THURSDAY, NOVEMBER 12, 1903.

THE SCIENTIFIC WORK OF THE IMPERIAL INSTITUTE.

Imperial Institute: Technical Reports and Scientific Papers. Edited by Wyndham R. Dunstan, M.A., F.R.S., with a preface by the late Sir Frederick Abel, Bart., G.C.V.O., K.C.B., F.R.S. Pp. xlvii+613. (London: Imperial Institute, 1903.)

OF the several purposes which the Imperial Institute was designed to serve, there is probably none which has been less regarded by the general public than that of scientific and technical research. Such work, however, was definitely one of the objects the advisory committee had in view when considering the proposed building some seventeen years ago; for, as the late Sir Frederick Abel has recorded, this committee was of opinion that the Institute would "afford accommodation for comparing and examining samples by the resources of modern science." In the furtherance of this design there has been gradually evolved an experimental branch, which eventually became known as the "Scientific and Technical Department" of the Institute. At the present time the staff includes ten assistants under the direction of Prof. Dunstan, and the chemical laboratories entirely occupy the upper floor of one wing of the Institute buildings, whilst the help of outside specialists, manufacturers, and commercial experts is invoked as occasion requires.

How this department struggled into existence is described by Sir Frederick in the preface to the volume under notice. It is rather pathetic reading sometimes. There was a difficulty in making any start at all, and to satisfy the "eternal want of pence" afterwards was a harder task still. Hat in hand the committee had to go, begging for money here and for professional help there, first getting, for example, "rupees to the value of 64*l*. 8*s*. 2*d*." from the Indian Government; then a grant of 300*l*. from the Commissioners of the 1851 Exhibition; next, "small gifts of money, and of some indispensable instruments" from such well-wishers as Sir Lowthian Bell and Dr. Mond; then a donation of 1000*l*. from the Goldsmiths' Company; and so on. How often, in those days, must the organisers have sighed for a sympathetic millionaire! Still—*solvitur laborando*—the thing was eventually done, and in 1896 the department, now on something like a stable footing, was taken in charge by Prof. Dunstan as director.

For the subsequent maintenance of the laboratories thanks are largely due to the Commissioners of the Exhibition of 1851. Acting with a wise liberality, the Commissioners in 1896 made the department a grant of 1000*l*. *per annum* for a term of years, and to this was added a second grant of a like amount two years later. In view of the work accomplished, this contribution of 2000*l*. *per annum* has been continued, and is still enjoyed by the department.

One question, however, may naturally be asked in connection with this matter. Should not the Government, now that it has taken the Institute under its wing, be induced to place the scientific department on a permanent footing—or at least to become wholly responsible for its support? There appears to be no reason why the Commissioners of the 1851 Exhibition should still assist in carrying on the work.

What has been accomplished by the scientific staff since 1896 is mainly set forth in the present volume. Part i. comprises a large number of technical reports upon various industrial products sent from India and the Colonies, with the view of ascertaining their commercial value and whether there was likely to be any market for them in this country or elsewhere. Minerals of several kinds (including coal, clay, iron-ores, and mica), fibres, oils, rubber, gums and resins, tanning materials, medicinal and food plants, timbers, and miscellaneous articles such as wines, aloes, and capsicums, have been examined and reported upon more or less exhaustively, with the practical result that in some cases a commercial demand has arisen for the article in question, and in others arrangements have been made for a regular supply of the substance, or, it may be, for its improved production and utilisation. Especially noteworthy would seem to be the recognition of *Caesalpinia digyna* as a tanning agent, and of *Podophyllum emodi* and *Hyoscyamus muticus* as sources of the drugs podophyllin and hyoscyamine respectively.

An interesting paper on the coal resources of India is included as an appendix to Part i. To those of us "who only England know," it may come as a surprise to learn that the coal output of the Indian collieries in 1900 exceeded 6,000,000 tons, or about 1/35th of that of the United Kingdom. In quality the coal is generally inferior by about 20 per cent. to that of this country, but on account of its cheapness it is largely used by steamships plying in Indian waters, and the output has increased six-fold since 1880. The supply is considered to be practically inexhaustible. Those amongst us whose geology is local rather than cosmopolitan will learn with interest that these immense Indian deposits are all of much later date than our own Coal-measures, for they occur in the Permian, Triassic, Jurassic, and even Cretaceous and Tertiary formations.

