THURSDAY, NOVEMBER 9, 1899.

THE GEOLOGY OF THE SOUTHERN UPLANDS OF SCOTLAND.

The Silurian Rocks of Britain. Vol. I. Scotland. By B. N. Peach, F.R.S., and J. Horne, F.R.S.E.; with Petrological Chapters and Notes by J. J. H. Teall, M.A., F.R.S. Pp. xviii+749; plates xxvii, and a coloured map. (Memoirs of the Geological Survey of the United Kingdom, 1899.)

THE student of historical geology, in his endeavour to obtain a comprehensive view of the sequence of events in a particular area, is too frequently conscious that he is gazing at a distorted picture. It is probably beyond the power of any one person to gather together the tangled mass of detail, and by a process of anamorphosis, to illustrate the geology of even a single country in such a manner that while the proportions of the whole work are harmonious, every important detail is also presented with conspicuous clearness. But that which is too much for one person may be carried out by a band of workers under the direction of one chief; and fortunately we in Britain, the mother-country of stratigraphical geology, not only possess this band, but know that it is actually engaged in the accomplishment of the desired work.

It is now some years since the first volume of a series of memoirs devoted to a detailed study of the various great groups of the British stratigraphical rock-column was issued by H.M. Geological Survey. This series, when complete, will place within reach of the geologist a history of the British strata, of which we cannot overestimate the value. The Jurassic rocks of Britain have already been described in two volumes: one, by Mr. Fox-Strangways, treating of the Jurassic rocks of Yorkshire; the other, by Mr. H. B. Woodward, describing those of the other British areas. Another volume, by Mr. Clement Reid, is devoted to the Pliocene strata, and we are now presented with the first volume of the series in which the British Silurian rocks will be described, the particular volume under consideration containing an account of the Silurian rocks of Scotland.

The most important area of Silurian rocks in Scotland is developed in the Southern Uplands, and to consideration of this area the present volume is essentially confined. It is noted, however, that igneous rocks and radiolarian cherts have been detected along the southern border of the Eastern Highlands; and in this connection it is interesting to note that Hugh Miller in his "Rambles of a Geologist" records, on the authority of Dr. Emslie, the occurrence of graptolites in a slate quarry at Gamrie Head, near Banff.

In glancing at the memoir by Messrs. Peach, Horne and Teall, we are at once struck with the fact that the great bulk of the contents consists of records of fresh observations. The amount of work which the authors have performed in the field and the laboratory is surprising even to the general reader, still more so to any one who from some knowledge of the area is cognisant of its extraordinary complexity.

Great as the amount of new work recorded in this volume undoubtedly is, the authors took up their study of the region subsequently to its description by a number of other geologists, of whom the illustrious Hutton was the first, while Prof. Lapworth, as is well known, reduced the stratigraphy of the area to order in several masterly papers appearing in the *Quarterly Journal of the Geological Society*, the *Geological Magazine*, and the *Annals and Magazine of Natural History*. The importance of Prof. Lapworth's work is acknowledged in the volume under notice, in the fullest manner, both in the chapter devoted to the history of previous researches in the south of Scotland and in those which treat of the geology of the region in detail.

Though Lapworth led the way to appreciation of the complicated nature of the geology, the authors of the memoir have not only verified his conclusions, but added a great deal of confirmatory matter, and have furthermore made a series of discoveries which throw light upon questions of prime importance to geologists.

Among the discoveries which are of general interest as shedding light upon geological matters of widespread importance, we may notice the discovery of Arenig graptolitic mudstones, radiolarian cherts and contemporaneous volcanic rocks over very wide tracts of country in the Southern Uplands and South-eastern Highlands; the detection of the occurrence of further volcanic outbursts in Llandeilo and Caradoc times; the evidences of the lateral variations in the sediments of different ages indicating a source of supply of terrigenous sediment to the north-west of the area, and of the gradual encroachment of the coarser sediments to the south-east, in the later periods of Silurian times; the definition of a Downtonian period between Ludlow and Old Red Sandstone times, and the description of the rocks of this period; and the discovery of a remarkable fauna of fishes in these Downtonian strata, which has been described by Dr. Traquair. The above discoveries are mainly due to Messrs. Peach and Horne, who, like Lapworth, have chiefly utilised the graptolites as a means of comparing the strata of different localities, though they have also obtained much assistance from the persistent cherts, which, as shown many years ago by Dr. G. J. Hinde, were largely formed by the accumulation of tests of radiolaria. The writers appear to adopt the suggestion that these radiolarian cherts are deep-water deposits, though, in consideration of the evidence which they adduce in support of the existence of a tract of land at no great distance to the north-west, it seems doubtful whether the cherts are strictly comparable with the abyssal radiolarian oozes of modern oceans. Mr. Teall gives a petrographical account of the remarkable volcanic rocks associated with the radiolarian cherts, and of the contemporaneous volcanic rocks of higher strata; also a description of the intrusive rocks of the Girvan and Galloway district, with details of the nature of the metamorphism impressed upon the rocks surrounding the irruptive igneous masses. One exceedingly significant suggestion is made to the effect that the coarsely crystalline plutonic rocks were consolidated beneath a small thickness of overlying rock-cover, though it is stated that the evidence for this is imperfect.

The results of the palæontological investigations are

summarised in lists of fossils, occupying about fifty pages at the end of the work; these, and the detailed lists of fossils appearing throughout the book, will be of the utmost value to the stratigraphical palæontologist.

The form in which the book is presented to the reader is excellent, and the work is well illustrated. In addition to the numerous diagrams and sections illustrative of the geology of the area, which are scattered through the memoir, there are seventeen plates reproduced from photographs illustrating the appearance of some of the sediments, including the radiolarian cherts, and especially of the volcanic rocks, both lavas and fragmental accumulations; in connection with the lavas, we may particularly note the illustrations of the remarkable rocks with "pillow-form" structure which are associated with the radiolarian cherts. Of the remaining plates, eight represent microscopic sections of various rocks, while two are devoted to illustrations of characteristic graptolites. In addition to these plates, there is a well-coloured geological map of the area, on the scale of ten miles to the inch.

The third chapter of the book, in which the authors give a general description of the Silurian rocks of the Southern Uplands, will be read by all geologists; the detailed descriptions in the other chapters will be largely utilised by those who visit the region; and, if we mistake not, these visitors will in future become very numerous, attracted to the district owing to the publication of a memoir upon a region of exceptional complexity but also of exceptional interest—a memoir which will at once take its place as a classic in geological literature. J. E. M.

THE PHILOSOPHY OF ATOMIC THEORIES.

Essai critique sur l'Hypothèse des Atomes dans la Science contemporaine. Par Arthur Hannequin, Professeur à la Faculté des Lettres de l'Université de Lyon. Second edition. Pp. 457. (Paris: Alcan, 1899.)

PROF. HANNEQUIN attempts, in the first of the two books into which his work is divided, by a discussion of the first principles of mathematical knowledge and a study of the progress of physical and chemical science, to establish at once the necessity and the contradictions of atomism; in the second book it is sought to reconcile the contradictions by an appeal to metaphysics.

According to M. Hannequin it is by a necessity of its nature that human science reduces all to the atom as it has already reduced all to motion—the need to render intelligible all that falls under the intuition of the senses or all phenomena. Our mind can only take hold of or comprehend what comes from itself, it only knows fully what it creates. Thus science in the measure of its rigour and certainty is a creation of our mind. The science *par excellence*, the science derived entirely from the mind is the science of number. Physical atomism is not imposed on science by reality, but by our method and by the nature of our knowledge. It does not necessarily imply the real discontinuity of matter; it implies only that we make it discontinuous in order to comprehend it. It has its origin in the universal use of number.

"The atom is found at the end of all analysis as the product of the struggle of quantity against magnitude, of unity and number against the multiplicity and continuity of space and time."

In Chapter i. of the first book M. Hannequin discusses the question whether pure geometry itself involves the notion of quantity, and therefore of number, and concludes that it does. Amalytical geometry more obviously does so, and the author discusses at some length what is involved in the process of differentiation. Infinitesimal analysis appears to him to lead the mind necessarily to postulate in every geometrical object indivisible elements. On the other hand he concludes that all attempts, such as that of Cantor, which is criticised at some length, to express continuity by means of number must fail.

The analysis which gives us the concept of the geometrical element would not of itself, according to M. Hannequin, have given us that of the atom, had not our mind demanded the mathematical explanation of nature.

With mechanics our mathematics approaches as closely as it can phenomena and reality. In Chapter ii., on "Atomism and Mechanics," the author sets out to show that our ideas of motion lead us straight to the discontinuity of matter. His treatment of the fundamental notions of mechanics, of motion, force, mass, is interesting but not always convincing. For instance, it scarcely seems legitimate to make the first law self-evident by saying that when a body is in a state of uniform rectilinear motion or is at rest, one has the right to affirm by definition that it persists in an identical state, and that to no change corresponds no cause; on the other hand, to every definite variation of velocity or to every acceleration must correspond a definite cause which we call a force.

The hypotheses of centres of force, such as that of Boscowich, are condemned by Hannequin on what appear to be inadequate grounds. Vortex rings meet with no better fate.

When we come to "kinetic atomism" the necessity of postulating atoms becomes more apparent than the author has thus far succeeded in making it, and at the same time contradictions also appear. The difficulties of kinetic atomism as brought out by M. Hannequin are twofold. In the first place, we have the contradiction between the indivisibility of the atom and its perfect elasticity. In the second place, the number of atoms can neither be infinite nor finite. It is apparently atomism of the most thorough-going kind that is here considered, action at a distance being excluded and gravitational energy being taken as kinetic; otherwise there is no difficulty in holding the number of atoms to be finite.

In Chapter iii., on atomism and nature, the author attempts to show that the particular sciences of nature arrive at atoms of different and decreasing orders.

The chemical atom is first considered; the laws of definite and multiple proportions, and the methods of determining the relative masses of the atoms with the aid of Avogadro's and Dulong and Petit's laws being discussed. The possibility of the existence within the chemical atoms of smaller primordial atoms is next treated with reference to Prout's hypothesis and the facts of thermal chemistry and chemical affinity.

From the facts of optics we deduce the existence of an æthereal medium, which according to Fresnel's view is discontinuous. (A good account is given in this section of the struggle between the corpuscular and undulatory theories.) The dispersion of light as interpreted by Cauchy lends support to the discontinuity of the medium.

Unfortunately, the luminiferous æther cannot be made to explain gravitation. The author discusses some of the theories of gravitation, such as that of Lesage. Moreover, the elastic æther which transmits light cannot account for electro-magnetic actions. Prof. Hannequin also finds difficulties in the electro-magnetic theory of light; these appear to rest, however, not on any impossibility of accounting for optical phenomena on the electro-magnetic theory, but on the irreconcilable differences in the properties of the æther as originally invented to explain light and those of the electro-magnetic æther.

In this way we arrive at a multiplicity of irreconcilable æthers as well as a multiplicity of irreconcilable atoms.

The necessity and the contradictions of atomistic explanations of nature having thus been brought out, the author concludes his first book as follows:—

"Why should atomism be found everywhere in modern science to such an extent that it is, as it were, its vital principle, if its contradictions were final, and if they had not their last reason in the very substance of a reality which only appears to us under the obscure veils of space and time, but which perhaps will reveal its law to him who will seek it above extension and duration, or in a word above the appearances which science analyses?"

We are thus led to the purely metaphysical part of the work, which it would be out of place to attempt to discuss here. The final chapter, however, sums up the conclusions arrived at. Science will never attain to the indivisible towards which she seems to be incessantly marching; if she did reach it, she would be unable to explain nature by means of it. Our difficulties vanish if we render to the atom its true sense—the element, definite but always complex, with a minimum of extension in space and a minimum also of dynamical attributes. And instead of seeing in it the real individual stripped of all activity and of all quality, all that we ought to see in it is the work of the mind pursuing in space the reduction without end of phenomena which, though pure appearances, are appearances which have their basis in reality.

There can be no question of the interest and importance of a philosophical examination of the foundations of science such as M. Hannequin has attempted.

He has, we think, exaggerated the inconsistencies of the "atoms" postulated for different purposes. So long as we do not imagine that we have ever to deal with absolute indivisible structureless atoms the contradictions do not exist. Most of us would agree with M. Hannequin as to the barrenness of any system of absolute atomism.

There is no reference in the book to any of the more direct methods in which matter is proved to have a discontinuous structure, and by which an estimate is obtained of the size of the molecules; such methods as are described in Lord Kelvin's lecture on the size of atoms (Popular Lectures and Addresses). This is surely a serious omission.

OUR BOOK SHELF.

Elements of Physics. By Henry Crew. Pp. xiv + 347. (London: Macmillan and Co., Ltd. New York: The Macmillan Company, 1899.)

THE writer of this review possesses a collection of text-books of physics written during the first half of this century, all the volumes put together occupying a length of about six feet on his book shelves. He sometimes wonders where a future collector would find the space for all the text-books written now, when professors who have not written their own text-books are beginning to be rare curiosities. The proportion of books, however, that possess any originality has not increased, and may be put down, roughly speaking, as one in ten. The rest may be good because they have been inspired by good books, but there is a dreary similarity between them.

It would be ungracious to make these remarks while reviewing one of the average class of productions, and it must therefore at once be stated that Mr. Crew's volume cannot help striking the reader at once as having been the result of a good deal of thought, both in wording and arrangement. The book is very elementary. I think it is customary in this country to enter somewhat more fully into many parts of the subject, even in a first course. On the other hand, it treats of several matters which it is customary to omit, and it is on this point that we wish specially to commend the volume.

I note with great satisfaction a general chapter on waves, before the special consideration of sound waves is entered upon, also the introduction—at an early stage—of the wave theory of light. The great amount of time which, owing to examination requirements, we are forced—often against our will—to devote to geometrical optics, would much more usefully be spent in explaining (as the writer seems to do) the elements of diffraction and interference.

It is, further, a satisfaction to see frequent allusions to the phenomena of every-day life, and this feature might have been still further extended by including, for instance, some reference to the principal meteorological phenomena. No doubt very often the most common occurrences are most difficult to explain, and it may be impossible to give to elementary students a satisfactory explanation of, *e.g.*, the rainbow or the blue colour of the sky. But unless the attempt be made the students generally carry away the impression that what they learn in the lecture room belongs to a different part of their existence from what they can see and observe outside the college buildings. The book begins with mechanical and kinematical principles, including among other matters the consideration of harmonic oscillation and a well-considered chapter on the properties of matter.

Altogether it forms an admirable introduction to the study of physics. The only criticisms I should like to make, refer to some of the illustrations; but as the book only suffers to a slight extent from the prevailing epidemic of bad illustration caused by the spreading microbe of cheap processes of reproduction, we must be satisfied and say no more about it. ARTHUR SCHUSTER.

A Laboratory Outline of General Chemistry. By Alexander Smith. Pp. 88. (Chicago: Kent Chemical Laboratory of the University of Chicago, 1899.)

THIS book comes with a strong claim to attention. I is an untrammelled attempt to lay down a course of practical chemistry in an educational and scientific spirit, and the author's introduction sounds a pleasing note.

Much thought, care, and experience are embodied in the work, and though no claim to originality of material is made there are a good many things included that are fresh to books on practical chemistry. The author makes some very just remarks on the difficult question of the correlation of lecture and laboratory work, and it

is to be remarked that the efficacy of the course he lays down must depend very largely on the adjustment to it of lecture and tutorial instruction. How successfully this difficulty has been met in the University of Chicago we have not the means of judging. The book as it stands leaves the reader under the necessity of constructing in imagination the whole course of lectures or preferably "conferences" to which it is essentially related, and it is hardly likely to be put in use by English teachers unless they are prepared to recast their oral teaching to suit it.

The particular order in which the topics of general chemistry are to be treated, the particular points to be elucidated by the student's own experiments, are matters which may afford room for endless choice, but after that, in the point of method, there is a clearer right and wrong to choose between. We believe that some chemists may take exception to Dr. Smith's order and choice of topics, but his method of bringing them before the student will probably meet with general approval. He strives throughout to cultivate the investigator's attitude of mind, bearing in mind however that it is impracticable for the laboratory training of a chemist to be wholly carried out on this plan. The text is interspersed with question marks and with parenthetical injunctions to the student to interpret and correlate his facts.

The exercises are all drawn from inorganic and physical chemistry, and include an elementary study of the cardinal points of theory. We can well believe that this course of practical work, combined with properly conducted class meetings, will furnish a much more effectual introduction to the study of chemistry than students ordinarily obtain in Universities, where the continuous expository lecture to junior classes, unlimited in size and containing all sorts and conditions of students, is still the customary, if not the inevitable, method of procedure. A. S.

Ueber den Habitus der Coniferen. Von Dr. A. H. Burt. Pp. 86. (Tübingen: Verlag von Franz Pietzcker, 1899.)

THIS inaugural dissertation is mainly concerned with an analysis of the forms exhibited by the different groups of conifers. Following Vöchtung, the author recognises two principal types—the monocormic and polycormic respectively. The former is characterised by the presence of a decided main axis, the lateral axes being dominated by its growth; the common spruce fir is an example of a monocormic conifer. Polycormic forms are met with in cypresses and junipers, in which the lateral branches are not all reduced to subordinate and graduated positions; whilst in the cedars, forms are met with which combine the characters of both of the principal types.

Elaborate tables of measurements of the relative lengths of main and lateral shoots, and of the angles made by them, are given in the text, and clearly bring out the factors on which the shapes of conifers depend.

Beasts: Thumb-nail Studies in Pets. By Wardlaw Kennedy. Pp. xvi + 152. (London: Macmillan and Co., Ltd., 1899.)

THE spirit of a true naturalist prevails throughout this book. The author records his experiences with a number of uncommon animal pets, among which were a young crocodile, a python, an armadillo, and a mongoose. His observations are of real scientific interest, and his humorous descriptions are pleasant to read as well as instructive. Though natural history cannot be learnt from books, the boy who reads the essays in this volume will be encouraged to observe the habits of animals for himself, and will thus learn to depend upon the evidence of his senses rather than to trust upon second-hand information. The book would be an acceptable Christmas present for any boy interested in natural history.

LETTERS TO THE EDITOR.

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Next Week's Leonid Shower.

THE anticipated return of the great Leonid shower within a few days is looked forward to with so much interest that it appears desirable to examine what data we possess for forming a forecast in relation to it.

In a paper on the perturbations of the Leonids, which is published in the *Proceedings* of the Royal Society for March 2, 1899, we gave the perturbations which have during the last thirty-three years affected those meteors which are situated near a particular station in the stream, namely the station through which the earth passed in 1866 and of which Adams had computed the orbit. It will be convenient to speak of this position in the immensely long stream of ortho-Leonids as station A.

By these calculations it was ascertained that this portion of the stream has been subjected to an unusual amount of perturbation during the revolution which has occupied the last thirty-three and a quarter years; so much so, that the advance of the node, upon which the epoch of the coming shower largely depends, has during this revolution been of more than three and a half times its average amount. Its having had this exceptional value has been caused by unusually close approaches of the great planets Jupiter and Saturn to the meteors during this revolution.

