THURSDAY, DECEMBER 17, 1891.

TWO ZOOLOGICAL TEXT-BOOKS.

Text-book of Comparative Anatomy. By Arnold Lang, Professor of Zoology in the University of Zürich. Part I. Translated into English. (London: Macmillan and Co.)

Lehrbuch der vergleichenden Entwickelungsgeschichte der Wirbellosen Thiere. Von Dr. E. Korschelt und Dr. K. Heider. Parts I. and II. (Jena: Fischer.)

THERE can be no doubt that the first-named of these two treatises, containing, as it does, a number of new engravings and process-cuts, and a recognition and exposition of some of the recent advances in zoological science relating to Invertebrata, will be useful to junior students in our Universities.

Whilst it will, no doubt, fulfil the author's purpose, and have a measure of success in its original German form, I must confess that it does not appear to me to be altogether satisfactory, whether we view it as an elementary sketch for junior students or as a work designed to assist the serious devotee of zoological research.

The most serious defect in the book from the latter point of view is that no attempt whatever is made to refer a given statement to the author who is responsible for it. A very short bibliography is appended to each chapter, but the reader of the book receives no assistance in tracing a new or striking observation to an original source. This curious reticence as to original authorities is carried to an extreme. For instance, on p. 137 there is a brief description (without figures) of Cœloplana and Ctenoplana; Korotneff is alluded to anonymously as "the discoverer of Ctenoplana"; neither his name nor that of Kowalewsky, the discoverer of Cœloplana, are mentioned; and the student has no means afforded him, either through the text or through the scanty bibliography, of finding out anything more as to these two remarkable forms. The same defect characterizes every page of the book; a very little trouble would have sufficed to remedy this, and thus not only to make the book useful to students but also to do justice and honour to those whose statements and observations Prof. Lang uses in order to build up his treatise.

The exact classification adopted by a writer nowadays, in so far as zoology is concerned, is to a large extent a matter of taste. One cannot expect to find oneself in agreement with a colleague on all matters of the kind. Prof. Lang is an authority on the Platodes or flat-worms, and I am glad to see that he assigns them a distinct position as an independent "phylum" of the animal kingdom; but I think that he has seriously injured the usefulness of his work by recognizing the "Vermes" as a phylum, including in it such diverse groups as the Nemertina, the Nemathelmia, the Annulata, the Prosopygia, the Rotatoria, and as an appendage (why an appendage when we have already such a mixed lot?) the Chætognatha. Prof. Lang, after doing this, proceeds to condemn his own action by stating that the so-called phylum of Vermes "is by no means a natural, well-demarcated division of the animal kingdom; now, as heretofore, it is like a lumber-room, to which all those groups are relegated which cannot be placed elsewhere." Prof. Lang was not compelled to maintain this ridiculous lumber-room. The consequence of doing so is that he is unable to treat any of the included classes fairly, and that some of the most important problems in morphology are tacitly assumed as solved, or are withheld from the student's consideration. Under the heading "Blood-vascular System," in the chapter on Vermes, we find brought together, and treated as though morphologically identical structures—(1) the canal system of the Nemertines; (2) the sub-cuticular network of the Acanthocephala; (3) the sinuses, vessels, and capillaries of the Leeches; (4) the closed vascular system of Chætopods; (5) the tentacular vessels of Sipunculids; (6) the red-corpuscled vascular system of Phoronis; and (7) the unexplored vascular systems of Brachiopods. Neither the method of juxtaposition adopted nor the space given permits the author to discuss whether any two of these so-called "blood-vascular systems" are homologous with one another, or whether any one of them is entitled to the name at all. It seems to me that, whilst senior students will be disappointed by the absence of any attempt to deal with the difficult problem of the real nature of the canals and their contained fluids in the cases of Nos. 1 and 3, the junior student will be seriously misled by the easy assumption that any system of canals in the so-called "Vermes" may be called "a blood-vascular system," and is homologous with any other, and with the standard blood-vascular system, viz. that of man. The entire chapter on the Vermes seems to me to be misleading, owing to the author's attempt to deal in a few pages with a number of very different but important groups under this unfortunate heading.

I need hardly say that I am sorry that Prof. Lang adheres to the old view (p. 540) that "the Arachnoidea are not nearly related to the Xiphosura and fossil Gigantostraca, but are racially connected with the Antennata, and are to be considered as Tracheata which have lost their antennæ." It is perhaps only natural that I should distrust the judgment of a zoologist who can at the present day maintain the above propositions. However much I may admire his original work on the Planarians, I cannot consider him a good general guide for the student of zoology. Though I regret Prof. Lang's opinion on this subject, I am not surprised at it, for, in the statement which follows his expression of opinion, he gives a one-sided and erroneous summary of the facts which he thinks can be adduced on either side of the question. Here, as so often elsewhere in the book, one notes the injustice done by Prof. Lang in not citing the name and the work of the author whom he is imperfectly quoting. The student who reads what Prof. Lang has to say on the relationship of the Arachnida to Limulus and the Eurypterines will be misled as to the mere facts of the case, and will not be helped by any reference towards obtaining a fuller knowledge of this interesting matter.

Though many of the illustrations are excellent, Prof. Lang's book cannot be recommended to English readers either for its originality or for its faithful exposition of cotemporary knowledge.

The translation appears to be fairly well executed, though the word "apparati," on p. 268, and the repeated use of "Disconanthe" and "Siphonanthe," in place of "Disconanthæ" and "Siphonanthæ," are astonishing, when we note that the translator is M.A. of the University which refuses to inquire whether "compulsory Greek" is useful or not.

A very different work from Prof. Lang's is the treatise on the embryology of the Invertebrata by Drs. Korschelt and Heider, of the University of Berlin, of which an English translation is in preparation. Two parts of this admirable book have appeared, containing 900 pages and more than 500 woodcuts, dealing with the embryology of the Porifera, Cnidaria, Ctenophora, Platyhelmia, Orthonectidæ, Dicyemidæ, Nemertina, Nemathelminthes, Acanthocephali, Rotatoria, Annelida (including Echiurids and Leeches herein), Sipunculidæ, Chætognatha, Enteropneusta, Echinoderma, and the Arthropoda. The various classes of the last-named phylum occupy two-thirds of the work at present issued. There remain still to be dealt with the Mollusca, the Bryozoa, and the Tunicata.

The best idea which can be given of the scope and value of this work is obtained when we compare it with Frank Balfour's treatise on comparative embryology. It is not too much to say that it is the most valuable text-book for the zoological student which has appeared since Balfour's book, and is a worthy successor to it. The mass of literature, vast as it was ten years ago, has increased enormously in the interval. Drs. Korschelt and Heider have carefully gone over it all; and not only that, but they accurately and clearly give each author's contribution to the subject in hand, citing authority for every statement made, so that the student can go to the original treatises for fuller detail. I do not know of any scientific treatise which shows so clearly the authors' desire to do justice to every fellow-worker of whatever nationality, and to produce a work which shall be a complete and trustworthy guide to the recent literature of a prodigiously prolific subject. Very often the authors abstain from offering a decided opinion upon a matter where the observations made have led previous writers to diverse conclusions: such cases are those in which the facts are incompletely observed and obviously require renewed investigation. But where the observed facts on one side or the other are of a decisive character, the authors, after giving both sides in detail, exercise a judicial function.

The book deals not only with the earlier but also with the later stages of development, and not merely with the facts of embryology, but with the conclusions as to the affinities of groups, which are so severely tested by the progress of embryological inquiry.

It is not possible to particularize in regard to such a work as this, but I have been struck by the very full way in which the morphology of the Crustacea, and each succeeding class of Arthropods, has been dealt with in every respect in which embryology throws light upon it. A very fully illustrated chapter gives a complete and impartial account of the researches of Sedgwick, Sheldon, and Kennell on the development of different species of Peripatus. The question as to the relationship of the Arachnida to Limulus and the Eurypterines, alluded to above, is fully treated by Drs. Korschelt and Heider. They summarize the arguments with clearness, and state and weigh fairly nearly every fact which has been adduced in favour of the association of Limulus and the Eurypterines with the Arachnida. Their conclusion is as widely different from Lang's as is their method of discussion.

There can be no doubt that we have in this new treatise on comparative embryology one of those invaluable, indispensable works for the production of which authors receive the gratitude and esteem of their fellow-workers in all lands. It is a truly first-rate book.

E. Ray Lankester.

MODERN ARTILLERY.

The Artillery of the Future and the New Powders. By James Atkinson Longridge, M.I.C.E. (London: E. and F. N. Spon, 1891.)

Mr. Longridge keeps pegging away at his favourite subject, which he originally brought forward, now more than thirty years ago, in the Proceedings of the Institution of Civil Engineers.

His valuable ideas are at length receiving recognition, and his principle of strengthening guns, by layers of wire wound with appropriate initial tension, is now largely employed in the construction of modern ordnance.

The chief object of the present book is to point out that the fullest application of his principle of wire strengthening permits of the use of much higher powder pressures than are considered admissible in Government circles; and that thereby guns may be much shortened and reduced in weight, while at the same time the full power of the most modern high explosives can be utilized.

This is to a great extent a return on the steps which have guided our gun designers in recent years; their chief object being, to reduce initial pressure as much as possible, say down to 17 tons per square inch, and to get the full power out of the powder by a great increase in the length of bore, up to 40 and even 50 calibres in length in guns of large size.

Mr. Longridge is fully acquainted with all the valuable and original work in gunnery science which has been developed of late years in France by Sarrau, Veille, and Sebert; and analyzes carefully in chapters ii. and iii. the various experimental methods and empirical formulas in use for the measurement of powder pressure in the bore of a gun.

In chapter iii. he attempts a theoretical explanation and formula for maximum pressure and total energy, but his investigation rests upon an assumption of the *adiabatic law;* and the mathematical treatment is not presented in an inviting or elegant form. Considering the unexplained chemical combinations which affect the rate of combustion of the modern smokeless powders, this mathematical assumption can only roughly account for an average performance, and leaves unexplained the violent abnormal effects sometimes experienced and shown in General Wardell's curves, to guard against which the gunmaker has to exercise a vigilant caution.

General Brackenbury is quoted as calling gunpowder the Spirit of Artillery, and in his official capacity, Superintendent of the Royal Gunpowder Factory, as a maker of gunpowder, saying metaphorically, "How sad the body is so weak" in preference to "What a pity the spirit is so strong."

But so long as steel is the strongest material of which the body—the gun—can be constructed, makers of powder and explosives, new and old, must be content to moderate and regulate the strength of their compounds. Much was expected of gun-cotton in its early days as a propulsive agent, but these hopes were falsified by the uncertainty of its action.

Again, with the vast extent of our Empire, climatic conditions have to be considered in their bearing on the action and preservation of explosives, conditions which do not affect French or German artillerists, who know the exact limits over which their warlike operations must take place. A. G. G.

GIANTS AND ACROMEGALY.

The Skeleton of the Irish Giant, Cornelius Magrath. By Dr. D. J. Cunningham, F.R.S. (Dublin: Published by the Royal Irish Academy, 1891).

NOTWITHSTANDING the close attention which has been applied to the clinical aspects of disease during so many centuries, every now and then some observer, more acute than his brethren, recognizes a morbid condition which had not previously been satisfactorily discriminated, and gives to it a name. Although in some cases the form of disease is thought to be new, and is described as such, it is generally found, when the records of medicine are examined, that corresponding cases and symptoms had been noticed previously, although their import had not been properly understood, and they had not been distinguished by a special name.

Amongst the latest contributions in this direction is a memoir published in 1886 by M. Pierre Marie, in which he described a morbid condition where the hands and feet were enlarged out of proportion to the rest of the body, chiefly due to a hypertrophy of the soft parts; and where the face had become remarkably elongated and deformed, partly from hypertrophy of the soft parts, but more especially from an increase in magnitude of the bones of the face, of the glabella and supraciliary ridges of the frontal bone, and of the pituitary fossa. To this condition M. Marie gave the name of Acromegaly. The attention of physicians and pathologists having thus been directed to the subject, several similar cases were described in the course of the next three or four years; and a few other cases and specimens previously recorded in medical literature were recognized as having been similarly affected. One of the most important of these was a skeleton in the Anatomical Museum of the University of Edinburgh, which was determined by Dr. H. Alexis Thomson to be a case of acromegaly, and the giant characters of the skeleton were associated with the peculiarly hypertrophied condition of the soft parts above referred to.

It was the perusal of Dr. Thomson's account of the Edinburgh skeleton which led Prof. Cunningham to pay especial attention to the characters displayed by the skeleton of the Irish giant Cornelius Magrath, which has been in the museum of Trinity College, Dublin, for 131 years, and to conclude that it also was an example of acromegaly. Dr. Cunningham's memoir, in addition to the anatomical description of the skeleton, contains much interesting information relative to Magrath himself, which he has collected from various quarters. Magrath was born in Tipperary in 1736, and died in Dublin in 1760, at the age of 23. He seems to have attained a height of 6 feet 8¾ inches when he was only sixteen years old; and for several years he travelled about as a show, and visited many of the great cities of Europe. The accounts which were given of his height in the periodical literature of the day, after he had reached his full dimensions, varied considerably; and a most exaggerated statement, that he was 8 feet 4 inches, made apparently with the view of out-rivalling the altitude of the skeleton of another Irish giant, Charles Byrne, in the Hunterian Museum, London, has found its way into anatomical literature. Dr. Cunningham has subjected all these statements to a careful analysis, and has studied and examined the skeleton itself, from which he concludes that the articulated skeleton is only 7 feet 2¼ inches high, and that this in all probability expresses the maximum height during life. Magrath is thus by no means the tallest giant whose height has been put on record. Charles Byrne was three or four inches taller; and Topinard, Ranke and Virchow have recorded examples of persons who ranged in height from 7 feet 3⅜ inches to 8 feet 4¼ inches. From an examination which Prof. Cunningham has made of the skeleton of Byrne in the Hunterian Museum, he has come to the conclusion that in certain particulars, *e.g.* the magnitude of the lower jaw, the dilated pituitary fossa, and the great size of the feet, it presents some of the characters of acromegaly. It must not, however, be supposed that giant growth is necessarily associated with the condition of acromegaly; for although it is not unusual to find the lower jaw disproportionately large in giants, yet it by no means follows that the other signs of acromegaly should be present.

Dr. Cunningham suggests that the morbid condition which M. Marie christened acromegaly should be known by the more etymologically correct term of "megalacria."

PEAKS AND PASSES IN NEW ZEALAND.

With Axe and Rope in the New Zealand Alps. By George Edward Mannering. With Illustrations. (London: Longmans, Green, and Co., 1891.)

TEN years ago the ice scenery of the New Zealand Alps was almost unknown even to the colonists. But in 1882 the Rev. W. S. Green, with two first-class Swiss guides, explored the glacier region beneath the highest peak—Aorangi, or Mount Cook—and arrived, after a long, difficult, and dangerous climb, on the summit of that mountain. His delightful volume "The High Alps of New Zealand," and the laborious explorations of Dr. von Lendenfeld in the following year, indicated that a region, certainly not inferior in grandeur and beauty to the Alps of Europe, could be reached in a journey of little more than two days from Christchurch. Since then the "Britain of the South" has become proud of possessing the "playground of Australasia"; the number of visitors has been rapidly increasing; an hotel has been built in a convenient situation near the foot of one of the glaciers; surveys have been undertaken; and the author of this volume, with one or two friends—inexperienced in mountain craft but inured to rough work in a wild country—commenced, in 1886, a series of expeditions in the "High Alps" of the Antipodes.

The Southern Alps proper, for over one hundred miles, form the backbone of the South Island, running roughly from north-east to south-west, the crest of the chain lying much nearer to the western than to the eastern coast. In the neighbourhood of Aorangi the former is about twenty miles away, while the distance of the other is quite five times as much. Thus the valleys fall more rapidly towards the west than towards the east, on which side also a wide tract of plain separates the sea from the foot of the hills. But in one respect, the New Zealand Alps, at any rate on their eastern flank, differ from their European namesakes, for they are pierced more deeply by the lowlands. Even at the foot of Aorangi, in the vicinity of which almost all the highest peaks are situated, the comparatively level floor of the Tasman valley is rather less than 2500 feet above the sea. Thus, although the New Zealand peaks are considerably lower than those of the European Alps—for few of them surpass 10,000 feet, and the highest summit of Aorangi is only 12,349 feet —they tower as high and as steep above their actual bases as the Oberland giants above the valley of the Lutschine. As Mr. Mannering says, Aorangi rises "for nearly 10,000 feet from the Hooker glacier, and Mount Sefton 8500 feet from the Mueller glacier, whilst the western precipices of Mount Tasman (11,475 feet) are stupendous." These words indicate another peculiarity of the New Zealand Alps. Here the snow-line lies very much lower than in Switzerland; in this central district it is only about 5000 feet above the sea. Thus the glaciers are actually greater, and descend much below those of Switzerland. The Tasman glacier, which may be compared with the Gross Aletsch of that country, is from 18 to 20 miles long, and terminates at a height of 2456 feet above the sea. On the western side the ice approaches occasionally to within 600 feet. Thus in the New Zealand Alps the Alpine climber meets with the same difficulties, and is rewarded by the same class of scenery, as he finds in the Old World amid peaks and passes three thousand feet higher. For instance, the Hochstetter Dome, first ascended by Dr. von Lendenfeld, though only 9315 feet above the sea, and presenting no special difficulties, is a very long and laborious excursion over ice and snow. Mr. Mannering and his two companions found it "twelve hours' hard going" from their camp—von Lendenfeld's party were out more than double the time.

But great as are these glaciers, they are, like those in our own hemisphere, attenuated representatives of their predecessors—for New Zealand also has had its Ice age. Once they extended far away into the lowlands. There, erratics and ice-worn rocks abound for miles. Lakes Tekapo and Pukaki are dammed by moraines, and in the valley of the Tasman River some singular terraces can be traced for 40 miles from the point where they commence, near the end of the glacier, at a height of some 2000 feet above the valley. Much *débris* is still transported by the glaciers of the eastern side of the chain, but those on the western are cleaner. The main range consists of stratified rocks, which disintegrate, as the climber soon discovers to his sorrow, rather readily; and Mr. Mannering attributes the difference in the amount of *débris* to the fact that the beds have a westerly dip. This, at any rate, accounts for the precipitous character of the eastern face of the mountains. We infer, also, that denudation has been more rapid on this side, for Aorangi projects in advance of the watershed, like the Viso and other peaks on the Italian side of the Alps.

The ascent of Aorangi is evidently a long, difficult, and even dangerous excursion. The route is quite as circuitous as that formerly followed in the ascent of the Bernina; for the great ice-fall of the Hochstetter glacier, 4000 feet high, has to be turned, and another glacier basin crossed, before beginning the steep ascent of the actual peak. Mr. Green's party was forced to turn back without actually touching the culminating point, though they had overcome all difficulties, for the short half-hour which the completion of the excursion would have required might have made return impossible. As it was, they were benighted among the glaciers. Mr. Mannering and his friend, after five attempts, reached a point about 100 feet below where Mr. Green halted, was compelled to turn back for the same reason, and had a dangerous descent over the snow-fields in the darkness. But as an Alpine Club was founded a few months since in New Zealand, there will probably not be many peaks to climb or passes to discover when another decade has passed.