In Part ii. are collected some thirty-five papers of a more purely scientific character. These embody the results of special chemical researches upon various plant-constituents by Prof. Dunstan and his co-adjutors, and of investigations into a number of colouring-matters, chiefly by Profs. Hummel and Perkin. Readers of the Chemical Society's publications will be familiar with most of these researches, all of which are interesting, whilst some are of particular importance. The investigations upon the constituents of Indian and American podophyllum, on the aconite alkaloids, and on cyanogenesis in plants may be specially indicated as good examples of the work which has been carried out. In some cases—as, for instance, in the paper on the action of alkyl haloids on aldoximes and ketoximes—it is not quite clear how the chemical question involved was connected with the special work of the Institute, but no doubt such general points would often arise during the progress of researches upon specimens forwarded for examination. On the whole, these "scientific papers" strike

one as being admirable descriptions of useful work, well conceived and ably executed.

As a separate establishment the Imperial Institute has ceased to exist, and is now a department of the Board of Trade. In its time it has played many parts. It has exhibited nuggets to us, sold us cakes and ale, discoursed sweet music to our ears, and charmed our eyes with its fairy-lamps and coloured fires. These things have vanished, as have also many of the splendid, but rather nebulous, generalities which we used to hear concerning the Institute's prospects and probable influence as a factor in Imperial affairs. But at least the definite work of the scientific staff remains, and, presumably, such services as those now rendered will be more and more brought into requisition as time goes on. It may well happen that Prof. Dunstan's laboratory will—to paraphrase a remark of Huxley's—become the forecourt of the temple of success for some at least of the original aims of the Institute, whatever may be the fate of the remainder.

C. SIMMONDS.

BABYLONIAN DEMONOLOGY.

The Devils and Evil Spirits of Babylonia. Vol. i. By R. C. Thompson, M.A. Pp. lxv+212; with 2 plates. (London: Luzac and Co.)

THE present volume is the first of two which Mr. Thompson intends to devote to a study of the evil spirits and devils of Babylonia, and it will, we believe, be welcomed by readers of many classes. We have been long familiar with the generalisations which writers are fond of making upon this fascinating subject, but so far as we know, no one has before attempted to give a systematic account of Chaldean demonology, and to add at the same time the reasons for the faith which is in him. Those who are interested in cuneiform decipherment will remember that some few years ago the Trustees of the British Museum began to publish a series of classified Assyrian and Babylonian texts, which they issued in parts, each containing 50 plates of text. The earliest parts contained all the material for the syllabary and grammar, then followed lists of words, and afterwards Mr. L. W. King's edition of the Creation tablets. In the present year were published the sixteenth and seventeenth parts of the series, which supplied copies of all the tablets relating to "evil spirits," "fever-sickness," and "headache," carefully made by Mr. R. C. Thompson, and these are the sources of the materials which have been translated in the present volume.

Mr. Thompson gives transliterations of his cuneiform texts on the left hand pages, and English translations on the right; this is an open and honest way of working, and we hope that English Assyriologists in general will follow his example. Nowadays the student demands facts, and the text is the greatest fact of all; no linguistic study can flourish upon bad foundations, and in our opinion the work of the man who hides his texts, or only makes them partially available for students, should be viewed with suspicion. Even a bad text is better than none, for at least workers in England, France, and Germany can correct it sooner or later. In the present case the British Museum publishes the texts, and Messrs. Luzac the translations, and as each portion of the work is done by the same man we are able to ascertain our position from a scholarly point of view to a nicety.

The publication of evil spirit texts, like so much else, was begun by the late Sir H. Rawlinson, K.C.B., and attempts were made to translate his copies first by Lenormant and secondly by Prof. Sayce. Sir H. Rawlinson, however, only published selections from the great mass of cuneiform literature in the British Museum, and it follows, as a matter of course, that even where they could translate the texts, the conclusions of Lenormant and Prof. Sayce were based on incomplete and insufficient evidence. The subject of Chaldean demonology is at the best a difficult one, and we have no hesitation in saying that the earlier works on it rather hindered than helped the understanding of the matter. Now that the tablets are joined up, and their right sequence found, it becomes clear that the Assyrian scribes were not so stupid as some have thought, and that there really was method in their madness.