Another effect of these abnormal perturbations has been to shift the position of the ellipse in which station A moves in a direction perpendicular to the earth's path, so that the point in which it pierces the plane of the ecliptic will, on the 15th of the present month, lie inside the earth's orbit at a distance from it of 0·0141 of the earth's mean distance from the sun. This would be a sufficiently large displacement to carry the stream entirely clear of the earth, if it were a mere cylindrical stream; in which case we should have no great shower this year. But we have satisfied ourselves, by an examination made by one of us into the dynamical conditions which prevailed when the Leonids were drawn by the planet Uranus into the solar system, that the stream is not thread-like but strap-shaped, so that its intersection with the plane of the ecliptic is an oval of some sort—probably a long oval—of which the longer axis originally lay nearly perpendicular to the earth's path. On account of this oval form of the section of the stream, the earth is likely to receive one of the great showers this year, notwithstanding the fact that the situation in the stream through which the earth passed in 1866, will on its return pass at some distance from the earth.

If the longer axis of the oval now lay perpendicular to the earth's path, the most probable epoch for the middle of the shower of this year would be 1899 November 15d. 18h., which epoch we offered with careful reservations in the paper which is above cited. A further examination, however, has shown us that perturbations have been acting on this oval ever since the Leonids became members of the solar system, tending very slowly to rotate its major axis in a retrograde direction through an angle which will ultimately become nearly a right angle. The data at our disposal do not enable us to compute how far this retrogade shift has carried the axis in the seventeen centuries during which perturbating forces have been acting upon it. Under these circumstances we must have recourse to observation to ascertain the amount of the shift. A laborious attempt to estimate it in this way has furnished 52° as the angle of shift, which would indicate that the epoch for the shower of this year is as much as twenty-two hours earlier than 1899 November 15d. 18h., that is it would bring it back to 1899 November 14d. 20h.; but we do not attach any value to this particular determination, inasmuch as the data which are as yet at our disposal are too uncertain for us to rely on them. What appears tolerably certain is that *some* shift of the position of the oval section of the stream has taken place, and that the middle of the shower is accordingly likely to come earlier than 1899 November 15d. 18h., probably some hours earlier, and possibly a considerable number of hours. Under these circumstances it appears desirable that a watch shall be maintained in the atter

part of the night between the 14th and 15th, as well as throughout the night between the 15th and 16th of this month, beginning the watch at 10.30 p.m. Before that hour observations cannot be made, the radiant point of the Leonids being below our horizon.

A computation of the perturbations of two other stations in the stream, in which we have made use of Dr. Berberich's results to supplement our own, has established a fact which we had anticipated, viz. that different parts of the immensely long ortho-stream have been so variously affected by perturbations that the stream cannot now be a uniform one evenly extended along a portion of its elliptic orbit. We must accordingly recognise that it is more or less sinuous, and that, moreover, the distribution of meteors along it is uneven. All such circumstances introduce further elements of uncertainty into any attempt which we may make to form a forecast.

On account of the abnormal amount of the perturbations within the last thirty-three years, the method by which the prediction was made in 1866 is not sufficient on the present occasion. It was based on the average amount of the shift of the node. If employed on this occasion, it would assign for the shower of this year the epoch 1899 November 14d. 12h., which is almost certainly too early.

London, November 4. G. JOHNSTONE STONEY.
A. M. W. DOWNING.

Undercurrents.

I AM much obliged to Admiral Makaroff for so courteously answering my queries in my letter to NATURE in the number for August 3, p. 316; and I regret that having mislaid my copy of his book, the "Vitiaz," I have not been before able to reply. On now studying his observations in the Strait of Bab-el-Mandeb, and his remarks in his letter (NATURE, October 5, p. 544), I fear I cannot any more share his opinions than I did before.

My point is that it is not sufficient to ascertain that there is a difference of specific gravity either between the surface water or either side of a strait, or between the surface and lower strata of water in a strait, to be able to come to the conclusion that such difference is the primary cause of surface and undercurrents in opposite directions. It has been shown by experiment that such differences give rise to a slow interchange of water, and to this extent I am of course prepared to agree that differences of specific gravity cause opposing currents; but the currents we are dealing with are of a vastly different character and strength.

I have already pointed out that my observations in the Dardanelles and Bosporus in 1872 showed that the currents did not always run in the normal directions, and that their variations were traceable to the varying winds; and to that I have nothing to add.

On looking at Admiral Makaroff's density observations in the Strait of Bab-el-Mandeb, I see that the specific gravity varied from 1·0279 at the surface to 1·0292 at 200 metres, while the surface waters of the Red Sea itself and of the Arabian Sea near Sokotra are given as 1·0300 and 1·0279 respectively.

In saying that "here are none of the differences of specific gravity demanded by Admiral Makaroff's hypothesis," I was referring to the great contrast between the difference in the densities of the Black Sea and Mediterranean, viz. ·017, and those of the Arabian Sea and Red Sea, viz. ·002, and never thought for a moment that the very small variation in density in the latter case could be held capable of setting up currents of 1½ knots in opposite directions at surface and bottom, as found by "Stork's" observations in the N.E. monsoon.

No observations have yet been made on the undercurrent in Bab-el-Mandeb in the S.W. monsoon; but the surface current is known to run in the contrary direction to what it does in the N.E. monsoon, *i.e.* again with the wind, or *out* of the Red Sea, and I should be much surprised to find that the undercurrent does not also run in the contrary direction, probably with much greater strength than the surface current, because the great evaporation of the sea has also to be made up.

Absolute proof of the causes of such phenomena as these under discussion comes slowly, and only after laborious observation; but I certainly think that the work of the last twenty-five years has tended to show that the influence of density as compared with wind is insignificant. W. J. L. WHARTON.

Florys, Wimbledon Park, November 4.

"Anlage" and "Rudiment."

SOME months ago Prof. Herrick, who is in charge of the department of Neurology in the "Dictionary of Philosophy and Psychology," which I am editing (now in the press of Macmillan and Co.), addressed a circular to various authorities asking their opinion on certain matters of terminology. The results were collated and discussed by Prof. Herrick in the *Journ. of Comp. Neurology*, vii. 3-4, 1898. Among the matters in question was the English equivalent of the German term *Anlage*. Prof. Herrick came to the conclusion that *Proton* and *Rudiment* were more available than any other words suggested (ruling out the use in English of *Anlage* with its German inflexion).

It now happens that the French and Italian committees, who are recommending equivalents, in their respective languages, for the terms in the Dictionary, make reports which I think are of importance. Prof. Delage, of Paris, for the French committee, recommends *rudiment*, and, as it happens, Prof. Morselli, of Genoa, sends in *rudimento* as the preferred Italian term. This agreement—and to say this is my aim in writing—affords a strong argument for the adoption of *Rudiment* in English. It is evident that it would be of immediate and very great advantage—for example, to translators from any one of these languages into any other—if *Rudiment* were made the common rendering of *Anlage* in the three other languages of modern science. The other great advantage would be that we already have the adjective form, *rudimentary*, in use.

Furthermore, the psychologists may use the same term for the German *psychologische Anlage* which has crept into recent German discussions. In English, biologists and psychologists will then have the common term *rudiment* with a well-understood signification. I am recommending this to the committee on terminology of the American Psychological Association, of which I happen to be secretary. J. MARK BALDWIN.

Oxford, October 22.

Interference Curves depending on Perspective.

CLOSELY allied to the halo round an observer's shadow (referred to in Mr. S. Newcomb's letter in NATURE, October 5) are a number of phenomena due to perspective, which may be seen every day by any one who is on the look out for them.

Among these may be mentioned the dark waves which seem to accompany a traveller when he looks through two series of upright palings which lie parallel to each other and his course; also the patterns like the grain of wood which appear when two superposed sheets of gauze are held against the light.

As these and the like appearances have not, as far as I know, hitherto been looked at from a mathematical point of view except in one instance,[1] the three following examples, which are typical but simple, may be of interest:—

(1) Interference rings due to parallel lines on a spherical surface, and their shadow or reflection on a plane or in a plane mirror.

Let a small part of a sphere of radius r be ruled with equidistant parallel lines, the distance between the lines being small compared with r. Let the convex surface of the sphere touch a plane mirror, and let surface be viewed from a distant point, the line joining the distant point, and the point of contact making an angle i, with the normal to the plane.

Taking the plane containing the point of view and the normal through the point of contact as the plane of reference, let α be the angle between the plane containing a line and its reflection and the plane of reference. Let θ be the angle which a point on the spherical surface distant ρ from the normal through the point of contact subtends at the centre of the sphere (so that $r \sin\theta = \rho$), and ϕ the angle which ρ makes with the plane of reference.

It is plain that where, from the point of observation, any part of any line hides the reflection either of itself or any other line, the field will look brighter in that direction than where the line and the reflection are both visible, and the condition which must be fulfilled in order that one line may hide the reflection of another n lines off is (neglecting second order quantities) that the distance between the hidden reflection and the line reflected (that is, twice the distance of the line from the reflector) multiplied by tan i should be equal to n times the projection of a on the plane of reference, or in symbols,

$$2r(1-\cos\theta)\tan i = \frac{na}{\cos\alpha},$$

[1] Lord Rayleigh's "Theory and Manufacture of Diffraction Gratings" (*Phil. Mag.*, 1876).

since this equation does not contain ϕ, ρ is constant whatever the value of ϕ may be; hence the bright parts of the field are circular rings surrounding point of contact of the plane and spherical surface.

The radii of the dark rings can be deduced from the relation

$$2r(1-\cos\theta)\tan i=\frac{2n-1}{2}\frac{a}{\cos\alpha};$$

and from these equations it is easily shown that for the bright rings

$$\rho=\sqrt{\frac{\lambda an}{\tan i\cos\alpha}},$$

and for dark rings

$$\rho=\sqrt{\frac{\frac{2n-1}{2}}{\tan i\cos\alpha}}.$$

This may be compared with the corresponding values for Newton's rings.

In both cases the radii of the bright and dark rings vary as the square roots of the even and odd numbers, and as the square root of the radius of the sphere and the wave length (which is analogous to a in the present case), but here the likeness ceases.

The rings here considered diminish as i increases, and increase as α diminishes.

Of course, in Newton's rings there is nothing which answers to the angle α.

The easiest way of examining these rings is to mould a small circle of wire gauze to form part of a sphere (which can readily be done by pressing it with a ball against any yielding substance) and laying it, convex surface downwards, on a piece of looking glass.

In general two sets of rings will be seen, one due to the wires of the warp, and the other of the woof of the gauze.

When the eye, however, looks parallel to one set of wires, the rings of that set are all infinite, and only the set due to the wires at right angles to the line of sight are visible.

If the gauze is made to turn slowly on the point of contact, both series appears, one growing, and the other diminishing, which are exactly superposed when $\alpha = 45°$.

A curious effect may be observed when a thick plate of glass is placed between the gauze and the looking glass.

The rings in this case become coloured, showing blue on their inner, and red on the outer margins of the dark bands.

The explanation is obvious, for the pencils of white light entering through the meshes of the gauze are dispersed on entering the glass, and in the neighbourhood of the dark rings only part of the dispersed pencils are cut off on their second passage through the gauze, so that the light which reaches the eye is coloured.

If t is the thickness of the glass plate, the greatest colour effect is obtained when $t=b\mu/2d\mu\tan r$, where b is the diameter of the wire and r the angle of refraction in the glass.

When the glass plate is used, of course the smallest visible ring is not that for which $n=1$, but it is unnecessary here to enter on the alteration in the formula for ρ caused by putting $2r(1-\cos\theta)+t)$ for $2r(1-\cos\theta)$.

(2) Interference rings caused by two series of straight lines, radiating at equal angles, from two centres in the same or parallel planes.

Let there be n lines in each series, then the angle between successive lines in each series is $2\pi/n$.

Let the lines of the first series be numbered 1, 2, 3 . . . p . . . n and those of the second $1', 2', 3' \ldots q' \ldots n$, and let the line 1 be parallel to the line 1'. Then the angle made by any line p of the first series with another q' of the second is $(p-q)2\pi/n$, hence the intersections of all pairs of lines for which $(p-q)$ is the same will lie on a circle passing through the two centres and having this segmental angle.

When the distance between the centres is a, the radius of the circle is

$$\rho=a\ \text{cosec}\ 2\pi(p-q)/n$$

if both centres are in the same plane, or

$$(a+b\sin i)\ \text{cosec}\ 2\pi(p-q)/n$$

if in different planes, where a = distance between the normals to the planes through the centres, b the distance between the planes, and i the angle made by the line of sight with the normal.

The loci of the intersections appear brighter than any other part of the field of view, hence the intersections of the two series show as a family of bright and dark circles which all pass through the two centres, and whose radii are as the cosecants of the multiples of $\frac{2\pi}{n}$.

This is shown in Fig. 1.

A pair of wheels of a carriage, one viewed through the other, show the phenomenon very well, especially when the wheels are turning fast enough to make the individual spokes indistinct.

Under favourable circumstances as to light and background, the appearance of the rings, contracting and expanding as the angle of view changes, is very striking.

(3) Interference curves from two series of straight lines, one radiating and the other parallel.

From a point P in the axis of Y let radiating lines be drawn to cut the axis of X at equal intervals a, and at a, $2a$, $3a$, &c., let lines be drawn parallel to Y.

Then, if the distance of P from the origin is h, to determine the coordinates of the intersection of the nth parallel line with the $n+p$th radiating line, we have, since $x=na$,

$$\frac{h-y}{h}(n+p)\,a=na,$$

hence

$$\frac{y}{h}(n+p)=p.$$

The locus, therefore, obtained by giving the value 0, 1, 2 . . ∞ to n will be a series of points on a rectangular hyperbola passing through P with its centre at $y=o\ x=-pa$.

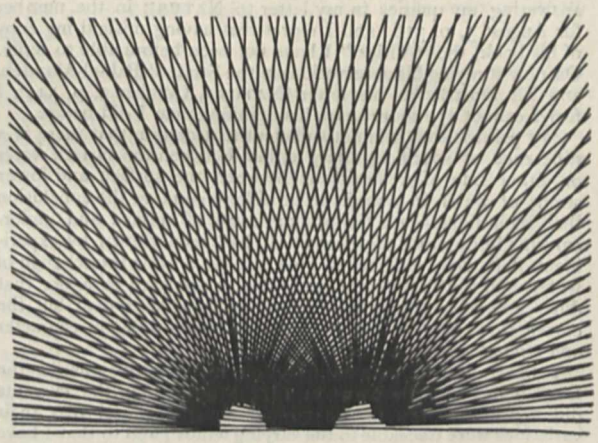


FIG. 1.

Thus the field of view will show a family of hyperlolæ (one for each value of p), all passing through P, the parameters being $\sqrt{pha}$.

In the same way, for the intersections of the nth parallel with the $2n+p$th radiating line we have

$$\frac{y}{n}(2n+p)=p,$$

which indicates a second family of hyperbolæ, the coordinates of the centres being $\frac{h}{2}$ and $-\frac{p}{2}$.

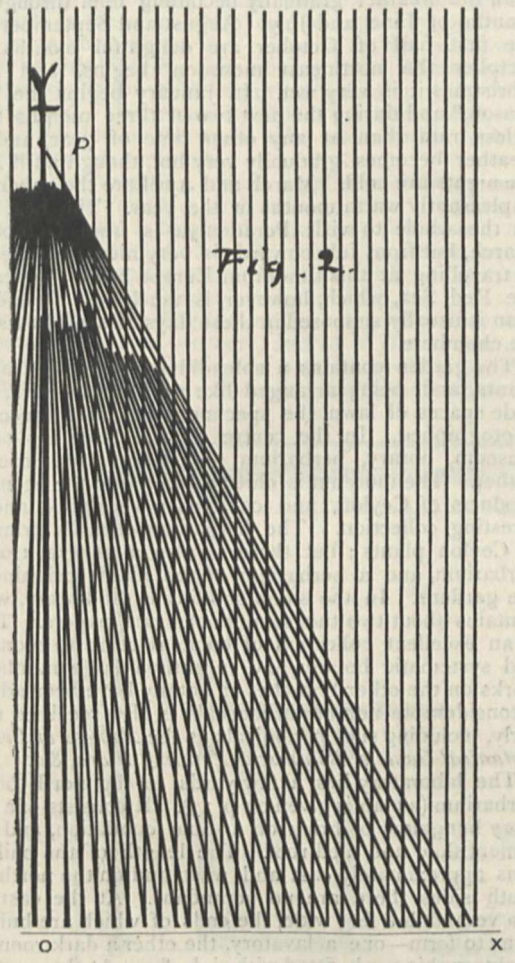
Similar families are formed by the intersection of the nth parallel, with the $3n+p$th . . . $4n+p$th . . . &c., radiating lines, the corresponding centres being $y=\frac{2h}{3}$, . . . $\frac{3h}{4}$, &c. and $x=-\frac{p}{3}$, $-\frac{p}{4}$, &c.

It will be readily seen that the dark and bright bands formed by the interfering lines follow the short diagonals of the quadrilaterals into which the two series of lines divide the field, and that for the bands to be conspicuous, there should be a great difference in the length of the two diagonals, and only a small difference in the length of the sides of the quadrilaterals.

For this reason only a part of each hyperbolic family is recognisable.

In Fig. 2 the first two families are both well seen in parts, and some of the curves of the third family can be recognised.

We may, if we choose, consider the radiating lines as the perspective view of a series of parallel lines in a plane inclined to X Y.



We then have the case of a row of vertical railings and their shadows on the ground.

In passing a line of such railings when the sun is low, the curves, which appear to travel with the observer, may often be noticed. A. MALLOCK.

3 Victoria Street, S.W., October 16.

The Indian Forest Service.

I AM very glad to see Prof. Schlich's defence of the Indian Forest Service in NATURE of November 2. I have myself been very closely connected with forest administration in the Bombay Presidency from 1871 to 1894. I may say that I have seen the Department there grow up from little better than chaos into a well-organised corps of spirited and well-trained officers; and there is not one word in Prof. Schlich's letter that I cannot heartily support.

Botanists can hardly be too abundant in India; but if we want good systematic botanists there, we must call them by that name, and either train them specially to that science, or get men so trained in the market.

It is to me surprising that the Indian forest officers have done so much botanical work as they have, to say nothing of the services of several of them to zoology; and it must be remembered that their appointments are even now won at a considerable cost in toil and money, that their pay is not high, and that their duties involve at least as much hard work of body and mind, as much hardship, and as much risk, as those of any other service in India.

Forestry is not all botany. It may, perhaps, be best defined as the "proper management of hardy life upon large areas." And the man who does that best is the best forester. We have a great many who do it well, and amongst these there will always be some to whom systematic botany is labour of love. But to insist upon any great general proficiency in one of the many subjects that a forester must study, will simply injure the general efficiency of the forest corps; and probably fail in the case of the favoured subject. W. F. SINCLAIR.

November 3.

Peripatus in the Malay Peninsula.

IN a recent issue of NATURE (October 19) the interesting fact is mentioned of the discovery by the Skeat Expedition of several specimens of Peripatus in the Malay Peninsula. Will you allow me to remark that in 1886 I described in the Notes from the Leyden Museum a specimen of Peripatus from East Sumatra, found among a lot of insects collected by Mr. Hekmeyer, of our Indian Medical Service. As it was the first specimen recorded from the Oriental region, Prof. Sedgwick, in his elaborate monograph of the genus Peripatus, considered the Sumatra species to be somewhat doubtful. The specimens, however, found by Mr. Evans in Kalantan appear to correspond so well with our specimen, as well in the number of pairs of feet (24) as in the colour, that I think a more detailed account will prove the identity of the animals found on both sides of the Malaka Strait. R. HORST.