Mountaineering in New Zealand is not for climbers fond of luxury. Guides and porters are at present unknown. Mr. Mannering and his companions had to carry their own "swag"—and heavy loads these were—cut their own steps, do everything and discover everything for themselves, for they were self-taught mountaineers. Sometimes he had only one companion, and then the labour and the danger were alike increased. The weather also seems to be more unsettled than it is in the Alps. The rainfall is heavy—150 inches in some places. Thus fresh snow often adds to the difficulties and the dangers of excursions, and falls of stones seem common, as might be expected. Mr. Mannering tells most pleasantly and unaffectedly a story of pluck, endurance, and skill, of which our kinsmen in New Zealand may be justly proud. He is a careful observer of Nature, and a true lover of mountain scenery, as well as a daring climber. His book contains a number of illustrations, taken from photographs, which show that the peak and glacier scenery of the Aorangi group is worthy of the author's enthusiastic praise; and it is not only very pleasant reading, but also adds much to our knowledge of the region. It may be added that, if the traveller is not satisfied with the perils of rocks and snow, those of flooded rivers are a common experience; and Mr. Mannering, in his final chapter, describes the doubtful pleasures of a canoe voyage down the Waitaki River.

T. G. BONNEY.

OUR BOOK SHELF.

Manual of the Science of Religion. By P. D. Chantpie de la Saussaye. Translated by Beatrice S. Colyer Fergusson. (London: Longmans, 1891.)

THOUGH the title of this volume seems to imply that it is a complete thing, it is really only the first half of Prof. de la Saussaye's book. Nearly three-fourths of the Amsterdam Professor's manual is devoted to a sketch of the chief ethnic religions and of Islam; whereas the English book, corresponding as it does to the first of the two German volumes, omits the ancient religions of Persia, Greece, Rome, and Germany, as well as Mohammedanism. Without these we have nothing that can fairly be called by the name borne on the title of the translation; and the omission of Persia in particular makes the book most tantalizingly imperfect as regards a single connected group of faiths. It is not fair either to the author or to his readers to give a part of the work as if it were a whole, and to set it forth to the world without even putting "vol. i." on the title-page.

The work of translation has been performed with care, and generally, so far as we have been able to test it, with accuracy. But the book is rather heavy reading, as translations from the German are apt to be, when the translator has not realized that the difference between the idioms of England and Germany is so great that a successful version must recast whole sentences instead of aiming at a literal reproduction of words and clauses.

As regards the substance of the book, the reception which it has obtained, in its German form, is a sufficient proof that Prof. de la Saussaye has met a felt want in the literature of his subject. A book that covers so wide a field cannot be without errors in detail. No man can know at first hand all the ancient literatures that are dealt with; nor can it be supposed that, on matters where specialists are often at variance, one who is not a specialist can always hit the mark. The general principles of the science of religion are not yet worked out with sufficient clearness to give the student of religions in general sure points of view for the criticism of the divergent results that have been reached by students of special religious literatures. Perhaps to say this is to say by implication that a general manual of the subject is an undertaking for which the time is not yet ripe; and certainly the science of religion (as distinct from the scientific study of individual religions in their historical development) is still in a very elementary stage. But Prof. de la Saussaye is no dogmatist; he frankly admits the obscurity in which many fundamental problems are still involved, and he writes throughout with great impartiality and moderation, as well as with extensive knowledge of recent researches. His book will be very useful to all who wish to know the present state of inquiry, and do not forget that many things in his exposition are to be taken as still doubtful, even where the author himself does not expressly accompany them with notes of uncertainty.

W. R. S.

Euclid's Elements of Geometry. Book XI. By A. E. Layng, M.A. (London: Blackie and Son, Limited, 1891.)

OF all Euclid's books, the eleventh is one that forms a stumbling-block to the beginner in solid geometry. Not that the proofs in themselves are of a difficult nature, but simply that the figures have to be drawn perspectively to illustrate the various planes, and the student finds it hard to bring himself to believe the equality of angles and lines which appear to him to be unequal.

The author of this book, like one or two others before him, by varying the thickness of the lines used in construction, simplifies matters very considerably, for by this means the eye can distinguish directly the different planes. Of the propositions themselves, little need be said, unless we mention the use throughout of all the well-known symbols: the occasional interpolated worked-out examples, and the notes and exercises, although not in any great quantity, will be found very useful. In the collection of miscellaneous examples, theorems relating to tetrahedrons, pyramids, spheres, &c., are included. Preceding the series of examination-papers, which are here arranged in a progressive order of difficulty, and taken from papers set lately, are two appendices, the first dealing with transversals, harmonic section, and pole and polars, the second with a few alternate proofs of propositions. The manner in which most of the proofs are worked out is both neat and brief, and the definitions are all clearly stated and illustrated. We may add that, although the work is not the best of its kind we have seen, yet it has many good points which recommend it to the student of geometry.

W.

Illustrations of the Flora of Japan, to serve as an Atlas to the Nippon-Shokubutsushi. By Tomitarō Makino. (Tōkyō, Japan: Keigyōsha 1, Urazimbōchō, 1891.)

THIS is a monthly publication, containing excellent uncoloured figures of plants, with analyses of their floral structure, fruit, and seed, and descriptions in English as well as in Japanese. The drawing and lithography, by Mr. Makino himself, are quite equal to the average work in this country—indeed, one might say above the average; the lithography being light and effective, with few lines in it. Moreover, the English descriptions are intelligible, correct, and idiomatic, and not too long, nor superfluous. Botanically and horticulturally this production of the Far East will be welcome, and even indispensable, in the West, as many new species are described. Already nine parts have appeared, with illustrations of fifty-seven species belonging to various natural orders. No system of classification is followed; whatever is of interest or novel being taken as it presents itself.

W. B. H.

About Ceylon and Borneo. By Walter J. Clutterbuck, F.R.G.S. (London: Longmans, Green, and Co., 1891.)

IN this volume Mr. Clutterbuck gives some account of Ceylon as he saw it during a recent visit, and as it was fourteen years ago, when he resided for a short time in the island. He then describes what he saw in the course of a visit to Brunei and British North Borneo. Readers who like books of travel will find a good deal to interest them in the author's impressions, which are recorded in a lively style.

LETTERS TO THE EDITOR.

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

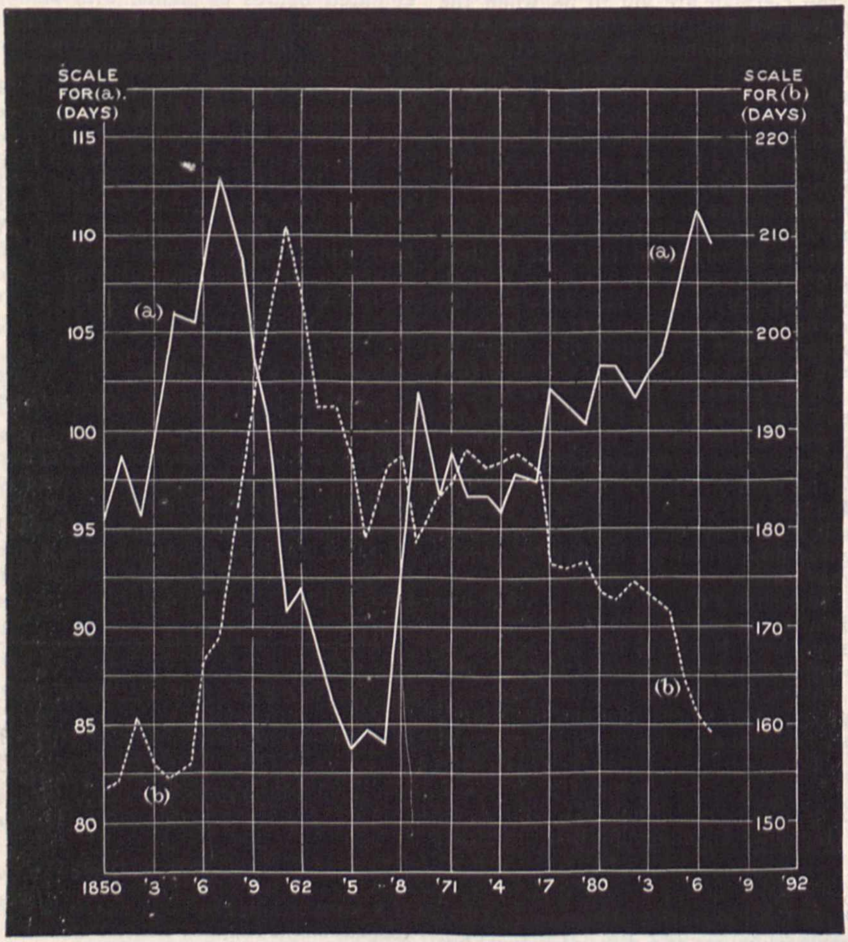
Wind Direction.

A SHORT time ago there was some correspondence in your columns on the relations of north-east and south-west winds in recent years; Mr. Prince, of Crowborough, having observed at that place that while, as a rule, the south-west winds were in excess of the north-east, the reverse had occurred in each of the five years 1885 to 1889. The Greenwich records were examined by Mr. Ellis with regard to this point, but he found them at variance with those of Crowborough, the south-west winds having continued in excess of the north-east throughout those five years.

By combining several directions, the Greenwich figures, as tabulated by Mr. Ellis in his paper to the Royal Meteorological Society (Quart. Journ., October 1890, p. 222), will be found to reveal some curious relations, which seem to invite attention. I have added together the figures (numbers of days) for north-east, east, and south-east winds on the one hand, and those for north-west, west, and south-west on the other; then smoothed each set of sums by means of five-year averages. The results are shown in the two curves of the accompanying diagram. The continuous curve (a) represents north-east, east, and south-east winds (and its vertical scale is at the left). The dotted line curve (b) represents north-west, west, and south-west winds (and its vertical scale is at the right). It will be understood that each year-point of those curves represents an average of five years.

It would appear that easterly winds (north-east, east, and south-east) at Greenwich have been increasing in prevalence, on the whole, since about 1865; the five years' average for that year is 83·8, and this grows to 111·4 in 1886 (about one-third). On the other hand, westerly winds (north-west, west, and south-west) have diminished, on the whole, since 1861; the five years' average for that year is 210·8, and this diminishes to 159·0 in 1887 (about one-fourth).

Judging by the past, we might perhaps consider that we must be near a decided turn of the curves; possibly past it in the case of easterly winds; in which case we should look for more westerly and less easterly wind in the near future.



(a) = North-east, east, and south-east wind (Greenwich). (b) = North-west, west, and south-west wind (Greenwich).
Actual figures smoothed by means of five-year averages.

From the "crest" of (a) in 1857 to the last point is thirty years. Are those long variations possibly a manifestation of the thirty-five years' period of Brueckner?

These curves might have begun at an earlier date, for the figures commence in 1841. But in the earlier years, and apparently to about 1855, a larger proportion of days seem to have been reckoned as "calms" than afterwards (owing to a difference of rule), so that the curves to about 1855 are not exactly comparable with the remaining portions.

I append a few figures, showing the derivation of maximum and minimum (or low point) averages:—

(a) 1857 *max.*

1855	1856	1857	1858	1859	Average.
114 ...	111 ...	113 ...	126 ...	99	112·6

(a) 1865 *min.*

1863	1864	1865	1866	1867	Average.
77 ...	104 ...	76 ...	72 ...	90	83·8

(b) 1861 *max.*

1859	1860	1861	1862	1863	Average.
199 ...	215 ...	203 ...	211 ...	226	210·8

(b) 1887 *low point.*

1885	1886	1887	1888	1889	Average.
157 ...	158 ...	155 ...	164 ...	161	159·0

A. B. M.

The Migration of the Lemming.

MY attention having recently been drawn to the question of the migration of that little Norwegian rodent the lemming, as a serious obstacle to the theory of natural selection, and hence to evolution generally, I write to call attention to what appears to me to be a possible factor in the *starting* of the migration.

It is that when the lemmings become too numerous for the means of subsistence upon the inland plateaux, which may be described as their home, the "fittest" lemmings, by battle, turn out from the district all those of their weaker brethren who are unable to withstand the contest.

The unfittest being thus driven out from their home, are forced to migrate somewhere. Why they move incessantly to the westward seems a problem yet to be satisfactorily solved.

My reason for suggesting such an origin for the migration is that it takes place every three or four years from the same plateaux. It is very evident, therefore, that—abiogenesis being now out of court—some lemmings must be left there to continue the species. Now, it is not likely that the weakest are left behind, otherwise their survival year after year would be quite problematical. Do not the facts point unquestionably to the strongest being left to continue the race?

To the criticism that there is no evidence of fighting having taken place amongst the migrants, my reply would be that no one, so far as I can learn, has seen a migration start, or seen one immediately after it has started—the only time, that is, when the effects of such fighting would be apparent, for after a few days those seriously injured would have died and have been left behind, while those only slightly injured would have recovered sufficiently to be indistinguishable from the remainder.

Churchfield, Edgbaston. F. HOWARD COLLINS.

The New Railway from Upminster to Romford, Essex.

ON the above railway, now being constructed, there is a section of unusual interest a few yards north-east of the church at Hornchurch, showing the Chalky Boulder Clay (15 feet seen) under sand and gravel belonging to the highest terrace of the Thames Valley, and resting on London Clay. Hitherto, Boulder Clay has not been seen in this district in connection with Thames Valley deposits, its most southerly exposures lying about three miles northward, on London Clay or Bagshot Beds.

I have been carefully watching this cutting for some time, with a view of sending an account of it to the Geological Society when it shall have been completely excavated. But, though much has still to be done, the half of it finished has already been sloped, and the arrangement of the beds—clear a month ago—greatly obscured. It has therefore been suggested to me that a few lines on the subject in NATURE may be the means of enabling geologists interested to visit this section while the Boulder Clay is still clearly visible in some portion of the cutting.

It may be useful to add that the distance from Hornchurch Station is about a mile, and that the visitor, after leaving the church on his right hand, should take the first road on his left.

T. V. HOLMES.

28 Croom's Hill, Greenwich Park, S.E., December 7.

Peculiar Eyes.

THE inability of keeping one eye shut and the other open at the same time, is a fact well known to drill-sergeants. I well remember, when a conscript some sixteen years ago, how a great number of recruits were unable, even after repeated efforts, to do so; but I had no difficulty about it. At that time, too, my eyes were about equal in power; but at present while the right eye is of normal power, the left eye presents a much less distinct image. I can only ascribe this to the habit of working at the microscope with the right eye without closing the left. It is especially at this work that the defective sight in the latter is noticeable. I do not think my ten months of rifle practice has anything to do with it, except, perhaps, in emphasizing the tendency to use the right eye, the image of which is now so predominant, that in covering a bull's eye, for instance, it is immaterial whether the left eye be closed or not.

G. K. GUDE.

5 Giesbach Road, Upper Holloway, December 7.

Grafted Plants.

REFERRING to Prof. Henslow's paper on "A Theory of Heredity based on Forces" (November 26, p. 93), the behaviour of grafted plants seems to require, for its explanation, the possession by both stock and graft of something analogous to a distinct individuality, call it what we may. It is difficult enough to understand, especially in the case of nearly-related forms, why the stock generally has no, or so little, influence on the graft; but, assuming the absence of individuality, the difficulty is largely increased. The graft takes its nourishment through the stock, and yet retains its characteristics unimpaired. I argue from this that not only does the graft possess an individuality of its own, but that this is so marked that it can take its nourishment direct from the stock, while at the same time straining out, as it were, whatever it is that constitutes the individuality of the stock. The phenomena presented by parasitic plants seem to bear out this view.

W. H. BEEBY.

Intelligence in Birds.

A FEW weeks ago I received a specimen of *Podoces panaeri*, the typical desert bird of Central Asia, which had been kept for some months in captivity at Perowsk. The first thing the creature began to do, when located by me in a spacious *volière*, was to pick some food (cooked rice with baked eggs), and to bury it in the very thick sand layer with which the floor of the cage was provided. This was the incessant occupation of the bird on the first day of its instalment. But the task was almost completely abandoned from the next day; the bird, evidently remembering the conditions of its former life in captivity, found it useless to make provision for the future when a fresh supply of food daily appeared.

The fact referred to seems to indicate, first, that the birds in question are in the habit of making provision in the wild state, the powerful and slightly curved bill being admirably adapted for the purpose of making holes, even in a hard ground. It shows, also, how abruptly the habits of animals can be modified when the conditions of their environment are changed.

Now, a question naturally arises, How must we regard this habit of burying food—as the result of a long inheritance, or as an effect of constant imitation of older birds by younger ones?

A. WILKINS.

Tashkend, Central Asia, November 8/20.

SIR ANDREW CROMBIE RAMSAY.

THOUGH this illustrious geologist has been laid aside by growing infirmity for the last ten years, the news of his death will carry regret into the hearts of many men of science, not in this country only but all over the world. Born in Glasgow, and intended for a mercantile profession there, he spent some few years in business; but, partly on account of delicate health, betook himself for rest and open-air exercise to the island of Arran. One of the friends of his early years, Prof. Nichol, of Glasgow University, the well-known writer on astronomical subjects, had much influence in directing his studies into a scientific channel, so that the marvellous geological lessons to be learnt from the rocks of Arran soon arrested Ramsay's attention. Throwing himself with all the ardour of an enthusiastic nature into the pursuit which he now took up, he was led to climb the mountains and traverse the glens throughout the length and breadth of Arran. In this way, face to face with the facts of Nature, and amid some of the most charming scenery of his native country, he taught himself the rudiments of geology, and acquired that clearness of insight for geological structure, that love of mountain-forms, and that freshness and originality of interpretation, which marked him out from his associates in later years. But above all, by actually mapping the grouping of the rocks, he gained that precision in field-work which was to bear such notable fruit in his connection with the Geological Survey. He constructed a geological model of Arran on the scale of two inches to a mile, and made copious notes of the geological structure of all parts of the island.

The meeting of the British Association in Glasgow in the year 1840 proved to be the turning-point in his career. The model and map of Arran which he had made were exhibited at the Geological Section, and he gave a brief account of them and of the geology of the island. Among the geologists who listened to him was Murchison, who, struck with his ability and his devotion to the science, offered to take him on an expedition which the author of the "Silurian System" had then projected to America. Ramsay accordingly went up to London, but found that the voyage across the Atlantic had been abandoned for a journey into Russia, and that he was not to take part in it. Murchison, however, spoke so warmly in favour of his young friend to Sir Henry De la Beche, the Director-General of the Geological Survey, that a post was at once found for him on the staff of the Survey, and before many days Ramsay was at work at Tenby. He joined the service in the spring of 1841, immediately after the publication of the little volume on Arran, which embodied the fruits of his labours in previous years. From that time onward his life was spent continuously in the work of the Survey until he retired at the end of 1881. So capable a lieutenant did he prove himself to the chief of the staff, that after only four years he was appointed Local Director for Great Britain.

From the first Ramsay showed that, with habits of patient observation and cautious induction, he combined a faculty for bold and broad generalization. His remarkable paper on the denudation of South Wales, published in 1846, was one of the earliest essays in which the amount and effects of denudation were worked out from detailed surveys of the geological structure of the ground. He then struck the key-note which may be heard through nearly all his subsequent contributions to scientific literature. He was one of the earliest observers to realize that the existing topography of the land has a long and interesting history, much of which may still be deciphered by the use of geological investigation.