It is to Mr. Thompson's credit that he has found out what the Assyrian method was in respect of the evil spirit tablets, and having found this his translations possess unusual value. He will hardly, we think, claim to have settled all the difficulties which he has encountered, but there is little doubt that his present work will form the standard one on the subject for many years to come. In the course of his study we find that he had destroyed a few ideals, and more than one favourite and popular theory. It was fashionable to assert a few years ago that the British Museum contained a tablet which bore on it an allusion to the Garden of Eden, but now that the fragment referred to has been put in its right order, we see that the text on it has nothing whatever to do with the Garden of Eden, and that the tree which was supposed to be nothing more or less than the Tree of Life is the *kish-kanu* plant, which grew in Eridu, and was believed merely to possess magical properties. Mr. Thompson has taken great pains to thresh this matter out, and we think that he has proved his points very thoroughly. We can only hope that this exposure will deter that class of Assyriologist which seeks for reputation and popularity by the "finding" of "Biblical parallels" from continuing its charlatanic practices. More harm has been done to Assyriology by such things than by all the mistakes which its followers, from Rawlinson down to Thompson, have made; for even the results which are certain have been discredited by many first-rate Semitic scholars who were unable to read cuneiform.

Another important result of Mr. Thompson's work is the proof that, *au fond*, the demonology of the Semitic peoples of Mesopotamia who used the cuneiform system of writing is of Sumerian origin, and there is good reason to suspect that the greater part of Babylonian psychology and eschatology were borrowed directly from their non-Semitic predecessors in the country. This remark applies also to many of the beliefs which the Hebrews took over from the Babylonians their kinsmen. Want of space will not permit the mention

of many minor points of interest in the volume before us, but we hope to refer to the subject again when the second portion of Mr. Thompson's work appears. Meanwhile, the book may be commended to all students of folk-lore, as well as to the Semitic philologist and anthropologist.

LINE GEOMETRY.

A Treatise on the Line Complex. By C. M. Jessop. Pp. xv+364. (Cambridge: University Press, 1903.) Price 10*s.* net.

THE systematic study of what is now called line geometry was begun by Plücker in his "Neue Geometrie des Raumes." There was, it is true, a fairly complete theory of the linear complex due to Chasles and others before the publication of Plücker's work, and the geometry of systems of lines (congruences) has in some respects not progressed very much since the date of Kümmer's celebrated memoir, but it was only after the idea of line coordinates had been introduced that the essential qualities of the new geometry were recognised.

In his treatise on the line complex, Mr. Jessop has aimed at presenting the extensive investigations of German and Italian geometers in a form easily accessible to the English student of mathematics. It has been found necessary to write an introductory chapter on the elementary methods of synthetic geometry that are used in the book; then the next four chapters contain the theory of line coordinates, in the general form introduced by Klein, and the linear complex. A great portion of these chapters will be familiar to anyone who has studied the theory of forces in three dimensions with attention; the only omission that occurs to us is a number of easy exercises on the use of line coordinates, particularly in the ordinary Cartesian form, but this defect is partly remedied by an excellent collection of examples at the end of the book.

The theory of the quadratic complex is naturally the most important part of the book—the linear complex is too well known, and the higher complexes too difficult to deal with, to illustrate the methods of the subject. The author has devoted six ample chapters (vi.–xi.) to this theory. Chapter vi. deals mainly with the singular surface, which is remarkable in all complexes as being both the locus of singular points and the envelope of singular planes. Two proofs of the identity of this locus and envelope are given, one depending on von Staudt's theorem concerning a tetrahedron, and the other on infinitesimal properties. The first is particularly interesting although peculiar to the quadratic complex, because a tetrahedron being the simplest form of the singular surface, von Staudt's theorem is a particular case of a property of Kümmer's quartic from which the result follows; the other proof can be extended readily to any complex (chapter xvii.). The discussion of Kümmer's quartic is the author's own, and will be very welcome to the beginner as being both elementary and direct.

It is curious that an infinite number of quadratic complexes have the same singular surface, the theory being similar to that of confocal quadrics. Such cosingular complexes are discussed in chapter viii., and by developing the idea of corresponding lines in cosingular complexes Mr. Jessop has obtained some very interesting and novel proofs. Another chapter deals with the beautiful classification of quadratic complexes, and contains an exposition of Darboux's proof of the fundamental theorem of Weierstrass on the equivalence of quadratic forms.

In chapter vii. an account of some special complexes is given, the greater part of the space being devoted to the tetrahedral complex; this complex was studied long before the introduction of line coordinates, and lends itself readily to synthetic treatment.

In another part of the book it is shown that a tetrahedral complex can always be found which contains the complete intersection of a quadratic complex and a linear complex. Substantially this important result is due to Kümmer, but the first complete account of it we owe to Caporali.

Only two chapters on congruences appear in the work; this part of the subject is difficult, because the analytical methods are clumsy when applied to such congruences as are not complete intersections of complexes, and the purely synthetic methods of Sturm and others are extremely tedious. Mr. Jessop follows Kümmer on the general principles, and only gives a detailed account of the simplest congruence, namely, that of the second order and the second class.