Leyden Museum of Natural History, October 30.

A Wooden Ball of Unknown Origin.

ON the shore of the island of Hadod, latitude 68° 40′ about, in Vesteraalin, north of Lofoten, there was found, probably in the autumn of 1897, a wooden ball, 4½ centimetres in diameter, covered by a thin layer of gum. The ball is of fine workmanship, and just able to float in the water. Circles are engraved upon four parts, and form small rhumbs over the whole surface; and on two places there is engraved with Latin Majuscles the name *Melfort*. Perhaps some of your readers can say from whence this ball has come. I am writing to the man who has the ball now, to ask him to send it to me. H. MOHN.

Det Norske Meteorologiske Institut, Kristiania, October 30.

Large Nicol Prisms.

IN the account of Dr. Spottiswoode's physical apparatus, lately given to the Royal Institution, there are allusions to several large Nicol prisms said to have been made by Mr. Ladd and by Messrs. Sisley and Spiller. Although it is no doubt the trade custom to mention only the names of opticians who sell pieces of apparatus, and not of any of those whom they employ to make them, I still venture to hope that in this case, where skill and labour of a very special kind were required, the name of the actual maker of the above-mentioned prisms may not be forgotten. I would therefore respectfully ask permission to give a few particulars as to size, &c., of some of the larger Nicol prisms which I have myself made from blocks of Iceland spar within the last thirty years.

(1) In 1873 Dr. Spottiswoode bought a very fine block of spar from Mr. Tulinius, of Copenhagen (who then owned and worked the spar quarry at Eskifiördkr in Iceland). Out of this, which was absolutely flawless, I made a Nicol prism having a clear field of 3⅜ inches diameter, the length of each side being 12 inches.

(2) In 1874 I made a second prism from the same block of spar just mentioned, and also a third from another piece of spar bought by Dr. Spottiswoode. Both of these prisms had a clear field of 3½ inches, the length of the sides being 11½ inches. These are now at the Royal Institution.

(3) In 1875 I made a Nicol prism for Mr. Frank Crisp, of 3½ inches field and 11½ inches in length, which he used in a polariscope in conjunction with the first one mentioned above, which he had acquired from Dr. Spottiswoode. These Mr. Crisp sold, and are now in England.

(4) In 1876 I made two more large prisms for Dr. Spottiswoode, one of 3-inch and the other of 2½-inch field, as spar was

even then beginning to get scarce. These are now at the Royal Institution.

In all these prisms the end faces were the natural crystal faces, only smoothed and polished; and the plane of section made an angle of 87° 30′ with them, or 21° 30′ with the length-axis of the prism.

In none of them was Canada balsam used as the cement (I have not used it for this purpose for thirty years past), but a special material. C. D. AHRENS.

Swiss Cottage, King's Road, Upper Teddington,
October 13.

AN ENGLISH STATION FOR BOTANICAL RESEARCH IN THE TROPICS (CEYLON).

THE Royal Botanic Gardens of Ceylon, under the direction of Thwaites and Trimen, to go no further back, have long been known as one of the most important centres of scientific work in systematic and economic botany. Thanks to the British Association for the Advancement of Science, a small room next to the director's office was fitted up as a laboratory, in which have worked many botanists, chiefly English. Among those who have worked in Ceylon during the last decade may be mentioned Profs. Bower, Farmer, Goebel and Potter, and Messrs. Freeman, Keeble, Pearson, Parkin, and others. During the last two years the laboratory has been very much overcrowded, being used by the staff of the gardens as well as by visiting botanists. With the commencement this year of a new research laboratory, now being erected by the Department of Public Works, and to be completed probably before the end of the year, this difficulty will be overcome, and there will be ample room for several workers from abroad in addition to the members of the staff. This being so, it may not be amiss to give at this time an account of the facilities now available in Ceylon for research in the tropics. While the laboratory is primarily intended for botanical research, there is no intention of excluding workers in other lines so long as there is room for them, though of course money cannot be spent in providing special apparatus for their work.

The Royal Botanic Gardens form a department of the public service in Ceylon, under a director. The head-quarters of the department are at Peradeniya, near Kandy, where the principal garden was established in 1821 by Moon. There are now smaller branch gardens in four other places in different climatic regions of the island. A brief account of these may be of interest.

The original Peradeniya garden lies within the municipality of Kandy, about four miles from the centre of the town. It may be reached by driving in a carriage or rickshaw, or by trains which run at intervals to a station near the garden. The roads here, as almost everywhere in the island, are excellent for cycling. The garden has an area of about 150 acres, and lies in a very beautiful situation, in a loop of the Mahaweli river, and in very mountainous country. Its elevation above sea is about 1550 feet, so that it has a much more pleasant climate than the low country. During the day the difference is but little, but the nights are very much colder than in Colombo, so that refreshing sleep can always be had; indeed, during most of the year a blanket is necessary. The mean annual temperature is 76° F., that of the hottest months (March and April) being 79°, that of the coldest (January and June) 74–75°. The highest shade temperatures ever reached are not excessive, rarely exceeding 90°, and in the present laboratory the highest in the last two years has been 82°, the lowest 65°. Work can thus be carried on with as little discomfort as in any European laboratory. The annual rainfall is about 90 inches, but owing to the great violence of tropical rain the number of rainy hours or days is very much less than in England. The number of days with rain averages 170 per annum, and it rarely rains more than four hours on any one day. Rain in the morning is also rare. The weather of the year depends on the monsoons. In the end of May the south-west monsoon begins to blow, and there is much wind and rain, the weather gradually becoming finer through the months of June and July. August and September and the first half of October are delightful months. In October the north-east monsoon begins, and until Christmas it is very wet. In January begins the "dry season," and during the next two or three months there is less rain than at any other time of year, and the weather becomes gradually very hot, though until April the nights are cold. March and April are the only really unpleasantly warm months in the year. The best time on the whole to visit Peradeniya is from October to March, but from July onwards is very nice, the objection to travelling at this time from Europe being the heat in the Red Sea, which, however, is much less formidable than is usually supposed in these days of swift boats and ice chambers.

The garden contains a splendid collection of tropical plants, and, being arranged like an English park, with wide spaces of lawn, the specimens are easily seen and photographed. In the centre lie the buildings of the museum, library, herbarium and laboratory, close together. The museum is chiefly devoted to the economic products of Ceylon, and contains a very good and interesting collection. The herbarium consists primarily of Ceylon plants; but there is also a general tropical herbarium, and a herbarium of the plants contained in the gardens. In the same building is the library, which contains about two thousand books and papers. There is an excellent collection of books relating to economic and systematic botany, and recently a large number of works on the other branches of botany have been added; a considerable number of journals is also received regularly, including such periodicals as the *Annals of Botany*, *Botanical Gazette*, *Botanische Zeitung*, *Flora*, &c.

The laboratory lies a few yards to the north of the herbarium (a plan is given on p. 33). It consists of a one-story bungalow of brick on a stone foundation, and with cement floor and tiled roof. The length of the building runs approximately east and west, and on the north and south sides there are no verandahs. At the east end is a verandah 8 feet wide, the ends of which are built up so as to form—one a lavatory, the other a dark room for photographic work, fitted with sink, &c. At the west end is also a verandah of the same size, not built up in any way.

The building has six entrances, provided with French windows, two at each end and two on the south side. The other windows stand above the ground, and open outwards. There are doors leading from each room into all the adjacent rooms, so that free ventilation can be obtained, and at the same time any room can be completely shut up if required to prevent draughts without interference with the accessibility of the others.

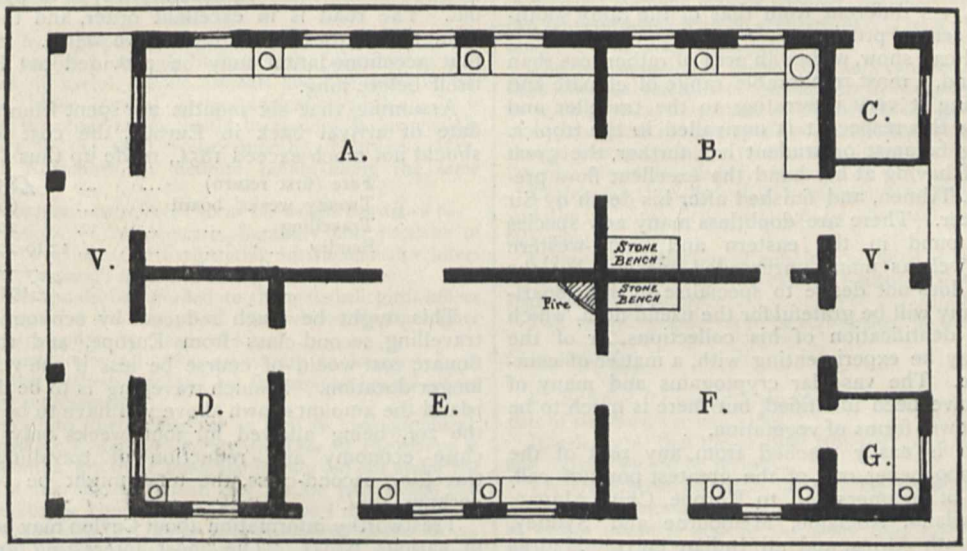
The principal room, the general microscopic and morphological laboratory, lies to the north-west, and is 36 feet long and 18 feet wide. It has four working windows facing north, each with table, shelves, sink, &c., and two other windows facing into the west verandah, which can also be used as microscoping windows if required. The central part of the room will contain larger tables for microtome and other apparatus, and writing table.

To the east of this room is the smaller room devoted to physiological and pharmacological investigations. Leading out of this room is a French window, which gives access to the little eastern verandah, which may be used for cultivation experiments, &c. This room has two good working windows facing north, besides the French window. It is provided with three sinks and a

large stone bench. South of the physiological is the chemical laboratory, of the same size and construction, and with the dark room opening out of it. West of the chemical laboratory is the economic, a large room 26 feet by 18 feet, with two good working windows, one French window, and a fireplace. This room is intended for experiments in the preparation, &c., of economic products, such as rubber, fibres, &c. Lastly, in the south-west corner of the building, is a small private laboratory for the director or for work requiring special privacy from interruption. This room is 18 feet by 10 feet, with one working window on the south side, and another looking into the western verandah.

The whole laboratory is well supplied with water from a pipe running round it, and starting from a cistern in the museum, at a height of about 15 feet above the laboratory. Gas unfortunately is not at present available, but of course there is no need for artificial light, the day in this country always lasting until 6 p.m.

When ordinarily filled, therefore, the laboratory can accommodate eleven workers, and at a pinch room can be made for four more. For persons working at systematic botany there is accommodation in the herbarium.



Plan of the new Laboratory, Royal Botanic Gardens, Peradeniya. A, General laboratory; B, Physiological laboratory; C, Lavatory; D, Private laboratory; E, Economic laboratory; F, Chemical laboratory; G, Dark room; V, Verandahs. Scale 1/16 inch to 1 foot.

Of the eleven places, the present staff and workers living in the colony will use five or perhaps six, so that there is room now available for five or six workers from Europe and elsewhere. The value to a botanist of a period spent in the tropics can scarcely be overrated, and with the accommodation now afforded at Peradeniya and in Java, the ease and comparative cheapness of the journey, and of living and travelling in Ceylon, there is no reason why many more should not visit and work in a tropical station than have so far done so.

The neighbourhood of Peradeniya is very beautiful; it is mostly cultivated in rice, tea, coco-nuts, fruit, &c., but there are some interesting pieces of wild vegetation within easy reach, and many fine pieces of forest, &c., can be reached within a short time by rail or road. The river below the gardens contains most of the known Ceylon species of that very remarkable order the Podostemaceæ. Kandy is within easy reach, and contains several good hotels, a good English club, tennis, croquet, cricket and football clubs, &c.; and there is a considerable society of English people in the town and suburbs. Colombo can be reached in four, Nuwara Eliya in five, hours by rail. The trains are comfortable, and provided with refreshment and sleeping cars.

For a few economic and other plants the climate of Peradeniya is somewhat too cold at night for complete success, and for trial of these and for the supply of the needs of the populous low-country of the south-west of the island, a second botanic and experimental garden is maintained at Henaratgoda, on the main line of railway, seventeen miles from Colombo. It lies only about twenty feet above the sea, in a very uniform steamy climate, with a mean temperature of about 82° F. The garden comprises forty acres, about twelve of which are still covered with jungle, forming an interesting feature in the garden. There is a very fair collection of plants in this garden, especially economic, including the original rubber trees sent to the East through the agency of Kew Gardens and the Government of India. *Helminthostachys zeylanica* is abundant in the district, and many interesting plants can be seen in paddy fields and elsewhere. There is a rest-house close to the railway station, a mile from the garden, and the garden contains a small laboratory with two working places.

A third garden is maintained at Hakgala, about six miles from the chief sanatorium of Ceylon, Nuwara Eliya. The garden occupies an extremely beautiful situation on the side of Hakgala Mountain, with an extensive view over a wide expanse of mountain country. It comprises about 550 acres of land, only about thirty-five of which are in cultivation, the rest being untouched natural country, some covered with jungle, some being grass land (pătănă, as it is locally called). The vegetation in the district all around here is very interesting, having been but little interfered with by cultivation in any way, and that only in a few spots. The interesting Horton Plains are eighteen miles from Hakgala, through wild country. There is a rest-house at the Plains, which lie 7200 feet above sea-level. The flora of these up-country regions is of great interest to a botanist. Many European genera are here represented, such as buttercups, violets, valerian, brambles, &c. Lycopods, Selaginella, Psilotum, &c., are very common. Many interesting biological features exhibit themselves in this vegetation.

The garden at Hakgala lies at 5600 feet above sea-level, and has a comparatively cold climate, with a mean

annual temperature of 61° F. Frost never occurs, though it is frequent at slightly higher elevations, such as Nuwara Eliya (6200 feet). There is, unfortunately, no accommodation for visitors at present nearer than Nuwara Eliya, six miles away; but it is hoped to erect a small laboratory in the garden, with a small living room attached, where workers may live and sleep.

A fourth garden is kept up at Badulla, the capital of the Uva province, at an elevation of 2200 feet, on the eastern side of the mountains. The chief botanical interest of this district lies in its somewhat drier climate, so that it has much more pāṭāṇā land than the western side of the mountains, and in the fact that its dry season comes, not in the north-east but in the south-west monsoon, so that the periodicity of the vegetation is different. Fruit, which at Peradeniya ripens in March and April, ripens at Badulla in August, and so on.

Yet another garden is maintained at the ancient capital of the island, the famous "buried city" of Anuradhapura, the capital of the north-central province. This lies in the middle of the dry country, which makes up about three-fifths of the island, and has an Indian climate, with rain almost confined to the last three months of the year, and drought during the remainder, including the south-west monsoon. The flora of this district is therefore, as might be expected, very different from that of the rainy south-western and central provinces.

The island can show, within an area of rather less than that of Ireland, a most remarkable range of climate and flora, rendering it very interesting to the traveller and naturalist; in this respect it is unrivalled in the tropics. The working botanist or student has, further, the great advantage of having at his hand the excellent flora prepared by Dr. Trimen, and finished after his death by Sir Joseph Hooker. There are doubtless many new species still to be found in the eastern and south-western districts, as well as many unrecorded species; but the student who does not desire to specialise in this department of botany will be grateful for the useful flora, which renders the identification of his collections, or of the plants he may be experimenting with, a matter of comparative ease. The vascular cryptogams and many of the mosses have been identified, but there is much to be done at the lower forms of vegetation.

Peradeniya is easily reached from any part of the world, Colombo being one of the greatest ports of call. Direct lines of steamers run to Europe, China, Japan, Java, Queensland, Adelaide, Melbourne and Sydney, Mauritius, South Africa, and all Indian ports. Madras may be reached in thirty-eight hours by boat and rail. To England there is a very large choice of steamers. The favourite lines with Ceylon people are perhaps the Bibby and the Norddeutscher Lloyd, but the P. and O., the Orient, Messageries Maritimes, British India, and many others, are much used. The first-named is the cheapest of the large English lines, but is first-class only. First-class returns to Colombo, available for six months, are from 70*l.* to 90*l.* Second-class, which is very comfortable on the largest lines, is from 50*l.* to 60*l.* A few pounds are necessary on the voyage for tips, sports, trips on shore, &c. Banking accounts may be opened in Kandy, and money easily remitted to and from Europe. The value of the rupee is now 1*s.* 4*d.*, and seems likely to remain at that figure.

Very little is necessary in the way of outfit. Drill and khaki clothes can be bought here for less than half their price in England; also topees (sun-hats). At Kandy the usual dress is similar to that worn in England in summer; at Nuwara Eliya it is colder, and tweed suits are often worn. All articles of clothing can be bought here, and usually as cheaply as, or more so than, in Europe.

The usual division of the day is as follows: Rising at daylight, a light early tea of eggs and toast is taken about 6.15, after which a walk in the garden is pleasant, commencing laboratory work at 7.30, and continuing till 11, which is the breakfast hour. After breakfast follows a rest indoors, but not sleep, and work may be resumed at about 1.30 for a couple of hours or so. After tea the remaining two hours of light are given to tennis, cycling, and other forms of exercise, followed by a bath, and dinner at 7 or 7.30. The evening is devoted to amusement.

Travelling in Ceylon is easy in all but the most out-of-the way or sparsely populated parts. Railways and good roads intersect the greater part of the island, and there are coach services to a great number of places not served by the railways. Rest-houses or Government inns are found in all towns that have no hotels, and at intervals of 14 miles along all main roads. The average cost of living while on tour may be put down as about Rs. 7 or 8 per diem exclusive of fares by rail or coach. Steamers run round the island, calling at all the chief ports.

There is at present no rest-house or hotel at Peradeniya itself, and visitors must live in Kandy, where arrangements have been made with some of the hotels to board persons working in the laboratory at from Rs. 5 to Rs. 7 per day. There is a convenient service of trains, but the most satisfactory way is to cycle in and out. The road is in excellent order, and the distance from the furthest hotel under five miles. It is hoped that accommodation may be provided at Peradeniya itself before long.

Assuming that six months are spent from starting to date of arrival back in Europe, the cost of the trip should not much exceed 185*l.*, made up thus:

Fare (first return)	£85
Twenty weeks' board	66
Travelling	20
Sundry	12 to 20
	£191

This might be much reduced by economy, and by travelling second-class from Europe, and the proportionate cost would of course be less if the visit were of longer duration. If much travelling is to be done in the island the amount shown above will have to be increased, the 20*l.* being allowed for four weeks only. By very close economy and reduction of travelling, and by travelling second-class, the total might be reduced to perhaps 140*l.*

Trustworthy information about Ceylon may be obtained in various books. The most interesting are Sir E. Tennent's "Ceylon," which is now out of print; and to a botanist, Trimen's paper "On the Flora of Ceylon as affected by Climate," in the *Journal of Botany* for 1886. Ferguson's Handbook and Directory contains a vast mass of information and statistics, and his "Ceylon in 1893" is also of interest.