The name of A. C. Ramsay will ever be honourably associated with the story of the gradual working out of the records of the Ice Age. Following up the results obtained by Agassiz, Buckland, Darwin, and others in this country, he threw himself with all his ardour into the study of the glaciation of Wales, tracing the limits of the glaciers of that region, and extending his experience by frequent excursions among the Swiss Alps. His scattered papers in scientific journals undoubtedly did much to stimulate general interest in the history of the Glacial Period, and to create a special and voluminous literature of this subject. His views differed much from those of some of the older geologists of the day, and led to some active controversy. Especially did opposition arise when, after studying long and carefully the erosive action of land-ice, he came to the conclusion that certain lake-basins in various parts of the world had been scooped out by ice. Murchison, Lyell, and others of less fame, entered the lists against him; but he had a considerable following among the younger geologists. And this controversy still fitfully continues.

In connection with his glacial work, mention should be made of his bold endeavour to prove that ice-action had been in operation more than once in the geological past. His paper on the Permian breccias of England called attention to the evidence of transport of fragments of rock from Wales, and to the resemblance between these fragments and those in glacial moraines and boulder-clay. He subsequently detected what he thought to be similar traces of ice-carried materials in the Old Red Sandstone; and in one of the last papers which he wrote he gathered together the various pieces of evidence in favour of a long succession of Glacial periods in the geological past.

Two of the most suggestive essays he ever wrote were his well-known Presidential Addresses to the Geological Society in 1863 and 1864, in which he worked out, from his wide practical acquaintance with the stratified formations of Britain, the idea of breaks in the succession of organic remains in the geological record. To the geologist and the palæontologist these papers marked a distinct epoch in the advance of geological inquiry; while to the biologist concerned with the history of the evolution of organized existence on this planet they were full of luminous thought.

By far the largest part of Sir Andrew's contributions to geological literature is to be found in the maps, sections, and memoirs of the Geological Survey. The mapping of the volcanic districts of North Wales, in which he took the leading part, will ever remain the best monument of his skill as a field-geologist. His exhaustive memoir on that region has long since taken its place as one of the standard works of reference in our geological literature.

In his later years he seems to have taken pleasure in reverting to some of the inquiries which he started in an early part of his career. He returned with renewed zest to the study of the history of topographical features, discoursed as to how Anglesey became an island, and traced out the story of the River Dee. In successive editions of the work on the "Physical Geography and Geology of Great Britain," which at first was given as six lectures to an audience of working men, he worked out in greater fulness the chief stages through which the surface of this country seemed to him to have passed before it acquired its present features.

Of the value of his scientific labours full recognition was made by his contemporaries. He was elected President of the Geological Society in 1862, President of the Geological Section of the British Association in 1866 and again in 1881, and President of the Association itself in 1880, when the meeting was held at Swansea. He received the Wollaston Medal of the Geological Society, the Neill Medal of the Royal Society of Edinburgh, and a Royal Medal from the Royal Society. He was chosen into the honorary list of many learned Societies at home and abroad. On the death of Sir Roderick Murchison in 1871, he was appointed Director-General of the Geological Survey. At the end of 1881 he resigned this office, was knighted for his distinguished services, and soon thereafter went to reside at Beaumaris, where his strength has gradually given way, until he died on the evening of the 9th inst.

There was in Sir Andrew Ramsay such simplicity and frankness that men of the most diverse natures were attracted to him, and as they came to know him more intimately the gaiety and kind-heartedness of his disposition attached them to him in the closest friendship. Fond of literature, and glad to relieve the pressure of his scientific work by excursions into the literary field, he had acquired a range of knowledge and of taste which gave a special interest to his conversation. Now and then he found time to write an article for the *Saturday Review* in which this literary side of his nature would find scope for its exercise. But the daily grind of the official treadmill left him all too little time for such diversions. His death removes from our midst one of the foremost geologists of our day, and from the friends who knew him in his prime, a large-hearted, lovable man, whose memory they will cherish till they too pass away.

A. G.

ON VAN DER WAALS'S ISOTHERMAL EQUATION.[1]

ONE of the objections raised against this equation by Prof. Tait in NATURE, vol. xliv. pp. 546 and 627, brings clearly to light the importance of the question whether the finite size of the particles should be accounted for by an equation of the form—

$$p_1(v - b) = \tfrac{1}{3}\Sigma mu^2, \quad \ldots \ldots \quad (1)$$

where p_1 represents the internal pressure, equal to the sum of the external pression p, and the molecular pressure a/v^2, and b some multiple of the total volume b_1 of the particles; or if this equation must rather have the form—

$$p_1 v = \tfrac{1}{3}\Sigma mu^2\left(1 + \frac{b}{v}\right). \quad \ldots \ldots \quad (2)$$

[1] Prof. Korteweg's paper and accompanying letter are of date November 4, but owing to an accidental delay they did not reach me until after the appearance of my last communication (NATURE, November 26, p. 80). Otherwise I should, of course, have made reference to them. It will be seen that Prof. Korteweg draws attention to the form of the virial equation applicable in one dimension. RAYLEIGH.
December 2.

In the *first* case, in substituting $p + a/v^2$ for p_1, and $R(1 + at)$ for $\frac{1}{3}\Sigma mu^2$, the well-known formula of Prof. Van der Waals is arrived at. In the *second* case, the same substitution leads to a quite worthless formula, unfit to explain even qualitatively the conduct of gases under compression.

The *first* form is the one which presents itself most naturally when, as was done by Van der Waals, the extension of the molecules is considered as a diminution of the volume in which they are moving; the *second* is obtained as a first approximation, when the virial equation is extended to the repulsive forces which come into play at the collisions. Of course, both methods, if they could be worked out with absolute rigour, would give the *same* result; but, this being impossible for both of them, the question as to which gives the better approximation is not at all an unreal one.

Now, it is extremely improbable that this question should have to be answered in a different way for linear and for three-dimensional space; yet for linear space the first method leads to a quite easy and *absolutely* rigorous solution, and the equation thus obtained is analogous to the *first* form.

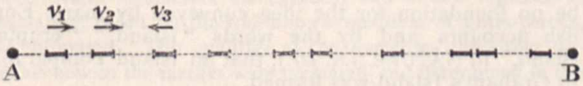


FIG. 1.

In order to prove this, let AB (Fig. 1) represent a linear space of length l, bounded by two rigid walls, A and B, and let there be moving in this space some perfectly elastic particles, all of the same mass, m, and length, λ, but having different velocities, $v_1, v_2, \ldots v_n$. At every encounter of these particles there will be simply an exchange between their velocities; therefore at every moment one of the particles will have the velocity v_1. On this particle we fix our attention, following it on its way till the next collision. After this collision we leave it to its fate, directing our attention to the other particle, which has now acquired the velocity v_1. Proceeding in this manner, it is obvious that at every collision a distance λ is economized, which has not to be travelled over by the centres of the molecules. Starting, then, from the wall A and passing over to the wall B and back again, the number of collisions is $2(n - 1)$, and the distance economized $2n\lambda$, (adding 2λ for the collisions against the walls). The distance travelled over by the centres consequently being $2l - 2n\lambda$, it is clear that the number of collisions with velocity v_1 against one of the walls amounts to $\frac{v_1}{2(L - n\lambda)}$ in one unit of time, and the corresponding change of momentum to $\frac{mv_1^2}{L - n\lambda}$, so that the pressure on the wall is measured by

$$p = \frac{\Sigma mv^2}{L - n\lambda} \quad \ldots \ldots \ldots (3)$$

Of course, for space of two and three dimensions, the problem is much more complicated. Yet in 1877 I gave a solution[1] of it for spherical particles which, according to my opinion, is rigorous so far as the several encounters between the molecules may be looked at as independent of one another. For a short time after each collision the possibilities of fresh collisions are considerably influenced by the proximity of the departing molecule. This influence, certainly of very difficult mathematical treatment, is disregarded in my calculations.

The outcome of these calculations[2] is that of every unit of distance only the $(1 - 4b_1/v)$th part has to be travelled over by the centres of the molecules, the $4b_1/v$ th part being economized at the collisions. Therefore the number of the encounters with the bounding walls is augmented in the proportion $1 : 1 - 4b_1/v$, and the formula $pv = \frac{1}{3}\Sigma mu^2$ is to be changed to

$$p(v - 4b_1) = \frac{1}{3}\Sigma mu^2. \quad \ldots \ldots \ldots (4)$$

In 1881, my friend H. A. Lorentz applied the virial equation to the calculation of the influence of the size of the particles on the pressure. In this manner he obtained the formula—

$$pv = \frac{1}{3}\Sigma mu^2 \cdot \left(1 + \frac{4b_1}{v}\right). \quad \ldots \ldots (5)$$

His paper, published in *Wiedemann's Annalen*, Bd. xii. p. 127, was inserted in the German and English versions of Van der Waals's pamphlet "On the Continuity of the Liquid and Gaseous States of Matter," at the end of the sixth chapter.

Considered as a determination of the factor, with which the total volume b_1 of the particles, when introduced in $v - b$, is to be multiplied, our results were identical, and confirmed the opinion expressed by Van der Waals about the value of this coefficient. Mr. Lorentz viewed his results in no other light, and had no intention at all to substitute his formula (5) for that given by Van der Waals. Indeed, in the passage of his paper which I quote here, he clearly indicates the weak point of his calculation:—"Strictly speaking, a correction ought to be made here, indicated by Mr. Van der Waals; in calculating the number of encounters, the extension[1] of the molecules should have been taken into account. The matter is simplified, however, if the influence of the virial arising from the repulsive forces, or the size of the molecules, is small; and if a correction to the first order is sufficient, then the uncorrected value of the number of encounters may be used in calculating the small repulsive virial."

Now it is not impossible to apply to Lorentz's formula the correction alluded to in this passage. In 1875 I calculated for the first time,[2] by a more rigorous method, the shortening of the mean free path of spherical particles, in consequence of their extension in the direction of motion. Some months later, Mr. Van der Vaals succeeded in the same calculations by a somewhat different method, extending it to the case of two sets of particles of different diameters. Both calculations lead to the same result, viz. that the mean free path is shortened in the proportion $v : v - 4b_1$; therefore the number of the collisions, and the term in the virial equation dependent upon these collisions, must be augmented in the reciprocal proportion; but then this equation takes the form—

$$pv = \frac{1}{3}\Sigma mu^2\left(1 + \frac{4b_1}{v} \cdot \frac{v}{v - 4b_1}\right) = \frac{1}{3}\Sigma mu^2 \cdot \frac{v}{v - 4b_1}, \quad . (6)$$

and becomes identical with the equation (3) of Van der Waals.[3]

In this manner the true formula is obtained by means of the virial equation, as it has been by the method of economized distances, and these verifications of the equation derived by Van der Waals are not without importance. Indeed, I always held the opinion that it is not quite allowable to conclude directly from the diminution of the free path of the molecule to a proportional augmentation of the pressure on the bounding walls. The number of the mutual encounters of the molecules, and the number of their collisions with the walls (or, rather, their passages through an ideal plane), are not

[1] *Verslagen en Mededeelingen der Kon. Ak. u. Amsterdam*, 2e Reeks, Deel x.; *Archives Neerlandaises*, t. xii.

[2] I am bound to acknowledge that the same correction, which is indicated further on for Lorentz's calculations, has to be applied to the number of collisions given in my paper.

[1] The extension in the direction of the motion is meant here. I have translated the first phrase from the original paper in *Wied. Ann.*, where it runs: "Streng genommen müsste man also hier eine Correction anbringen, wie sie von Herrn van der Waals angegeben würde; man hätte nämlich bei der Stosszahl die Grösse der Molecüle zu berücksichtigen."

[2] *Verslagen en Mededeelingen*, 2 Reeks, Deel x.; *Archives Neerlandaises*, t. xii.

[3] I owe this remark to a verbal communication by Van der Waals.

proportional numbers under *all* circumstances. A change in the shape of the molecules, or an augmentation of their diameters, will affect the first number in a much greater proportion than the second. But, as I have shown, the equation of Van der Waals holds good, independently of this assumption.

D. T. KORTEWEG.

Amsterdam, November 4.

THE BIRD-GALLERY IN THE BRITISH MUSEUM.

A LONG-NEEDED and much-wished-for reform, to which the attention of naturalists should be specially invited, has been commenced in the Bird-gallery of the British Museum. Under the old *régime* at Bloomsbury, the rule was, as it is even now in most of the Continental Museums, that every specimen should be stuffed, and exhibited in the public gallery. The natural, if not the necessary, consequence of such a rule is that, as time progresses, the shelves become crowded with badly mounted specimens, which are very unpleasing to the general observer, and most inconvenient to the scientific worker.

In the British Museum, however, the idea of mounting every specimen has been long ago abandoned. The main collection for scientific work is, we need hardly say, that of skins. These are arranged in cabinets, in numbers which it would be impossible to find space for if "mounted." When thus disposed of they are much more easy to find, and more convenient for examination, than "mounted" specimens. Though it may be sometimes necessary to refer to the Bird-gallery, the working ornithologist of this country, as a rule, uses only the skin collection.

This being so, the question arises as to what is the best way of making the Bird-gallery useful, and attractive to the general public. As to this there can be no question, it appears, that the Bird-gallery should be fitted up as an "Index Museum," and should contain a series of the principal types of bird-life arranged in systematic order from the highest to the lowest. Every family should be placed in a separate case, in its proper position between the two groups to which it is most nearly allied. In each family a series of well-mounted specimens should illustrate the principal sub-families and genera, and the male and female and other plumage of the leading species. Nests and eggs should be added to show the mode of nidification, and maps to show the areas of distribution. Diagrams and preparations of particular structures should be placed at the head of each group, to exhibit its special peculiarities; and finally, every specimen and diagram should be clearly labelled and explained. It will readily be understood that a Bird-gallery filled up in this way would be a most instructive object, and much more useful and attractive than the crowded rows of uniformly-set-up specimens that are offered to view in most public Museums. Some such plan as this, we take it, is what the authorities of the British Museum have now in view.

For a commencement, the family of Woodpeckers has been selected, and a case devoted to its illustration has been fitted up. A series of well-mounted specimens shows the leading forms of the group, and diagrams, preparations, and maps exhibit its principal peculiarities and the distribution of the species.

This is at present only the beginning of a very important change of plan. But there can be no question that if the scheme is carried out, and the whole Bird-gallery is treated in a similar way, an admirable reform will have been effected.

THE OCTOBER ERUPTION NORTH-WEST OF PANTELLERIA.

SOME time after the news arrived in this country of the volcanic outburst in the neighbourhood of Pantelleria, my friend Mr. Gerard Butler, F.G.S., undertook to visit the island, and to investigate the interesting phenomena that were being exhibited there. Mr. Butler has now returned, having made a large collection of specimens of rocks and minerals, and I trust that before long we shall have fuller information concerning this remarkable district. The following short note embodies the general results of his inquiries concerning the recent eruptions; but telegrams received since his return state that renewed outbursts have led to the formation of an island at the spot, and mariners have been warned to avoid it.

JOHN W. JUDD.

Royal College of Science, London, December 14.

In NATURE of December 3 (p. 120), a short sketch is given of a paper by M. Ricco on the above, which those interested in the subject may read in the *Comptes rendus* for November 25.

It may be worth while for one who visited Pantelleria soon after the eruption to point out that there appears to be no foundation for the idea conveyed by many English accounts and by the words "island," "erupted island," in NATURE (*loc. cit.*), that an island comparable to Graham's Island was formed.

It seems that by a submarine eruption which, after prefatory earthquakes between October 14 and 17, was first observed on the latter day, about 5 kilometres to the north-west of Pantelleria, a narrow band of floating bombs, extending for about a kilometre in a north-east and south-west direction, was produced.

The persistence during the eruption of this linear band may perhaps indicate the line of fracture of the sea bottom.

There appears to have been always deep water at the scene of eruption. Ricco tells us that soundings at the middle and ends of the floating shoal of bombs found no bottom at 320 metres.

The brittle cindery bombs readily broke up, giving vent to the superheated steam they contained; when, or upon their becoming otherwise waterlogged, they sank, so that, on October 26, soon after the eruptive action ceased, all traces of it had disappeared in deep water.

G. W. BUTLER.

NOTES.

WE regret to have to record the death of Prof. Stas, the eminent Belgian chemist. He died at the age of seventy-eight.

AT last Thursday's meeting of the Royal Society, the President read from the chair a letter from Prof. Dewar, which had been put into his hand as he entered the meeting-room, in which Prof. Dewar stated that he had at 3 p.m. that afternoon "placed a quantity of liquid oxygen in the state of rapid ebullition in air (and therefore at a temperature of -181° C.) between the poles of the historic Faraday magnet in a cup-shaped piece of rock salt (which is not moistened by liquid oxygen and therefore keeps it in the spheroidal state)," and to his surprise, Prof. Dewar saw the liquid oxygen, as soon as the magnet was stimulated, "suddenly leap up to the poles and remain there permanently attracted until it evaporated."

ACCORDING to information sent to Berlin, Emin Pasha and Dr. Stuhlmann, travelling in the region between Lakes Victoria, Tanganyika, and Albert Edward, have discovered what they take to be the ultimate source of the Nile. This is a river called Kifu, which is supposed to have its sources in the Uhha country, lying to the east of the northern part of Lake Tanganyika, about 4° of south latitude. It flows into the southern end of Lake Albert Edward.

THE death of Dr. F. C. Dietrich, Keeper of the Botanical Museum at Berlin, is announced. He was eighty-six years of age.

AT the annual general meeting of the Institution of Electrical Engineers on Thursday, December 10, Prof. Ayrton was elected President for the coming year. The following are the Vice-Presidents: Alexander Siemens, R. E. Crompton, Sir David Salomons, and Sir Henry Mance. In moving the adoption of the annual report, Prof. Crookes said that the number of members elected during the past year was greater than in almost any previous year. He announced that Prof. Nikola Tesla is on his way to England, and had promised to lecture before the Institution in January next. Prof. Crookes added that the Council would spare no pains to insure that the lecture should be thoroughly well experimentally illustrated. Mr. W. H. Preece, F.R.S. (Past-President), read a paper on "The Specification of Insulated Conductors for Electric Lighting and other Purposes." In this paper the fallacy of the present mode of specifying electric light conductors was exposed, and a new standard of insulation, based on the well-known qualities of gutta-percha, was proposed. The qualities of the numerous insulating materials now in the market were measured and determined in this new standard, and it was shown that any classification of cables should be based on the pressures to be resisted, and should depend on the thickness of the insulating wall. The introduction of cheap and nasty cables, owing to competition and the absence of specification and inspection, was strongly commented on. It was shown that all danger was eliminated by the use of proper material and proper design. The paper concluded with the recital of Mr. Preece's latest specification.

PROF. A. HANSEN, of Darmstadt, has been appointed to the Professorship of Botany and Directorship of the Botanic Garden at Giessen.

PROF. E. WARNING, of Copenhagen, is at present engaged on a botanical expedition to the West Indies and Venezuela. Herr G. Schweinfurth and Prof. O. Penzig have returned from their journey in Abyssinia; and Herren J. Bornmüller and Sintenis from their botanical expedition, in the course of which they have visited the island of Thasos, Mount Athos, and the Thessalian Olympus.

