shows innumerable very small dark spaces. With large striking distance it appears within a largely-branching brush. (The appearances of the brush discharge, got best in petroleum, are also described.)

FROM data obtained in various parts of Germany, Austria, and Switzerland (*Wied. Ann.* No. 12), Herr Holtz finds a well-marked increase in risk from lightning in these parts since 1854, while no such increase appears in the number of thunderstorms. Hence he infers the causes to be telluric, and he suggests as probable causes the clearing of forests and increase of railways (attracting storms more to towns and villages); further, the increased use of metal in buildings.

PROF. BOMBINI has lately communicated to the Bologna Academy an interesting paper on spherohedry in crystallisation (*Riv. Sci. Ind.* No. 21), by which he means any known manner of production of a fibrous-radiate structure. From a survey of facts he concludes that the great phenomenon of crystallisation comprises two different orders of attractive energy. In the first there is simple centralised attraction, with concurrence of the elements attracted to a common centre. In the second there is attraction with directive polarity according to certain axes of symmetry, and concurrence of the attracted elements towards nodal points in a certain reticular system. Between these two kinds of crystallogenic action there are many gradations, or rather syntheses, superpositions. Further, the correlations between the sphericity characteristic of the liquid state; the spherohedry of globosity with radiated structure; the isometry of radiate pseudocubical groups; leading from the *amorphous* state of liquids to the absolutely reticular state of the true crystals (isotropic, orthoprismatic, and clinohedric) confirm the cubicity of the first system, and at the same time point to some further significant terms in the progressive series of the physical states of inorganic matter. Prof. Bombini indicates three conditions: I. Spherohedric crystallisation; II. Polyhedric crystallisation; and III. Pseudocubic, &c., crystallisation. The third may be considered intermediate between the first and the second; the first appearing as a term of transition between the sphericity of the liquid state and the polyhedry of physical solidity.

GEOGRAPHICAL NOTES

THE February *Proceedings* of the Geographical Society opens with Capt. Holdich's paper on the "Geographical Results of the Afghan Expedition"; but of more importance from a geographical point of view are Mr. Wilfred Powell's "Observations on New Britain and Neighbouring Islands." The latter is accompanied by a sketch-survey of the north-east portion of New Britain by the author, which of itself is of considerable value. A correspondence between Admiral Ryder, Naval Commander-in-Chief at Portsmouth, and the Council of the Society follows, by which we learn that the latter, in declining his offer to establish certain medals, are of opinion that "the plan of granting medals to officers and seamen for independent surveys is impracticable," and further that they do not consider it their business to take any action in regard to an international congress of hydrographers.

UNDER the title of "Union Géographique du Nord de la France," a geographical association was formed some time ago, with its head-quarters at Douai, and branches at Amiens, Arras, Boulogne, Cambrai, Charleville, Dunkerque, Laon, Lille, St. Omer, St. Quentin, and Valenciennes. In the first part of the *Bulletin* of the Union, which has been sent to us, the list of members covers about fifty pages. The object of the association is by every means to promote the development and spread of geographical knowledge, investigating specially questions relating to the industry, commerce, and agriculture of the region of the Nord. The *Bulletin*, a volume of some size, contains papers on the Exploration of the Sahara, Nordenksjöld's last voyage, a Project for Exploring the Wellé, the Proposed Canal between the Atlantic and the Mediterranean, and the Maritime and Commercial Statistics of Dunkerque. In the *Comptes rendus* of the meetings of the various societies are abstracts of papers on a great variety of subjects, and there are besides a geographical chronicle and a pretty full bibliography. We have no doubt the Association will do much good in the North of France.

PROF. UJFALVY has left St. Petersburg on his return from Central Asia. The journey he made during last summer was not so successful as his preceding travels, because of a serious

illness which kept the traveller in his bed for more than two months. Nevertheless the ethnographical collections brought in are very interesting.

THE *Smolensky Vestnik* gives the following information as to Colonel Prjevalsky. He was born on April 12, 1839, at the village of Otradnoye, in the Smolensk district. His mother and his old nurse, both still alive, were the first who inspired him with a warm love of nature, and his life, on the estate of his mother, contributed to the development of this love. He studied at the Smolensk College (gymnasium), and notwithstanding the desire of his mother, who wished him to enter a university, he entered as a sub-officer in the Polotzk infantry regiment. Promoted to the grade of officer, he went to the military academy, and soon we find him as an officer during the Polish campaign, and afterwards as a teacher of geography and history in the cadet school at Warsaw. A keen hunter, he could not stay long in a city, and he soon undertook a journey to the Oussouri. This determined his ultimate career; the richness of the fauna and the pleasure of hunting in uncivilised countries determined him to undertake further journeys, first to Southern Mongolia, then to Lob-nor, and finally to Tibet, which he reached last year.

UNDER the title of "The Expiring Continent," Mr. A. W. Mitchinson gives an account of his travels in Senegambia, mainly of journeys he made up the rivers Senegal and Gambia. The work contains no dates, thus detracting somewhat from its scientific value, and abounds with speculations and reflections on all sorts of subjects connected with Africa. His notes on what he saw during his journeys are of value as showing the recent condition of the country visited, and, as may be inferred from the title, the author's views are rather desponding. His inference from his observations on the small district visited by him, that the African continent as a whole is "expiring," is far too sweeping. While like the other continents it contains "desert places," the bulk of it, so far as we know it, is capable of the greatest industrial development. That its waters are drying up as a whole there is no reason for believing; but evidently in this and in other respects there is ample room for trustworthy scientific examination. The publishers are Allen and Co.

THE February number of *Petermann's Mittheilungen* begins with a paper on the Chukchis on the shores of the Arctic Ocean, their number and present position, based on two articles by O. Nordqvist and Lieut. Hovgaard. Dr. Gustav Radde contributes the first part of a narrative of his journey to Talgsch, Aderbeijan, and Sawalan in 1879-80. From the papers in the *North American Review* a long account is given of M. Désiré Charnay's explorations of the ruins in Central America. There is an elaborate and detailed map, with accompanying text, illustrating Dr. Junker's journey through the valley of the Chor Baraka, in the Egyptian province Taka in 1876.