Intending visitors should communicate some time in advance with the director, mentioning what line of work they propose to take up, and any special facilities they may require. JOHN C. WILLIS.

THE STOCKHOLM INTERNATIONAL FISHERIES CONFERENCE.

THE International Conference, which met in Stockholm from June 15 to June 23 last, and had for its object the arrangement of a scheme for the exploration of the northern seas in the interests of fisheries, has now issued its report. The Conference assembled at the invitation of the Government of Sweden, and official representatives attended on behalf of the Governments of Germany, Denmark, Great Britain, Norway, Holland, Russia and Sweden.

The formal resolutions unanimously passed by the delegates—Messrs. Archer, Cleve, Drechsel, Ekman, von Grimm, Heincke,

Hensen, Herwig, Hjort, Hoek, Knudsen, Krümmel, Lehmkuhl, Lundberg, Murray, Nansen, Petersen, Pettersson, D'Arcy Thompson, Trybom, Åkerman—were as follows :—

Considering that a rational exploitation of the sea should rest as far as possible on scientific inquiry, and considering that international co-operation is the best way of arriving at satisfactory results in this direction, especially if in the execution of the investigations it be kept constantly in view that their primary object is to promote and improve the fisheries through international agreements, this International Conference resolves to recommend to the States concerned the following scheme of investigations, which should be carried out for a period of at least five years.

Programme for the hydrographical and biological work in the Northern parts of the Atlantic Ocean, the North Sea, the Baltic and adjoining Seas.

A.—THE HYDROGRAPHICAL WORK.

I. The hydrographical researches shall have for their object: the distinction of the different water-strata, according to their geographical distribution, their depths, their temperature, salinity, gas-contents, plankton and currents, in order to find the fundamental principles, not only for the determination of the external conditions of the useful marine animals, but also for weather-forecasts for extended periods in the interests of agriculture.

II. As the hydrographical conditions are subject to seasonal changes, and as these strongly influence the distribution and life-conditions of useful marine animals and the state of the weather and other general meteorological conditions, it is desirable that the observations should be made so far as possible simultaneously in the four typical months, February, May, August and November, at definite points along the same determined lines.

III. The observations referred to in II. would consist of:—

(*a*) Observations of temperature, humidity and pressure of the air every two hours; self-registering instruments for interpolation, and Assmann's aspirator should be used.

Opportunities should be afforded to the meteorological offices to make on board the ships physical observations on the higher levels of the atmosphere by means of kites.

The other meteorological observations are to be carried out according to the methods adopted by the meteorological offices of the nations represented.

The observations, meteorological as well as hydrographical, made on board the special steamers at the time of the survey in the typical months, are to be immediately worked out under the supervision of the central bureau (see C) for publication in a bulletin, wherein the conditions of the sea and the atmosphere are to be represented by tables and synoptical charts in co-operation with the meteorological institutes of the nations represented.

(*b*) The temperature of the surface water shall be taken every two hours, or, when necessary, more frequently. It is desirable that self-registering apparatus should be used for interpolation.

Observations on the vertical distribution of the temperature are to be taken at the points mentioned in II., and should be taken regularly at intervals of 0, 5, 10, 15, 20, 30, 40, 50, 75, 100, 150, 200, 250, 300, 400 metres, and so on; but all *critical* parts of the curve must be determined by extra-readings.

The bottom-temperature is to be investigated with all possible care.

(*c*) At every point and from every depth where the temperature is observed, a sample of water shall be collected for the determination of its salinity and density.

By *salinity* is to be understood the total weight in grammes of the solid matter dissolved in 1000 grammes of water.

By *density* is to be understood the weight in grammes[1] of one cubic centimetre of water of the temperature *in situ* $t°$, *i.e.* the specific gravity *in situ* referred to pure water of +4°C. $\left(= S\frac{t°}{4°}\right)$.

For orientation, preliminary determination of the salinity should be made on board ship with expedient instruments, but the exact determination of the salinity and density of all samples shall take place in a laboratory for scientific work.

(*d*) At certain depths of the points mentioned in II., and elsewhere on the surface, water samples should be collected for analysis of the gas-constituents (oxygen, nitrogen and carbonic acid).

IV. For measurement of depth the *unit* to be adopted is the metre, together with which the depth may be also recorded in English fathoms.

Geographical points are to be referred to the longitude of Greenwich, and horizontal distances are to be expressed in sea-miles (=1852 metres).

Thermometers to be used for the determination of the surface-temperature may be either centigrade or Fahrenheit, but for publication all numbers are to be reduced to centigrade.

In the centigrade thermometers the distance between two degree-marks should be at least 5 mm. and the degree divided at least in two parts; the Fahrenheit thermometer to be divided in a corresponding manner.

The use of Pettersson's insulated water-bottle is recommended for moderate depths, and the thermometers used for this apparatus should have a space at least 10 mm. between the marks of one degree, and the degree should be divided in ten parts.

For greater depths of the ocean Negretti-Zambra's or other thermometers of a similar type should be used.

The glass to be used for the thermometers as well as the thermometers should be tested and approved by the central bureau (see C, *a*).

For the determination of salinity and density either chemical or physical methods may be adopted, provided that the salinity can be determined with an accuracy of $0,_{05}$ in a thousand parts (and the density up to $0,_{00004}$).

The determination of these constants can be founded either upon chemical analysis of the halogen by weighing or titration, or upon physical determination of the specific gravity by means of hydrostatical balance pycnometers and hydrometers, provided that measures be taken to exclude disturbances arising from thermal effects, capillarity, viscosity, &c.

The chemical analysis shall be controlled by physical methods, and the physical determinations by chemical analysis in the following manner:—

From every collection of samples examined at least three shall be selected and sent to the central bureau. *Standard samples* shall be sent in return.[1]

The *specific gravity* is to be represented in the tables by the formula $S\left(\frac{0°}{4°}\right)$.

V. Samples for gas analysis are to be collected each time in a pair of sterilised vacuum tubes.

It is desirable that the existing tables of absorption of nitrogen and oxygen should be revised.

VI. Qualitative plankton-observations should be made every six hours by pumping through a silk net (N : r 18) for the space of fifteen minutes, and at the same time a sample of water (III. *c*) should be taken.

At the points mentioned in II. samples for quantitative analysis are to be collected according to the method of Prof. Hensen at different depths depending on the hydrographical circumstances.

Petersen's modification of Hensen's net is recommended.

Observations on transparency and colour of the water should be made at the points mentioned in II.

Opportunities should be afforded to bacteriological institutions to carry out investigations in the ocean.

VII. Observations on currents and tides should be carried out as frequently as the circumstances allow.

The currents should be examined, when possible, by direct current-meters and by surface and intermediate floats and by bottom-rollers.

The ship should be anchored occasionally in order to make frequent observations during a complete period of tide.

VIII. It is desirable that a chart should be prepared of the bottom of the seas examined, showing the nature of the sea-bottom.

The description of the deposits is to be carried out on a definite plan, to be afterwards settled (see Appendix III.).

IX. The normal observations are to be carried out along the

[1] Units of weight are here used instead of mass-units.

[1] By *standard* water shall be understood samples of filtered sea-water, the physical and chemical properties of which are known with all possible accuracy by analysis, and statements of which are sent to the different laboratories, together with samples.

In respect to halogen the ordinary water-samples have to be compared with the standard water by analytical methods.

lines provisionally drawn on the annexed chart, where *R* denotes the Russian, *F* the Finnish, *S* the Swedish, *G* the German, *Da* the Danish, *Du* the Dutch, *N* the Norwegian, and *B* the British lines.

The special points are to be decided by the respective nations, and when once chosen the subsequent observations are to be repeated at the same points.

The particular instructions for the stations will be given by the respective nations, and the communications as to the extent and the nature of the observations shall take place through the central bureau (see C, *a* and *e*).

X. It is desirable, in carrying out these investigations, to make use of regular liners, light-ships, &c., and coast stations for the purpose of taking temperature-observations and collecting samples of sea-water and plankton.

These observations are to be taken not only in the typical months, but also during the intervening periods.

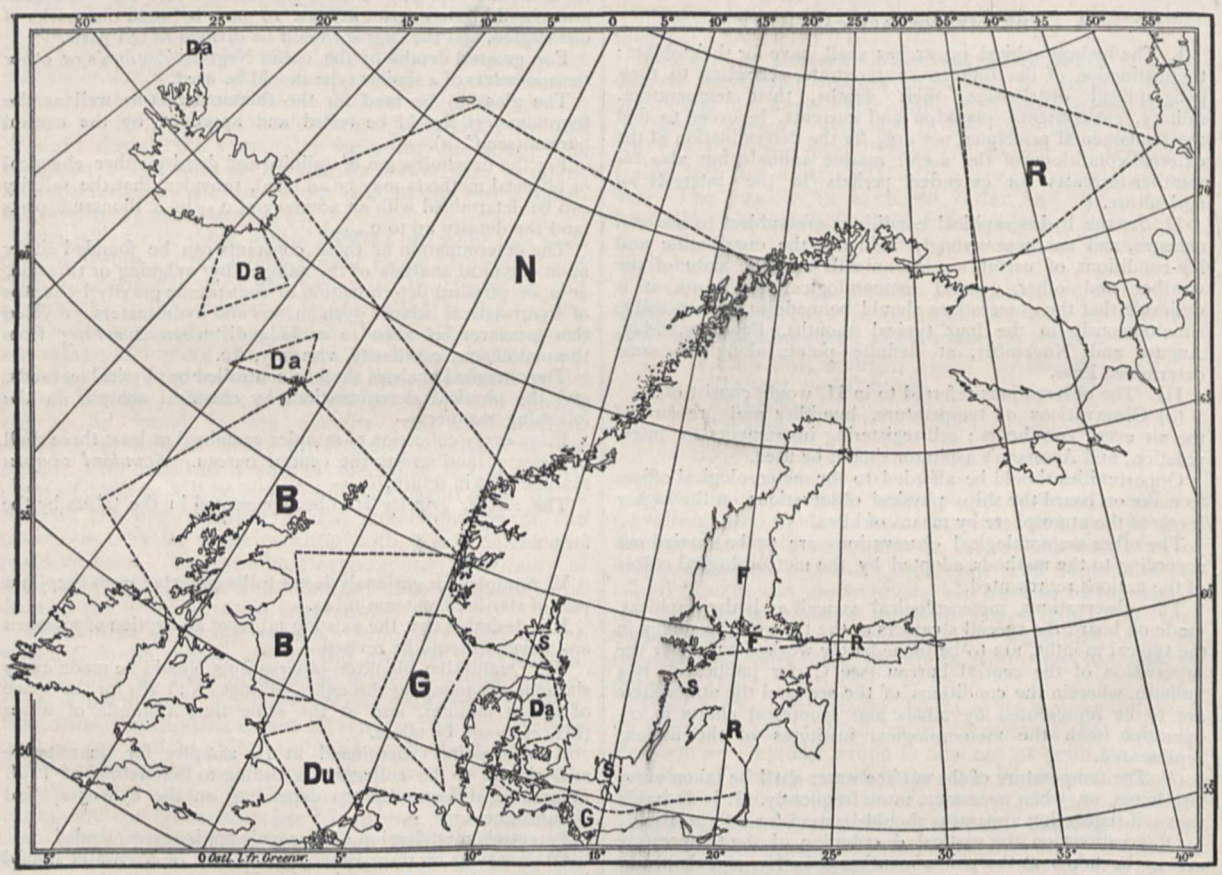
abundance, and average size of economic fishes, and the causes of the same.

II. (*a*) Experimental fishings *on* the known fishing grounds during the time of the fishery, as well as *outside* these areas and seasons.

(*b*) Preparation of uniform statistics of the experimental catches, with particulars of the number, species, size, weight and condition of the fish; for example, as done on board the *Garland* by the Scottish Fishery Board.

(*c*) The uniform use of appropriate apparatus for the experimental capture of the different species and sizes of fish.

(*d*) The experimental marking and liberation of fish, for instance, of plaice, on as large a scale as possible and over extensive areas; for example, as carried out by Dr. C. G. Joh. Petersen and Dr. T. W. Fulton (Reports of the Danish Biological Station and the Fishery Board for Scotland) and others (see Appendix IV.).



Division of Areas for Investigations in connection with Fisheries.

B.—The Biological Work.

I. (*a*) Determination of the topographical and bathymetrical distribution of eggs and larvæ of marine economic fishes; for example, by quantitative methods, such as those of Hensen, and with special reference to the most important species, such as plaice, cod and haddock, herring, &c. (see Appendix I.).

(*b*) Continued investigation of the life-history and conditions of life of young fishes of economic species in their post-larva stages and till they reach maturity, with special reference to their local distribution.

(*c*) Systematic observation of mature marketable fishes with reference to their local varieties and migrations, their conditions of life, nourishment (as, for instance, by investigation of the contents of the stomach), and natural enemies; also observations on the occurrence and nature of fish food at the bottom, the surface and intermediate waters down to depths of at least 600 metres (see Appendix I.).

(*d*) Determination of periodic variations in the occurrence,

III. (*a*) It is desirable to collect uniform statistics of the number, weight and value of the fish landed, of the means of capture, and of the persons engaged in the industry; for example, as in the General Reports of the Scottish Fishery Board.

(*b*) It is desirable to collect material for the preparation of maps, showing the fishing grounds and the kinds of fishing here practised (*cf.* A. VIII.).

C.—Organisation of a Central Bureau.

I. The Conference recommends that there should be for the international hydrographical and biological researches of the seas an international Council with a central bureau, furnished with a laboratory (see Appendix II.). The central bureau will be:—

(*a*) To give uniform directions for the hydrographical and biological researches in accordance with the resolutions drawn up in the programme of the present Conference, or in

accordance with such modifications as may be introduced later with the consent of the States represented.

(*b*) To control the apparatus and to insure uniformity of methods.

(*c*) To undertake such particular work as may be entrusted to it by the participating Governments.

(*d*) To publish periodical reports and papers which may prove useful in carrying out the co-operative work.

(*e*) To decide the graphic representations, scales, signs and colours to be used in the charts for the purpose of obtaining uniformity in the publications.

(*f*) To make, in connection with the investigations, application to the telegraph administrations for the purpose of obtaining determinations from time to time of the changes in the resistance of the cables which cross the areas in any direction.

II. (*a*) The permanent international Council should consist of commissioners elected by the Governments interested. Each Government may appoint two commissioners who may be represented at meetings by substitutes.

(*b*) The Council elects its president and vice-president, and appoints all officials connected with the central bureau. Should the general secretary represent hydrographical sciences, his principal assistant should represent the biological sciences, or *vice versâ*.

(*c*) The Council shall draw up its own order of proceedings.

(*d*) The expenses of the central office are approximately estimated at 4800*l*. (96,000 marks) yearly.

(*e*) The place of the central bureau, to be decided by the Governments concerned, shall at the same time be the residence of the general secretary, and should be conveniently situated for hydrographical and biological researches.

(*f*) It will be for the Governments concerned to decide among themselves the share to be borne by each.

Scheme for the Expenditure of the Central Bureau.

	£
(1) General Secretary	750
(2) Principal Assistant	500
(3) President, for incidental expenses other than travelling expenses	200
(4) Vice-President, for incidental expenses other than travelling expenses	100
(5) Office, laboratory, scientific and technical assistants, draughtsmen, clerks, servants, postage, telegrams and similar expenses	2250
(6) Travelling expenses	300
Note: Travelling expenses of commissioners attending meetings of the Council shall be borne by their respective Governments.	
(7) Printing	500
(8) Incidental expenses	200
	£4800

D.—It is desirable that these investigations should begin May 1, 1901.

E.—The Conference declares that it is of the greatest importance, both for high sea fisheries and for the weather forecasts for long periods, that the Faröe Islands and Iceland should be included in the European telegraph system as soon as possible.

F.—The relation between the quantity of halogen contained in the water and the density of the water shall be carefully investigated by an experimental revision of the tables compiled by Knudsen (Ingolf Exp. ii. 37). The tables compiled by Makaroff, Krümmel and others for the relation of specific gravity to density and salinity are likewise in urgent need of experimental revision.

It is proposed to undertake these investigations in the technical institute at Copenhagen under the direction of a committee consisting of Sir John Murray, Messrs. Knudsen, Pettersson, Nansen, Krümmel, H. N. Dickson, and Makaroff. The means for carrying out these works are to be requested from such learned societies as have funds for such purposes.

G.—The Conference recommends that these resolutions be brought by the nations concerned to the knowledge of the Governments of France and Belgium.

H.—In case the resolutions of the Conference should be accepted by the States, it is anticipated that some length of time will elapse before the organisation of the central bureau is completed. In the meantime the Governments may wish to possess an organisation in connection with this Conference which may be useful in constituting the Council and the central bureau.

The members of the third committee—Åkerman, Drechsel, Von Grimm, Herwig, Hoek, J. Murray, Nansen, Pettersson—hereby offer their services for this purpose.

Appendix I. is on the quantitative estimation of pelagic fish-eggs and larvæ, by Prof. Hensen; Appendix II., on the Central Laboratory, by Prof. Nansen; Appendix III., on plankton investigations, by Profs. Cleve and Pettersson; and Appendix IV., on the marking of fishes in the waters of the region of the Baltic and the North Sea, by Dr. Trybom.

NOTES.

ONE of the most transcendent sights that it is given to man to witness is due next week. Those who saw the "falling stars" of 1866 readily acknowledge that there is no other phenomenon which is equal to it in majesty and enthralling beauty; and although comparisons are always odious, and generally misleading, some have held that the 1866 display was far more striking than a total eclipse of the sun. It is to be hoped, therefore, that the sky will be clear during the early mornings of next week. It appears from a communication of Messrs. Johnstone Stoney and Downing, which appears in another column, that it is not yet known whether the densest part of the meteors will be encountered on the morning of the 15th or during the next night. It is to be regretted that bright moonlight will certainly prevent the shower from being seen with the same effect as in 1866, if it should happen before the morning hours.

CERTAINLY not for many years has there been so much anxiety, either expressed or silently borne, as since some days ago, when the wire joining Ladysmith and civilisation was broken. Not only have the relatives of the 10,000 Britons beleaguered there been anxious, but all who take interest in the severe struggle which is now going on. It has been a matter of general surprise that in a campaign in which the cutting of telegraph wires was the first thing to be expected, and the investment of several isolated garrisons for a time was to be taken for granted, Marconi apparatus was not installed as a matter of course. We do not share this surprise; science, and especially the latest developments of science, are the last things to interest our Government and the Government Departments; they do not believe in science, they care to know very little about it, and the scientific spirit is absent from too many of their plans and doings. Hence we have now to be thankful that they have reached the level of the pigeon post, which has been the only official means, and that on the part of one or two birds, to keep us in touch with our beleaguered forces. It is stated that even the Commander in Chief, Lord Wolseley, has expressed some surprise that the so-called "Intelligence Department" of the Army allowed the Ladysmith force to go to the front with mountain guns against a Boer force which they should have known might be armed with Schneider-Canet cannons of large calibre; and it would seem that probably a terrible disaster has been prevented, not by our Intelligence Department, not by the outfit of our Army, but by the apparently accidental arrival of naval guns and *personnel* at the last moment. Why is there not a Scientific Committee to do what it can in advising the military authorities? If they could do nothing, nobody would be the worse, but they might be able to do much to the nation's advantage.