THE following are the lecture arrangements of the Royal Institution before Easter, so far as they relate to science:—Prof. John G. McKendrick, six Christmas lectures to juveniles, on life in motion, or the animal machine; Prof. Victor Horsley, twelve lectures on the structure and functions of the nervous system (the brain); Prof. E. Ray Lankester, three lectures on some recent biological discoveries; Dr. B. Arthur Whitelegge, three lectures on epidemic waves; Prof. J. A. Fleming, three lectures on the induction coil and transformer; the Right Hon. Lord Rayleigh, six lectures on matter, at rest and in motion. The Friday evening meetings will begin on January 22, when a discourse will be given by the Right Hon. Lord Rayleigh, on the composition of water; succeeding discourses will probably be given, among others, by Sir George Douglas, Prof. Roberts-Austen, Mr. G. J. Symons, Prof. Percy F. Frankland, Sir David Salomons, Prof. L. C. Miall, Prof. Oliver Lodge, Mr. John Evans, and Prof. W. E. Ayrton.

LAST week a deputation of gentlemen interested in the University Extension movement had an interview with Lord Cranbrook, President of the Privy Council, to ask for a Government grant in aid of the local lectures delivered under the auspices of the organizing bodies. Among those present were Sir George Stokes, Prof Bryce, Prof. Jebb, Mr. James Stuart, the President of Magdalen College, Oxford, the Master of University College, Oxford, and the Master of Selwyn College, Cambridge. Lord Cranbrook reminded the deputation that his official duties related only to public elementary schools, and that a Government grant could be obtained for the University Extension movement only from the Treasury. He expressed sympathy, however, with the objects of the movement, and promised to consider carefully and to bring before his colleagues the arguments advanced by the deputation. Referring to the general question of secondary education, Lord Cranbrook said it was most desirable that clever boys and girls who have passed through the elementary course should be enabled, by bursaries or in some other way, to go to intermediate schools, and thus be prepared for such instruction as is offered by University Extension lecturers. He feared, however, that those who expected this object to be attained by means of a Government grant might "have to wait for some time."

ON the invitation of the Council of the Photographic Society of Great Britain, Mr. Leon Warnerke lately undertook to submit to the Society a description of the photographic technical schools on the Continent. With that object in view he visited, during last summer, Belgium, Germany, Austria, and Russia, taking notes with pencil and camera. The results are embodied in an interesting paper which was read at a recent meeting of the Society, and is now printed in the *Photographic Journal*.

THE organizing joint committee of the Essex County Council and the Essex Field Club on technical instruction have issued a circular announcing that they have resolved to appoint a certain number of lecturers on science subjects. The services of these teachers are offered free (with the exception of travelling and hotel expenses of the lecturers, where necessary) to local technical instruction committees, under certain conditions to be settled hereafter; the local committees guaranteeing audiences or classes of students (not less than twenty in number), providing rooms, gas, &c., and defraying all necessary local expenses. Syllabuses of short courses of lectures already approved are sent with the circular. They relate to elementary vegetable physiology, economic entomology, and elementary practical mechanics.

THE Royal Commission for the Chicago Exhibition are anxious to comply with a request made to them by the executive authorities of the Exhibition, that a typical collection of economic British minerals may be included in the British Section, and they are now applying to owners and managers of mines, asking for specimens of the principal British minerals. Mr. B. H. Brough, the Instructor in Mine-surveying at the Royal College of Science, South Kensington, has kindly undertaken to classify and arrange the collection, and any suitable specimens may be addressed to him. What is required is not specimens of special value or rarity, but samples of ordinary ores, &c., so that the collection when complete may be fully illustrative of the mineral resources of the kingdom. At the close of the Exhibition the collection will be presented to an American Museum.

PROF. H. A. HAZEN, acting under instructions from the U.S. Weather Bureau, is in Chicago preparing a report on its weather—the mean temperature, the winds, snows, showers, humidity, early frosts and late snows. The report will be based on all the observations and records made for the last fifty years, the object being to convince everyone interested in the approaching Exposition that Chicago is exceptionally favoured in point of fine weather.

MR. ROSEWATER, who was a distinguished member of the U.S. Military Telegraph Corps during the American civil war, and is now President of the Old Timers Telegraphic Association, has lately been studying the various Government telegraph systems in use in Europe. The results of his investigations will shortly be submitted to what is expected to be an unusually interesting and important meeting of the New York Electric Club.

A COPY of "Whitaker's Almanack for 1892" has been sent to us a few days in advance of publication. Great care has been taken, as usual, to keep the Almanack up to date. Additional space is devoted to educational matters, and for the first time educational progress and occurrences are dealt with in a separate article. There is also a separate article on agricultural education. Other subjects separately treated are the rise, progress, and achievements of the great lines of ocean steamers, naval gunnery, and the results of the census. Of course, various sections resemble in subject those of former years, but even these are for the most part entirely fresh in substance. In many instances the changes wrought during the interval of a single year are so numerous that scarcely a line of the section in which the subject is treated remains unaltered.

OWING to his declining to take up his residence in Rio de Janeiro, Dr. Fritz Müller, of Blumenau, Sta. Catharina, has been summarily dismissed by the new Government of Brazil from his post of "Naturalista viajante" to the Museum at Rio de Janeiro. The great services which Dr. Müller has rendered both to zoological and botanical science during his forty years' residence in Brazil are too well known and too widely acknowledged to need dilating on. Dr. F. Müller is now close on completing his seventieth year; and Dr. Karl Müller, of Halle, the editor of *Natur*, proposes to seize the opportunity of collecting from his fellow-naturalists some substantial recognition of the honour in which he is held.

DR. H. E. HAMBERG has communicated to the Swedish Academy of Sciences a paper on the radiation of the upper clouds round barometric minima, prepared from the cloud observations available at Upsala Observatory for the years 1874–89. The arrangement of the highest clouds—cirrus and cirro-stratus—in the form of parallel bands has long been noticed by meteorologists in this country, and various papers on the subject have been written by Mr. W. C. Ley, MM. Hildebrandsson, Köppen, and others; and the movements of these clouds, in conjunction with the wind prevailing at the earth's surface, are at times sufficient to determine approximately the direction in which an atmospheric disturbance exists, even without the use of synoptic charts. For instance, a barometric minimum often exists in a direction nearly perpendicular to that of the radiation, and, generally, on that part of the horizon where the bands of upper clouds are most dense, or whence they seem to radiate, but it is always necessary to take into account the direction of the wind at the earth's surface. The author draws the following conclusions from his investigation:—(1) The radiation of the upper clouds is closely connected with barometric minima. (2) Near a barometric minimum, with the pressure below 29·9 inches, the radiation forms with the radius of the depression an angle of about 70°, the deviation of the radiation from the direction of the surface wind being positive (*i.e.* to the right), by some degrees, on the south-west of the barometric minimum, and negative on the south-east of it. (3) Further from the barometric minimum, with a pressure of 29·9 inches and above, the inclination to the radius is rather greater, about 75°, except where the barometric minimum lies to the north of the place of observation, in which case it is much lower. (4) The angle formed by the radiation is generally greater in the rear of a barometric minimum, reaching nearly 90° in a high pressure; on the other hand, it is smaller in front, especially to the south-east of a minimum, and further from the centre. (5) Compared to the general circulation of the air in a barometric minimum, the radiation of the upper clouds most resembles the direction of the wind near the earth's surface. The meaning of this last sentence is not obvious; but the other conclusions agree, on the whole, with the views of other meteorologists who have studied the subject.

THE *Meteorologische Zeitschrift* for November contains a summary, by Dr. J. Hann, of the meteorological observations taken at Cairo from 1868–88. The observations have been published *in extenso*, together with a good introduction upon the climate, in the Bulletin of the Egyptian Institute, and although similar observations have occasionally been published before, the present series contains much new and useful material. The most striking feature in the climate of this part of Egypt is the *Chamsin*, the hot and dust-bearing wind which makes its appearance in March or April for about three to four days at a time, and robs a large portion of the trees of their leaves. In the intervals during which this wind is not blowing the weather is pleasant and clear during spring-time, and the nights fresh and calm. During the summer the north winds prevail, with high temperature, very clear air, and great dryness. Towards September humidity appears with the rise of the Nile, the ground is at times covered with heavy dew, and the heat becomes oppressive on account of the moisture. In October and November fog occasionally occurs in the morning, and rain begins to fall. After this season the temperature is uniform and pleasant. Snow is unknown, frost very seldom occurs, and rain is not very frequent. The absolute maximum temperature of the 21 years period was 117° in August 1881, which was also closely approached in May 1880, viz. 116°·4. The absolute minimum was 28°·4 in February 1880, and the mean annual temperature was 70°·5. Rainfall is only given for the years 1887–88, in which 0·87 and 1·67 inches fell respectively. The relative humidity sinks at times even on a daily average to 12 per cent., and has been known to fall as low as 3 per cent. at certain hours. Thunderstorms and hail are very rare. The original work contains a long investigation on the connection between the height of the Nile and the weather, a comparison between the present climate and that at the beginning of this century, and several carefully prepared diagrams referring to all meteorological elements.

THE refraction and velocity of sound in porous bodies allowing passage of sound, such as sponge, wadding, felt, &c., have been recently made a subject of investigation by Herr Hesehus (*Rep. der Physik*). His plan was to make a plane-convex spherical lens of iron wire net, and fit it, filled with the porous body (variously condensed), into an aperture in a screen. A pipe of variable tone was sounded on one side, and the behaviour of a sensitive flame noted on the other. From the distance of the focus, when found, could be deduced the refractive index and the velocity in the lens. The refrangibility grows with increasing density of the porous substance, while the velocity on the average is lessened; the latter is also less, the greater the sound-wave. The author gives details of experiments in which the velocity varied from 146 to 261 metres per second (with ebonite shavings). From an empiric formula which he gives, he makes deductions regarding the propagation of sound in tubes, considered as only a special case of its spread through the pores and passages of a porous body. He hopes further research in this field may do something to elucidate the passage of light and electricity through media.

THE Report of the United States Commissioner of Education has been submitted to the Secretary of the Interior. It says that the usefulness of the Bureau depends directly upon what it prints and publishes, and therefore urges an appropriation of 30,000 dollars for general printing for the fiscal year 1892-93, and makes a special request for a specific appropriation of 20,000 dollars to continue the series of educational histories of the several States. The Commissioner reports that there were enrolled in 1889-90 in the public schools of the United States of elementary and secondary grade 12,686,973 pupils, as against 9,867,505 in 1880. The enrolment formed 20·27 per cent. of the population of 1890. The average daily attendance of pupils on each school day in 1890 was 8,144,938. The whole number of public school teachers in the past year was—males, 125,602; females, 233,333. The total amount expended during the past fiscal year for public school purposes was 140,277,484 dollars, is against 63,396,666 dollars in 1870, and 78,004,687 dollars in 1880. The expenditure per capita of population in 1880 was 1.56 dollars, while in 1890 it was 2.24 dollars.

THE U.S. Bureau of Education has issued, as one of its "Circulars of Information," an excellent paper on "Sanitary Conditions for School-houses," by Albert P. Marble, Superintendent of the Public Schools of Worcester, Mass. Dr. Marble has for many years studied the problems of ventilation, heating, lighting, draining, and school-house construction; and his suggestions are well worthy of consideration in this country, as well as in America. The value of the Circular is increased by an appendix, in which are given a number of designs of school buildings of various sizes, carefully selected with a view to commodiousness, healthfulness, and economy of construction. In an official statement prefixed to the Circular, attention is especially called to a series of nineteen plates constituting the prize designs selected and published by the State of New York in 1888.

IN the interesting paper on insectivorous plants, read before the Royal Horticultural Society on September 22, 1891, and now published in the Society's Journal, Mr. R. Lindsay refers to the experiments by which Mr. Francis Darwin has shown the amount of benefit accruing to insectivorous plants from nitrogenous food. Mr. Lindsay says his own experience in the culture of Dionæa is that when two sets of plants are grown side by side under the same conditions in every respect, except that insects are excluded from the one and admitted to the other, the latter, or fed plants, are found to be stronger and far superior to the former during the following season. He points out the importance of remembering that the natural conditions under which these plants are found are different from what they are under cultivation. In their native habitats they grow in very poor soil and make feeble roots, and under these conditions may require to capture more insects by their leaves to make up for their root deficiency. Under culture, however, fairly good roots for the size of plant are developed. "Darwin," says Mr. Lindsay, "mentions that the roots of Dionæa are very small: those of a moderately fine plant which he examined consisted of two branches, about one inch in length, springing from a bulbous enlargement. I have frequently found Dionæa roots six inches in length; but they are deciduous, and I can only conjecture that the roots mentioned by Darwin were not fully grown at the time they were measured. What is here stated of the natural habits of Dionæa applies more or less to all insectivorous plants."

GOOSEBERRIES are so much liked by most people that it is very desirable the season for them should, if possible, be prolonged. According to Mr. D. Thomson, who has a good paper on gooseberries in the current number of the Journal of the Royal Horticultural Society, this can be done easily in the northern part of Great Britain. At Scotch shows it is quite usual to see fine fresh gooseberries about the middle of September. These, as a rule, are gathered from ordinary bushes that have perhaps been shaded with mats or canvas after becoming ripe. The best way to lengthen out the season of gooseberries, Mr. Thomson says, is to plant a portion of a wall with a due north aspect with some Warringtons, and train them on the multiple-cordon system, and keep the laterals spurred in precisely the same way as is adopted with red currants on fences or walls, or in fact with gooseberry bushes grown in the ordinary way. The main shoots should not be closer than 10 inches. If a coping of wood be placed on the wall to throw off wet, a net being used to protect the fruit from birds, the gooseberries can be kept fresh till far into October, and are then very useful and acceptable.

THE authorities responsible for the working of the free public libraries of Manchester cannot complain that these institutions are inadequately appreciated. From the Thirty-ninth Annual Report on the subject to the Council of the city we learn that, during the year ended September 5, 1891, the number of visits made by readers and borrowers to the Manchester libraries and reading-rooms reached an aggregate of 4,327,038, against a total for the preceding twelve months of 4,195,109. The number of volumes lent for home reading was 702,803. Of these, only thirteen are missing.

AT a recent meeting of the Chemical Section of the Franklin Institute, Dr. Bruno Terne read a paper on the utilization of the by-products of the coke industry. In the course of his remarks he said it seemed strange, and nevertheless was a fact, that, with all the ingenuity of the American people in the advancement of the purely mechanical part of the technical industries, they have been and are still slow in the development of chemical industries. "If," said Dr. Terne, "you will visit our coal region to-day, you will find the nightly sky illumined from the fires of the coke ovens, and every one of the brilliant fires bears testimony that we are wasting the richness of our land in order to pay the wiser European coke manufacturer, who saves his ammonia and sends it to us in the form of sulphate of ammonia; and who also saves his tar, which, after passing through the complex processes of modern organic chemistry, reaches our shores in the form of aniline dies, saccharin, nitrobenzol, &c." Dr. Terne thinks that every pound of ammonia used in America ought to be produced there, and that every pound of soda should be made from American salt wells by the ammonia process.

MR. COLEMAN SELLERS contributes to the December number of the *Engineering Magazine*, New York, the first of a series of articles on what he calls "American Supremacy in Mechanics." Incidentally, he notes that most English inventions brought to the United States have to be "Americanized, simplified, made accessible in the case of machinery, and constructed with a view to ease of repair as well as to durability when under the care of careless attendants." Mr. Sellers does not think it would be worth the while of Americans to copy "the solidity and immense weight that some deem a merit in English machinery."

ACCORDING to the "World's Fair Notes," sent to us from Chicago, the party which, under the direction of Mr. Putnam, has been making excavations in the mounds of Ohio, made an important discovery on November 14. While at work on a mound 500 feet long, 200 feet wide, and 28 feet high, the excavators found near the centre of the mound, at a depth of 14 feet, the massive skeleton of a man incased in copper armour. The head was covered by an oval-shaped copper cap; the jaws had copper mouldings; the arms were dressed in copper, while copper plates covered the chest and stomach, and on each side of the head, on protruding sticks, were wooden antlers ornamented with copper. The mouth was stuffed with genuine pearls of immense size, but much decayed. Around the neck was a necklace of bears' teeth, set with pearls. At the side of this skeleton was a female skeleton.

ACCORDING to a telegram received in New York from Mexico, the Mexican Government has ordered the inhabitants of the villages in the neighbourhood of the town of Colima to abandon their homes and seek refuge elsewhere, as the volcano in the vicinity, which was recently in eruption, shows signs of fresh activity, and the country for miles around it is illuminated by the flames issuing from the crater.

THE census of 1890 in Austria-Hungary shows that the rate at which the population increased during the preceding ten years was very different in the two great divisions of the Monarchy. The increase in so-called Cisleithania was 7·9 per cent.; in Transleithania, 10·82 per cent. In the individual provinces the increase was very unequal. In Lower Austria it was 13·8 per cent., this high rate being due to the attractive force of Vienna. Then came Bukowina with 13·1 per cent.; Galicia, 10·4 per cent.; Silesia, 6·5 per cent.; Moravia, 5·5 per cent.; Bohemia, 5 per cent.; the Alpine lands, from 3·2 to 3·6 per cent.; and Tyrol, 0·9 per cent. A different set of figures is yielded by the increase of the various nationalities. Among these the Poles stand highest, with 15 per cent.; then the Serbo-Croatians, 14 per cent; the Ruthenians, 11 per cent.; the Germans, 5·66 per cent.; the Czechs, 5·65 per cent.; the Slovenians, 3·18 per cent.; and the Italians, under 1 per cent.

MR. HENRY LAVER records in the current number of the *Zoologist* the capture of a spotted eagle at Elmstead, near Colchester, on October 29, 1891. On that day a farm labourer saw a strange bird, evidently in an exhausted condition, alight in the field in which he was working. When he went after it, it rose, and flew about a hundred yards. He soon came up to it, and, after some little difficulty, from its pugnacity, captured it alive and uninjured, and in a few days sold it to a gipsy, who in turn disposed of it to Mr. Pettitt, the local taxidermist. Mr. Laver says its plumage appears to indicate good health, and that its appetite favours that idea. If any injury led to its capture, all marks of it have quite disappeared.

THE new instalment of the Transactions of the Leicester Literary and Philosophical Society (vol. ii. part ix.) contains an abstract of an interesting lecture by Mr. Harold Littledale, of the College, Baroda, on some of his experiences with big game in India. Mr. Littledale gave an especially good account of shooting in the Himalayas. The ibex and markhoor were found at altitudes varying from 10,000 to 20,000 feet, and could be obtained only by perseverance in the face of many dangers and obstacles. Of the markhoor (*Capra megaceros*), a splendid animal which is becoming increasingly rare, he obtained ten examples, and ibex had also fallen to his gun, with 45 inch horns—the maximum development being about 52 inches. Various species of sheep also occurred, as the magnificent *Ovis poli*, which the lecturer had not yet met with, *Ovis ammon*, *Ovis cycloceros*, &c. The chamois was found commonly in the Himalayas, and Hodgson's antelope could be shot at elevations of 20,000 feet. Amongst the other mountain animals described were the snow leopard, Sikkim stag, and musk deer (*Moschus moschiferus*), with its tusks about 5 inches in length.