The latter portion of the book does not strike us as being so attractively arranged as the earlier parts, but the final chapter on the connection of line geometry and differential equations is valuable as an introduction to Lie's theories.

There is no doubt that the book will be a boon to a student of the subject, and that anyone with a taste for geometry will find much that is interesting and something that is new in it. J. H. G.

OUR BOOK SHELF.

Geological Rambles in East Yorkshire. By Thomas Sheppard, F.G.S. Pp. xi+235; 53 illustrations and geological map. (London: A. Brown and Sons, 1903.)

THIS is a pleasantly written and attractive guide to the geology of east Yorkshire, the work of a sturdy local geologist who shows himself to be master of his subject and of the literature past and present. Under his enthusiastic leadership we are taken from Hull to the out-of-the-world promontory of Spurn Head, where we learn many lessons about recent geological changes. Thence we are conducted northwards to Withernsea and Hornsea, examining some of the finest sections in the Boulder-clay of Yorkshire; successive beds of drift with transported mollusca and Scandinavian rocks, deposits with local detritus, and others with rocks from the Cheviots and elsewhere. We see also lacustrine deposits and peat beds, remains of old lakes, of which Hornsea Mere alone appears to survive. Then we are taken on to Bridlington, noted for its shelly "Crag," really a part of the basement Glacial drift, which is now hidden behind a strong sea-wall. The buried cliff of Sewerby, with its basement clay and older mammaliferous deposit yielding *Elephas antiquus*, hippopotamus, rhinoceros, &c., claims attention. From this we pass on to the fine

Chalk cliffs of Flamborough Head, beginning near Sewerby with beds which are rich in sponges and yield also Marsupites, and we continue along the headland to lower divisions of Chalk at Selwick, Thornwick and Bempton, and finally to the base with its Red Chalk at Speeton. Here, amid a region of landslips, we notice one slip on the part of the author (p. 61), where he refers to the Red Chalk of Cromer, meaning, of course, Hunstanton. The Speeton Clay, as unravelled by Mr. G. W. Lamplugh, is duly described, from the Gault through the Lower Cretaceous which constitutes the Speeton Clay proper, to the Kimeridge Clay. From this tract we are taken to the Corallian rocks of Filey Brigg, and on to Gristhorpe and Scarborough, where the work of Mr. W. H. Hudleston and Mr. Fox-Strangways, as well as that of earlier geologists, is duly mentioned.

Thus all the Jurassic divisions are in turn described as we proceed along the coast, as the author takes us to the Lias of Robin Hood's Bay, Whitby and Redcar. He then brings us back to the Humber, discourses on the warp, which is material not carried down by the rivers, but derived from the waste of the Boulder-clay cliffs and brought in by the tide. From Hull again to Hessle we see more of Glacial drifts; we are taken over the Oolites of Brough and South Cave, and across the Yorkshire Wolds, the charms of which are well described, and thence we come back to Holderness.

The work is admirably illustrated with photographic views, many of them taken by Mr. Godfrey Bingley, and from its clear and accurate descriptions it is well calculated to rouse up and foster an interest in geology.

Les Produits coloniaux d'Origine animale (Bibliothèque Coloniale). By H. J. de Cordemoy. Pp. viii+396; illustrated. (Paris: Baillière et Fils, 1903.) Price 5 francs.

THE object of the series of which the volume before us forms a part is to bring before the French public in an interesting and popular style the origin of the foreign food supplies and products used in the arts and commerce, and more especially those which are yielded by their own colonies. The idea is an excellent one which might well be copied in this country, and, so far at any rate as the present volume is concerned, the Colonial Institute of Marseilles, to which the series owes its conception, is to be congratulated on the project.

The author of the present volume divides his subject into two main headings, the one including foreign food supplies and the other all colonial products of animal origin employed in French industries and arts. As regards the first section, attention is concentrated in one chapter on the manufacture of beef-essence in Madagascar and New Caledonia, while the second, and much larger one, is devoted to fish and fishing, and such special products as edible swallow-nests, béche-de-mer, &c. The most valuable fishery appears to be that for thunny on the Tunisian coast, the concession for which is let to Count Raffo for forty years at an annual rent of 5400 francs. The most remarkable fishery at Tunis is that of octopus. Poor food one would think; but it appears that in Greece and Crete there are two annual fasts, during which the consumption, not only of meat, but of fish and the flesh of all animals "having blood is prohibited." As the octopus is not considered to come within this prohibition, it forms, in a dried condition, an important food supply during the seasons in question.