AT the anniversary meeting of the Royal Society on November 30, the following Fellows will be recommended by the President and Council of the Royal Society for election into the Council for the year 1900. The names of new members

are printed in italics:—President: Lord Lister. Treasurer: Alfred Bray Kempe. Secretaries: Sir Michael Foster, K.C.B., Prof. Arthur William Rücker. Foreign Secretary: *Dr. Thomas Edward Thorpe*. Other members of the Council: *Horace T. Brown*, Captain Ettrick William Creak, R.N., Prof. James Dewar, *Prof. Edwin Bailey Elliott*, *Dr. Hans Friedrich Gadow*, Prof. William Dobinson Halliburton, Prof. William Abbott Herdman, *Sir John Murray*, *K.C.B.*, Sir Andrew Noble, K.C.B., *Prof. Arnold William Reinold*, Dr. George Johnstone Stoney, *George James Symons*, *J. J. H. Teall*, Prof. Joseph John Thomson, *Prof. Edward Burnett Tylor*, *Sir Samuel Wilks*, *Bart.*

THE gold medal of the Highland and Agricultural Society of Scotland has been awarded to Prof. Cossar Ewart in recognition of his intercrossing and other experiments. Seeing that the Scottish Agricultural Society has a reserve fund of well nigh 100,000*l.*, and that there was a clear profit of over 4000*l.* at the last show—the show at which Prof. Ewart's zebra hybrids attracted so much attention—it is a matter of some surprise that the directors of the Society have not ere this voted a substantial sum in aid of the extremely costly experiments which for some years have been steadily carried on in the vicinity of Edinburgh.

DR. W. H. CORFIELD, professor of hygiene and public health in University College, London, has been appointed to the newly-created post of consulting sanitary adviser to Her Majesty's Office of Works, for the Royal Palaces and Public Buildings in charge of the Department.

AT the recent annual meeting of the Royal Academy of Medicine in Ireland, the following distinguished men of science were elected honorary Fellows of the Academy: Sir J. Burdon-Sanderson, Bart., F.R.S.; Prof. Howard Kelly, Baltimore; Prof. Koch, Berlin; Prof. Kocher, Bern; Prof. Th. Leber, Heidelberg; Sir W. MacCormac, Bart., K.C.V.O., London; Prof. Martin, Berlin; Prof. Nothnagel, Vienna; Prof. Osler, Baltimore; and Sir W. Turner, F.R.S., Edinburgh.

AN egg of *Aepyornis maximus*, measuring nearly a yard in circumference, was sold at Mr. J. C. Stevens's auction rooms on Tuesday, the price realised being forty-two guineas.

WE regret to see the announcement of the death of Dr. Edward Orton, the distinguished geologist, and president of the American Association for the Advancement of Science.

SIX public lectures on "England in South Africa," illustrated by maps and lantern slides, will be given at the Imperial Institute on Thursday evenings during this month and next, by Mr. Basil Worsfold. The first lecture will be delivered this evening.

WE learn from *Science* that Mr. J. B. Hatcher, and his assistant Mr. O. A. Peterson, have returned from their third exploration of Patagonia, where they were sent by the Geological Department of Princeton University. Very extensive collections have been made of both vertebrate and invertebrate fossils of Patagonia, and much material illustrating the zoology and botany of that region has been obtained.

THE leases of the auriferous deposits of the north-western shore of the Sea of Okhotsk, in Siberia, recently discovered and explored by a special commission sent into the region referred to by the Russian Imperial Government, are to be put up for auction at St. Petersburg in February 1900. The conditions of the leases may be seen on application at the Intelligence Branch of the Commercial Department of the Board of Trade.

IT is stated by the *Daily News* that Prof. Starr, of Chicago, who for many years has made a study of the ethnographical aspects of the interior of Mexico, has presented his valuable collection of objects, gathered during various expeditions into the heart of Mexico, to the Folk Lore Society, and the latter have, through the medium of their president, Mr. E. Sidney Hartland, offered to place the collection on permanent deposit in the Museum of Archæology and Ethnology at Cambridge.

THE new session of the Society of Arts will be opened on November 15 with an address from the chairman of the Council, Sir John Wolfe Barry, K.C.B., F.R.S. In it it is probable that he will develop the subject of his address last year, "London Communications," and will make some suggestions as to the practical means of carrying his proposals into effect. The first paper after the opening meeting will be by Mr. D. E. Hutchins, who will draw attention to the want in this country of measures for the proper conservation of woods and forests. At the next meeting Mr. Allan Wyon will give a paper, principally of an antiquarian nature, on the Great Seals of England. At the other meetings before Christmas it is probable that Mr. Joseph Cash will describe the substitutes which have recently been introduced to replace silk, and the methods of their production. Mr. F. G. Aflalo will draw attention to the necessity for some legislation to restrict sea anglers from catching immature and undersized fish; and Mr. H. Bloomfield Bare will describe and illustrate the methods, which have recently achieved considerable success in America, of teaching drawing by the use of the blackboard, both hands being employed. Mr. H. H. Cunynghame, who has devoted a great deal of attention to the subject, will give a course of Cantor Lectures before Christmas on the art of enamelling. It is intended to demonstrate practically the whole process of enamel-making during the course. The Juvenile Lectures will be by Mr. Herbert Jackson, of King's College, who will lecture on phosphorescence.

AN important article on Mangabeira rubber appears in the current number of the *Kew Bulletin*. Partly in consequence of an improvement in the purity of the rubber, the price has recently advanced and the price of the best sorts is not much less than that obtained for Para rubber. The chief centres for export of Mangabeira rubber are Bahia and Pernambuco. Although but little is known so far of the cultivation of Mangabeira, it may be said that there is a considerable probability of its becoming an important tree in rubber-culture. The apparently easy accommodation of the tree to soil and climate, its early and considerable yield, together with the fact that even under the rough treatment of the Indians it preserves its fruitfulness, and also the facility with which it can be cultivated, promise a future. And, taking a wide view of its possibilities, from its presence in the red coffee-growing soils of the west of the Province of São Paulo, it appears suitable for the red earths of the German colonies of Africa, Usambara and Togoland alike, such, for instance, as occur at Misahöhe in the latter Colony. For these soils it promises to be considerably better suited than the Ceara rubber plant and the Para rubbers, and will probably give better results than *Castilloa*, than which it is more hardy, earlier maturing, and smaller.

THE information at present available on the subject of injurious insects in India forests is brought together in an illustrated pamphlet (pp. 152) by Mr. E. P. Stebbing, which has been issued from the office of the superintendent of Government printing, Calcutta. Locusts and white ants or termites are among the most destructive pests of the insect kingdom. The former invades the fertile plains of India from its home in the sandy deserts of Rajputana, Sind, and the Punjab,

and in the line it takes not a green leaf or shoot is left either in the forest or field. It is pointed out that as the life-history of the pest readily proves that forests and moisture are its greatest enemies, the reclamation of arid sandy areas by means of plantations would tend to check its multiplication. As to the white ant, though it is a most unwelcome intruder in any building, it renders service to man in the forest by rapidly converting fallen branches, dead trees and decaying wood of all kinds into mud, each particle of wood eaten being replaced by earth. Where termites are numerous, the insects only feed on the outer dead portions of the bark of the trees, and do no damage to healthy trees. The instinct of these insects is marvellous. Mr. Stebbing states that he has often noticed that should a tree have a dead branch on its trunk, no matter at what elevation, an earthen gallery is run up by the white ants, and the branch attacked, the decaying wood being replaced by soil, which soon falls to the ground.

A NOTE on a new departure which has been made in connection with the artificial hatching of salmon in Norway appears in the *Journal* of the Society of Arts. Formerly the young fry were allowed to escape as soon as they began to require food, and, therefore, when in a very delicate and defenceless condition. They are now retained in captivity, and fed four times a day upon the raw liver of slaughtered animals, until the autumn, after the system which obtains in America. According to Consul Nelson, of Bergen, the results of the first year's experiment at the Government hatchery on the Drammen were satisfactory; on 280,000 ova treated, the loss was only 2 per cent., and in the middle of October about 211,000 fry were turned out, while the percentage of loss has been still further reduced of late years. A belief is prevalent among the coast fishermen that salmon and sea-trout spawn successfully in salt water, and in this connection a series of experiments were conducted under proper supervision, from which it appeared that (1) roe taken from salmon captured in a river, or from sea-trout which have remained until the spawning time in sea water, cannot be successfully developed in salt water, and (2) salmon and sea-trout roe impregnated in fresh water may be hatched out in brackish water containing a small percentage of salt up to eight or nine per mille—that is to say, rather less than one-third of the salt contained in the sea water on the Norwegian coast.

FEW people are aware that a number of European rivers which were once almost destitute of fish are now well stocked with species propagated from fry obtained from America. An idea of the extent of the operations of the U.S. Fish Commission, by which this change has been brought about, may be obtained from an article in the *Scientific American*. About ten years ago young fry of American landlocked salmon were shipped to Scotland, and since then they have multiplied rapidly, much to the detriment of the Scotch fish. A shipment of American black bass fry was made to France for stocking the rivers and streams, and, like the American salmon in Scotch waters, they have flourished so marvellously that to-day they are quite common articles of diet at the French hotels and restaurants. The French streams, since the introduction of the American bass, have doubled in their productive value, and there is every reason for the French anglers to be grateful to the U.S. Fish Commission for stocking their waters with a new species of food fish. Other varieties of fish have been shipped to France and elsewhere for scientific experiments. The American rock bass has been introduced into several English streams, and the American brook trout is to-day in flourishing condition in the clear, cold streams of Russia and other northern countries of Europe. The waters of Switzerland abound with many American common river and brook fish, which make the angling there superior to anything in the past. It is even reported that the fine American muskalonge has found a satisfactory home in the Rhine and Danube rivers.

WE have received the Report of the Meteorological Commission of the Cape of Good Hope for the year 1898, a folio Blue Book of 168 pages, containing valuable results of meteorological observations made under the direction of the Commission, which has been collecting systematic information since the year 1861. The system now embraces two stations of the first order, 54 of the second order (barometric stations), 17 thermometric stations and 370 rainfall stations. These include observations made in the South African Republic, the Orange Free State, and at various other stations outside Cape Colony. The most noteworthy feature of the present Report is the inclusion of returns from the splendidly equipped station established by the De Beers' Company at Kenilworth, near Kimberley, at which hourly observations have been made during the whole year. It is believed that this is the only station of its kind, not only in South Africa, but in the whole African continent. An interesting ocean-current bottle notice was found on the coast, about latitude 34° 2′ south, and longitude 20° 47′ east. It was thrown from the *Blengfell* in latitude 39° 58′ south, and longitude 23° 22′ east, and had taken two years one hundred and thirty days in travelling 4° 56′ north and 35′ east, having evidently been caught in the Agulhas current. Among other useful information, the Report contains notes on the weather of each month and the whole year, drawn up by the Secretary, with a series of diagrams giving the mean monthly rainfall over the whole Colony, with the percentage differences from the means for ten years (1885–94).

THE Report on the administration of the Meteorological Department of the Government of India in 1898–99, which has just been issued, is divided into two parts: (1) a general account of the more important work of the department, and (2) details of administration. The total number of stations (including four first-class observatories) amounted to 174, and the number of rainfall stations from which monthly statements have been published was 2280. Seismographs have been established at three suitable observatories, and a brief list of the earthquake shocks is now given in the *Monthly Weather Review*; a full account of the work done is promised in the next year's Report. Some important observations of the direction and velocity of the upper clouds have been made, and the results will be published in due course. The seasonal forecasts, based on the snowfall of the mountain districts, show only a moderate agreement with the actual weather experienced, but storm warnings appear to have been carried out very satisfactorily, timely warning being given of all the more important storms which visited the Indian coasts; the opinions of the warnings of floods are also generally satisfactory. The Department is greatly assisted in its useful work by the liberality of the Eastern Telegraph Company, and the Indo-European Telegraph Department, for the concession of free telegrams from Aden and Persia.

IN the Bradshaw Lecture, delivered before the Royal College of Physicians of London on November 2, and published in the *Lancet*, Dr. A. Foxwell points out that the first result of exercise is an increase in the rate and depth of the respirations—that is, of the respiratory exchange. The respiratory quotient, CO_2/O_2, is not increased, but if anything diminished: in other words, the tissues are as rich (or richer) in oxygen during exercise as during rest. This necessitates a great increase in the absorption of oxygen at this time; for it has been shown that a man gives off ten times as much carbonic acid when on the treadmill as he does when asleep. But it is a remarkable fact that arm work, per unit of work done, requires a greater

absorption of oxygen than climbing, and climbing than walking on the level. If the amount of oxygen absorbed during sleep per minute be 100 grams, then in a minute's walking at three miles an hour on the level it would be 500 grams; in climbing a yard high 5000 grams, and in doing the same amount of kilogram metres by turning a wheel (arm work) 7000 grams. Such an enormous increase in the absorption of oxygen and giving out of carbonic acid must seriously strain the resources of the organs concerned. Dr. Foxwell considers that the lungs and the right ventricle of the heart bear the brunt of the extra labour involved in short strenuous exertions.

IN the *Physical Review* for September, Messrs. W. O. Atwater and E. B. Rosa give the first part of a paper describing a new respiration calorimeter and certain experiments made with it on the conservation of energy in the human body. The apparatus described has been devised and the methods of experimenting have been elaborated for use in inquiries bearing (1) on the question as to whether the principle of conservation of energy holds good in the living organism, and (2) assuming this law to be true, on the acquisition of more definite knowledge of the ways in which the body is nourished and of the values and uses of food. We would suggest that in experiments upon the living organism, the second law of thermodynamics opens up a much more interesting field of study than the first law. It has been suggested that vital processes afford the most likely region in which to seek for the existence of Maxwell's "demons," and should their non-existence be established, information as to the relative efficiency of the human individual as compared with a perfectly reversible thermodynamic engine is much to be desired.

THE Soulanges Canal, which has recently been opened for traffic, completes the scheme for providing a 14-feet water-way from the Great Lakes to Montreal, in place of 9-feet, which previously had been the ruling depth for the navigation. It is considered that owing to the increased size of the vessels which will now be able to reach Montreal from the Great Lakes, the price of conveyance of wheat and other products of the North-west will be so reduced as to lead to the diversion of the principal part of the traffic which now finds its way to this country through America by the Erie Canal and New York. The St. Lawrence has been dredged and deepened below Montreal, so that large ocean-going vessels navigate the river up to that city, which has become the head both of the ocean and inland navigation. The Soulanges takes the place of the old Beauharnois Canal, it being found less costly to construct an entirely new water-way over this length than to widen and deepen the old one. The new canal connects Lake Francis with the Ottawa River. The fall in this length is 82 feet, which is overcome by four locks, this descent forming about half the total fall between Lake Ontario and the St. Lawrence. Electricity is used for lighting the locks and for operating the machinery for opening and closing the gates and sluices. The canal has cost 1,000,000*l.*; the total sum expended by the Dominion on the improved water-ways amounting to nearly 8,000,000*l.*

THE current number of Petermann's *Mittheilungen* contains a valuable paper on the fundamental lines of structure of the Eastern Alps, by Dr. C. Diener. An examination of the new material collected during the last few years leads the author to the opinion that the old division of the Eastern Alps into three zones, one crystalline and two limestone zones, is inadequate: the division is rather into five zones, which radiate eastward. The "Flysch" zone forms part of a tectonic unit running to north-eastern Switzerland and the western Alps, next comes the northern limestone zone, and then the central zone, which is made up of a number of different parts. The fourth zone is the "Drauzug" of Suess, and the fifth the southern limestone zone.

THE Smithsonian Institution has just issued a reprint of two old papers, by Dr. Otis T. Mason, on the Latimer Collection of Antiquities from Porto Rico, and on the Guesde Collection from Pointe-à-pître, Guadeloupe. There seems to be some doubt whether the wonderful examples of stone carvings were the work of Caribs or of their more peaceful neighbours; the evidence seems rather to point in favour of the former view. At Porto Rico are found mammiform stones which consist of a human or animal image associated with a conical projection; there are also found so-called "collars." These are slender ringed stones shaped something like a horse-collar; they average about seventeen inches long and twelve inches wide. They are beautifully worked and usually decorated with elaborately carved panels; the significance of these two groups of objects is unknown. Those interested in aboriginal stone-work should consult these papers, which have numerous illustrations; those in the second paper are in that queer dotted American style in which even contour lines are usually omitted. The wonderful results that can be obtained by savages without metal tools are here well demonstrated.

WE have received the parts of the Brazilian journal *Lavoura* for May, July and August 1899. They include articles on imported insect-pests, the Soja bean, agriculture, and various other observations, mostly illustrated, principally of local agricultural interest.

THE seventh edition of Foster and Langley's well-known "Course of Elementary Practical Physiology and Histology" (Macmillan) differs in several respects from preceding editions. Most of the lessons have been rewritten, a few have been added, and the lesson on the dissection of the rabbit and dog has been omitted. Dr. L. E. Shore has revised and rewritten the portions of the book dealing with chemical physiology, and with the physiology of muscle and nerve, and his name appears with Dr. Langley's, on the title-page, as joint editor of the new edition. The volume will doubtless be as widely used and appreciated in the future as it has been for more than twenty years.

WE have received from Mr. C. L. Wragge, chief of the Weather Bureau, Brisbane, a set of weather charts of Australasia for January 1898. The isobars are extended seawards over the Great Australian Bight and to New Zealand. These curves are to a great extent problematical, as indicated by the broken lines, and even over the land they appear to have been drawn from insufficient data in the western and north-western districts; the charts are also too much after date to be of general interest. We should prefer to see charts drawn by each Colony separately, from its own materials, and published within reasonable time after date.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Mr. Charles Dallas; a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, presented by Mr. D. Woosman; a Shag (*Phalacrocorax graculus*), European, presented by Mr. E. S. Montague; a Herring Gull (*Larus argentatus*), two Glaucous Gulls (*Larus glaucus*), European, presented by Mr. H. J. Pearson; seven Cape Scorpions (*Opisthopthalmus capensis*) from South Africa, presented by Dr. W. F. Purcell; a Cardinal Eclectus (*Eclectus cardinalis*) (habitat?), a Grand Eclectus (*Eclectus roratus*) from Moluccas, a Mealy Amazon (*Chrysotis farinosa*) from South America, four Blanding's Terrapins (*Emys blandingi*), five Prickly Trionyx (*Trionyx spinifer*) from North America, deposited; twelve Golden Carp (*Carassius auratus*), European, purchased.

OUR ASTRONOMICAL COLUMN.

HOLMES' COMET (1899 *d*).

Ephemeris for 12h. Greenwich Mean Time.

1899.	R.A. h. m. s.	Decl. ° ′ ″
Nov. 9 ...	2 28 9·89 ...	+48 58 11·4
10 ...	27 0·16 ...	54 29·8
11 ...	25 51·41 ...	50 28·4
12 ...	24 43·76 ...	46 7·7
13 ...	23 37·30 ...	41 28·3
14 ...	22 32·11 ...	36 30 7
15 ...	21 28·27 ...	31 15·7
16 ...	2 20 25·87 ...	+48 25 43·7

COMET GIACOBINI (1899 *e*).

Ephemeris for 12h. Berlin Mean Time.