MR. W. H. ROSSER has written for the benefit of candidates preparing for the Board of Trade examinations a general explanation of what is usually known as the "Compass Syllabus." It is entitled "Compass Deviation: a Syllabus of Examination in the Laws of Deviation, and in the Means of Compensating it," and is published by Messrs. James Imray and Son. The pamphlet is to be regarded as an appendix to Mr. Rosser's "Deviation of the Compass considered practically."

MM. H. LÉVEILLÉ AND A. SADA, of Pondicherry, have started a new botanical journal with the title *Le Monde des Plantes: Revue Mensuelle de Botanique*. The first number appeared on October 1. It is published at Le Mans (Sarthe).

THE Council of the Owens College have published the first volume of "Studies in Anatomy." It is edited by Prof. A. H. Young, and presents a part of the results of investigations conducted in the anatomical department of the College during the last three or four years.

MESSRS. BAILLIÈRE, TINDALL, AND COX have issued a second edition of Dr. Edridge-Green's work on "Memory: Its Logical Relations and Cultivation."

A NEW edition of "Falling in Love: with other Essays on More Exact Branches of Science," by Mr. Grant Allen, has been published by Messrs. Smith, Elder, and Co.

MESSRS. BEMROSE AND SONS have issued a second edition of a "Hand-book to the Geology of Derbyshire," by the Rev. J. Magens Mello. The work has been rewritten, and is illustrated with a map and sections.

A CURIOUS compound of lead, sodium, and ammonia, $Pb_4Na.2NH_3$, is described by M. Joannis in the current number of the *Comptes rendus*. M. Joannis has been studying the nature and reactions of the substance known as sodammonium, obtained by dissolving metallic sodium in liquefied ammonia. The deep blue liquid thus produced has been shown in a previous communication (see NATURE, vol. xliii. p. 399) to decompose slowly at the ordinary temperature into hydrogen gas and sodamide, a compound of the composition $NaNH_2$, which M. Joannis isolated in the form of colourless crystals. That such a compound as sodammonium $(NaNH_3)_n$, really exists in the blue solution in liquefied ammonia would appear to be the most natural assumption from these experiments. The reactions of sodammonium now described lend additional support to this view. When a rod of pure lead is placed in a saturated solution of sodammonium in water, the reddish-brown liquid becomes rapidly blue, and finally assumes a deep green tint. A small quantity of hydrogen is evolved at the same time owing to the decomposition of a portion of the sodammonium into sodamide, as above described. The lead gradually disappears, and a solid substance possessing an indigo-blue colour is deposited. This blue substance is found upon analysis to consist of the compound $Pb_4Na.2NH_3$, and would appear to be a sodammonium in which a portion of the sodium is replaced by lead. It dissolves readily in liquefied ammonia with formation of a solution possessing a bottle-green tint. It is not very stable, dissociating spontaneously on standing, with production of a grey substance very much resembling spongy platinum. Upon exposure to air it becomes warm owing to its rapid oxidation. It behaves in a somewhat remarkable manner towards water. When introduced in small quantities at a time into ordinary water, the first portions dissolve completely, the oxygen dissolved in the water oxidizing the lead to litharge, which at once dissolves in the alkaline solution formed. As soon, however, as the oxygen in the water is used up, further additions of the substance result in the precipitation of black floccula of metallic lead. Another interesting reaction of sodammonium is that with metallic mercury, which behaves in an entirely different manner from lead. When the solution of sodammonium in liquefied ammonia is poured over a globule of mercury, rapid action occurs, with the ultimate elimination of the whole of the ammonia, and production of a sodium amalgam of the composition $NaHg_8$, which has been obtained in well-formed crystals. This reaction is the more interesting inasmuch as M. Berthelot, from purely thermo-chemical considerations, has previously indicated the possible existence of such a compound of sodium and mercury.

THE additions to the Zoological Society's Gardens during the past week include a Sooty Mangabey (*Cercocebus fuliginosus* ♀) from West Africa, presented by Mr. H. E. Dampier, J.P.; a Rufous-necked Weaver-Bird (*Hyphantornis textor* ♂) from West Africa, presented by Commander W. M. Latham, R.N., F.Z.S.; a White Stork (*Ciconia alba*), European, presented by Mr. Walter Chamberlain, F.Z.S.; eighteen Grenadier Weaver Birds (*Euplectes oryx*), ten Golden-backed Weaver Birds (*Pyromelana aurea*), nine Black-capped Weaver Birds (*Hyphantornis nigriceps*), four Red-bellied Waxbills (*Estrelda rufiventris*), three Triangular-spotted Pigeons (*Columba guinea*), four Dwarf Chameleons (*Chamæleon pumilus*) from South Africa, presented by Mr. R. W. Murray.

OUR ASTRONOMICAL COLUMN.

JUPITER AND HIS FIRST SATELLITE.—A series of observations of spots and markings on the planet Jupiter were communicated to the Royal Astronomical Society at the November meeting by Mr. Barnard. A careful study of numerous details observed during a period of twelve years has led to the conclusion "that the red colour of any of the markings is an indication of their age; or in other words, when a spot or marking (other than the white spots) first appears it is dark or black, but after some time turns red." Several examples are given of this transition, and the great red spot seems to be no exception to the rule. Measurements of transits of the broken chain of small black spots just north of the north equatorial belt, discovered by Mr. Barnard during the present year, show that the spots have a very large relative motion, for they complete a revolution around Jupiter in about thirty-seven days. The oblong dusky spot discovered near the great red spot last year is diminishing its longitude by about 0°·54 per day, and so completes a revolution relatively to the latter in about 167 days. This, and other new red markings in the southern hemisphere, seem to have their origin in the region of the great red spot. Their period of rotation is about the same as the round white spots in the same hemisphere, the longitudes of which diminish by about 0°·6 per day. The observations show that the great red spot is stationary in longitude, and possibly shorter and broader now than in 1880. Further observations of the first satellite have been made in order to throw light upon the apparent duplicity of this body in transit, distinctly seen by Mr. Barnard on September 8, 1890. It is noted:—"The phenomena seen on these occasions would rather discourage the idea of actual duplicity. At these times the satellite has appeared egg-shaped when in relief on the dark belt. . . . I am confident that this particular phase, and perhaps also that of apparent duplicity, is explained by a bright belt on the satellite or by darkness of the polar regions, which is the same thing." Mr. Stanley Williams has suggested that the phenomenon observed on September 8, 1890, may have been due to the satellite having been seen in transit as a dark spot close to a dark spot on the surface of Jupiter which transited at the same time.

SPECTRA OF THE SUN AND METALS.—Some extremely fine comparative photographic spark-spectra of the sun and metallic elements were exhibited by Mr. F. McClean at the meeting referred to in the above note. The spectra extend, in six sections, from λ 3800 to λ 5750—that is, from about L of the solar spectrum to near D. They are divided into two series—one containing spectra of the sun, iron, platinum, iridium, osmium, palladium, rhodium, ruthenium, gold, and silver; the other containing spectra of the sun, iron, manganese, cobalt, nickel, chromium, aluminium, and copper. The scale of wave-length adopted is that of Ångström's map. Since the spark was taken in air all the spectra have air-lines running through them. The purest materials obtainable were used as electrodes: nevertheless a large number of lines due to foreign substances appear on the photographs. The commonest impurity is calcium, its lines being present in very nearly all the spectra. No attempt has been made to eliminate the lines having their origin in such impurities; hence, as Mr. McClean remarks, it is impossible "to obtain any complete results from these two series of photographs alone. Photographs of the spectra of all the common oxidizable metals, and particularly of calcium, barium, magnesium, and titanium are first required."

Astronomische Nachrichten, No. 3068, contains the following ephemeris for the comet $Tempel_3$-Swift for 12h. Paris mean time:—

1891.	α. h.	m.	s.	δ. °	′	″	Log Δ.
Dec. 17	1	38	47	+27	4	45	9·4220
18		46	1		13	33	
19		53	10		21	1	9·4339
20	2	0	13		27	3	
21		7	10		31	55	9·4467
22		14	1		35	32	
23		20	44		38	4	9·4606
24		27	19		39	24	
25		33	47		39	50	9·4753
26		40	7		39	18	
27		46	19		37	59	9·4907
28		52	22		35	47	
29		58	17		32	57	9·5068
30	3	4	5		29	24	
31		9	43		25	2	9·5235

Astronomische Nachrichten, No. 3069, contains a paper by Prof. Pickering on the distribution of energy in stellar spectaa. Since stellar magnitudes obtained by various processes, such as photography, eye-observations, &c., cannot be compared when the light of stars is of different colours, the method he proposes is to adopt a single wave-length in the spectrum to which all intensities should be referred, a curve or series of numbers being necessary to give a measure of the rays of each different wave-length. For rays of different wave-lengths he says: "The intensities may be determined by comparing the densities of different portions of the photographic spectrum." The line fixed upon was that of the hydrogen line G, "as it is near the centre of the photographic spectrum." The photographs he employed were those forming part of the Henry Draper Memorial, all taken under similar conditions, and in each one separately twenty points were taken and compared by comparison with a standard photographic wedge. Each of the measures thus obtained was converted into logarithmic intervals, and the measure, corresponding with that of the hydrogen line G of wave-length 434, was deducted. By subtracting the values of the logarithm of the energy of the solar light, the remainder showed "the excess or deficit of energy of the star as compared with that of the sun, eliminating the various sources of error enumerated above." In the table below we give the results for three stars as obtained by Prof. Pickering:—

λ.	Log E.	α Can. Maj.	α Aur.	α Orion.	E.
390	− 0·26	+ 0·37	+ 0·32	− 0·57	0·55
400	− 0·19	+ 0·10	+ 0·c8	− 0·38	0·65
410	− 0·12	+ 0·10	+ 0·03	− 0·23	0·76
420	− 0·07	+ 0·00	+ 0·01	− 0·11	0·85
430	− 0·02	+ 0·00	+ 0·00	− 0·02	0·95
440	+ 0·02	− 0·01	+ 0·00	+ 0·05	1·05
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

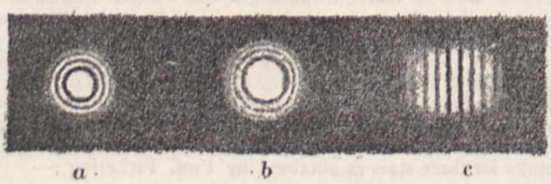
The values in the second column representing the *logarithm* of the energy of the solar light, while those in the last one represent the energy of sunlight itself. Thus in the case of α Orionis, the energy for the wave-length 390 is represented by − 0·57, sunlight being 0·55. The absolute energy is found "by adding the tabular number to that given for sunlight in the second column," so that we have − 0·26 − 0·57 = − 0·83, corresponding to a ratio of 0·15. Thus the energy of the light of α Orionis of wave-length 390 is only about one-seventh of that of wave-length 434.

In this number, also, Mr. Truman Saffard contributes a paper on the observation of North Polar stars in the vertical of Polaris. After mentioning the difficulty of observing polars in the day-time, of connecting other polars with double transits of Polaris, and of the independence that now exists in the various Polar catalogues, he describes a method which tends to eliminate many of these deficiencies. It consists in adjusting a transit so that Polaris will be near its centre wire at eastern elongation, which takes place about 19h. 23m. sidereal time, and the two stars Camelopardalis 25 H and Schwerd 1172 (Carrington 2965), which pass the same vertical within about half an hour of this time, the latter above Pole, earlier than the Pole-star reaches the elongation, the former, below Pole, later. In this way the right ascension of Polaris plays a small part in its azimuth of elongation, which is dependent solely on the declination and latitude. Assuming the present declinations of the two stars mentioned, with probable errors of $< \pm 0''.2$ and $\pm 0''.3$ respectively, he finds that the right ascension would probably be in error by $\pm$ 0·002s. and $\pm$ 0·004s. In fact, the probable errors "dependent upon anything but the transit of the star to be determined will be much less if the present method is used (with an equal instrument), than if stars in the same declination, but opposite Polaris in right ascension, were observed by direct comparisons in the meridian." By applying this method to other stars of different right ascensions and "gradually increasing declinations," as the R.A. of Polaris or its opposite is approached, numerous co-ordinates thoroughly independent can be obtained, and will "provide zero points for the proposed number of photographic plates 2° square, and consequently help to settle the places of all stars in that region."

MEASUREMENT OF JUPITER'S SATELLITES BY INTERFERENCE.

IT has long been known that even in a telescope which is theoretically perfect, the image of a luminous point is composed of a series of concentric circles with a bright patch of light at the common centre. This system of circles can easily be observed by examining any bright star with a telescope provided with a circular diaphragm which diminishes the effective aperture. The appearance of the image is shown in Fig. 1, *a*. In the case of an object of finite angular magnitude the image could be constructed by drawing a system of such rings about every point in the geometrical image. The result for a small disk (corresponding to the appearance of one of the satellites of Jupiter as seen with a 12-inch telescope whose effective aperture

Fig 1



a *b* c

has been reduced to six inches) is given in Fig. 1, *b*; the chief points of difference between this and Fig. 1, *a*, being the greater size of the bright central disk, and the lesser clearness of the surrounding rings. The larger the disk the more nearly will the appearance of the image correspond to that of the object; and the smaller the object the more nearly does it correspond with Fig. 1, *a*, and the more difficult will be the measurement of its actual size. Thus, in the case just cited, the actual angular diameter is about one second of arc, and the uncertainty may amount to half this value or even more.

The relative uncertainty, other things being equal, will be less in proportion to the increase in the aperture, so that with the 36-inch telescope the measurement of the diameters of Jupiter's satellites should be accurate to within ten per cent. under favourable conditions.

It is important to note that in all such measurements the image observed is a diffraction phenomenon—the rings being interference fringes, and the settings being made on the position of that part of a fringe which is most easily identified. But such measurements must vary with the atmospheric conditions and especially with the observer—for no two observers will agree upon the exact part of the fringe to be measured, and the uncertainties are exaggerated when the fringes are disturbed by atmospheric tremors.

If, now, it be possible to find a relation between the size of the object and the *clearness* of the interference fringes, an independent method of measuring such minute objects will be furnished; and it is the purpose of this paper to show that such a method is not only feasible, but in all probability gives results far more accurate than micrometric measurements of the image.

In a paper on the "Application of Interference Methods to Astronomical Measurements"[1] an arrangement was described for producing such fringes, by providing the cap of the objective with two parallel slits, adjustable in width and distance apart. If such a combination be focussed on a star, then, instead of the concentric rings before mentioned, there will be a series of straight equidistant bands whose length is parallel with the slits, the central one being brightest,[1] Fig. 1, *c*.

The general theory of these fringes may be found in the *Philosophical Magazine* for March 1891. The general equation showing the relation between the *visibility* of the fringes and the distance between the slits is:

$$V^2 = \frac{\left[\int \phi(x) \cos kx\, dx\right]^2 + \left[\int \phi(x) \sin kx\, dx\right]^2}{\left[\int \phi(x)\, dx\right]^2} \quad . \quad (1)$$

which reduces to the simpler form

$$V = \frac{\int \phi(x) \cos kx\, dx}{\int \phi(x)\, dx} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

when the object viewed is symmetrical.

A number of applications of this formula are discussed in the former paper, but for the present purpose attention will be confined to the case in which the object viewed (or rather its projection) is a circular disk, uniformly illuminated.

In this case equation (2) becomes

$$V = \int_0^1 \sqrt{1 - \omega^2} \,.\, \cos \pi \frac{\alpha}{\alpha_0} \omega \,.\, d\omega \quad . \quad . \quad . \quad . \quad . \quad (3)$$

in which α is the angular diameter of the object, and α_0 is the smallest angle resolvable by an equivalent aperture; that is, the ratio of a light-wave to the distance between the slits.

The curve expressing this relation is given in Fig. 2, in which the ordinates are values of the visibility of the fringes, and the abscissæ are the corresponding values of the α/α_0.

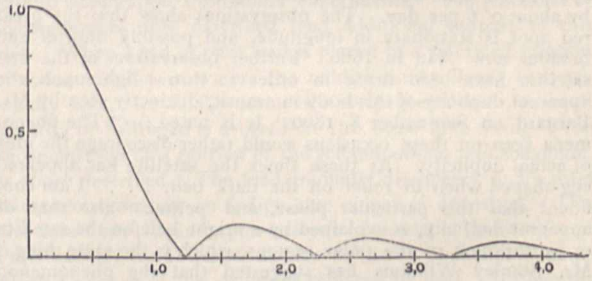


FIG. 2.

From this it will appear that the fringes disappear at recurring intervals, and in a laboratory experiment as many as four such disappearances were noted, and the average error in the resulting value of α, the angular magnitude of the disk, was found to be less than two per cent.

From the curve it is evident that the first disappearance is most readily and accurately observed, and for this we have

$$\frac{\alpha}{\alpha_0} = 1.22;$$

whence, putting s for the distance between the centres of the slits, and taking for the wave-length of the brightest part of the spectrum 0·0005 mm.,[2] and dividing by the value of a second in radians we have

$$\alpha = \frac{1.38}{s} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

In consequence of the kind invitation extended by Prof. Holden, it was decided to make a practical test of the usefulness of the proposed method at Mount Hamilton.

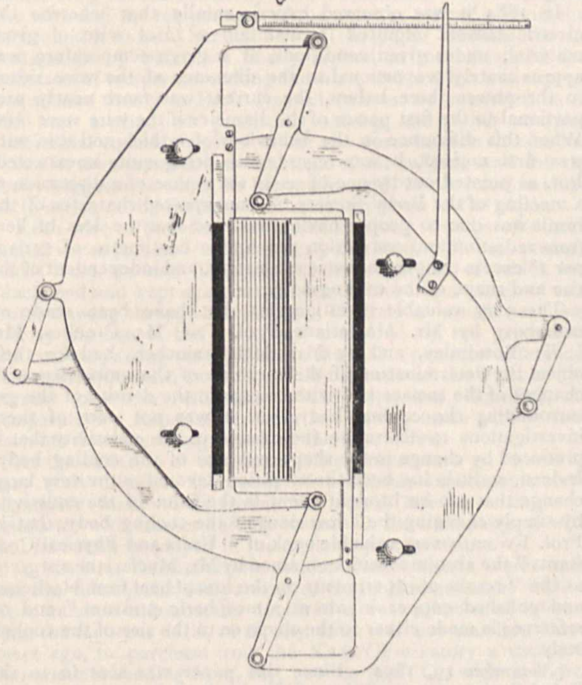
[1] *Philosophical Magazine*, July 1890.

[1] These will be superposed on another set of fringes due to diffraction from the edges of the slits; but the latter are too faint and broad to cause any confusion.

[2] The wave-length will, of course, vary somewhat with the object observed, but may be made constant by interposing a red glass.

For the preliminary experiments which are to be described it was thought desirable to use the 12-inch equatorial. Accordingly, a cap, provided with two adjustable slits, was fitted over the objective, and provided with a rod by means of which the distance between the slits could be altered gradually and at will by the observer, while the distance was measured on a millimetre scale attached to the sliding jaws. This arrangement, which was constructed under the supervision of Mr. F. L. O. Wadsworth, of Clark University, is shown in the accompanying diagram, Fig. 3.

Fig 3



With this apparatus the satellites of Jupiter were measured, with results as given in the following table :—

TABLE I.