MESSRS. W. AND A. K. JOHNSTON have sent us the first two parts of a "Statistical Atlas of England, Scotland, and Ireland," by Mr. G. Phillips Bevan. These two parts include Religious and Educational Statistics, and subsequent parts will be devoted to Industry, Crime, Marine, Agricultural, Railways, Geology, and Mining, &c.; there will be fifteen parts in all. In the first two parts a vast amount of useful statistics are graphically exhibited on the maps, and systematically arranged in separate tables. Much of the information thus exhibited could not be obtained from any other single source.

NO. 90, the concluding part of the fifteenth volume of the *Zeitschrift* of the Berlin Geographical Society, contains the conclusion of the late Dr. Erwin von Bay's interesting journal of his journey from Tripoli to Ghât and Air, and a paper on the region which caused the recent contest between Chili and Bolivia, by Dr. C. Marten. The rest of the number, 130 pages, is occupied with the bibliography of the past year, one of the most valuable features of this most important of geographical journals. The bibliography is practically exhaustive, is arranged in a thoroughly systematic manner, and includes works relating to all departments of geography.

M. SIBIRIAKOFF has safely returned to St. Petersburg, where he had a brilliant reception. At a meeting of the Society for the Furtherance of Russian Commercial Navigation, M. Sibiriakoff pointed out the grave errors contained in Russian marine charts, which caused two of his captains to mistake the Gydan Bay for the Yenisei Estuary. They entered it on September 12, and soon met with thick-packed ice. The *Nordland* had stopped at once, the *Oskar Dickson* proceeding some 100 versts further to the south. Thence the travellers had journeyed to Obdorsk, with Samogedes as guides.

THE Rüppell fund at Frankfort-on-the-Main, which was founded in honour of the Nestor of African travellers, Dr. Eduard Rüppell, and for the exclusive object of supporting scientific exploration, consisted of the sum of 35,570 marks (1770*l.*) at the end of last year. From this the Senkenberg Naturforschende Gesellschaft, at their last meeting, granted the sum of 3000 marks (150*l.*) to Dr. Wilhelm Kobelt of Schwanheim, an eminent conchologist. Dr. Kobelt is now engaged upon the investigation of the existing and fossil molluskan fauna of the Mediterranean, and had during the last few years repeatedly visited Italy and Sicily for this purpose. His next tour, which is to extend from March to September, will comprise Spain, Algeria, and, if possible, Morocco. We may remind our readers that the journeys of Drs. Noll and Grenacher to Spain and the Canary Islands in 1871, as well as those of Verkrüzen to Newfoundland in 1874 and 1875, were also largely supported by grants from the Rüppell fund.

GEODETICAL measurements will be begun next spring on the stretch between Great St. Bernard and the St. Gothard for connecting together the Italian and the Swiss geodetical network.

A NEW expedition will start, next spring, for the exploration of the Obi, under the direction of M. Moïséeff. Six pupils of the Marine School of Arkhangelsk will accompany him.

THERE is some talk of uniting the three geographical societies of Switzerland, those of Berne, Geneva, and St. Gall, as well as those which may be created afterwards, into one great Swiss geographical association, which will have a central committee and an annual general assembly devoted to the study of geographical questions, and especially of those which have a commercial interest.

UNDER the title of "Das Frauenleben der Erde," illustrated by A. von Schweiger-Lerchenfeld, A. Hartleben of Vienna has published a highly interesting description of the social life of the women of all nations. The work contains much that is of ethnographical value, and the numerous well-executed illustrations, as well as the attractive style of the text, are likely to render it of popular interest.

THE Austrian Section of the German and Austrian Alpine Society held its annual meeting at Vienna, on January 26 last. The Section now numbers 1302 members.

ON January 29 a branch of the Berlin "Centralverein" for commercial geography was formed at Düsseldorf. The new branch is directing its main attention to South Africa.

IN the place of the late Dr. Mook, Dr. Manthey has joined the Riebeck expedition, which will leave Cairo in the course of a few days, and will, first of all, proceed to Socotra by way of Aden.

ABNORMAL VARIATIONS OF BAROMETRIC PRESSURE IN THE TROPICS AND THEIR RELATIONS TO SUN-SPOTS, RAINFALL, AND FAMINES

MR. F. CHAMBERS, in his valuable and highly interesting article (vol. xxiii. p. 88) under the above title, has made an important step towards placing the relation between secular weather changes and sun-spots on a more substantial basis than it has hitherto occupied. This has been mainly effected by his employing the most reliable data we at present possess of the latter phenomena, thereby bringing the salient features of their *minor* variations for the first time into direct comparison with a definite meteorological element, which, it may be remarked, possesses the distinct advantage of representing the integrated effect of changes occurring throughout the entire atmospheric envelope.

He has also shown how the remarkable lag which takes place in the occurrence of the critical barometric epochs at the more easterly stations may be utilised to previse famines from a knowledge of what is going on at more westerly ones.

This however would only be practicable if we knew for certain that famines in all the districts mentioned invariably took their rise from one set of conditions, such as failure of the usual summer rains, preceded and accompanied by high barometric pressure. In attributing the majority of the famines occurring within the tropics to such a proximate cause, Mr. Chambers

would no doubt be correct; but this relation between pressure and rainfall, strange though the fact may appear, does not apparently hold in the winter in the sub-tropical region of Northern India, nor is famine always caused in *this* region by a failure of summer rain alone.

For as Mr. S. A. Hill has shown in a paper on "Variations of Rainfall in Northern India" ("Indian Meteorological Memoirs," No. vii. p. 204), a *heavy* winter rainfall generally coincides with a *high* barometric pressure over Northern India, and *vice versâ*, while two of the most severe famines in Mr. Chambers' list, viz., those of 1837-38 and 1860-61, in Northern India were caused by "a partial failure of the summer rains, followed by an almost complete absence of the usual winter fall."

It is straining the evidence therefore to attempt to relate these famines, as Mr. Chambers has done, to the *previous* occurrence of high barometric pressures, since if the law just quoted held good, the famine of 1860-61 was mainly due to the absence of winter rain, caused by the *low* pressure which observations show actually existed at that time, and the same was very probably the case in 1837-38, a strongly-marked epoch of sun-spot maximum.