1899.	R.A. h. m. s.	Decl. ° ′
Nov. 9 ...	17 30 5 ...	+6 35·6
10 ...	31 42 ...	6 51 8
11 ...	33 18 ...	7 8·0
12 ...	34 55 ...	7 24·2
13 ...	36 33 ...	7 40·4
14 ...	38 10 ...	7 56·6
15 ...	39 48 ...	8 12·9
16 ...	17 41 26 ...	+8 29·2

THE COMING METEOR SHOWER.—Much has recently been written respecting the necessary preparations for obtaining photographic record of the Leonids, but hitherto these instructions have only taken into consideration the determination of the position and appearance of the meteor trail. There must be many, however, who are in a position to attempt to obtain a record of the composition of the meteorites. The only additional apparatus will be either a prism or a diffraction grating. After the camera has been focussed, the prism or grating can be very simply attached to the hood of the lens, and the whole then constitutes a small prismatic camera which will give the spectrum of any meteor whose image falls on the plate. A grating is preferable, as the reduction of the spectrum is more easily made, and there is also the advantage that an ordinary picture of the object is obtained in addition to the spectrum. Practically perfect transmission gratings can now be obtained very cheaply of sufficient size to cover the lenses of ordinary cameras. If a prism is used, it should preferably be set at minimum deviation to allow of subsequent comparisons being made.

LONG FOCUS PHOTOGRAPHIC TELESCOPE.—Prof. E. C. Pickering some time ago asked for donations to enable a photographic lens of unusually long focus to be made for the use of the Harvard College Observatory. We hear that now the whole of the necessary amount has been subscribed by anonymous donors, and that a lens of about 12 inches aperture and over 100 feet focal length will probably be ready for trial during the ensuing year.

SECULAR PERTURBATIONS OF VENUS.—Prof. Eric Doolittle, of the Flower Observatory, has completed his investigation of the perturbations of Venus by the computation of those caused by the planet Neptune. The perturbations arising from the six inner planets have been published in the *Astronomical Journal*, Nos. 409, 428, 418, 434, 438 and 465, and the present communication appears in No. 470.

The planetary elements used have been adapted from Dr. G. W. Hill's "New Theory of Jupiter and Saturn."

All the equations are given in tabular form, and the variations arising from the combined action of all the disturbing planets are given in the form of six equations, one for each element.

ENGINEERING PROGRESS AND PROBLEMS.

THE eighty-first session of the Institution of Civil Engineers was opened on Tuesday with an address by the president, Sir Douglas Fox. A general survey of engineering progress during the present century was given in the address, the following being a few of the points to which reference was made:—

British engineers have two chief bodies of competitors to reckon with—the engineers of the great and growing empire of Germany and those of the United States, who have been thoroughly trained in theory and practice, and are proving their ability and courage by the vast works they originate and carry out.

German and other continental engineers are greatly assisted in many ways by paternal Governments, whose officers they generally are, and who lay down valuable regulations, and in many instances establish standards of quality and design.

American engineers are encouraged by the vast demands of a comparatively new country, in which nature exists on a magnificent scale, only equalled by Switzerland and India, and of a rapidly rising civilisation calling loudly for the most recent improvements in locomotion, in building, in lighting, in telephonic and telegraphic communication.

An important matter demanding careful consideration by civil engineers, if not by the Institution itself, is whether competition in the world's race could be facilitated by the establishment, upon sufficient authority, of standard specifications for such materials as steel and cement, and the introduction of standard types for bridgework, roofing and other structures frequently occurring in practice, and for locomotives and rolling stock.

The question of the adoption of the metric system has been ably dealt with by others. I therefore only desire to record my opinion that it is of the utmost importance to the engineers and traders of this empire, that this simple and effective mode of measurement, already in force in almost every other civilised nation, should be introduced here. Having had occasion for many years to work under both systems, I can bear testimony to the great saving of time and of labour effected by the use of the metrical weights and measures, and to the ease with which the system is acquired, even by those trained to use our antiquated and complicated standards. I am strongly of opinion that the two great Anglo-Saxon nations, Great Britain and the United States, must fall into line with the rest of the world in this matter, and it would be a notable and interesting mark of our entry into a new century if, as has already been suggested to our Government, the metric system could be made compulsory as from A.D. 1900. One great obstacle to British designs and manufactures finding their way upon equal terms through the continent of Europe and into the vast empire of China, Japan and elsewhere, would thus be removed, and engineers throughout the world would be thinking and designing upon a basis of like dimensions.

Nothing has more largely contributed to engineering successes of late years than the introduction of cheap steel of good quality and of high tensile strength, both for rails and for plates and rolled sections. Remarkable uniformity of quality has been attained, and, whilst the life of rails has been greatly increased, structures such as the Forth Bridge have been rendered practicable. At the present time mild steel is almost exclusively used for the construction of ships, thus greatly increasing their carrying capacity. Some anxiety is being caused to engineers by the manifest signs in rails and axles of fatigue after considerable wear, and the report of the Board of Trade Committee upon this subject is awaited with much interest.

With reference to this matter and to other questions involving scientific research, the resources of this Institution might, I suggest, be advantageously employed. Large numbers of experiments upon steel and other materials have been made with small specimens, but the testing to destruction of full-sized members of bridges and other structures, and experiments upon the effects of impact and of loads running at high speeds have been generally beyond the limits of private enterprise. As a result comparatively few of such records are available, whilst the value to our members would be very great.

There is no department of engineering which has benefited more by the inventive genius of the century than that of mining. Improved methods of sinking deep shafts, tubbing back water, and winding at high speeds from great depths, have enabled much coal to be opened up. Electricity has been impressed into the service with most beneficial results, not only of economy, but of safety and improved sanitation, and is now largely used for underground haulage, for lighting, for pumping at the face, and, in the shape of telephones, for communication. In dealing with gold and other ores, chemistry, electrolysis and mechanical engineering have combined to reduce cost and waste. Every effort is still necessary on the part of our mining engineers to face the competition, and the labour-saving appliances, not only of Belgium and Germany, but still more of the United States. It is surely to be regretted that it has been found necessary to obtain so

large a portion of the mining machinery for our Colonies from our Transatlantic cousins.

It seems probable that liquid air, which can now be produced at a very cheap rate, will prove a most valuable auxiliary for cooling, and thus assist in ventilating mining drifts and railway tunnels. Experiments in this direction are being made in connection with the works of the Simplon Tunnel, which are now in full activity.

The problems now opening up to the civil engineer are of surpassing importance. Trunk railways through Russia, China, Persia, Africa; irrigation works to supply the wants of growing populations; harbours large enough to receive the vessels of the future (already eclipsing the *Great Eastern*, of which the chief shortcoming was that she was before her time); central installations to furnish lighting, power, traction and heating to whole counties; the extension of the telephonic communication—with and without wires; the abolition of the smoke and smell of cities; the replacement of horses by mechanical power in the streets; the increase of the speed of trains to 100 miles per hour; the erection of buildings of great height where land is valuable; the utilisation of waste products, especially the refuse of cities; the improvement of the water-supply; the reclamation of land; the profitable working of deep seams of coal.

These are but some of the branches in which engineering progress in the twentieth century may be expected to develop. They will call with increasing force for engineers sanguine for the future, educated upon a basis of sound scientific attainment, trained in experimental research, and qualified by practical experience—obtained, I trust, by means of that regular course of pupilage under members of the Institution which, in the less favourable circumstances of the past, has nevertheless produced the engineers who have achieved the results to which I have referred.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE chief point of interest on the first day of the meeting of the Section, apart from the President's address, was a discussion on the rival systems for the identification of criminals of the Bertillon method and that based on finger-prints as propounded by Mr. E. R. Henry and adopted in British India. Mr. Henry, who is the Inspector-General of Police in the Bengal Civil Service, gave a demonstration of his system. The author referred to the importance of fixing human personality so that no efforts made to confuse it subsequently may prove availing. Of this problem the Bertillon system offered first scientific solution. But experience in India has shown that the "Personal Equation" error of measures predominates so much as to vitiate seriously the correctness of the recorded results under that system. Finger-prints, on the other hand, being absolute impressions taken from body under conditions which eliminate error in transcribing or recording, the "Personal Equation" error is reduced to a minimum. Taking the impressions of all ten digits occupies only a fraction of the time required for measuring, while search is more exhaustive and many times more rapid. This new system has been introduced on a most extensive scale throughout British India, and the Legislature has recognised it by passing an Act to amend the law of evidence so as to make relevant the testimony of finger-print experts.

The main difficulty hitherto experienced had been that of providing an effective system of classification. But this difficulty has been overcome. A thin film of printer's ink is spread over a piece of flat tin, and each finger in turn is pressed on the film, and after being thus inked is pressed on paper where a clear, sharp impression is left. Fingers are impressed in their natural order of thumb, index, middle, ring, and little, those of the right hand being above, and the corresponding digit of the left hand below them.

All impressions must be either arches, loops, whorls, or composites—there is a great preponderance of loops and whorls. In primary classification arches are included under loops, and composites under whorls, and therefore, for purposes of primary classification, an impression must be either a loop or whorl. The digits are taken in the following pairs: (1) right thumb and right index; (2) right middle and right ring; (3) right little and left thumb; (4) left index and left middle; (5) left ring and left little finger. Taking first pair and denoting loop by L and whorl by W, we get the following arrangements. Right thumb may be L and right index L; right thumb may be L and right index W; right thumb may be W and right index L; and right thumb may be W and right index W. So there are four, and not more than four, arrangements possible. Similarly, in second pair, there are four such arrangements, which, taken with those of the first pair, yield 16 combinations; taking the third pair we get 64 combinations, and by adding the fourth and fifth pairs, this number rises to 256 and 1024. Now 1024 equals 32 squared; in other words, a cabinet containing 32 sets of 32 pigeon-holes arranged vertically would provide all the locations required. A diagram was shown how this works in practice. But the following rule is very simple. The first of each pair is shown as numerator, the second of each pair as denominator, yielding for the five sets of pairs some such formula as the following: $\frac{L}{W}; \frac{W}{L}; \frac{L}{L}; \frac{W}{W}; \frac{L}{W}$. A whorl in the first pair counts 16, in the second pair 8, in the third 4, in the fourth 2, in the fifth 1. No numerical value is given to a loop. Substituting these values in the formula we get $\frac{0}{16}; \frac{8}{0}; \frac{0}{0}; \frac{2}{0}; \frac{0}{1} = \frac{1}{16}$. Add 1 to both numerator and denominator and invert the fraction which becomes $\frac{17}{1}$, and this is the primary classification number, and represents that the card containing these impressions will be found on the twentieth pigeon-hole of the eleventh vertical row. The secondary classification required to break up accumulations is equally simple, and the search formula or legend for each card can be prepared rapidly without any key and brings search down to groups of very small volume.

Naturally Dr. Garson argued in support of the French system as taught by him to the English police. He had previously read a paper on the "Personal equation in anthropometry," and had fully described the well-known Bertillon system; he admitted there was always a margin of uncertainty in measurements, but denied that it need be so large as Mr. Henry asserted. He expressed regret that the Indian Government had abandoned the Bertillon system for one based solely on finger-prints.

A paper, also illustrated by lantern slides, was read by Francis Galton on "Finger-prints of young children," in which he demonstrated that clear prints of all ten fingers of a baby would suffice for after-identification by an expert, but by an expert only. Although new ridges may appear in infantile life the type of each pattern persists all through life, and is never doubtful to a practised eye.

The whole of Friday was devoted to samples of the work accomplished by the Cambridge Expedition to Torres Straits and New Guinea. Dr. A. C. Haddon, the organiser and leader of the expedition, led off with a short report on the work done (*cf.* NATURE vol. lx. p. 413), and illustrated with lantern slides the physical character of the inhabitants. A communication on the linguistic results of the expedition, by Mr. Sidney H. Ray, was laid before the Section.

The language of the Eastern tribe of the Straits bears no resemblance to the Melanesian, and but little to the Australian group of languages, while that of the Western tribe is decidedly of the Australian type. Most of the coast languages of the Port Moresby and Hood Bay districts are very closely akin to the languages of the Melanesian Islands, except some, such as the Koitapu, Koiari and Cloudy Bay dialects, which approach the Australian type, but has nothing in common with the Melanesian. Mr. C. S. Myers gave an interesting paper on savage music, based on his observations in Murray Island and Sarawak.

As our modern orchestra admits the noises of drums and cymbals, and our harmony allows chords which in a more classical period were inadmissible, we, in our inquiry into past and primitive music will not refuse to consider certain sounds as musical even though they be noisy. Sympathy should be our sole test of music. In savage life the songs of a tribe are its chief heritage. Certain songs recorded on the phonograph in Murray Island, Torres Straits, are now obsolete, and will probably die out with the old men. Neither there nor in Borneo could any trace of the notes of birds be found in the music. Of the two fundamentally distinct elements in music, rhythm and melody, the one has its basis in bodily movement, the other in the emotional recitative. In Murray Island the drum is beaten to accentuate the words of the old songs, the music being singularly lacking in rhythm; among the North American Indians, on the other hand, rhythm is well developed. The

extraordinary complexity of rhythm in certain Malay music was graphically recorded. The Murray Islanders have a wonderfully developed idea of rhythm, as is proved by their being able regularly to continue accurately recorded beats of prescribed rapidity for a considerable period. Many suggestions have been made as to which of the intervals came most naturally to the human voice. The Murray Islanders have no polyphonic music, but in a chorus accompanying the songs of the Kenyah and allied races in Borneo a long-drawn note a fifth below the key-note runs drone-like through the song. A similar interval has been noted in one of the rare examples of polyphonic music found in North America.

Writers have been led to conclude that various peoples employed far smaller intervals than our own, misled apparently by viewing the numerous intervals as if they formed a scale instead of a series of notes from which various scales were derived. In this way travellers have been induced to look for quarter-tone music in uncivilised parts of the world; but the author had no doubt that those quarter-tones, which have been written down as occurring between any two whole (or semi-) tones, merely express a gradual descent in the voice from one of these tones to the other. The insensitiveness of the ear of the Murray islanders to minute differences of interval was estimated by means of tuning-forks. The common incorrect intonation in savage music was alluded to.

Mr. C. G. Seligmann followed with an account of the seclusion of girls at puberty in Mabuiag and other of the Western islands of Torres Straits and also on the mainland at Cape York. The girl is surrounded with bushes in a dark corner of her parents' house, and for months is only allowed to go out at night. The sun may not shine on her; no man may come into the house; ill-luck would befall her father if he saw her; she may not feed herself; and there are other restrictions. Various modifications of the seclusion were described. These observations are of especial interest, as it is a new locality for these interesting customs, the significance of which have been discussed by Frazer in "The Golden Bough." The same author read a paper on some customs of the Otati tribe of North Queensland; and another, illustrated with lantern slides, on the Club Houses and Dubus of British New Guinea. In the Papuan Gulf the club houses of the men are of large size and highly decorated; no women may enter them. Further down the coast their place is taken by platforms, or dubus, the posts of which are generally carved, in some instances probably so as to resemble crocodiles' heads. As a general rule women may not approach the dubu.

The morning's session concluded with a very interesting report on the investigations on comparative psychology made in Torres Straits and New Guinea. Dr. W. H. R. Rivers gave a general account of the work done, with observations on vision, &c. The natives show very considerable variability in character and temperament; they do not appear to be especially susceptible to suggestion, but exhibited very considerable independence of opinion. One hundred and fifty natives of Torres Straits and Kiwai were tested for colour-blindness without finding one case; about eighty members of other races were tested with a similar result, but of eight Lifu islanders three were colour-blind. The names used for colours by the Torres Straits islanders were very fully investigated; there were definite names for red, less definite for yellow, and still less so for green, while a definite name for blue was either absent or borrowed from English. Corresponding to this defect of colour terminology, there appeared to be an actual defect of vision for colours of short wave-length. Numerous observations were made on writing and drawing; the most striking result was the care and correctness with which mirror writing was performed. Unexpected success attended the experiments on the estimation of time. Nearly all the investigations gave some indication of the liability to fatigue and the capability for improvement by practice. Mr. C. S. Myers gave an account of his observations on hearing, smell, taste, reaction-time, &c. Few Murray Islanders surpass a hyper-acute European in auditory acuity, while the majority cannot hear as far. The sense of rhythm is remarkably accurate. There is no reason to believe that they are able to perceive such traces of odour as would be imperceptible to the most sensitive European noses. Experiments were made to determine the appreciation and recognition of the common tastes. The time of simple reaction is probably somewhat shorter than would be that given by a corresponding class of Europeans. The observations of Mr. W. McDougall on the sense of touch showed that the natives have a greater delicacy of discrimination than white men, and at the same time less sensibility to pain.

In the afternoon Dr. Haddon gave a lantern exhibit that lasted for a couple of hours; over one hundred slides were shown, illustrating native handicrafts, customs and mode of life. A number of sacred stones and spots were shown, and their legends narrated. A series of sixteen slides fully illustrated the process of pottery-making at Port Moresby; other slides showed men cutting out canoes with stone adzes at Keapara; raising a pile, and the process of tattooing at Bulaa; and a number of beautiful photographs portrayed the singing games of Papuan children. Most of the photographs exhibited were taken by Mr. A. Wilkin.

Saturday was devoted to archæological papers, and several members of the French Association were present at the session The most important communications were: one by Mr. A. J. Evans on the occurrence of "Celtic" types of Fibula of the Hallstatt and La Tène periods in Tunisia and Eastern Algeria; the appearance of Celtic types of Fibula among the Numidians finds its complement in the discovery of large hoards of Carthaginian and Numidian coins on the transit line of the amber trade between the Save and the Adriatic. The other, by Mr. G. Coffey, on Irish copper Celts; of these there are eighty-two examples in the Dublin Museum; they are found all over Ireland, and appear to represent a transition from stone to bronze types, and can be arranged in series showing development of form from stone to bronze implements. It would thus appear that, prior to a knowledge of bronze, copper was known and used for cutting implements in Ireland.

Physical anthropology was represented on Monday morning. Mr. J. Gray read a paper, with lantern illustrations, on recent and most excellent ethnographical work in East Aberdeenshire, based on observations on nearly 14,000 children. The maps showed very clearly the penetration up the valleys of an immigrant fair type among a dark population. A very valuable paper, also illustrated by numerous lantern slides, was read by Mr. D. MacIver on recent anthropometrical work in Egypt.

The author gave examples of the ways in which anthropometry may aid archæological investigation, and pointed out the unusually favourable conditions for such anthropometrical work which exist in Egypt. He gave a summary of the series of Egyptian measurements at present available, of the difficulties which have arisen in their interpretation, and of some new methods of publishing measurements specially designed to meet them; these graphic methods were suggested by Flinders-Petrie, and will doubtless prove of value to other investigators.

Details were given of three important series of specimens from Egypt, viz.:

(1) Prehistoric Series; from the excavations of 1898–9.

(2) VI. to XII. Dynasties; from the excavations of 1898.

(3) XII. to XVI. or XVII. Dynasties; from the excavations of 1898–9.

These series were considered (*a*) separately, with the object of ascertaining the race type represented in each; (*b*) in comparison with one another, to show their affinities and differences. The paper concluded with a most instructive and suggestive essay on the light which such comparison throws on Egyptian history.

Prof. A. Macalister followed with notes on a collection of 1000 Egyptian skulls, and exhibited curves compiled from the indices.