No. of Satellites.	I.	II.	III.	IV.	Seeing.
August 2 ...	1″·29 ...	1″·19 ...	1″·88 ...	1″·68 ...	Poor.
August 3 ...	1·29 ...	— ...	1·59 ...	1·68 ...	Poor.
August 6 ...	1·30 ...	1·21 ..	1·69 ...	1·56 ...	Poor.
August 7 ...	1·30 ...	1·18 ..	1·77 ...	1·71 ...	Good.
Mean...	1·29	1·19	1·73	1·66	

These are the values of the angular diameters of the satellites of Jupiter as seen from the earth. To reduce these to Jupiter's mean distance these values are to be multiplied by 0·79, which gives for the final values—

I.	II.	III.	IV.
1″·02 ...	0″·94 ...	1″·37 ...	1″·31

For the sake of comparison these values are recorded in the following table, together with those given by Engelmann, Struve, and Hough, and the last column contains some results kindly furnished by Prof. Burnham with the 36-inch on the same date (August 7) as the last of the series by A. A. M. :—

TABLE II.

No. of Satellite.	A. A. M.	ENG.	ST.	HO.	BU.
I...	1·02 ...	1·08 ...	1·02 ...	1·11 ...	1·11
II.	0·94 ...	0·91 ...	0·91 ...	0·98 ...	1·00
III.	1·37 ...	1·54 ...	1·49 ...	1·78 ...	1·78
IV.	1·31 ...	1·28 ...	1·27 ...	1·46 ...	1·61

It was found impossible to see the reappearance of the fringes on increasing the distance, yet the results of Table I. show that the disappearance could still be sharply marked. Indeed the concordance of the observations made under different circumstances on different nights was even closer than was expected. With a larger telescope both the brightness of the fringes and their distance apart will be increased, and it may be confidently predicted that the accuracy will then be even greater.

The values given in the second column, "Engelmann," are probably more reliable than the succeeding ones, but it is well worth noting that the results obtained by interference agree with the others quite as well as these agree with each other.

It should also be noted that the distance between the slits was about four inches. It may therefore be stated that for such measurements as have just been described, a telescope sufficiently large to admit a separation of four inches—say a six-inch—suitably provided with adjustable slits is fully equal to the largest telescopes now used without them.

It is hoped that within a few months the 36-inch equatorial will be supplied with a similar apparatus and observations begun for the definite measurement of the satellites of Jupiter and Saturn and such of the asteroids as may come within the range of the instrument.

In concluding, I wish to take this opportunity of expressing my appreciation of the courtesy of Director Holden in placing all the facilities of the Observatory at my disposal, and of the hearty co-operation of all the astronomers of the Observatory, especially the valuable assistance of Prof. W. W. Campbell in making the observations.

A. A. MICHELSON.
Mount Hamilton.

THE SAMOAN CYCLONE OF MARCH 16, 1889.

THE Samoan hurricane of March 16, 1889, is one of those historic storms that have been rendered for ever memorable by the episodes of disaster and gallantry that attended them; by the escape of H.M.S. *Calliope*, which forced her way out of Apia harbour in the teeth of the hurricane, amid the cheers of the brave American sailors, who, themselves face to face with imminent death, forgot for a moment their own dire peril in their admiration of the daring and successful act of seamanship that rescued their more fortunate brothers. Mr. Everard Hayden, of the U.S. Hydrographic Office, has lately issued a preliminary Report on this storm, which, despite the regrettable meagreness of the data at his command, has, nevertheless, a certain scientific interest, inasmuch as less is known of the cyclones of the Pacific than of those of most other tropical seas.

The Apia storm, like the cyclones of the South Indian Ocean, was evidently formed on the northern limits of the south-east trades, and was one of a series that were generated in this region in March 1889. The first of these, in Mr. Hayden's opinion, appears to have originated on the 5th of the month, some 500 miles north-north-east from the Samoan Islands, and to have travelled first in a south-westerly direction, recurving in the latitude of these islands, but at 150 to 200 miles to the west of them, after which it took a south-eastward course between Tonga and Nuië. It seems to have been a storm of great severity, and its passage was felt at Apia on the 6th and 7th, though not with any great intensity. It was succeeded by the cyclone that forms the principal subject of Mr. Hayden's Report. This, he thinks, was formed about March 13, some 300 miles to the north-east of the Samoan Islands, and on the 15th its centre passed either directly over, or a little to the north of, Apia harbour, moving, therefore, on a south-west course. He considers that it then sharply recurved, and that, with greatly increased strength, it passed a second time over Apia on the 16th, the day of the great naval disaster. The chief facts which led Mr. Hayden to this conclusion are those observed at Apia itself, for no positive evidence is forthcoming from the supposed birthplace of the storm, and only one ship reports the state of the weather anywhere to the north of Samoa. The peculiar feature of the Apia observations is, that the barometer fell steadily from the 12th to the afternoon of the 15th (about 0·7 inch), then rose (about 0·25 inch) during the latter part of that day, and then again fell on the 16th to a reading slightly lower than that of the previous day. On the 15th, squalls of moderate force (wind southerly, force 2 to 6) were experienced, and in the after part of the day, as the barometer rose, the direction changed from south to north and east. There had been no heavy sea, and it was thought that the gale was over. At midnight, however, the barometer began falling again, the wind had increased, and the sea was high. The barometer continued falling, and the gale rapidly developed its full strength. From early morning of the 16th, for nearly twenty-four hours, it blew a hurricane, and the catastrophes commenced with the loss of the *Eber*.

Any attempted interpretation of facts so meagre must necessarily be in a great measure speculative. We have given that of Mr. Hayden, and others have been suggested. One, that of Lieutenant Witzel, is to the effect that the storm of the 16th was distinct from that of the previous day, and originated over Savaii (the island to the west of Upolu, in which is the harbour of Apia). Another, by Mr. Dutton, is that the storm of the 15th, after approaching the Samoan Islands on a south-west track, recurved to west and north-west, and during the following night again recurved sharply, describing a loop north of Savaii, and then returning towards Upolu, whence it moved southwards and south-eastwards. Our own interpretation is somewhat different from any of these, and seems to be more in accordance with the habits of tropical cyclones, the movements of which are by no means so erratic as that implied by Mr. Dutton's hypothesis, while it does not involve the extremely and, we think, improbably sharp recurvature suggested by Mr. Hayden, nor the equally improbable generation of a second vortex only one day in the rear of the storm of the 15th, as supposed by Lieutenant Witzel. None of these explanations seem to take account of the circumstances that attend the formation of tropical cyclones, which, as we have elsewhere pointed out, differ in many respects from the storms of the temperate zone.

It is evident from [the considerable and steady fall of the barometer at Apia from March 12 to 15, that the Samoan Islands lay within the area of disturbance in which the storm was generated, and that the formation of the vortex was simply the concentration of this disturbance, which probably took place nearer to Apia than is supposed by Mr. Hayden, but still at such a distance that the first effect of the concentration—viz. a slight rise of the barometer in the area immediately around, and especially on the polar side—was felt at the Samoan Islands. If, then, as seems probable, the vortex was not formed until the afternoon of the 15th, this, in conjunction with the ordinary diurnal rise between 4 and 10 p.m., would account for the slight rise observed at Apia on the latter part of that day, and only the second fall to a minimum on the 16th was due to the actual passage of the cyclone. From the severity of the storm, as felt at Apia harbour, it is clear that Upolu must have been traversed by at least a portion of the inner vortex, but it could hardly have been very close to the centre, seeing that the barometer never fell to 29 inches; and therefore the long duration of the hurricane (24 hours) can only be explained by the very slow rate at which the storm was then travelling. This slow rate of progression strengthens the probability that it had not proceeded far from its birthplace, since, as a rule, tropical cyclones move forward slowly at first, and only gradually acquire greater speed of translation. It also strengthens the inference that it had originated not very far to the north or north-east of Upolu.

This explanation, as already remarked, can only be regarded as tentative, but it seems at least worthy of consideration by those who may have fuller data at hand. H. F. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Sheepshanks Astronomical Exibition has been awarded to P. H. Cowell, Scholar of Trinity College.

A memorial signed by 107 members of the Senate is published by the Vice-Chancellor: it expresses the opinion that "the whole question of degrees in science should be considered by the University." Among the signatures are some of those who took the Greek as well as some who took the anti-Greek side in the recent controversy.

In view of the fall in the aggregate of the Colleges the Council of the Senate propose to obtain powers for deferring the next increment of the College contribution to the University from 1893 to 1895, and the following increment (from £25,000 to £30,000) for seven years further—namely, to 1903.

Sir George Gabriel Stokes and Prof. Macalister, M.D., are among the delegates appointed to represent the University at the Dublin Tercentenary Festival next year.

Mr. E. W. Hobson, of Christ's College, is approved as Deputy for the Lowndean Professor of Astronomy for the Lent and Easter Terms.

We regret to hear that Prof. Adams's health does not yet allow him to resume his duties.

SOCIETIES AND ACADEMIES.

London.

Royal Society, November 19.—"The Thermal Emissivity of Thin Wires in Air." By W. E. Ayrton, F.R.S., and H. Kilgour.

In 1884 it was observed experimentally that whereas the electric current required to maintain a *thick* wire of given material, under given conditions, at a given temperature was approximately proportional to the diameter of the wire raised to the power three halves, the current was more nearly proportional to the first power of the diameter if the wire were *thin*. When this difference in the behaviour of a thick and thin wire was first noticed, it was regarded as being quite unexpected. But, as pointed out by one of us in the course of a discussion at a meeting of the Royal Society, the unexpected character of the result was due to people having assumed that the loss of heat from radiation and convection per square centimetre of surface per 1° excess temperature was a constant, and independent of the size and shape of the cooling body.

The very valuable investigations that have been made on emissivity by Mr. Macfarlane, Prof. Tait, Mr. Crookes, Mr. J. T. Bottomley, and by Mr. Schleiermacher, had for their object the determination of the variation of the emissivity with changes of the surface and with change in the density of the gas surrounding the cooling body, but it was not part of these investigations to determine the change in the emissivity that is produced by change in the shape and size of the cooling body. Indeed, so little has been the attention devoted to the very large change that can be brought about in the value of the emissivity by simply changing the dimensions of the cooling body, that in Prof. Everett's very valuable book of "Units and Physical Constants" the absolute results obtained by Mr. Macfarlane are given as the "results of experiments on the loss of heat from blackened and polished copper in air at atmospheric pressure," and no reference is made either to the shape or to the size of the cooling body.

[*November* 19, 1891.—Since this paper was sent in to the Royal Society a new edition of this book has appeared, and, in consequence of a suggestion made to Prof. Everett, the word "balls" has been added after the word "copper" in this new edition, as well as the following paragraph:—

"*Influence of Size.*—According to Prof. Ayrton, who quotes a table in 'Box on Heat,' the coefficient of emission increases as the size of the emitting body diminishes, and for a blackened sphere of radius r centims. may be stated

$$\cdot 0004928 + \frac{\cdot 0003609}{r}.$$

The value of r in Macfarlane's experiments was 2."]

The laws which govern the loss of heat from very thin cylindrical conductors have not only considerable scientific interest in showing how the shape of a body affects the convection currents, but they are of especial importance to the electrical engineer in connection with glow lamps, hot-wire voltmeters, fuses, &c. We therefore thought it desirable to ascertain the way in which the law of cooling for thick wires, which involved the diameter raised to the power three halves, passed into the law for the cooling of thin wires, involving only the first power of the diameter. For this object, the investigation described in the paper was commenced at the beginning of 1888, and the emissivity was measured of nine platinum wires, having the diameters of 1·2, 2·0, 2·9, 4·0, 6·0, 8·1, 9·3, 11·1, and 14 mils, or thousandths of an inch.

Suspecting that some of the published results on the currents required to fuse wires had been much influenced by the cooling action of the blocks to which the ends of the wires were attached, we started by making a calculation of the length necessary to give to our wires, so that the loss of heat by conduction should not introduce any important error into the determination of the emissivity. To do this it was necessary to calculate the distribution of temperature along a wire through which a steady current was flowing, and from which heat was lost by radiation, convection, and conduction, and it was further necessary to improve on the calculation one of us had published on this subject in the *Electrician* for 1879, by taking into account the fact that the emissivity, as well as the thermal and electric conducting power, of the wire differed at different points in consequence of the difference of temperature.

Until we had completed the experiments described in this paper, we could, of course, only employ in this calculation values that we had guessed at as being something near the truth for the emissivity of platinum wire for different diameters and at different temperatures. Hence, after the completion of the experiments, we took up the mathematical investigation again, substituting for the emissivity such a function of the diameter of the wire and the temperature of the point as we had experimentally found it to be. Section IV. of the paper contains the investigation by which we finally arrived at the calculated distribution of temperature along the wire, and we have to express our sincere thanks to Prof. Henrici (whom we consulted as to the best method of practically solving the rather complex differential equation arrived at) for the warm interest that he has taken in the mathematical treatment of the subject, and for the many suggestions which he has made, and which have enabled us to arrive at the mathematical solution given in the paper.

Each wire to be tested was stretched along the axis of a horizontal water-jacketed cylinder 32·5 cm. long, 7·62 cm. external and 5·8 cm. internal diameter, the inner surface of which was blackened and kept at a constant temperature by a stream of cold water flowing through the jacket. The rate at which heat was lost by any one of the wires was measured by the product of the current passing through it into the P.D. (potential difference) maintained between its ends, while the ratio of the P.D. to the current gave the resistance of the wire, and, therefore, its temperature. Experiments were in this way made with various currents flowing through each of the nine wires.

As the variation of resistance with temperature is known to vary with different specimens of platinum, experiments were separately made to determine the actual law of variation of resistance with temperature up to 300° C. for each piece of wire that had been employed in the emissivity experiments.

In this later determination various thermometers were used, and the subsequent comparison of these thermometers with a Kew standard thermometer involved a vast amount of labour, from the fact that it is, or at any rate was not possible three years ago, to purchase from the Kew Observatory a standard thermometer reading from, say, 200° to 300° C., with a short, wide chamber at the base in which the mercury expanded below 200° C. All that could be obtained was a long thermometer which had been carefully tested between 0° and 100° C., and the remainder of whose tube had been simply calibrated for uniformity of bore. The consequence was that when we desired to compare one of our thermometers reading, say, from 200° to 300° C., with the Kew standard, their bulbs were very far apart when both were immersed in the oil-bath, and with the tops of the mercury columns just above the surface of the oil. A short description is given in the paper of the devices employed to overcome this difficulty, and which enabled an accurate comparison to be made between the thermometers.

On examining the curves, accompanying the complete paper, which show the emissivity for each temperature for each of the nine wires, we see that—

(1) For any given temperature the emissivity is the higher the finer the wire.

(2) For each wire the emissivity increases with the temperature, and the rate of increase is the greater the finer the wire. For the finest wire the rate of increase of emissivity with temperature is very striking.

(3) Hence the effect of surface on the total loss of heat (by radiation and convection) per second, per square centimetre, per 1° C. excess temperature, increases as the temperature rises.

On comparing the loss of heat from the wire of 1·2 mils diameter when at 300° C. with that from the wire of 6 mils diameter when at 15° C., both being in an inclosure at 10° C., we see that the former loses per square centimetre of surface per second not

$$\frac{300-10}{15-10}, \text{ or 58 times}$$

as much heat as the latter, as it would if the emissivity were the same; but, instead,

$$60 \times 58, \text{ or 3840 times}$$

as much heat; arising from the fact that the emissivity—that is, the number of calories (gramme C.°) lost per second, per square centimetre of surface, per 1° C. excess temperature—of the 1·2 mil wire at 300° C. is 60 times as great as that of the 6 mil wire at 15°, the emissivity of the latter wire varying very rapidly near 15° C.

From the curves which accompany the complete paper, each curve giving the variation of emissivity with temperature for a particular wire, the following table has been drawn up, giving the emissivities of the various wires at eight useful temperatures, and it will be observed that, in consequence of our investigation having been made on wires of which the thickest was thinner than the thinnest ever previously used in absolute determinations of emissivity, the emissivities we have experimentally obtained are far greater than any previously arrived at.

Diameter of wire in		Emissivities.							
Mils.	Millimetres.	40° C.	60° C.	80° C.	100° C.	150 C.	200° C.	250° C.	300° C.
1·2	0·0305	0·008230	0·009560	0·010300	0·010846	0·011875	0·012783	0·013625	0·014400
2·0	0·0508	0·005950	0·006860	0·007500	0·007900	0·008600	0·009070	0·009480	0·009850
2·9	0·0737	0·002193	0·003336	0·004086	0·004552	0·005095	0·005379	0·005628	0·005845
6·0	0·1524	0·002460	0·002660	0·002806	0·002930	0·003212	0·003460	0·003666	0·003837
8·1	0·2057	—	—	—	0·002804	0·002939	0·003076	0·c03217	0·003352
9·3	0·2362	—	—	—	0·002297	0·002448	0·002586	0·002718	0·002843
11·1	0·2819	—	—	—	0·002053	0·002216	0·002363	0·002490	0·002608
14·0	0·3556	—	—	—	0·001894	0·002027	0·002136	0·002224	0·002286

The wire of 4 mils diameter is omitted from the table, as the experiments showed that its specific resistance was much greater, its temperature coefficient much smaller, and its emissivity much smaller than if it had been of platinum. This piece of wire probably, therefore, contained iridium or silver.

We find that the emissivity of thin platinum wires of different diameters at the same temperature can be very fairly expressed by a constant plus a constant into the reciprocal of the diameter of the wire. For example, we find that

$$\text{At } 100^\circ \text{ C. } e = 0{\cdot}0010360 + 0{\cdot}0120776 d^{-1}, \quad \ldots \quad (1)$$
$$\text{,, } 200 \text{ ,, } e = 0{\cdot}0011113 + 0{\cdot}0143028 d^{-1}, \quad \ldots \quad (2)$$
$$\text{,, } 300 \text{ ,, } e = 0{\cdot}0011353 + 0{\cdot}016084 d^{-1}, \quad \ldots \quad (3)$$

where d is the diameter of the wire in mils, or thousandths of an inch.

The statement, not unfrequently made, that the current required to maintain a wire of a given material at a given temperature above that of the surrounding envelope is proportional to the diameter of the wire raised to the power three halves, is equivalent to stating that the emissivity is independent of the diameter. Now from the three formulæ (1), (2), (3), given above for e, we may conclude—

That for a temperature of 100° C. the value of d in the formula

$$e = 0{\cdot}0010360 + 0{\cdot}0120776 d^{-1}$$

must be something like 220 mils, or 5·6 mm., in order that the neglect of the second term may not make an error in e of more than 5 per cent., and something like 1·15 inch, or 29·3 mm., if the error is not to exceed 1 per cent.

That for a temperature of 200° C. the value of d in the formula

$$e = 0·0011113 + 0·0143028d^{-1}$$

must be something like 244 mils, or 6·2 mm., in order that the neglect of the second term may not make an error in e of more than 5 per cent., and something like 1·28 inches, or 32·5 mm., if the error is not to exceed 1 per cent.

And that for a temperature of 300° C. the value of d in the formula

$$e = 0·0011353 + 0·016084d^{-1}$$

must be something like 267 mils, or 6·8 mm., in order that the neglect of the second term may not make an error in e of more than 5 per cent., and something like 1·39 inches, or 35·3 mm., if the error is not to exceed 1 per cent.