It has moreover been shown by Mr. Hill in the paper just referred to that "the summer rains of the North-West Provinces and Rajpootana have failed quite as often when sun-spots were numerous as when they were few, but whereas in the *former* case a comparatively slight scarcity has generally been developed into a severe famine through the failure of the winter rains, this has seldom happened in the latter case, the distress at such times being alleviated by the in-gathering of the rabi harvest, rendered more abundant than usual by a copious winter fall." This saving clause with respect to the winter rainfall of Northern India does not unfortunately apply to Southern India, where failure of the usual monsoon supply means drought and probably famine until the next monsoon, *i.e.* for an entire year.

On the whole it is plain that high and low atmospheric pressures differ specifically in their effects in different parts of the Indian peninsula, since while the former is generally associated with drought in the southern provinces, the latter in the winter is almost equally fatal in the northern provinces. If therefore the future prevision of famines is to be based on the empirical law connecting high barometric pressure with the occurrence of drought and famine, propounded by Mr. Chambers, it must be remembered that this law strictly applies only to regions where the annual water-supply is dependent upon the monsoons alone, and therefore lying for the most part between the two tropics.

It may be remarked that at least half of the Indian peninsula lies north of the tropic of Cancer.

Though I am sceptical as to the idea of motion from west to east, conveyed by the existence of a lag at the more easterly stations, this in no way affects the possibility of prevision as long as the lag remains fairly constant. I am therefore of opinion that in regard to this question the evidence furnished by Mr. Chambers is exceedingly valuable, and that so long as districts are only taken into account that lie within the tropics, such as Southern India, the possibility of prevising famines by noting the occurrence of barometric maxima at more westerly stations may in time be accomplished. For Northern India, and probably other similar sub-tropical regions, the matter is at present more complicated. E. DOUGLAS ARCHIBALD

P.S.—In the preceding letter I have only dwelt upon the limitation to be applied to Mr. Chambers's conclusions in the case of Northern India. It is obvious however that there are at least two distinct difficulties to be explained, before they can be finally accepted, even for countries within the Tropics, viz. (1) Why the barometric waves should commence on one meridian rather than on another, and (2) if, as Mr. Chambers thinks, the waves of pressure travel slowly round the earth, why they do not reappear at the place where they started after an interval of about one year and eight months (calculated from the lags given in Mr. Chambers's paper). At present there does not appear to be the slightest evidence to show that they reappear at all, and if they do not, when and where do they disappear?—E. D. A.

MR. E. D. ARCHIBALD states in his friendly criticism of my paper on "Abnormal Variations of Barometric Pressure in the Tropics, and their Relations to Sunspots, Rainfall, and Famines," that the occurrence of a decided lag in the barometric movements at easterly, as compared with westerly stations, could only be utilised to previse famines if we knew for certain that famines in those districts to which the method is applied invariably took their rise from *one* set of conditions, such as failure of the usual summer rains, preceded and accompanied by high barometric pressure. It appears to me, however, that if the variations of the rainfall can be *definitely* related in *any* manner to the corresponding variations of the barometric pressure, there is no necessity for such a limitation. If, for instance, in Northern India, "a heavy winter rainfall generally coincides with a high barometric pressure, and *vice versâ*," as Mr. Archibald seems prepared to admit, then the occurrence in the *winter* of a *high* pressure would portend a *heavy* winter rainfall, and *vice versâ*, and in this case the failure of the winter rains might be foreseen by observing the progress eastward of the barometric *minima*.

But I am not aware that the relation above mentioned between the barometric pressure and the winter rainfall of Northern India has yet been worked out with sufficient definiteness for the purpose in view, for although there does appear to be some evidence in favour of that relation when the *average* pressure and the *total* rainfall of the whole winter are taken into account, yet on the other hand it is now known that the short rainy periods of the winter are periods of relatively *low* pressure. It is not improbable that these periods of low pressure, and the rainfall which accompanies them, are connected with the feeble cyclonic disturbances which (as appears from the charts of storm-tracks published by the American Government) occasionally enter the north-west of India in the winter months and travel down the Ganges Valley sometimes as far as Bengal. The facts concerning these winter rains seem to accord far better with this view of their origin than with the old notion of their connection with the upper anti-monsoon current, an idea which I observe has now been abandoned by Mr. Blanford, the Meteorological Reporter to the Government of India, although up to a recent date it was still retained by some other Indian meteorologists. The question is as yet involved in much obscurity, and I must, with the above suggestion, leave it to be dealt with by those more immediately concerned.

But whatever the relation between the winter rainfall and the barometric pressure may be, I cannot help thinking that Mr. Archibald attaches an exaggerated relative importance to these winter rains, for, from the register of Allahabad, the capital of the province, it appears that the winter rain amounts on the average to only 1·54″, whereas the average summer rain amounts to 36·84″. And similarly at Delhi, the average total winter rain is only 3·01″, while that of the summer is no less than 24·60″. Such being the case, I think it would be difficult to prove that "the famine of 1860-61 in the North-West Provinces was *mainly* due to the absence of the winter rain," more especially as the summer rain of 1860 in that province was deficient to the extent of nearly one-half, the fall having amounted to only 54 per cent. of the average.

Neither does it seem clear why the methods of forecasting the general character of a coming season, which are suggested in my paper, should of necessity be applicable only to intertropical regions. It is true that I have dealt only with barometric data furnished by stations lying within the tropics, but my only reason for doing so was that there seemed a better prospect of obtaining definite results from the records of tropical stations, where the weather is generally of a comparatively settled character, than from those of stations situated in extra-tropical regions, where the weather is generally more disturbed. Indeed I am not without hope that the results I have obtained will induce European meteorologists to take up the subject with a view to the possibility of prevising the general character of coming seasons in Europe from observations recorded in America.

FRED. CHAMBERS

STANDARD THERMOMETERS

DEAR SIR,—The Kew Committee have instructed me to forward you the enclosed Memorandum on Standard Thermometers, and to request on their behalf that you would be so good as to publish it in NATURE if you consider it suitable for insertion. G. M. WHIPPLE

Kew Observatory, Richmond, Surrey, February 9

DR. LEONARD WALDO has recently communicated to the *American Journal of Science* an article entitled "Papers on Thermometry from the Winchester Observatory of Yale College."