In the afternoon Prof. W. M. Flinders-Petrie read a paper on sequences of prehistoric remains. In written history the value of chronology lies almost entirely in its defining the sequence of events; and if the order of changes in a civilisation can be fixed, the reference to a scale of years is but a secondary matter. Hitherto only very vague and general terms, referring to places and not to age, have been used in naming prehistoric remains. But if we possessed a perfect record of an unlimited number of contemporary groups of objects all of which have had a time of invention, popularity, and decay, and the use of which overlap each other, it is clear that with patience it would be possible to arrange all the series of groups in their order of time, and so establish definite sequences among the various objects. If then a sequence can be established, a scale of notation is needed. As a scale of years is impossible, a scale of equal activities is the most reasonable. This may be reached by placing all the available material in order and then dividing it into a scale of equal parts. Such a scale, though not equal in time, will yet give a fair unit for measuring a civilisation. This

Prof. Flinders-Petrie has accomplished for prehistoric Egypt, and his demonstration indicated that his system is an important addition to precision in dealing with undateable archæological remains. A second paper by the same indefatigable and brilliant investigator dealt with early Mediterranean signaries and the sources of the alphabet.

The large series of signs used in Egypt about 2500 B.C. is now shown—by such signs existing as far back as 5000 B.C.—to be independent of the hieroglyphic system or any derivatives of that. Similar signs in Crete show this system to have extended to the Mediterranean by about 2000 B.C.

On looking at the more extended forms of the Greek alphabet found in Karia and Spain, about sixty signs are seen in use, representing about forty-three sounds. Three-quarters of these signs are common to the system found in Egypt and Crete.

The only conclusion at present seems to be that signs were in use from 5000 B.C. onward, and developed by 2500 B.C. to over 100 in Egypt, of which half survived in the fuller alphabets of Karia and Spain. The compression and systematising of these signs was due to twenty-seven of them being adopted for a numerical system by the Phœnicians, and thus the *alpha beta* order was enforced by commerce on all the Mediterranean. This accounts in the only satisfactory way for the confusion of the early Greek alphabets, and is a view forced on us by the prevalence of these same signs long before Phœnician commerce.

On Tuesday Dr. A. C. Haddon read some notes on the Yaraikanna Tribe of Cape York :—

The Yaraikanna are fairly typical Australians in appearance ; six men were measured, average height 1·625 m. (5 ft. 4 in.), cephalic index 74·7 (extremes, 72·4-77·7). A lad is initiated by his *mawara*, apparently the men of the clan into which the boy must subsequently marry ; he is anointed with "bush-medicine" in the hollow of the thighs, groins, hollow by the clavicles, temples, and back of knees to make him grow—the bull-roarer is swung. In the *Yampa* ceremony the initiates (*langa*) sit behind a screen in front of which is a tall pole, up which a man climbs and catches the food thrown to him by the relatives of the *langa*. Then the bull-roarer is swung and shown to the *langa ;* lastly, a front tooth of the *langa* is knocked out, with each blow the name of a "land" belonging to the boy's mother or of her father is mentioned, and the land, the name of which is mentioned when the tooth flies out, is the territory of the lad. Water is next given to the boy, who rinses out his mouth and gently empties his mouth into a palm-leaf water vessel ; the clot by its resemblance to some animal or vegetable form determines the *ari* of the lad. The *ari* appears to be analogous to the *manitu* or *okki* (or "individual totem" of Dr. J. G. Frazer) of the North American Indians. After the ceremony the boy is acknowledged to be a man. Other *ari* may be given at any time by men who dream of an animal or plant, which is the *ari* of the first person they meet on awakening. The *Okara* ceremony was alluded to, and various customs, among which may be noted—children must take the "land" or "country" of their mother, a wife must be taken from another country, all who belong to the same place are brothers and sisters.

Mr. W. Crooke discussed the primitive rights of disposal of the dead, as illustrated by survivals in modern India ; the points considered were : customs connected with the preservation of the corpse, such as various forms of mummification ; platform burial ; direct exposure of the dead to beasts of prey ; general exposure of the dead ; the question of the priority of burial to cremation ; transitions from burial to cremation, and *vice versa* : disposal of those dying in a state of taboo ; shelf or niche burial ; crouched or sitting burial ; disinterment of the corpse ; jar or urn burial ; and dismemberment of the corpse.

A theoretical paper on pre-animistic religion was read by Mr. R. R. Marett, his general thesis being :—

The term religion denotes a state of mind embracing emotional and ideal constituents, whereof the former constitute the universal and constant, the latter the particular and variant element. Self-interpretation in ideal terms on the part of the religious emotion of the savage has found most complete and definite expression in animism, the "belief in spiritual beings." Animism, however, as compared with "supernaturalism," namely, that state of feeling almost uncoloured by ideas which is the primary form taken by man's awe of the supernatural (or extraordinary) is but as the strongest sapling in a thicket of heterogeneous growths, which, in the struggle for existence, has come to overshadow the rest and give a character to the whole. The vagueness of primitive "supernaturalistic" utterance is illustrated by, *e.g. andriamanitra* (Malagasy), *ngai* (Masai), *mana* (Melanesians), *wakan* (North American Indians), *kalou* (Fijians). A "pre-animistic" validity as manifestations of religion thus attaches to a variety of special observances and cults ; and it may therefore be interesting in the case of some of the more important of these to distinguish between the original basis of "supernaturalistic" veneration and the animistic interpretation that as the result of successful competition with other modes of explanatory conception (notably "animatism," namely, the attribution of life and will, but not of soul or spirit, to material objects and forces) is thereon superimposed in accordance with the tendency of the religious consciousness towards doctrinal uniformity.

In the afternoon Colonel R. C. Temple discoursed on the thirty-seven Nats (or Spirits) of the Burmese.

The belief in the Nats, or supernatural beings who interfere in the affairs of mankind, is universal among all the native inhabitants of Burma of every race and religion. Every writer about the Burmese and their customs mentions the Nats. The subject is, however, still but vaguely understood. The Nats are of three distinct kinds : (1) the supernatural beings due to the Buddhist cosmogony ; (2) the supernatural beings familiar to the creatures, objects and places with which man is concerned due to the prehistoric animistic beliefs of the people ; (3) the supernatural beings who are ghosts and spirits of the notorious dead. Of the many orders of Nats thus created, that of the Thirty-seven Nats is by far the best known among the people. These are the ghosts of the departed royalties of fame, and their connections. About them nothing seems to have been previously published in England, and this paper was a preliminary attempt at an adequate representation of them, and of the history, real or supposed, connected with them during life. The paper was illustrated by a map in order to explain the relative position of the places chiefly connected with the very complicated political history of Burma and its numerous dynasties, so far as these are concerned with the stories related of the Thirty-seven Nats. The paper was further illustrated by a beautiful lantern slide of an image of each of the Thirty-seven Nats from the unique and authentic collection of large carvings of them in teak wood by Burmese artists in the possession of the author.

The most important communication on Wednesday morning was a description of two new methods of anthropological research by Dr. W. H. R. Rivers. He commenced by emphasising the importance of great accuracy in all anthropological investigations. His first exhibit was a contribution to exactitude in recording colours, more especially those of the skin of natives. Lovibond's tintometer proved of great service in matching colours, but it is not very suitable for matching skin-colours ; for this a colour-wheel is most suitable, the only objection being that the paper discs are liable to fade, and it is not always certain that any two issues of coloured discs would be of exactly the same tint. By having a large number of discs the original records could be filed for future reference and, if kept in the dark, they would not fade. If permanent and absolutely comparable discs could be produced the colour-wheel would answer all practical purposes. The second was a most important sociological method, and consisted in accurately recording the genealogies of all the individuals of an island or limited community for as far back as the informants can remember. It is necessary to use only the terms of "father," "mother," "wife," "children," "man," "woman," "boy" and "girl." The first two were qualified by "proper" or "true," so as to avoid ambiguity. By asking what A calls B, &c., the names and system of relationship can be obtained with absolute precision. In a totemistic people their totems were also recorded, which yielded evidence as to marriage restrictions. This method also furnishes definite statistics on the size of familes, proportion of sexes, number of early deaths, prevalence of adoption, and various other sociological data which are very difficult to obtain with accuracy by any other method. This method of Dr. Rivers' should be adopted by all investigators, as it is almost impossible to overrate its value.

The rest of the day was devoted to African ethnography. Dr. R. Koettlitz exhibited some interesting ethnographical specimens from Somali, Galla and Shangalla, including some scales and weights of seeds and stones for weighing gold-dust, and the first example of salt-money that has been brought to England. Papers by Lieut.-Colonel J. R. L. Macdonald on the ethnography of the lake region of Uganda, and by Lieut.

H. Pope Hennessy on notes on some West African tribes north of the Benue, were laid before the Section.

The usual reports of various Committees were read at various times, the most voluminous being that of the Ethnographic Survey of Canada. It stated that during the past year the work of the Committee had been extended in important directions. The introduction into the North-west of large bodies of Europeans who were to become permanently incorporated in the population suggested the importance of securing as soon as possible such facts relating to their general ethnology as might seem to establish a suitable basis for the study of these people under the influence of their new environment. Satisfactory arrangements had been made with respect to Russian refugees known as the Doukbohors, and it was probable that similar arrangements might be completed during the coming year with regard to other large bodies of immigrants. The exceptional circumstances in British Columbia, the fact that it was becoming more difficult each year to obtain trustworthy accounts of its people, the rapid disappearance of old customs, dress, and modes of living had seemed sufficient reasons for devoting to their study a much larger share of the resources of the Committee than might otherwise appear justifiable. An appendix contained an account of early Canadian settlers and studies of the Indians of British Columbia. On the whole Section H may be congratulated on the very uniform high excellence of the papers, it probably being one of the very best meetings that the Section has ever had.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A meeting of the Junior Scientific Club was held in the University Museum on Wednesday, November 1. After private business, Mr. F. C. Lees (Hertford) read a very interesting paper on geysers in action, exhibiting also an excellent working model. A brisk discussion afterwards ensued.—Mr. Gibson (Ch. Ch.) also read his paper on the retention of plant-food in the soil, which had been postponed from the previous meeting.

CAMBRIDGE.—At the annual election on November 6, at St. John's College, the following were elected Fellows: Mr. W. A. Houston, fifth Wrangler 1896 and Smith's Prizeman 1898, Lecturer in Mathematics at University College, Liverpool; Grafton Elliot-Smith, B.A. 1898, M.D. of the University of Sydney. Dr. Elliot-Smith, who entered the University in 1896 as an Advanced Student, has made a number of highly important contributions to the comparative anatomy of the brain, and is one of the assistant-demonstrators of anatomy under Prof. Macalister.

The Council of the Senate propose that, having regard to the extensive and valuable collections procured for the University by the Torres Straits Expedition, a further grant of 100*l.* (making 550*l.* in all) be made from the Worts Travelling Scholars' Fund to Dr. Haddon towards the expenses of the expedition.

Mr. C. Hose, of Borneo, has presented to the Museum of Zoology a fine example of the ourang outan's nest. A collection of skeletons and skulls of the extinct Moriori race, which formerly inhabited the Chatham Islands, has been acquired for the Museum of Anatomy.

Mr. Timothy Holmes has been added to the Medical School Buildings Syndicate. It is understood that the plans for the buildings are in a forward state of preparation.

Mr. F. W. B. Frankland, third Wrangler in 1897, has been elected to a Fellowship at Clare College.

MR. HORACE PLUNKETT, M.P., has been appointed vice-president of the new department of Agriculture and Technical Education for Ireland.

THE educational movement in Wales has afforded an exceptional opportunity of bringing the Principality into the front rank in the matter of scientific education, and it cannot fail to be a matter of regret to well-wishers of the movement to notice indications that the "modern side" of education is not developing to the same extent in Wales as in other countries. In the recent scholarship examination at the University College of North Wales only six science candidates presented themselves, of whom three were not Welsh, while twenty-five candidates intending to qualify in arts entered.

AMONG other agencies by which the Technical Education Committee of the Essex County Council is cultivating scientific knowledge is the County School of Horticulture at Chelmsford, the prospectus of which is before us. The aim of the School is to impart sound elementary instruction in the best methods of cultural treatment, based upon a knowledge of the structure and physiology of plants. The garden attached to the School covers an area of three acres, and is entirely devoted to educational uses. Horticultural and botanical students in Essex are fortunate in possessing an institution in which wisely planned courses of work upon plants can be followed under such good conditions as are available at Chelmsford.

THE purposes for which the Technical Education grant is used in the various counties are shown concisely in a document just published by the County Councils Association. The counties are arranged alphabetically, and under each is given information concerning the work done in regard to (*a*) schools of science and art, (*b*) technical institutes, (*c*) agricultural schools and institutes, (*d*) domestic economy schools and institutes, (*e*) day or other schools or classes giving instruction in agricultural, commercial, domestic, manual or technological subjects. The Returns (which refer to 1897–98) also show the number of scholarships and exhibitions given by each County Council, and the provision made for examination and inspection of classes.

REPORTS received from time to time, referring to the work carried on under the auspices of Technical Education Committees of County Councils, show that in many agricultural counties the committees are gradually building up a system of teaching and experiment which serves much the same purpose as the educational branches of the agricultural experiment stations in the United States and elsewhere. In Somerset, for instance, the committee, of which Mr. C. H. Bothamley is the director, have organised courses of instruction in most branches of agricultural work; and the instructors not only lecture, but visit farms, gardens and orchards for the purpose of giving information and advice, for which no fees are charged, on points, both general and special, arising in agricultural practice, such as the manuring of arable and grass land, the treatment of wireworm, farm buildings, water supply, and similar matters. On one farm the failure of the mangold crop for the second year in succession was found to be due to an attack of large numbers of a very minute beetle, which Miss Ormerod identified as what is known as the pigmy mangold beetle, an insect which rarely occurs in sufficient numbers to be injurious, and which was in fact first recognised in this country in 1896. It is satisfactory to read that information has been given by several farmers to whom previous visits have been paid, to the effect that favourable results have followed the adoption of the methods suggested by the county instructor. A scheme for the establishment of an experimental farm has been drawn up, and will be put into effect as soon as the Secondary Education Bill is passed. School gardens are already carried on at several places in the county, and with much success. In other sciences, as in agriculture, the Somerset Education Committee appear to be proceeding on the right lines, and good results must attend efforts so wisely directed.

THE U.S. *Experiment Station Record* gives information concerning an extensive system of agricultural education which the Government of Russia is organising. The scheme provides for (1) higher education, furnished by independent agricultural institutes situated in the chief agricultural zones of Russia, and by chairs of agriculture and allied sciences in the universities; (2) agricultural high schools, which are in the nature of technical schools, and schools with courses in agriculture; (3) lower agricultural schools,; and (4) the diffusion of general agricultural information. The schools for the so called lower education include (*a*) secondary agricultural schools, (*b*) primary agricultural schools, (*c*) agricultural classes, and (*d*) practical agricultural courses. These lower schools are to be under the jurisdiction of the minister of agricultural and imperial domains. They are to be maintained at the expense of municipalities, local communities, associations, &c., but may receive a part of their support from the Government. The secondary schools are to be established on Government land, or land donated for that purpose. The other lower agricultural schools may be established on private estates. The secondary schools are open to young men of all conditions who have completed the course in the primary public schools. The diffusion of general agricultural information is to be provided for by the organisation

of public readings or lectures on agricultural questions for the benefit of different classes of the population, instruction of the teachers in public schools in agriculture, horticulture, gardening, apiculture, &c., and providing the public schools with small plots of land and means for cultivating the same; also by the teaching of agriculture in the normal schools, and the introduction of supplementary courses in agriculture in the village schools. There are now in Russia three schools for higher agricultural instruction, nine agricultural high schools, eighty-three lower schools, and fifty-nine special courses. Steps have already been taken for the establishment of about fifty additional agricultural schools.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xxi. No. 4, October.—Memoir on the substitution-groups whose degree does not exceed eight, by Dr. G. A. Miller (pp. 287–338), is an exhaustive piece of work, amply furnished with bibliographical notes. The author's aim is to give enough of the general theory of group construction to find all the possible groups whose degree does not exceed eight without any tentative processes. The earliest work that gives considerable attention to substitution-groups is stated to be that by Ruffini, entitled "Teoria generale delle equazioni, in cui si dimostra impossibile la soluzione algebraica delle equazioni generali di grado superiore al quarto" (1799). The author has won his spurs in this field, and the present memoir shows a thorough mastery of his subject. There is a good table of contents appended.—On a class of equations of transformation, by J. Westlund. In this paper the writer discusses those equations whose roots are the $n + 1$ values of

$$\nu_{\mu} = \prod_{\nu}^{p} sn^{2\alpha}.\ cn^{\beta}.\ dn^{\gamma}\ (4p\omega/\kappa),$$

where α, β, γ, are any positive or negative integers, and

$$\omega = \frac{4\mu\kappa + 4\nu i\kappa}{n},$$

μ and ν being integers. For the notation reference is made to Weber, "Elliptische Functionen," § 67.—Dr. Wilczynski, in an article entitled "On Linearoid Differential Equations," follows up a previous article in the *Journal* (April 1899). This he looks upon as being a reconnoissance upon a new field of promise. *Linearoid* "suggests" the relation of the present equations to linear differential equations.—Prof. W. H. Metzler contributes a short note on the roots of a determinantal equation. The theorem is similar to one discussed by Dr. T. Muir in vol. xix. (pp. 312–318).—Non-quaternion number-systems containing no skew units, by Dr. Starkweather, opens with a brief statement of a few properties of number-systems in general. Then follows a proof of a statement made by Scheffers (*Math. Ann.* xxxix. 306, 310) as to the possibility, in this special class of number-systems, of a selection of units having certain simple multiplicative properties. He then shows that the units can be chosen so as to give in general a very much simplified form of multiplication table, and a method is given for deriving systems of the type considered in n units from those in $(n-1)$ units. Application of the principles he deduces is made to systems, the degree of whose characteristic equation is two less than the number of units. Other points are discussed, and a table of all the possible non-equivalent orms is given.

VOL. VI. of the *Anales del Museo Nacional de Buenos Aires* contains the following papers:—Contributions to our knowledge of the herpetological fauna of Argentina and the neighbouring countries, by C. Berg; some cases of vegetable teratology, fasciation, proliferation, and synanthy (three plates), by A. Gallardo; species of *Ampullaria* of the Argentine Republic, by H. von Ihering; diagnostics of new South American Diplopoda, by F. Silvestri; new or critical Argentinian fungi (two plates), by C. Spegazzini; observations on Argentinian and other South American Lepidoptera, by C. Berg; brief comparative description of *Lepidocampa* and *Campodea* (two plates), by F. Silvestri; new South American Tenthredinidæ, by F. W. Konow. Of these the fifth only is in Latin, and the last in German; the remainder are in Spanish.