Generally, then, we may conclude that to assume that the emissivity is a constant for wires whose diameters vary from a small value up to 1 inch is to make a large error in the case of the greater number of the wires, and an error of hundreds per cent. in the case of some of them.

Using the formula (3) which we have arrived at for determining the emissivity of platinum wires of different diameters at 300° C., it follows that to maintain a platinum wire 0·75 mil in diameter at 300° C. would require a current density of 331,000 amperes per square inch; and, if the emissivity of a copper wire of the same diameter and at the same temperature may be taken as being the same, it follows that to maintain a copper wire 0·75 mil in diameter at 300° C. would require a current density of 790,000 amperes per square inch.

November 26.—"A New Mode of Respiration in the Myriapoda." By F. G. Sinclair (formerly F. G. Heathcote), M.A., Fellow of the Cambridge Philosophical Society.

The Scutigeridæ respire by means of a series of organs arranged in the middle dorsal line at the posterior edge of every dorsal scale except the last.

Each organ consists of a slit bounded by four curved ridges, two at the edges of the slit, and two external to the latter. The slit leads into an air sac. From the sac a number of tubes are given off; these tubes are arranged in two semicircular masses. The ends of the tubes project into the pericardium in such a manner that the ends are bathed in the blood and aërate it just before it is returned into the heart by means of the ostia. In the living animal the blood can be seen through the transparent chitin of the dorsal surface surrounding the ends of the tubes; and in the organ and surrounding tissues cut out of a Scutigera directly it is killed the blood corpuscles can be seen clustering round the tube ends. If the mass of tubes of a freshly killed specimen are teased out under the microscope in glycerine, they can be seen to be filled with air. The tubes each branch several times. Each tube is lined with chitin, which is a continuation of the chitin of the exo-skeleton. Each tube is also clothed with cells, which are a continuation of the hypodermis. The tubes end in a blunt point of very delicate chitin.

I therefore hold that the respiratory organ in Scutigera holds a position intermediate between the tracheæ of Myriapods and the lungs of Spiders. I hold with A. Leuckart (*Zeitsch. für Wiss. Zool.*, vol. i. p. 246, 1849, "Ueber den Bau und Bedeutung der sog. Lungen bei den Arachniden") that the tracheæ have developed into the lungs of Spiders and Scorpions, and I think that the organs in question form a series of which the lowest term are the tracheæ, the next the organ of Scutigera, then the lungs of Spiders, and then of Scorpions.

Zoological Society, November 17.—Dr. A. Günther, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of October 1891, and called special attention to the following: a young Buffon's Skua (*Stercorarius parasiticus*), captured near Christchurch, Hampshire, and presented by Mr. E. Hart, and a Land-Crab (*Geocarcinus ruricola*) from the island of Fernando de Noronha, brought home and presented by Mr. D. Wilson-Barker.—The Secretary read a letter from Dr. G. Martorelli, of Milan, inclosing a coloured drawing of both sexes of a hybrid Duck bred in the public Garden of Milan, between *Branta rufina* ♂ and *Anas boschas* ♀.—Mr. G. A. Boulenger gave an account of the various forms of the Tadpoles of the European Batrachians, and a statement of the characters by which the different species may be distinguished in this stage of their existence.—A communication was read from Mr. Edgar A. Smith, containing descriptions of new species of Shells from New South Wales, New Guinea, and the Caroline and Solomon Islands, based on specimens lately presented to the British Museum by Mr. John Brazier, of Sydney.—Lord Walsingham gave an account of the Microlepidoptera of the West Indies, based primarily on the collections made in St. Vincent and other islands by Mr. H. H. Smith, under the direction of the joint Committee of the British Association and the Royal Society for the exploration of the Lesser Antilles.—A communication was read from M. E. Simon containing the first portion of an account of the Spiders of the island of St. Vincent, based on specimens obtained under the direction of the same Committee.—A communication was read from Mr. H. Nevill, urging the importance of founding an experimental Zoological Station in the tropics, and advocating the claims of Trincomalee in Ceylon for such an institution.—Dr. Johnson Symington read a paper on the nose, the organ of Jacobson, and the dumb-bell shaped bone in the *Ornithorhychus*.—Mr. A. Smith-Woodward read a paper on a Mammalian tooth from the Wealden formation of Hastings, being the first trace of a Cretaceous Mammal discovered in Europe. This remarkable fossil the author was inclined to refer provisionally to the genus *Plagiaulax* of the Purbeck Beds, and to call *Plagiaulax dawsoni*, after its discoverer.—A communication was received from Mr. C. Davies Sherborne, giving an exact account of the dates of issue of the parts, plates, and text of Schreber's "Säugethiere." Great difficulties in synonymy had arisen from previously imperfect knowledge of these dates.

December 1.—Mr. Henry Seebohm in the chair.—Mr. Sclater exhibited a specimen of a Shearwater obtained near Sydney, and brought from Australia by Prof. Anderson Stuart. This specimen had been determined by Mr. Salvin to belong to *Puffinus gavia*, a New Zealand species not hitherto known to occur in Australia.—Mr. Seebohm exhibited and made remarks on specimens of several very interesting birds recently obtained in Ireland. Amongst these was an example of the Yellow-browed Warbler (*Phylloscopus superciliosus*) obtained on the Tearaght Rock, the most westerly station in Europe.—Dr. E. Hamilton exhibited a specimen of the Red-breasted Snipe of North America (*Macrorhamphus griseus*), obtained in Scotland.—Mr. W. B. Tegetmeier exhibited some specimens illustrative of the abnormal form of the bill in birds caused by injuries to that organ during life.—Mr. G. A. Boulenger read some notes on specimens of Reptiles from Transcaspia recently received by the British Museum, and pointed out that examples of several well-known Indian species occurred in this collection.—A communication was read from Miss E. M. Sharpe containing the second portion of her descriptions of new Butterflies from British East Africa, collected by Mr. F. J. Jackson during his recent expedition.—Mr. A. D. Michael read a paper upon the association which he had observed between certain Acarines of the family Gamasidæ and certain species of Ants. The author came to the following conclusions: (1) that there is an association between some Gamasids and Ants; (2) that a species of Gamasid usually associates with one or two species of Ant preferentially; (3) that the Gamasids of Ants'-nests are not usually found elsewhere; (4) that the Gamasid abandons the nest if the Ant does; (5) that the Gamasids live upon friendly terms with the Ants; (6) that the Gamasids are not true parasites; (7) that they do not injure the Ants or their young; (8) that the Gamasids will eat dead Ants, and are probably either scavengers or messmates.—A communication was read from Mr. Edward Bartlett containing an account of the specimens of Rhinoceros from Borneo contained in the Museum of Sarawak.—A communication was read from Mr. T. T. Somerville, of Christiania, containing notes on the Lemming (*Myodes lemmus*).

Anthropological Institute, November 24.—E. W. Brabrook Vice-President, in the chair.—A paper on the perforated stones of South Africa, by H. Mitford Barber, was read.—An account of the Similkameen Indians of British Columbia, by Mrs. S. S. Allison, was read. The tribe at present inhabiting the upper valley of the Similkameen are immediately descended from a small band of the warlike Chilcotins, who established themselves in the upper valley of the river about a hundred and fifty years ago, and intermarried with the Spokans. They have much deteriorated, both physically and mentally, within the last twenty years, and are rapidly becoming extinct. The average stature of the men is about 5 feet 6 inches; their frames are lithe and muscular and their movements quick and graceful. Their complexion is very light, and they have small hands and feet. The colour of their hair varies from jet-black to red-brown, and in some cases it is almost curly. They are born horsemen and capital shots. The sharp horns of the mountain goat were formerly fixed on shafts of hard wood and used as spears both in hunting and warfare; stone knives and hatchets were also used. The summer dwellings of the Similkameen Indians were made of mats of cedar bark, manufactured by the Hope Indians, which were thrown over a circular frame of poles. The winter houses were simply pits dug in the ground and roofed with poles and earth. All sickness was supposed to be the work of an evil spirit, who fastened on a victim and hung on, drawing away his life, until charmed away by the doctor, who worked himself into a state of frenzy, singing and dancing while he was trying to lure the evil spirit from his patient. Many of the medicine-men exercise strong mesmeric power over their patients, and they use several herbs as medicines; their panacea for all ills, however, is the vapour-bath. When an Indian died he was laid out in state on a couch of skins; everything put on the body was new; his bow and arrows were laid at his side, along with his knife. His friends then assembled round him to feast, and when the feast was over his friends advanced, and taking his hand bade him farewell. Immediately after a funeral takes place the encampment is moved, lest the spirit of the deceased should revisit it. A widow or widower is forbidden to eat meat and certain vegetables for a month, and must wear quantities of spruce bush inside their shirts, next their skin. Cannibalism was never known among the Similkameens. In the mountain is a certain stone which is much venerated by the Indians, and it is said that striking it will produce rain. Polygamy was allowed, and if the husband and wife tired of each other, the price of the woman, or its equivalent, was returned by her father or guardian, and the parties were then free to contract another matrimonial alliance; but adultery, though it was generally compromised, was sometimes punished by cutting off the woman's nose or splitting her ears. Occasionally sick persons were buried before they were quite dead, and a good deal of infanticide was practised. The author has not found these Indians to be thieves, and gives them a general good character in other respects.

Geological Society, November 25.—Sir Archibald Geikie, F.R.S., President, in the chair.—The following communications were read:—On the os pubis of *Polacanthus Foxi*, by Prof. H. G. Seeley, F.R.S. Hitherto the evidence of the systematic position of *Polacanthus* has not been very precise. The author has detected the missing pubis as an isolated specimen. This he regards as the anterior portion of the left pubis, and appends a full description of the bone. He furthermore gives a critical account of our knowledge of other pelvic bones of the genus, and is led to associate *Agathaumus*, *Cratæomus*, *Omosaurus*, and *Polacanthus* in near alliance, in the Scelidosaurian division of the Order *Ornithischia*.—A comparison of the red rocks of the South Devon coast with those of the Midland and Western Counties, by Prof. Edward Hull, F.R.S. The author believes, with Dr. Irving, that the red rocks of Devonshire are representatives of the Permian and Trias which occupy so large a portion of the district bordering Wales and Salop, and which extend into the Midland Counties, and comments on the remarkable resemblance between the representative beds on either side of the dividing ridge of Palæozoic rocks which underlies East Anglia and emerges beneath the Jurassic strata in Somersetshire. He believes that the breccia forming the base of the series in the Torquay district is a representative of the Lower Permian division, but differs from Dr. Irving, in assigning the red sandstones and marls of Exmouth to the Trias, and not to the Permian as that author has done. He compares them with the Lower Red and Mottled Sandstones, and regards the Marls as of local origin, thus causing the beds to diverge from the normal type. The Budleigh Salterton Pebble-beds, with overlying sandstones and pebbly beds, he assigns to the horizon of the Pebble-beds of the Midland area, and points out that fossils of Silurian and Devonian types occur in the pebbles of both areas. The Upper Division of the Bunter is well shown at Sidmouth, and the author takes a calcareous breccia, two feet thick, which is found in the cliffs, as the basement-bed of the Keuper division.—Supplementary note to the paper on the "Red Rocks of the Devon Coast-section," Q.J.G.S., 1888, by the Rev. A. Irving. In this note the author accepts Prof. Hull's determination (see above) of the breccia at Sidmouth as the base of the Keuper, and discusses the age of the sandstones containing vertebrate remains discovered by Messrs. Whitaker, Metcalfe, and Johnston-Lavis. He brings forward evidence in support of his view that these are really of Upper Bunter age, notwithstanding the character of the organisms. He adds new material in support of his contention that the sandstones and marls which Prof. Hull assigns to the Lower Bunter are really Permian; but he is inclined to think that the breccias (in part, at least) pass laterally into the sandstones, and do not underlie them. From this it follows that the break between the Permian and Trias of Devon is marked by the absence of the Lower Bunter of the Midlands, and the author quotes remarks of Mr. Ussher in support of his view that there is an unconformity at the base of the Pebble-bed. In conclusion the author refers to the difficulties of ascertaining the exact age of the breccias, and notes that we cannot prove that the highest Carboniferous beds are present in Devonshire. He observes that there is no valid reason why the great breccia-sandstone series of Devon should not be the true equivalent of the Lower Rothliegendes both in time and position in the sequence, and that some portions of them may be even older than the Rothliegendes of some districts. He discusses the evidence furnished by the igneous rocks, and points out the abnormal position both for the British and German areas which these would occupy, if the breccias were of Triassic age. The reading of this paper was followed by a discussion, in which Mr. H. B. Woodward, Mr. Hudleston, Mr. Topley, Prof. Boyd Dawkins, the President, Prof. Hull, and the author took part.

December 9.—Sir Archibald Geikie, F.R.S., President, in the chair.—The following communications were read:—On the rocks mapped as Cambrian in Caernarvonshire, by the Rev. J. F. Blake.—High-level Glacial gravels, Gloppa, Cyrn-y-bwch, near Oswestry, by A. C. Nicholson (communicated by W. Shone). These gravels are found at Gloppa, and are situated at a height of from 900 to 1160 feet above sea-level, on the eastern slope of a ridge of Millstone Grit which forms the western border of the Cheshire and Shropshire plain. The beds present the appearance of having been abruptly cut off on the north-eastern slope. The gravels are in places much contorted, and false-bedding is frequent. They contain numerous striated erratics. Amongst the boulders are Silurian grits and argillites, granites like those of Eskdale, Criffel, &c., Carboniferous rocks, Lias shale, and Chalk flints. The shells are often broken, rolled, and striated, but the bulk of them are in fairly good condition. A list of the shells is given, including nine Arctic and Scandinavian forms not now living in British seas, nine northern types, also found in British seas, two southern types, and nearly fifty species of ordinary British forms. Comparative lists of the shells of Moel Tryfan and of those now living in Liverpool Bay are placed side by side with the list of shells from Gloppa. The reading of this paper was followed by a discussion, in which Dr. Hicks, Prof. Hull, Mr. Shone, Prof. Blake, the President, and the author took part. Some remarks sent by Mr. Clement Reid were read by the Secretary.—The subterranean denudation of the Glacial Drift, a probable cause of submerged peat and forest-beds, by W. Shone.

Royal Microscopical Society, November 30.—*Conversazione*.—There was a numerous attendance at this meeting, which passed off very successfully. The following objects and instruments were exhibited:—*Megalotrocha albo-flavicans*, by Mr. F. W. Andrew.—Foraminifera from the London Clay, by Rev. G. Bailey.—*Amphipleura pellucida*, *Arachnodiscus Ehrenbergi*, Polycystinæ from Barbadoes, a microscope with new substage focussing arrangement, by Messrs. R. and J. Beck.—Foraminifera from the Chalk, by Mr. E. T. Browne.—Hyaline Foraminifera from the Folkestone Gault—viz. *Vitriwebbina Sollasi*, n. sp. (Chapman), *V. lævis*, Sol., *Polymorphina Orbignii*, n. var. *cervicornis* (Chapman), by Mr. F. Chapman.—A thickened nodule of *Nitella translucens*, by Mr. E. Dadswell.—*Volvox* and *Batrachospermum* in saturated solution of common salt; diatom structure in medium (Br Ant_1, Br Ars_1, $Piperine_2$), by Mr. J. E. Ingpen.—*Filaria sanguinis hominis* (*diurna* and *nocturna*), prepared by Dr. P. Manson; *Bacillus anthrax* in lung; microscopes with new focussing arrangement to substage, by Messrs. Johnson.—*Epistylis flavicans*, *Lophopus crystallinus*, *Argulus foliaceus*, by Mr. R. Macer.—Transverse section of fertile head of *Equisetum arvense* showing spores and elators in *situ*, section of *Pilia grandiflora* showing reticulate and pitted cells, by Mr. G. E. Mainland.—*Hoplophora carinata* v. *pul-*

cherrina, a South European mite, by Mr. A. D. Michael.—Photographs and drawings illustrating the absorption of the tubercle and other bacilli by the leucocytes, photographs of micro organisms in dental caries, by Mr. J. H. Mummery.—Exhibition of natural history objects with the projection microscope, monochromatic light apparatus for microscopic work, by Messrs. E. M. Nelson and C. L. Curties.—Phagocytes inclosing tubercle-effusion from dorsal lymph-sac of frog, by Mr. Pound.—*Cherryfield rhomboides* in balsam, with a new $\frac{1}{12}$ apochromatic homogeneous immersion 1·4 N.A., by Messrs. Powell and Lealand.—A collection of different species of Rotifera, by Mr. C. Rousselet.—Photograph of a new apparatus for measuring drawings made with the camera lucida, by Sir Walter Sendall, K.C.M.G.—Petrological slides, transparencies of rock sections, Foraminifera, &c., by Mr. G. F. Smith.—Starch from potato fruit under $\frac{1}{4}$ inch, with polariscope, by Mr. W. T. Suffolk.—Photographs of *Podura* scales, by the Hon. J. G. Vereker.—Section of passion-flower, by Mr. J. J. Vezey.—Blight of grape vine (*Phylloxera*); *Bacillus mallei* (glanders); Pacinian corpuscles in mesentery of cat, chlorophyll of moss, Diatomaceæ from Jutland, a slide containing 100 species of *Pleurosigma*, by Messrs. Watson.

Entomological Society, December 2.—The Right Hon. Lord Walsingham, F.R.S., Vice-President, in the chair.—Dr. D. Sharp, F.R.S., exhibited and commented on a number of photographs of various species of *Lucanidæ* belonging to M. René Oberthür.—Mr. C. G. Barrett exhibited specimens of local forms and varieties of Lepidoptera, taken by Mr. Percy Russ near Sligo, including *Pieris napi*, var. near *bryoniæ; Anthocharis cardamines* (male), with the orange blotch edged with yellow, and yellowish forms of the female of the same species; very blue forms of *Polyommatus alsus;* males of *P. alexis*, with the hind margin of the under wings spotted with black, and very handsome forms of the female.—The Rev. S. St. John exhibited two specimens of *Lycæna argiades*, taken in Somersetshire by Dr. Marsh in 1884; three specimens of *Deilephila euphorbiæ*, bred from larvæ found feeding on *Euphorbia paralias* on the Cornish coast in September, 1889; and a series of various forms of *Anchocelis pistacina*, all taken in a garden at Arundel. Lord Walsingham, F.R.S., Mr. Barrett, and Mr. McLachlan, F.R.S., took part in the discussion which en-ued.—Mr. Jenner-Weir exhibited and made remarks on two dark specimens of *Zygæna minos* which had been caught in Carnarvonshire. He remarked that the specimens were not representatives of complete melanism, and suggested that the word "phæism"—from φαιός, dusky—would be a correct word to apply to this and similar departures from the normal coloration of a species.—Mr. C. J. Gahan exhibited specimens of the common "book-louse," *Atropos pulsatoria*, Fabr., which he had heard making a ticking noise similar to that made by the "death-watch" (*Anobium*).—Mr. B. A. Bower exhibited the following rare species of Micro-Lepidoptera: *Spilonota pauperana*, Fröl.; *Gelechia osseella*, Stn.; *Chrysoclysta bimaculella*, Haw.; and *Elachista cingilella*, Fisch.—Mr. R. Adkin exhibited a variety of *Anthocharis cardamines*, and one specimen of *Sesia scoliæformis* bred from a larva found at Rannoch.—Mr. G. T. Baker read a paper entitled "Notes on *Lycæna* (recte *Thecla*) *rhymnus*, *tengstræmii*, and *pretiosa*." A discussion followed, in which Lord Walsingham, Captain Elwes, and Mr. Baker took part.—Mr. F. Merrifield read a paper entitled "The effects of artificial temperature on the colouring of *Vanessa urticæ* and certain other species of Lepidoptera." The author stated that both broods of all three species of *Selenia*, *Platypteryx falcataria*, *Vanessa urticæ*, *Bombyx quercus* and var. *callunæ*, and *Chelonia caja* were affected by temperature in the pupal stage, the lower temperature generally producing the greater intensity and darkness of colour; some of the *Vanessa urticæ* made a near approach to the var. *polaris* of Northern Europe. A long discussion ensued, in which Mr. E. B. Poulton, F.R.S., Prof. Meldola, F.R.S., Mr. Barrett, Mr. Jenner-Weir, and Lord Walsingham took part.—Mr. W. Bateson read a paper entitled "On the variation in the colour of the cocoons of *Eriogaster lanestris* and *Saturnia carpini*," and exhibited a large number of specimens in illustration of the paper. Lord Walsingham congratulated Mr. Bateson on his paper, and on the intelligent care and method shown in his experiments, and said that he was glad to see that at Cambridge there was an entomologist ready to enter this interesting field of investigation, and perhaps at some future day to contest the palm with Mr. Poulton as representing the sister University of Oxford. He had noticed that the larvæ of *S. carpini*, if left in a box with dead food, and probably partially starved, made a light-coloured cocoon; but that when the cocoon was made under natural conditions, on living food-plants on the moors, it was of a dark colour. Mr. Poulton and Prof. Meldola continued the discussion.