In it he treats of the errors of three standard thermometers constructed for him at the Kew Observatory, and after describing minutely the instruments, the manner in which he verified the accuracy of the positions of the fixed points, and the appliances he used in the work, proceeds to state that he then rigorously examined the thermometers for errors depending on calibration. Of these he says: "The results of our calibration are given in the following table. The observations were made with Apparatus II., and special care was taken to guard against any changes of temperature. The reduced results are as follows, where each line is the mean of three observations:—

Thermometer.	Date.	Extreme readings.	Computed length of col.	Correction for calibration error.
	1880.	° °	°	°
Kew, 578	Oct. 15	− 1·1 + 33·6	32·487	At 32 C. = +0·007
		+ 31·0 + 65·1	32·507	65 C. = −0·014
		+ 63·7 + 98·6	32·487	99 C. = +0·007
Kew, 584	Oct. 15	+ 32·2 + 82·3	49·040	79 F. = +0·021
		+ 76·1 + 127·3	49·068	123 F. = −0·006
		+ 119·1 + 170·1	49·078	166 F. = −0·016
		+ 162·2 + 213·2	49·060	212 F. = +0·001
Kew, 585	Oct. 15	− 1·0 + 50·9	49·813	50 C. = +0·015
		+ 49·0 + 100·9	49·843	100 C. = 0·000
		+ 99·1 + 151·7	49·820	150 C. = +0·008
		+ 148·9 + 201·0	49·807	200 C. = +0·029
		+ 199·2 + 250·8	49·747	250 C. = +0·110

REMARKS.—The observations were all made by daylight, and at one sitting for each thermometer. The extreme variations of the temperature of the room during the observations as measured by two thermometers, one at each end of the tube being measured, were as follows:—

Kew, 578 = 0°·0 F.
584 = 0°·1 F.
585 = 0°·1 F.

The length of the column used for the Kew calibration, and by which the thermometers were graduated, was 5°·026 C. for Kew 578, 10°·405 F. for 584, and 10°·673 F. for Kew 585. We may therefore conclude that between 0° and 100° C. the errors of the three Kew standards depending on the calibration are practically insensible; for the errors shown above are too small to be certainly detected, owing to the width of the lines which make up the graduation of the thermometer scales.

Accidental errors of graduation could not be guarded against except by the direct examination of every degree, and that accordingly has been done.

The tedious examination of each degree was accomplished with the aid of Prof. J. E. Kershner. We used the apparatus I., and each degree was measured twice. The resulting means were expressed in terms of hundredths of one division of the eye-piece micrometer, and gave a subdivision of about $\frac{1}{4350}$, $\frac{1}{2930}$, and $\frac{1}{2100}$ of 1° in the cases of Kew 578, 584, and 585 respectively. There were about 2300 separate micrometer readings made, and the result of the reductions shows that no sensible accidental errors have been introduced into the graduations of these standards.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The latest edition of the schedule of subjects for the Moral Sciences Tripos fully recognises physiology. In the advanced part of the examination special knowledge is required (1) of the physiology of the senses and of the central nervous system; (2) of experimental investigations into the intensity and duration of psychical states; and (3) of such facts of mental pathology as are of psychological interest. Questions will also be set relating to the philosophic treatment of the relation of body and mind as regards both the method and the general theory of psychology. Mr. Lewes's "Problems of Life and Mind," vols. iii.-v., Dr. Michael Foster's "Text-book of Physiology," Book iii., Wundt's "Physiologische Psychologie," Fechner's "In Sachen der Psychophysik," Maudsley's "Physiology of Mind" and "Pathology of Mind" are among the books recommended.

MR. J. M. H. MUNRO, D.Sc. Lond., F.C.S., has been elected resident Professor of Chemistry in the Wilts and Hants Agricultural College, Downton, Salisbury, and he will act in co-operation with Prof. A. H. Church, M.A.Oxon. Dr. Munro headed the list in first-class honours in chemistry at both of the examinations for the B.Sc. degree, and obtained the chemical exhibition of the University in 1874. He was also classed in botany and vegetable physiology, and in logic and moral philosophy, and took the Doctor's degree in 1877. He recently received a grant from the Chemical Society in aid of a research on which he is at present engaged.

SCIENTIFIC SERIALS

THE *Proceedings of the Royal Irish Academy* ("Science"), part 5, vol. iii., series 11, December, 1880, contains—W. R. Roberts, on the satellite of a line meeting a cubic.—A. H. Anglin, mathematical notes.—Prof. J. P. O'Reilly, on the directions of main lines of jointing observable in the rocks about the Bay of Dublin, and their relations with adjacent coast-lines;—also on the correlation of the lines of faulting of the Palamow coal-field district, Northern India, with the neighbouring coast-lines.—Prof. E. Davy, preliminary report on some new organic nitroprussides.—Prof. W. King, preliminary notice of a memoir on rock-jointing in its relation to phenomena in physical geography and physical geology.—J. F. Knott, on some anomalies in human anatomy (woodcuts).—Prof. Mackintosh, note on the occurrence of a premaxillo-frontal suture in the skull of the koala (*Phascolarctos cinereus* (with plates 10 to 13).—G. H. and G. A. Kinahan, eurites or basic felstones of Silurian age.—G. H. Kinahan, supposed Upper Cambrian rocks in the counties of Tyrone and Mayo.

THE *Proceedings of the Royal Irish Academy*.—"Polite Literature and Antiquities," part 2, vol. ii. series 11, December, 1880, contains the following papers of interest to the student of nature:—W. Frazer, description of a great sepulchral mound near Donnybrook (in Co. Dublin), containing human and animal remains, as well as some objects of antiquarian interest referable to the tenth or twelfth centuries (woodcuts).—G. Allmann Armstrong, particulars relative to the finding of human remains in the neighbourhood of Dundalk (woodcut).—R. J. Ussher and G. H. Kinahan, on a submarine crannog at Ardmore, Co. Waterford (plate 1 and woodcut).—Thos. Plunkett, on an ancient settlement found about twenty-one feet beneath the surface of the peat in the coal-bog at Boho, Co. Fermanagh (plate 2).