THE numbers of the *Journal of Botany* for October and November are chiefly occupied by papers on descriptive and geographical botany. These are varied by an article, by Mr. E. S. Salmon, on certain peculiar structures found on the peritheces of the parasitic fungus *Phyllactinia corylea*, which appear to have a function in connection with its dissemination. The degeneration of these structures produces mucilage, by which the perithece of the fungus is firmly attached to the leaf of the host-plant.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 4.—Mr. G. H. Verrall, President, in the chair.—The President announced the death, at the advanced age of eighty-six years, of M. Hippolyte Lucas, an Honorary Fellow of the Society. He also announced the death of Mr. Samuel Stevens, and in reference thereto said the Society had to deplore the loss of one of its oldest and most highly esteemed Fellows.—Mr. J. J. Walker exhibited a specimen of *Galerita bicolor*, Drury, a North American beetle of the family Carabidæ, said to have been taken many years ago at Doncaster. He also exhibited a remarkable variety of *Vanessa urticae*, L. (*ichnusoides*, De Selys), which was captured in the Isle of Sheppey on August 28.—Mr. B. A. Bower showed dark aberrations of *Boarmia rhomboidaria*, Hb., in which the normal colour of the fore wings is replaced by dark brown, causing the fuscous markings to stand out very prominently.—Mr. C. J. Wainwright exhibited a number of Dipterous insects, including a long series of *Anthrax paniscus*, Rossi, taken in Cornwall at the end of July and beginning of August; a series of *Eumerus ornatus*, Mg., from Herefordshire, and *Eumerus lunulatus*, Mg., from Cornwall; and a specimen of *Mallota eristaloides*, Lœw, taken near Hereford last July.—Mr. H. J. Donisthorpe exhibited specimens of *Dytiscus dimidiatus*, Berg., and *D. circumcinctus*, Ahr., taken last August in Wicken Fen. He also showed eight specimens of *Athous rhombeus*, Oliv., taken last June in the New Forest.—The Rev. F. D. Morice exhibited three female specimens of *Exoneura libanensis*, Friese, taken at Brumana on Mount Lebanon, near Beirut. He commented upon the remarkable distribution of the genus *Exoneura*, Smith, this genus having been hitherto recorded only from Australia.—Mr. G. J. Arrow read a paper on sexual dimorphism in the Rutelid genus *Parastasia*.—Mr. W. L. Distant contributed descriptions of four new species of Cicadidæ, and Mr. Claude Fuller a paper on some species of Western Australian Coccidæ.

Royal Microscopical Society, October 18.—Mr. E. M. Nelson, President, in the chair.—The President called attention to an old microscope by Cary, presented to the Society by Mr. Gleadow. An instrument of the same design was figured in the *Journal* for 1898, p. 474.—Messrs. Watson and Sons exhibited their new school microscope, which was provided with a diagonal rack and pinion coarse adjustment, but no fine adjustment, their idea being to produce a strong well-made instrument at a low price. Dr. Dallinger had seen this instrument, and thought it would admirably answer the purpose for which it was intended; the coarse adjustment was so well made that he had no difficulty in focussing a $\frac{1}{8}''$ objective with it. The President thought the microscope was strongly made and well fitted, and would be found to be a very useful instrument. Messrs. Watson also exhibited a new form of eye-piece, named the "Holoscopic," which was fitted with an adjustment to render it either over- or under-corrected and suitable for use with either achromatic or apochromatic objectives.—Dr. Measures exhibited a microscope for photo-micrography, made by Zeiss, having a new form of fine adjustment which admitted of the arm being made of any length without throwing extra weight upon the fine adjustment screw. Dr. Dallinger considered the way in which the speed of the fine adjustment had been reduced was most ingenious; the motion was extremely slow, being only $\frac{1}{8}\frac{1}{3}''$ for every revolution of the screw. A protest had always been made in the Society against the fine adjustment having to carry much weight, and it was therefore satisfactory to find that this one had to lift only one-fifth of the weight usually put upon the fine adjustment. The President said the application of an endless screw was a novel way of slowing down the fine adjustment; the reduction of weight upon the thread was an important improvement, and the increased length of arm was another good feature.—The President then described a new form of fine adjustment by Reichert, which was shown applied to his Austrian model, exhibited by Mr.

C. Baker; the indicator to this fine adjustment was movable, so that it could be set to zero when required, thus greatly facilitating the reading of the divisions on the head of the screw. The instrument was fitted with the English standard substage, and the axis of the trunnions was placed above the stage to ensure a better balance. Two other microscopes by Reichert were also exhibited, one being a student's without fine adjustment, but fitted with a dissecting loupe as a substage condenser. The President next showed a microscope fitted with his new stepped rackwork coarse adjustment by Messrs. Watson and Sons; there was no "loss of time," though the pinion was pressed but lightly into the rack. The President also exhibited a dissecting stand by Andrew Ross, which was about forty or fifty years old, and was still a thoroughly good working instrument; and though the lenses were not achromatic, they gave very good images.—Mr. C. Lees Curties exhibited some stereoscopic photo-micrographs taken on the Ives principle by Mr. E. R. Turner, who briefly described the method of taking them.—Dr. Hebb said they had received part vi. of Mr. Millett's "Report on the Foraminifera of the Malay Archipelago," which would be taken as read and published in the *Journal*.—Mr. F. Enock gave an extremely interesting account of his observations on the life-history and habits of British trap-door spiders, illustrating the subject with most excellent original lantern views.

MANCHESTER.

Literary and Philosophical Society, October 17.—Prof. Horace Lamb, F.R.S., President, in the chair.—The Secretary read the draft of the address which was recently presented by the Society to Sir G. G. Stokes, Bart., on the occasion of the jubilee of his tenure of the Lucasian Professorship of Mathematics at Cambridge University, and also the reply received thereto.—Prof. Dixon stated that the restoration of Dalton's tomb had been effected under the direction of the committee appointed, and that there remained a balance in hand of about 27*l*. It was hoped to raise this sum to 50*l*., and to form a vested fund which would provide for any future repairs that might be necessary.—The President announced that the Society had had presented to it another relic of Dalton, in the shape of his diploma of honorary membership of the Edinburgh Medical Society, to which he was elected in 1818.—Mr. Thomas Thorp read a paper on diffraction grating films and their application to colour photography, and exhibited an apparatus which showed photographs of objects in their natural colours by the aid of gratings, and without the use of pigments or dyes.—A paper entitled "On the electrical resistance between opposite sides of a quadrilateral, one diameter of which bisects the other at right angles," was read by Dr. Charles H. Lees.

NEW SOUTH WALES.

Royal Society, July 5.—Mr. W. M. Hamlet, President, in the chair.—Suggestions for depicting diagrammatically the character of seasons as regards rainfall, and especially that of drought, by H. Deane. The author called attention to the inadequacy of the ordinary methods of judging of the dryness or otherwise of seasons by using the totals of the rainfall and comparing them with the average. He explained that the proper way of exhibiting the character of any period is by showing diagrammatically the progressive dryness that takes place in the soil after rainfall ceases. This is marked by a descending line, and being from time to time more or less compensated for by falls of rain, these are indicated by rises. The only useful rain to the soil itself is what soaks in and tends to saturate it; all beyond this, although it may be useful for conservation and for keeping up the flow of rivers, is waste so far as the particular ground on which the rain has fallen is concerned. The diagrams exhibited show the effect of this "loss and compensation" system, and the dryness of the years and parts of years given in the series 1883 to 1898, inclusive, are rendered visible and measurable.—The initiation ceremonies of the aborigines of Port Stephens, New South Wales, by W. J. Enright.

August 2.—Mr. W. M. Hamlet, President, in the chair.—On the crystalline camphor of eucalyptus oil (eudesmol) and the natural formation of eucalyptol, by Mr. Henry G. Smith. In August 1897, the author, with Mr. R. T. Baker, announced the discovery of a crystalline camphor or stearoptene in eucalyptus oil. This substance was named *eudesmol*. The present paper deals with the chemistry of this camphor and its relation to eucalyptol. Eudesmol has been found in the oil of many species of eucalyptus, and should be present at certain times of the year in all those eucalyptus oils that are eventually rich in eucalyptol. Eudesmol has a formula $C_{10}H_{16}O$, is isomeric with ordinary camphor, but has the oxygen atom combined in a different manner. It does not appear to be ketonic, and it cannot be reduced by sodium in alcohol or by other methods. It is optically inactive. It forms a dinitro-compound and a dibromide, but does not form a nitrosochloride. It melts at 79–80° when perfectly pure, but has a tendency to form products having a lower melting point. On oxidation with dilute nitric acid, camphoronic acid is formed, but no camphoric acid. A large amount of evidence is brought forward to show eudesmol to be intermediate in the formation of eucalyptol, and that eucalyptol is derived directly from the fraction containing eudesmol if the oil be kept in the crude condition for some time under ascertained conditions. Oxygen is necessary to this alteration. It is shown that the oxygen atom enters the eucalyptol molecule during the formation of eudesmol, and that by the natural alteration of the high boiling fraction of oils containing eudesmol (*E. macrorhyncha*, for instance) eucalyptol is formed. The synthesis by Perkin and Thorpe (*Journ. Chem. Soc.*, 1897, 1169) shows camphoronic acid to be trimethyl tricarballylic acid, as was first suggested by Bredt, and as eucalyptol is derived from eudesmol, and eudesmol forms camphoronic acid, the question is raised whether Brühl's formula for eucalyptol is correct. It is suggested that the oxygen atom in eudesmol is quadrivalent, and that the peculiarity of eucalyptol may be thus accounted for. From the formula suggested for eudesmol camphoronic acid, as trimethyl tricarballylic acid, can be constructed.—Observations on the determination of the intensity of drought, by Mr. G. H. Knibbs. The paper was really a continuation of the subject of Mr. H. Deane's paper, read at a previous meeting. It was shown that if the degree of saturation of ground was taken as the reciprocal of the measure of drought intensity, as suggested by Mr. Deane, then, theoretically, it was determinable. The essential features of Mr. Deane's solution and of the nature of the problem were discussed.—Divisions of some aboriginal tribes, Queensland, by Mr. R. H. Matthews. A short paper dealing with the social organisation of some native tribes of Queensland.

PARIS.

Academy of Sciences, October 30.—M. van Tieghem in the chair.—Remarks on the volume, "Connaissance des Temps pour l'année 1902," by M. Poincaré. This work contains an important improvement as the result of a conference of directors of observatories in England, Germany, America and France. This year the work contains the mean positions of all the stars in Prof. Newcomb's catalogue, the apparent positions of which do not already appear in one of the four official publications.—On the intervention of plants in the formation of calcareous tufa, by M. de Lapparent. The author points out that the results published by M. Stanislas Meunier in the last number of the *Comptes rendus*, concerning the function of mosses and microscopic algæ in the formation of calcareous tufa, were discovered as far back as 1862 by M. Cohn.—On the Giacobini comet, by M. Perrotin. The elements of the comet have been calculated by M. Giacobini, from the observations made in various observatories. The form of the orbit is at present sensibly parabolic. At the time of its discovery the nebula surrounding the nucleus amounted to 1'5 minutes of arc; at the present time this is reduced to 1'0 minute. The nucleus appears to have increased in lustre, being now of about the eleventh magnitude.—Remarks by M. Fouqué on the alterations introduced by M. de Lapparent in the new edition of his "Treatise on Geology."—On the hyperabelian functions, by M. Georges Humbert.—On congruences of normals, by M. E. Goursat.—On the propagation of electric oscillations in dielectric media, by M. Albert Turpain. The author quotes the expressions of Maxwell and of Helmholtz and Duhem for the relations existing between the velocity of light, the velocities of propagation of the Hertzian waves in different media, and the dielectric constants of those media, and shows that the experiments of Arons and Rubens, Cohn and Zeeman, and of Blondlot do not clearly distinguish between the Maxwell and Helmholtz-Duhem hypotheses. The author describes an experiment which he believes to be free from ambiguity, the results of which are in accord with the views of Helmholtz and Duhem.—Transmission of Hertzian waves through liquids, by M. Édouard Branly. The receiver was placed in the centre of a large glass vessel containing the liquid

under examination, and measurements were made of the distance to which the exciter had to be removed to produce no effect upon the receiver. Distilled water or spring water possesses a much greater absorptive power for the rays than oil or air, and the effect of sea water was so great that any thickness over 20 cm. was sufficient to completely absorb the radiations, its power of arresting the rays being greater, in fact, than the same thickness of cement.—On Wehnelt's electrolytic interrupter, by M. E. Rothé. The author describes a curious phenomenon produced by varying the resistance of the circuit. For any given interrupter with a fixed potential difference, there appears to be a limiting resistance, such that for all lower resistances a condition of rapidly varying current strength only is possible. For all higher resistances there may be either the same state of affairs, or a steady current, according to the manner in which the current is established.—On the atomic weight of boron, by M. Henri Gautier. Analyses of boron chloride and bromide lead to values for the atomic weight of boron of 11·01 and 11·02 respectively, single determinations varying between 10·98 and 11·04. The chloride and bromide were prepared from the halogen and boron, the latter being prepared by Moissan's method. The author considers that his products were free from dissolved hydrobromic or hydrochloric acids, and that the lower figures obtained by Abrahall (10·84) by the analysis of boron bromide, were due to traces of hydrobromic acid dissolved in the halogen compound.—On the mixed oxyhydrides of fatty and aromatic acids, by H. A. Béhal. The existence of the mixed anhydrides discovered by Gerhardt has been called in question by Rousset, but comparative experiments carried out by the author upon a mixture of benzoic anhydride and acetic anhydride and the mixed acetobenzoic anhydride prepared by Gerhardt's method show that the mixed anhydride really exists, although always containing a little benzoic anhydride as an impurity.—Naphthopurpurin, an oxidation product of naphthazarin, by M. Georges F. Joubert. The analogy between the behaviour of alizarin and naphthazarin is further shown by the ready oxidation of the latter by sulphuric acid and manganese peroxide to naphthopurpurin, or tri-oxynaphthoquinone.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 9.

MATHEMATICAL SOCIETY, at 8.—Certain Correspondences between Spaces of n Dimensions: Dr. E. O Lovett.—On the Form of Lines of Force near a Point of Equilibrium; The Reduction of Conics and Quadrics to their Principal Axes by the Weierstrassian Method of reducing Quadratic Forms; and on the Reduction of a Linear Substitution to a Canonical Form; with some Applications to Linear Differential Equations and Quadratic Forms: T. J. I. Bromwich.—On Ampère's Equation $Rr+2Ss+Tt+U(rt-S^2)=V$: Prof. A. C. Dixon.—The Abstract Group isomorphic with the Symmetric Group on k Letters: Dr. L. E. Dickson.—The Fundamental Solutions of the Indeterminate Relation $\lambda x \geqq \mu y$: Major MacMahon, R.A., F.R.S.—Note on Clebsch's Second Method for the Integration of a Pfaffian Equation: J. Brill.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 8.—*Papers received*: Observations of Mars, 1898-99: Rev. T. E. R. Phillips.—Observations of Jupiter and his Satellites at Mr. Crossley's Observatory, Bermerside, Halifax, 1898-99: J. Gledhill.—Observations of Nebulæ made at the Chamberlin Observatory, Denver: H. A. Howe.—(1) On the Probable Proper Motion of the Annular Nebula in Lyra; (2) The Exterior Nebulosities of the Pleiades; (3) Diameters of Ceres and Vesta: Prof. E. E. Barnard.—*Papers promised*: Theory of the Figure of the Earth carried to the Second Order of Small Quantities: Prof. G. H. Darwin.—Distribution of Stars Photographed at Oxford for the Astrographic Catalogue: F. A. Bellamy. Variation of Personal Equation with Stellar Magnitude: Prof. H. H. Turner.—Photographic Magnitudes: a Comparison of the Greenwich Astrographic Plates with the Magnitudes of the Bonn Durchmusterung: F. W. Dyson and H. P. Hollis.—Ephemeris for Physical Observations of Jupiter, 1899-1900: A. C. D. Crommelin.

PHYSICAL SOCIETY (Central Technical College, Exhibition Road, South Kensington), at 5.—Contact Electricity: F. S. Spiers.—On the Heat of Formation of Alloys: J. B. Tayler.

MALACOLOGICAL SOCIETY, at 8.—Additions to the List of Marine Shells of South Africa published in 1897, with Descriptions of Seventeen New Species: G. B. Sowerby.—Remarks on a Collection of Helicoid Hand-Shells from Japan and the Loo-Choo Islands: G. K. Gude.—*Metastracon*, a New Slug-like Genus of Dart-bearing Helicidæ: Henry A. Pilsbry.

MONDAY, NOVEMBER 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Opening Address: The President.—Travels in Bokhara: Willy Rickmer Rickmers

TUESDAY, NOVEMBER 14.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Waterloo and City Railway: H. H. Dalrymple-Hay.—The Electrical Equipment of the Waterloo and City Railway: B. M. Jenkin.

MINERALOGICAL SOCIETY, at 8.—Florencite, a New Hydrated Phosphate of Aluminium and Cerium Earths from Brazil: Dr. Hussak and Mr. Prior.—On a New Mineral from Cornwall: Mr. Hutchinson.—Mineralogical Notes: Prof. Miers.—On Various Sulpharsenites of Lead from the Binnenthal: Mr. Solly; with Analyses by Mr. Jackson.—Crystallised Stannite from Bolivia: Mr. Prior and Mr. Spencer.—On the Constitution of the Mineral Arsenates and Phosphates. Part IV. Beudantite: Mr. Hartley.—Petrographical Notes on some Rock Specimens from the Little Island of Trinidad, South Atlantic: Mr. Prior.

WEDNESDAY, NOVEMBER 15.

SOCIETY OF ARTS, at 8.—Opening Address: Sir John Wolfe Barry, K.C.B., F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Diurnal Variation of the Barometer in the British Isles: Richard H. Curtis.—Note on Earth Temperature Observations: G. J. Symons.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Exhibition of Foraminifera: A. Earland.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Note on the E.M.F. of the Organ Shock, and on the Electrical Resistance of the Organ in *Malapterurus electricus*: Prof. F. Gotch and G. J. Burch.—On the Formation of the Pelvic Plexus, with especial reference to the Nervus Collector in the genus Mustelus: R. C. Punnett.—On the Least Potential Difference required to produce Discharge through various Gases: Hon. R. J. Strutt.—On the Propagation of Earthquake Motion to Great Distances: R. D. Oldham.—An Experimental Research on some Standards of Light: J. E. Petavel.

LINNEAN SOCIETY, at 8.—The Comparative Anatomy of certain Species of *Encephalartos*, a Genus of the *Cycadaceæ*: W. C. Worsdell.—On a Collection of *Brachyura* from Torres Straits: W. T. Calman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

CHEMICAL SOCIETY, at 8.—The Chlorine Derivatives of Pyridine. Part IV. Constitution of the Tetrachloropyridines: W. J. Sell and F. W. Dootson.—Contributions to our Knowledge of the Aconite Alkaloids. Part IV. On Japaconite and the Alkaloids of Japanese Aconite: Wyndham R. Dunstan, F.R.S., and H. M. Read.—On the Determination of Transition Temperatures: H. M. Dawson and P. Williams.

FRIDAY, NOVEMBER 17.

ANATOMICAL SOCIETY, at 4.—A Persistent Left Inferior Vena Cava: Stanley Boyd.—Specimen of Sacculated Œsophagus: Miss Stoney.—Child's Skull, showing Parietal Perforations: Prof. A. M. Paterson.—Note on the Morphology of the Biceps Flexor Cruris: Prof. B. C. Windle, F.R.S., and F. G. Parsons.—Lantern Demonstration of certain Points in the Lymphatic System of the Appendix: C. B. Lockwood.

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