Linnean Society, December 3.—Prof. Stewart, President, in the chair.—The President announced the recent bequest by the late Sir George MacLeay, K.C.M.G., of a marble bust of his father, the late Dr. William Sharp MacLeay, formerly a Fellow and Vice-President of the Society.—The President then exhibited a series of specimens of a South American beetle, showing the extremes of variation of colour observable within the limits of a single species.—Mr. J. E. Harting exhibited a photograph of an abnormally situated nest of the chimney swallow (*Hirundo rustica*), which had been built for the second time on a swinging hook in an outhouse; and made some remarks on three recorded cases of swallows nesting in trees, a most unusual habit.—The Botanical Secretary read a paper by Mr. W. West, on the Fresh-water Algæ of the West of Ireland, and exhibited by way of illustration a number of preparations under the microscope, and a series of beautiful drawings by the author. The paper was criticized by Messrs. A. W. Bennett and E. M. Holmes, both of whom testified to the excellence of the work done and the value of the drawings.—The Zoological Secretary next read a paper by Dr. W. H. Strachan, on the tick pest of Jamaica, which was characterized as of so serious a nature as to demand investigation by entomologists, with a view to a remedy. An interesting discussion followed, in which Mr. D. Morris gave a variety of details from personal experience during a residence of some years in Jamaica, and Mr. A. D. Michael pointed out the generic characters of certain West Indian ticks which were likely to include those found in Jamaica by Dr. Strachan. The question of remedy for this plague was discussed by Dr. John Lowe, and Messrs. T. Christy, C. Breeze, and T. J. Briant.

CAMBRIDGE.

Philosophical Society, November 23.—The following communications were made:—The self-induction of two parallel conductors, by Mr. H. M. Macdonald. The well-known expression for the self-induction of two parallel wires (Maxwell, § 685) holds only for the case when neither of them is magnetic. For the case when both wires are magnetic, the value of the coefficient is found, in this paper, in the form of an infinite series. This series can be expressed in finite terms when only one of the wires is magnetic, and then gives

$$\mathrm{L} = \tfrac{1}{2}(\mu + \mu_0) + 2\mu_0 \log \frac{b^2}{aa'} + 2\mu_0 \frac{\mu - \mu_0}{\mu + \mu_0} \log \frac{b^2}{b^2 - a^2},$$

where μ_0 is the permeability of the surrounding media (viz. usually unity), a the radius of the magnetic wire of permeability μ, a' the radius of the other wire, and b the distance between their lines of centres. The effect of the magnetic quality is exhibited by means of numerical tables.—The effect of flaws on the strength of materials, by Mr. J. Larmor. The effect of an air-bubble of spherical or cylindrical form in increasing the strains in its neighbourhood was examined; and it was suggested that the results might be of practical service in drawing general conclusions as to the influence of local relaxations of stiffness of other kinds. In particular, a cavity of the form of a narrow circular cylinder, lying parallel to the axis of a shaft under torsion, will double the shear at a certain point of its circumference; and the effect of a spherical cavity will not usually be very different. It is assumed in the analysis that the distance of the cavity from the surface of the shaft is considerable compared with its diameter, so that the influence of that boundary may be left out of account in an approximate solution.—The contacts of certain systems of circles, by Mr. W. McF. Orr.—On liquid jets, by Mr. H. J. Sharpe. The problem is treated by the method of Fourier series.

DUBLIN.

Royal Society, November 18.—Prof. A. C. Haddon, President of the Scientific Section, in the chair.—An analysis of the spectrum of sodium, by Dr. G. Johnstone Stoney, F.R.S. The position of the lines which present themselves in the spectrum of hydrogen are given, or approximately given, by Balmer's law, viz.

$$n = k\left(1 - \frac{4}{m^2}\right),$$

where $k = 274{\cdot}263$. In this formula n becomes the oscillation frequency of the successive lines, when for m we write the integer numbers 3, 4, 5, &c. Similarly, Profs. Kayser and Runge have found that A, B, and C can be determined so that the empirical formula,

$$n = A + B\frac{1}{m^2} + C\frac{1}{m^4},$$

shall approximately represent the positions of the lines in any one of the three series that present themselves in the spectra of the other light monad elements—Li, Na, K, Rb, Cs. These formulæ have an important physical meaning. They indicate that n is a function of $1/m$; in other words, that although the periodic times of the successive rays are not themselves a fundamental period with its harmonics, as is the case with the vibrations that give rise to musical sounds, they in some way depend on an event of this simple character which is going on in the molecules from which the spectrum emanates. Balmer's law may be represented by a very simple diagram which places this relationship in evidence. Draw the parabola

$$y^2 = \frac{1}{4k}(k - x),$$

and place its axis horizontal. Erect an ordinate at the distance k from the vertex. Double this out, and using its double length as unit, set off upon it the harmonics 1/3, 1/4, 1/5, &c. From each of the points so determined draw horizontal lines to the curve: these are the values of n for the successive lines of the hydrogen spectrum. Now, having regard to the fact that the light monad elements, H, Li, Na, K, Rb, Cs, have all of them series of lines which appear to belong to the same general type, we are justified in assuming that Balmer's law is the simplest case of a general law which prevails throughout all the light monads. Hence, if the oscillation-frequencies be plotted down as the horizontal lines of a diagram constructed as above with $x = n$ and $y = 1/m$, the curve passing through the ends of the lines in the other monads should be some curve of which the parabola is a particular case. This may happen in different ways, but the simplest hypothesis is that they are hyperbolas or ellipses. Accordingly, the author has tried this hypothesis in the case of the sodium spectrum, with the result that hyperbolas approximately represent series P (the principal series) and series S (the series of sharp lines), and that a parabola represents the third series, series D (the series of diffuse lines); and with the further interesting result that the only line in the sodium spectrum which has not hitherto fallen into its place as a member of one or other of the three series proves to be in reality the first term of series S, with a value for n which is negative instead of positive. The physical meaning of this is that the revolution going on within the molecules round that elliptic partial which gives rise to this double line is in the opposite direction to what it would have been if its n had been positive (see memoir by the author "On Double Lines in Spectra," recently published in the Transactions of the Royal Dublin Society). The equation of an hyperbola being

$$(a - x)^2 = P(b + 1000 \,.\, y^2),$$

the values to be attributed to the constants for series P of the sodium spectrum are approximately—

$$\log P = 3{\cdot}7740300$$
$$a = 3337{\cdot}4120$$
$$b = 1438{\cdot}35$$

and their values for series S are—

$$\log P = 2{\cdot}5263843$$
$$a = 434{\cdot}0587$$
$$b = 108{\cdot}514.$$

The equation of a parabola being

$$x = a - 1000 \,.\, by^2,$$

the values of the constants for series D are—

$$a = 244{\cdot}93,$$
$$\log b = 0{\cdot}04357.$$

The investigation shows that in series P and series S of the sodium spectrum, the curve of nature is not an exact hyperbola, but a curve slightly less curved in the neighbourhood of its vertex. It also indicates that there is probably a line in the sodium spectrum, belonging to series P, at or a little less than the wavelength 2130.—Mr. J. Joly exhibited and described a shutter for use in stellar photography. This shutter enables any bright star in the field of the telescope to be covered at will, so as to secure better definition. The shutter is a small watch-spring magnet, adjustable to any part of the field, and pivoted so that it can be rotated by the action of a current which circulates round the field in a narrow coil. In one position of the magnet the star is exposed, in the other covered. A modification for parallax work, suggested by Mr. A. A. Rambaut, and used at Dunsink Observatory, has the magnet and coil to one side of the field, and the shutter, which is carried on a needle attached to the magnet, fixed in the centre of the field. There is no vibration in these shutters, owing to the small mass of the moving parts. In the first form, the current in the one coil may control shutters placed in any part of the field of the telescope, so that, if desirable, more than one star may be covered.—Prof. T. Johnson described the structure and function of the peculiar swellings (callosities) of *Nitophyllum versicolor*, Harv., and pointed out the bearing of his observations on the specific character of *N. versicolor*, and Schmitz's views on the structure of the Floridean thallus.—Mr. E. W. L. Holt read a list of the rarer shore and deep-sea fishes obtained during the cruise of the s.s. *Harlequin* on the west coast of Ireland (1891). One fish, *Centrophorus squamosus* (Gm. L.), taken in deep water off the Mayo coast, is new to the British fauna. The following are new to the Irish fauna: *Raia oxyrhynchus* (Linn.), from 500 to 375 fathoms, and from shallow water; *Raia microcellata* (Mont.), from shallow water—coast of Mayo and Donegal; *Rhombus norvegicus* (Gthr.), from shallow water—Donegal Bay; *Arnoglossus grohmanni* (Bonap.) was again taken; *Crystallogobius nilssoni* (Düb. and Kor.) proved to be abundant everywhere, between 10 and 35 fathoms. The following were amongst the forms, usually inhabiting littoral water, which were taken at more than 100 fathoms: *Scyllium canicula*, *Acanthias vulgaris*, *Galeus vulgaris*, *Raia oxyrhynchus*, *Gadus æglifinus*, *Conger vulgaris*.

PARIS.

Academy of Sciences, December 7.—M. Duchartre in the chair.—Reply to a note by M. Besson on phosphides of boron, by M. Henri Moissan. The author points out that he remarked upon the reaction between boron and phosphorus in a paper presented on April 6, 1891, and more fully described its properties on July 6, 1891. He therefore claims priority over M. Besson, who first presented a note on the subject on July 13.—On the theory of linear differential equations, by M. André Markoff.—On modifications of the adiabatism of a contracted gaseous stream, by M. H. Parenty.—The vapour tensions of cobalt chloride solutions, by M. Georges Charpy. The graphic representation of the tensions at different temperatures of a solution saturated in the cold (containing 32 per cent. of $CoCl_2$) gives two right lines from 20° to 40°, and from 75° onwards respectively, joined by a curve. Each of these right lines corresponds to a definite state of hydration of the salt; the lower represents the tension of a red solution, the upper of a blue one. These results agree with those of M. Etard, but the interval of passage between the two states is from 40° to 75° instead of from 35° to 50°, as found by this observer, a difference explained by the use of saturated solutions in his experiments.—Action on some metals of sodammonium and potassammonium, by M. Joannis. (See Notes.)—Calculation of the temperature of ebullition of isomeric ethers of the fatty acids, by M. G. Hinrichs.—Thermal data concerning active malic acid and potassium and sodium malates, by M. G. Massol. The heat of solution of the anhydrous acid is (per mol. in 4 litres), $-$ 3·31 Cal.; heats of neutralization—by K = + 26·23 Cal., by Na = + 24·86 Cal.; heats of solution of the anhydrous salts:

$C_4H_5O_5K$ in 6 litres = $-$ 5·78 Cal.
$C_4H_4O_5K_2$ in 8 litres = + 1·55 Cal.
$C_4H_5O_5Na$ in 6 litres = $-$ 1·66 Cal.
$C_4H_4O_5Na_2$ in 8 litres = + 1·78 Cal.

The heats of formation of the salts indicate that malic acid lies between succinic and oxalic acids in the energy of its action.—

The rotatory power of silk, by M. Léo Vignon.—Ammonia in atmospheric waters, by M. Albert Lévy. At the previous meeting of the Academy, MM. Marcano and Müntz gave the results of twenty estimations of ammonia in rain caught at Caracas, and the mean (1·55 mgr. per litre) was thought by M. Müntz to be higher than that obtained in our latitudes. M. Lévy, however, shows that a higher proportion has been frequently obtained in France and elsewhere. He has estimated the ammonia and nitric acid in all the rainfalls at Montsouris for sixteen years. The average number is 150 per year; and from these 2000 or 3000 measures, a mean weight of 2·2 mgr. of ammonia per litre has been obtained.—In which part of the nervo-muscular system is inhibition produced?, by M. N. Wedensky.—The antennal gland of Amphipodes of the Orchestiidal family, by M. Jules Bonnier.—New list of large Cetacea stranded on the French coast, by MM. G. Ponchet and H. Beauregard.—On the parasitic fungus of *Lachnidium acridiorum*, Gd., by M. A. Girard. —On the germination of grains of *Araucaria Bidwilli*, Hook., and *Araucaria brasiliensis*, Rich., by M. Ed. Heckel.

BERLIN.

Physiological Society, November 13.—Prof. du Bois Reymond, President, in the chair.—Prof. H. Munk gave an account of further experiments made in his laboratory, on the effect on the larynx of section of the superior laryngeal nerve in the horse, and which had again led as their result neither to paralysis nor atrophy of the laryngeal muscles.—Dr. Krüger having investigated the chemical constitution of adenin and hypoxanthin, finds that they belong to the uric acid group. When treated with hydrochloric acid at 130° C., they yielded glycocoll, and by a more profound decomposition with bromine, potassium chlorate, and hydrochloric acid, alloxanthin and urea were obtained.

Physical Society, November 20.—Prof. Kundt, President, in the chair.—Prof. A. du Bois Reymond explained, starting from the discovery of electrodynamic rotations produced by alternating currents made by Galileo Ferraris in 1888, how the rotation of the magnetic field is employed in the construction of rotatory current motors, and exhibited several forms of the instrument to the Society. The principle discovered by Ferraris has undergone very material modification during its practical application, and has led to most interesting scientific results.

December 4.—Prof. von Helmholtz, President, in the chair. —Dr. Assmann described his aspiration-meteorograph intended for use in captive balloons.—Dr. Wolff spoke on the permanency of an accumulator battery which had been standing for a year, until the fluid in it had evaporated to dryness, and which, on being recharged, almost immediately recovered its original strength.

Meteorological Society, December 1.—Prof. Schwalbe, President, in the chair.—Dr. Assmann spoke on meteorological observations during balloon voyages and in captive balloons. For the determination of temperature, humidity, and atmospheric pressure in a free balloon, the aspiration thermometer and an aneroid barometer suffice. Comparative measurements made by Rotch in Paris and in Berlin, during balloon voyages, showed that a Richards thermograph records a temperature some 8° C. higher than does a maximum and minimum thermometer, and the latter shows a temperature always 2° C. higher than does an aspiration thermometer. In order to carry out prolonged observations on humidity during a balloon trip, three aspiration thermometers must be combined, of which two are alternately moistened while the third is kept dry. For use in captive balloons self-registering instruments must be employed, whose construction, owing to the frequently violent vertical jolts of the balloon, presents considerable difficulty. The speaker exhibited tracings which showed that these difficulties had been overcome by him. Temperature is recorded by a bent Bourdon tube filled with alcohol, humidity by a hair hygrometer, and atmospheric pressure by an aneroid; all these instruments being placed in a space in which aspiration is continuously kept up. Each instrument records upon a cylinder which rotates once in about five hours. The German Ballooning Society proposes to make simultaneous observations (1) in a free balloon, (2) with a self-recording apparatus suspended by a long cable from the car of the balloon, (3) with a second similar apparatus in a captive balloon, and (4) at the earth's surface. By this means simultaneous determinations of temperature, humidity, and pressure at four different air-levels would be obtained.—Prof. Spörer described the appearance of two groups of sun-spots, of which one was unaccompanied by any disturbances of terrestrial magnetism, while the other was followed by very strong disturbances.

BOOKS, PAMPHLETS, AND SERIALS RECEIVED.

BOOKS.—La Rose: J. Bel (Paris, Baillière).—Les Champignons: A. Acloque (Baillière).—La Place de L'Homme dans la Nature: T. H. Huxley (Baillière).—Analysis of Theology: Dr. E. J. Figg (Williams and Norgate). —Sul Regime delle Spiagge e sulla Regolazione dei Porti: P. Cornaglia (Torino, Paravia).—Reports on the Mining Industries of New Zealand, 1891 Wellington, Didsbury).—Annual Report of the Department of Mines, N.S.W., 1890 (Sydney, Chapman).—The Embryology of the Sea Bass: Dr. H. V. Wilson (Washington).—Electricity up to Date: J. B. Verity (Warne).—Studies in Anatomy from the Anatomical Department of the Owens College, vol. i. (Manchester, Cornish).—The Living World: H. W. Conn (Putnam). —A Natural Method of Physical Training: E. Checkley (Putnam).—Notes on Building Construction, Part 4 (Longmans).—Botanical Wall Diagrams (S.P.C.K.).—Œuvres Complètes de Christiaan Huygens, tome quatrième (La Haye, M. Nijhoff).—L'Electricité dans la Nature: G. Dary (Paris, G. Carré).—Thermodynamique: H Poincaré (Paris, G. Carré).—Through Equatorial Africa: H. von Wissmann; translated by M. J. A. Bergmann (Chatto and Windus).—Mission Scientifique au Cap Horn, 1882–1883, tome vii., Anthropologie, Ethnographie: P. Hyades and J. Deniker (Paris, Gauthier-Villars).—Whitaker's Almanack, 1892 (Whitaker).

PAMPHLETS.—Higher Education in Indiana: Dr. J. A. Woodburn (Washington).—Rules for a Dictionary Catalogue, 3rd edition; C. A. Cutter (Washington).—Promotions and Examinations in Graded Schools: Dr. E. E. White (Washington).—Sanitary Conditions for School-houses: A. P. Marble (Washington).

SERIALS.—Journal of the Chemical Society, December (Gurney and Jackson).—Journal of the Royal Horticultural Society, vol. xiii. Part 3 (117 Victoria Street).—L'Anthropologie, 1891, tome ii No. 5 (Paris, Masson).—The Asclepiad, No. 32, vol. viii. (Longmans).—Botanische-Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Vierzehnter Band, 4 Heft (Williams and Norgate).

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