THE *Scientific Proceedings of the Royal Dublin Society*, vol. ii. new series, part vii., November, 1880, contains:—V. Ball, on the mode of occurrence and distribution of diamonds in India.—A. B. Wynne, on some points in the physical geology of the Dingle and Iveragh Promontories.—Dr. C. A. Cameron, on the action of water upon mercuric sulphate.—J. H. Luby, voluntary act of self-destruction by the worker bee.—G. F. Fitzgerald, F.I.C.D., notes on fluorescence.—Thos. Plunkett, on chert in the limestone of Knockbeg, county of Fermanagh (woodcut).—R. M. Barrington, M.A., on the introduction of the squirrel into Ireland (with a map).

Vol. iii., new series, part i., January 1881, contains:—C. E. Burton and Howard Grubb, on a new form of ghost micrometer for use with astronomical telescopes (plates 1 to 4).—E. T. Hardman, on a travertine from Ballisodare near Sligo, containing a considerable amount of strontium.—W. Smith, preliminary note on the manufacture of paper from melic grass (*Molinia cærulea*).—D. M'Ardle.—On some new or rare Irish Hepaticæ (with plates 5 and 6).—Percy Evans Freke, on North American birds crossing the Atlantic (with tables).

Journal and Proceedings of the Royal Society of New South Wales, vol. xiii., 1879 (Agents in London Messrs. Trübner and Co.), contains—On the "gem" cluster in Argo, by H. C. Russell.—On the water of Sydney Harbour, by the Rev. W. H. Sharp.—On the anatomy of Distichopora, with a monograph of the genus, by Rev. J. E. Tenison-Woods (two plates).—On the geological formations of New Zealand compared with those of Australia, by Dr. Jas. Hector.—On the languages of Australia in connection with those of the Mozambique and of the south of Africa, by Hyde Clarke.—On *Ottelia præterita*, F. v. M., by Baron von Müller, with a plate (an alisma-like leaf-impression from the green-bush quarry near to Parramatta, apparently allied

to *Ottelia ovalifolia*).—On a compiled catalogue of latitude stars, epoch 1880, by H. S. Hawkins.—On the occurrence of remarkable boulders in the Hawkesburg rocks, by C. S. Wilkinson.—On the Wentworth hurricane, by H. C. Russell.—Abstract of the meteorological observations taken at the Sydney Observatory, by H. C. Russell. (January to December, 1879).

American Journal of Science, December, 1880.—Note on the zodiacal light, by H. C. Lewis.—The early stages of renilla, by E. B. Wilson.—Geological relations of the limestone belts of Westchester, co. New York, by S. D. Dana.—Abstract of some palæontogical studies of the life-history of *Spirifer brevis*, H, by H. S. Williams.—Index to vols. xi.-xx.

Journal of the Franklin Institute, January.—Experiments with the Parkins machinery of the steam yacht *Anthracite*, by Chief-Engineer Isherwood.—The determination of silicon and titanium in pig-iron and steel, by Dr. Drown and Mr. Shimer.—An adaptation of Bessemer plant to the basic process, by Mr. Holley.—The value of the study of the mechanical theory of heat, by Mr. Wolff.—Blasting, by Mr. Kirk.—On the wholesomeness of drinking-water, by Mr. Haines.—An inquiry into the laws of the beautiful in music, by Prof. Clarke.

THE last number of the *Journal* of the Physical and Chemical Society (Russian) contains, besides minutes of meetings, papers on the electrolyse of formic and mellite acids, by M. N. Bunge.—On the variations of the quantity and pressure of oxygen in the lungs, by Prof. Ivan Setchenoff.—On products of the decomposition of albuminous matters, by Dr. Danilevsky.—On hops, by M. Tchekh; and several smaller notes on organic chemistry.—In the physical part, M. Shvedoff continues his researches on hail, trying to establish by various very interesting arguments the cosmic origin of hail, which he considers as a variety of meteorites.—M. Reinboth describes a new naphtha barometer which has a great sensibility.—M. Van der Flith gives several new mathematical formulæ concerning electrodynamics.

THE *Schriften der physikalisch-ökonomischen Gesellschaft zu Königsberg* (1879, i. and ii.; 1880, i.).—These parts contain the following papers:—On the *Uredo* fungus, by Dr. Caspary.—On the Gastræa theory, by Prof. Kupffer.—On pisciculture, by Dr. Seidlitz.—On some acoustical and optical experiments with the telephone, by Prof. Berthold.—On the phonograph, by Dr. Zenker.—On the ancestors of carnivora, by Dr. Albrecht.—What is species, and what variety? by Dr. Caspary.—On bacteria, by Dr. Baumgarten.—On the observations made at the station for measuring the temperature of the soil in various depths at the Botanical Gardens at Königsberg, by Prof. E. Dorn.—On some periodical phenomena in inorganic nature, by Dr. Jentsch.—On the ancestors of hoofed animals and Edentata, by Dr. Albrecht.—On the rhythmical motions in the animal and in the human body, by Prof. Grünhagen.—On the fauna of New Zealand, by Prof. Zaddach.—On the archæopteryx, by Prof. Zaddach.—On the ancestors of rodentia, by Dr. Albrecht.

Bulletin de l'Academie Royale des Sciences (de Belgique), No. 12, 1880.—Application of the tuning-fork to study of the propagation of sound and vibratory movements in liquids, by M. Montigny.—On the falling stars of November 27, 1880, observed at Brussels Observatory, by M. Houzeau.—On two plesiosaurs of the lower lias of Luxembourg, by M. van Beneden.—Science and the imagination (lecture at public *séance*), by M. Stas.—Voyages and metamorphoses of a drop of water, by M. Van der Mensbrugghe.—Announcement of the results of prize competitions.—Reports on memoirs, &c.

Rivista Scientifico-Industriale, No. 1, January 15.—Singular verticillate configuration (in the form of a rose) of the laminæ of crystallised water, by Prof. Bombicci.—On storms, by Prof. Cantoni.—A modification of the Ruhmkorff coil, by Dr. Scarpa and S. Baldo.—Two new species in the Mediterranean fauna, by Prof. Richiardi.—Some ammonites of the middle lias, by S. Canavari.—Paramagnetism and diamagnetism of liquids, by Prof. Marangoni.—Experiments proving that air saturated with moisture is an insulator as well as dry air, by the same.

Journal de Physique, January.—Atmospheric absorption of ultra-violet radiations, by M. Cornu.—Experimental researches on the psychrometer, by M. Macé de Lépinay.—On the division of instantaneous currents, by M. Brillouin.—Electric *explorateur* of M. Trouvé, by M. Guriel.—M. Trouvé's apparatus for examination of deep natural or artificial cavities, by the same.—On resultant sounds, by M. Nicotra.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 3.—Prof. Owen read a third part of his description of the great extinct horned lizard of Australia (*Megalania prisca*). The materials had been transmitted from the same formation and locality-petrified drift-bed of King's Creek, Queensland, as the subjects of Part 2, and were discovered by Mr. Geo. Fred. Bennett, about thirty feet from the fossil skull. They proved to be, when recomposed, the opposite extremity of the animal, and consisted of an ossified sheath of the tail, in annular segments supporting conical cores of horn-like weapons. Of these segments the three terminal ones had coalesced; a fourth detached segment fitted the antepenultimate ring. Each ring, save the last, supported two pairs of horn-cores, of which dimensions were given and drawings exhibited of the natural size. From tip to tip of the dorsal pair of the antepenultimate segment measured ten inches. In this segment was included the corresponding vertebra, exemplifying the caudal modifications of the type of the dorsal, sacral, and other vertebræ of *Megalania* described in the parts communicated to the Royal Society in 1858 and 1880. The author then entered into an exhaustive review of analogous caudal armatures in other animals. The nearest approach, in the class *Reptilia*, was made by the small existing Australian lizard (*Moloch horridus*) and by the *Uromastix princeps*, recently described by the late Arthur W. E. O'Shaughnessy, of whom Prof. Owen spoke in terms of deep regret and respect.

The supports of the caudal horns or spines in the above small lizards retained the immature condition of fibro-cartilage. Examples where histological development had proceeded to ossification were cited from recent and fossil *Reptilia*. In the latter the nearest approach to the caudal armature of *Megalania* was presented by the *Scelidosaurus*, of the Dorsetshire lias. A still nearer resemblance to the singular structures described in the present paper was made by certain extinct species of gigantic armadillos, e.g. *Glyptodon asper*, from South American tertiaries.

The author associated this repetition or lingering of a reptilian osteodermal character in the mammalian class with the previously-known repetition of the horny scutation of lizards in the mammalian pangolins (*Manis*); he referred to the low dental condition in the numerous similar simple teeth of armadillos and the still lower characters which had suggested the ordinal term "Edentata." He cited the tenacity of life and long continuance of the muscular irritability after death in the sloths; the winter sleep of bats and certain rodents, with their faculty of circulating blood in the venous state; the quills in hedgehogs and porcupines as indicative of a repetition of a dermal character of an oviparous class; the anatomical modifications giving a faculty of flight, as in Pterosaurians.

The sole common organic character of, and peculiar to, such members of a large and otherwise much varied group of mammals was a cerebrum, small, not extending upon the cerebellum, smooth or with few and simple convolutions, but with the hippocampal commissure ascending to connect the hemispheres above the lateral ventricles, and so constituting the anthropotomical "corpus callosum." A still lower group of mammals had no such commissural development, but this common cerebral character was associated with as many and great variations of inferior structures as in the *Lissencephala*. The *Lyencephala* included the marsupials and monotremes.

In the discussion which followed the reading of the paper the chief objection was an averment that the author had no evidence of its subjects having belonged to *Megalania prisca*, and that they were more probably parts of some Chelonian reptile.

To this the author replied that he had evidence both negative and positive. From the year 1857 he had received parts of the skeleton of a great terrestrial reptile from localities hundreds of miles apart in the provinces of New South Wales, Victoria, Queensland, but not a single fragment of a carapace, plastron, or other characteristic part of a Chelonian; every large reptilian fossil was not only "Lacertian," but of the very genus and species *Megalania prisca*. Perhaps no part of the axial skeleton was more differentiated than the occipital vertebra in a lizard and a tortoise. In the latter the elements remained as distinct as in a fish; in the former as confluent as in the mammal; this at least was the case in *Moloch* as it is in *Megalania*. Finally Prof. Owen pointed to the vertebra in organic connection with the tail-sheath in the fossils last received; it was Lacertian, not Chelonian.

"On a Method of Destroying the Effects of Slight Errors of Adjustment in Experiments of Changes of Refrangibility due to Relative Motions in the Line of Sight," by E. J. Stone, F.R.S., Director of the Radcliffe Observatory, Oxford.

Let arrangements be made for the reversion of the prisms without any disturbance of the other optical arrangements, including, of course, the position of the cylindrical lens, if one be used. Any slight errors of adjustment which prevent the light from the star and the comparison light from falling upon the train of prisms under the same optical circumstances, so far as mere direction is concerned, will have opposite effects in the reversed positions of the prisms; but the separation of the emergent lights due to relative motion will remain unchanged by the reversal of the positions of the prisms.

If, therefore, the apparent change of refrangibility due to relative motion remains unchanged by the reversion of the prisms, all doubts about the effects of errors of adjustment will be removed. But if the results in the reversed positions of the prisms sensibly differ, then the existing errors of adjustment must be removed, or their effects allowed for by taking a mean of the results in reversed positions, before any reliance can be fairly placed upon the determination of relative motions in the line of sight.

A reversible spectroscope was arranged by me, and made by Mr. Simms, some years ago, but I have never since had an equatorial, with a good driving clock, under my control, with which the experiment indicated could be properly tried.

With the direct prisms now in use the required reversion can be easily arranged. I am not likely for some time to have the use of a good equatorial, and I therefore publish the plan with the hope that some one more fortunately situated may give it a fair trial.

The experiment is a crucial one, and in my opinion should be tried.

Chemical Society, February 3.—Dr. Gladstone, vice-president, in the chair.—It was announced that a ballot for the election of Fellows would take place at the next meeting of the Society.—The following papers were read:—On the estimation of organic carbon in air, by Drs. Dupré and Hake. The carbon is converted into carbonic acid by passing the air over heated oxide of copper; the carbonic acid thus produced is absorbed by baryta water, and the carbonate is converted into sulphate which is weighed. The carbonic acid present in the air, as such, is estimated in a similar way and deducted. The mean quantity of organic carbon in ten litres of ordinary London air was 0·000154; Boussingault and Verser found ten times as much. The authors also refer to the results obtained by Pettenkofer in his well-known experiments on the elimination by animals of H and CH_4. Pettenkofer seems to have entirely neglected the organic carbon in the atmosphere, and thus his results require very important corrections.—On the action of the copper-zinc couple upon nitrates and the estimation of nitric acid in water analysis, by M. W. Williams. Some strips of clean zinc foil are placed in a wide mouth stoppered bottle and covered with a 3 per cent. solution of copper sulphate: when the zinc has acquired a sufficient coating of copper the solution is poured off and the copper zinc couple washed. The water to be analysed is then poured on the couple and allowed to remain for some hours at 24° C., after the addition of a little pure sodium chloride. The nitrates are thus completely converted into ammonia, which is estimated by nesslerising.—On the position taken by the nitro-group on nitrating the dibromo-toluenes, by R. Nevile and A. Winther.—On some of the various derivatives of toluene and the toluidines, by R. Nevile and A. Winther.

Anthropological Institute, January 25.—Anniversary Meeting.—Edward B. Tylor, F.R.S., president, in the chair.—Dr. Tylor, the retiring president, gave the annual address on the year's progress of the science of man and civilisation. He described the excellent arrangements in the United States for supplying Indian agents, missionaries, and others in contact with native tribes, with manuals to guide them in collecting information as to laws, customs, languages, religion, &c., the very memory of which will die out with the present generation of Indians. He contrasted the active intelligence of the United States in this with the fact that the Dominion of Canada, though kindly and wise in their practical management of the Indians, do not seem alive to the value of the scientific knowledge which is being lost among them for want of a little cost and trouble in collecting it. Dr. Tylor also spoke of Prof. Flower's study of the mountaineers of Fiji, the Kai Colo, a race who have the narrowest skulls of all mankind. The public have not yet become aware of the value of minute measurement of skull-dimensions, but Prof. Flower has clearly shown in it a means of bringing the study of races under arithmetical calculation, a step which will do much to bring anthropology among the exact sciences.—The new president is Major-General A. Pitt-Rivers, F.R.S.

Physical Society, February 12.—Prof. W. G. Adams in the chair.—This being the annual general meeting, the yearly report was read by the Chairman. The report showed that the Society now numbered 321 members as against 298 of last year. Two eminent members, Sir T. H. Elliot and the Rev. Arthur Rigg, had been lost by death. The Society had decided to republish the scientific papers of Dr. Joule in a collected form.—Dr. Atkinson, treasurer, read the balance-sheet for the past year, which showed the Society to be flourishing.—The new Council and Officers were then elected, Sir W. Thomson retaining the presidency.—Mr. Bakewell and Herr G. Wiedemann were created Honorary Members.—Votes of thanks were passed to the Lords Commissioners of the Council of Education for granting the use of the meeting-room to the Society, to Prof. Adams and to Dr. Guthrie, the demonstrator, the auditors, and the secretaries, Professors Rheinhold and Roberts.—The meeting was then resolved into a special general meeting, and a resolution put and carried giving the Council power to invest money of the Society in the name of the Society, or of persons appointed by them, in certain stock, home and foreign.—The meeting was then constituted an ordinary one, and Mr. T. Wrightson, C.E., read a paper by Prof. Chandler Roberts and himself on the density of fluid bismuth. By means of the oncosimeter, an instrument which records on a band of paper the sinking or floating effect of a ball of the solid metal immersed in the molten metal, they had determined the density of fluid bismuth from six experiments to be 10·055. A former value by a different method was 10·039. In the discussion which ensued, Mr. Wrightson stated that his experiments proved solid cast iron to be heavier than fluid, and to sink in the latter when first immersed, but it rapidly became lighter as its temperature rose, till it floated when in its plastic state, and was consequently lighter than when in the molten state. The oncosimeter could be utilised for determining the change of volume in melting rocks, and Prof. Chandler Roberts suggested that it might throw light on the difference of state between the carbon of grey pig and white iron.—Dr. O. J. Lodge exhibited working models showing the hydrostatic analogies between water and electricity. A battery was represented by a pump, conductors by open pipes, dielectrics by a pipe closed by an elastic membrane, electrometers by pressure gauges. With these analogues he showed the action of a Leyden jar, and the passage of telegraphic signals along a cable.

Geological Society, February 2.—Robert Etheridge, F.R.S., president, in the chair.—Joseph Groves, George Lewis, Rev. Edouard Méchin, S.J., James Osborne, and the Rev. William Sharman were elected Fellows of the Society.—The following communications were read:—On the coralliferous series of Sind and its connection with the last upheaval of the Himalayas, by Prof. P. Martin Duncan, F.R.S.—This communication is the result of the author's study and description of the fossil corals of Sind, undertaken at the request of the Geological Survey of India. The history of the researches in the geology of the Tertiary deposits of Western Sind was noticed in relation to a statement made some years since by the author and Mr. H. M. Jenkins, F.G.S., that there was more than one Tertiary series there, in opposition to both D'Archiac and Haime. After a brief description of the geology of the Khirthar and Laki ranges of hills, which were called Hala Mountain by the French geologists, the succession of the stratigraphical series demonstrated by the survey under Blanford and Fedden was given, and the author proceeded to discuss the peculiarities of the six coral faunas of the area, and to argue upon the conditions which prevailed during their existence. A transitional fauna, neither Cretaceous nor Eocene, underlies a trap; to the trap succeeds a great development of Nummulitic beds containing corals, the Ranikot series, some of which are gigantic representatives of European Nummulitic forms. A third fauna, the Khirthar, succeeds, and a fourth, Khirthar-Nari, which was a reef-building one; and a fifth, the Nari, is included in the Oligocene age. An important Miocene coralliferous series (the Gaj) is on the top of all. These faunas above the trap are Nummulitic, Oligocene, and Miocene in age, and in the first two European forms

which are confined to definite horizons, are scattered indefinitely in a vertical range of many thousands of feet. The corals grew in shallow seas, but most of them were not massive limestone builders, but there were occasional fringing reefs, or rather banks of compound forms, which assisted in the development of limestones. Many genera of corals which elsewhere are massive are pedunculate in Sind, and the number of species of the family Fungidæ is considerable. There are also alliances with the Eocene coral fauna of the West Indies. The depth of the coralliferous series and the intercalated unfossiliferous sandstones, &c., is, according to the Survey, 14,000 feet, without counting an estimated 6000 feet of unfossiliferous strata in one particular group. The subsidence has therefore been vast, but not always continuous. After noticing the numbers of genera and species in this grand series of coral faunas and the remarkable distinctness of each, the author proceeded to discuss the second part of his subject. When president of the Society he had stated in his anniversary address for 1878 that he was not convinced of the truth of the theory of the Geological Survey of India regarding the Pliocene age of the last Himalayan upheaval. The considerations arising from the position of a vast thickness of sedimentary deposits overlying the Gaj or marine Miocene, and containing *Amphicyon*, *Mastodon*, *Dinotherium*, and many Artiodactyles of the supposed pig-like ruminant group, lead to the belief that the author was not justified in opposing the theory enunciated by Lyddeker and the directors of the Survey. The position of these Manchhar strata on the flanks of the mountain system of Sind was compared with that of the sub-Himalayan deposits. The faunas were compared, and the Sewalik deposits, the equivalents of the Upper Manchhar series of Sind, were pronounced to be of Pliocene age. They were formed before and during the great upheaval of the Himalayas, and in some places are covered with glacial deposits. A comparison was instituted between these ossiferous strata and the beds of Eppelsheim and Pikermi, and the author discussed the question relating to the age of terrestrial accumulations overlying marine deposits.—On two new crinoids from the Upper Chalk of Southern Sweden, by P. H. Carpenter, M.A. Communicated by Prof. P. Martin Duncan, F.R.S. Stem-joints of a crinoid resembling those of *Bourgueticrinus* have long been known in the Plänerkalk of Streben (Elbe); but on the discovery of the calyx it was found to differ considerably from that genus. It was then referred to the genus *Antedon* by Prof. Geinitz. Stems also resembling *Bourgueticrinus* have been found in the upper chalk of Köpinge (S. Sweden), and a calyx resembling that described by Prof. Geinitz has also been found. Prof. Lundgren kindly entrusted this to the author for description. For these two fossils he considers not only a new genus but also a new family required. He proposes for the former the name *Mesocrinus*, as the characters of its calyx ally it to the Pentacrinidæ. The author describes the characteristics of the genus *Mesocrinus* and of the species *M. suecica* (the Swedish) species, and its differences from *M. fischeri* (from Streben), and discusses the relationships of the genus, which combines the characters of a *Pentacrinus*-calyx with a *Bourgueticrinus*-stem.—A new species of Comatula (*Antedon impressa*) from the Ignaherga limestone of Scania was also described, and its systematic position discussed.

Entomological Society, February 2.—Mr. H. T. Stainton, president, in the chair.—The president thanked the Society for electing him to that office, and nominated Sir John Lubbock, Bart., and Messrs. Meldola and Distant as vice-presidents for the ensuing year. Two new members were then elected.—Exhibitions and communications:—Mr. O. Salvin exhibited two boxes of insects collected by Mr. Champion in Guatemala.—Mr. W. A. Forbes exhibited a leaf from New Britain, having a curious filamentous growth upon it, caused by a *Coccus;* and also the larva of one of the *Blattidæ*, from Pernambuco, which presented a remarkable resemblance to an Isopod crustacean.—Mr. R. McLachlan exhibited a coleopterous larva from South America attacked by a fungoid parasite (*Sphæria*), and a *Noctua* from South Wales similarly attacked by an *Icasia*. He also exhibited *Thore concinna*, a beautiful new dragon-fly from Ecuador.—Mr. T. R. Billups exhibited *Pezomachus distincta*, a hymenopterous insect new to Britain; and a new species of *Stibentes*.—Mr. F. P. Pascoe exhibited a specimen of *Peripatus Novæ-Zealandiæ*, and made some observations on the structure and affinities of this anomalous genus.—Mr. W. L. Distant exhibited a new species of *Platypleura* from Madagascar.—Mr. W. F. Kirby announced the death of Dr. Gabriel Koch, of Frankfort-on-the-Main, the author of several works on the geographical distribution of *Lepidoptera*.—Mr. R. Meldola read a letter from M. André in reply to some criticisms made at a former meeting of the Society respecting the publication of new species on the wrapper of a periodical work.—The Secretary read a cutting from an Australian newspaper, communicated by Mr. G. Giles, relative to the death of a child, in consequence, as was supposed, of the bite of a small spider.—Papers read:—Mr. A. G. Butler communicated a paper entitled "Descriptions of new genera and species of Heterocerous *Lepidoptera* from Japan."—Mr. R. McLachlan read some notes on *Odonata* of the sub-families *Cordulinæ*, *Calopteryginæ*, and *Agrioninæ* (Legion *Pseudostigma*) collected by Mr. Buckley in the district of the Rio Bobonaza in Ecuador.—Mr. W. F. Kirby read a list of the Hymenoptera of New Zealand, in which eighty-two species were enumerated, five being described as new.—Mr. Joseph S. Baly communicated a paper entitled descriptions of new species of *Galerucidæ*.

Victoria (Philosophical) Institute, February 21.—A paper on the implements of the Stone age as a primitive demarcation between man and other animals, by Dr. Thompson, LL.D., of Harvard University, was read; after which a second brief paper on the caves of Devonshire was read by Mr. Howard, F.R.S., in which the author, as a chemist, pointed out the important bearing that the new investigations into the mode of formation of the cave floor had upon the whole question at issue.

VIENNA

Imperial Academy of Sciences, February 17.—V. Burg in the chair.—Prof. Schmarda presented a paper by Henry B. Brady, F.R.S., on Arctic foraminifera from soundings obtained on the Austro-Hungarian North Pole Expedition of 1872-74. It will be published in the *Denkschriften der Academie*.—F. Steindachner, ichthyological materials (part 10).—F. Wald, studies on chemical processes producing energy.—E. Brücke, supplement to his communication of January 7 on an uncrystallisable acid obtained by oxidation of egg albumen. It is not a pure substance, but a mixture.—E. Weiss, on the computation of the differential quotients of the radius vector and the apparent anomaly in orbits of great excentricity.—T. V. Rohon, on *Amphioxus lanceolatus*.—Dr. Td. H. Skraup, on synthetical experiments in the Chinolin series.

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