As regards the second and much larger section of the work, limitations of space render anything approaching a detailed notice an impossibility. It must suffice, therefore, to state that this section is subdivided into three groups. Under the first, which includes products used in leather and textile manufactures, as well as for dress and ornament, are classed silk, hides, furs, hair, wool, feathers, ivory, coral, sponge, tortoiseshell, mother-of-pearl, horn, &c. In the second group are ranged wax, fat, oil, gelatin, and perfumes; while the third and last group is devoted to resinous products, such as lac, and the dyes afforded by the cochineal insect and other animals.

While congratulating the author on the amount of information he has conveyed in a small space, and on the interesting manner in which this is described, we venture to think that the illustrations, some of which are too large for the pages, are hardly up to modern methods and requirements. R. L.

A Text-book of Botany. By Dr. E. Strasburger, Fritz Noll, H. Schenck, and the late A. F. W. Schimper. Second edition, revised with the fifth German edition, by W. H. Lang. Pp. ix + 671; with 656 illustrations, in part coloured. (London: Macmillan and Co., Ltd., 1903.) Price 18*s.* net.

THE new edition of the English version of the "Bonn Text-book" is based on the fifth German edition. It marks an improvement on its predecessor, and is brought well up-to-date as regards the text, whilst we also note an improvement in the figures, some of the older illustrations having been omitted or replaced by better ones. The coloured representations, however, do not strike us as very useful, and we would have willingly seen them disappear.

The principal innovation in the present volume consists in the inclusion of a bibliography, which, without pretending to be complete, cannot fail to be of use to the serious student who wishes to find his way about the literature of the science.

The popularity already enjoyed by this treatise (in spite of defects inherent in any attempt to compress a big subject into the narrow limits of a single volume) is well deserved, and Dr. Lang is to be congratulated on the excellence with which he has carried out his share in presenting the book to English students.

Bacteria in Milk and its Products. By Prof. H. W. Conn, Ph.D. Pp. vii + 306. (London: Rebman, Ltd., 1903.) Price 6*s.* net.

THIS little book gives an excellent account of the relation between milk and its products and bacteria and allied organisms. It is written in simple language, and might be read with profit by those engaged in the "milk" industries who have had little scientific training. After a few introductory pages upon the nature of bacteria, the bacterial contamination of normal milk is discussed, and plain directions are given for its reduction, milk vessels, water supply, milking, cooling, and the sanitary control of dairies being all dealt with. The various fermentations that occur in milk, milk from diseased cows, the sterilisation of milk, cream ripening, artificial starters, butter and cheese, are some of the subjects considered in later chapters, and the book concludes with directions for the bacteriological analysis of milk and for some of the simpler chemical determinations. A full bibliography is appended, but the titles are too contracted; in many instances it is difficult to recognise the publication to which reference is made.

R. T. HEWLETT.

Junior Algebra Examination Papers. By S. W. Finn. Pp. vi + 87. (London: Methuen and Co., 1903.) Price 1*s.*

THE seventy-two examination papers contained in this little book are modelled on questions set at such school examinations as the university locals. The questions are graduated, and full answers are supplied. A useful table of contents enables the teacher to discover rapidly the scope of the different test papers.

LETTERS TO THE EDITOR.

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

Hyksos-Hittites.

IN the *Times* of October 28 there appeared, under the signatures of Prof. J. M. Mackay, of Liverpool University, and Messrs. Percy Newberry and John Garstang, a letter on an important archæological subject, entitled "Etruscan and Hyksos—a Hittite Clue." The object of this letter appears to have been to prove a culture-connection in the second millennium, B.C., between the Etruscans in Italy, the Kheta or "Hittites" in Asia Minor and northern Syria, and the mysterious Hyksos or "Shepherd Kings" who invaded Egypt, and usurped its government between the thirteenth and eighteenth dynasties.

The subject is, of course, one of considerable interest, and the theory is a suggestive one, but readers of the *Times* would hardly guess from the tenor of this letter that the theory enunciated in it has been well known to all archæologists for the last fourteen years at least! In fact, the theory was adumbrated by several workers in the field of Oriental archæology before it was finally thrown into a concrete form and placed before scholars by Father A. C. de Cara, in the year 1889. As expounded by this learned Jesuit, the theory is simply repeated by the three writers of the letter already mentioned; hardly any original additions are made, and these are not of a character to command the adherence of students. For example, it is suggested, though not definitely said, that the well-known company of immigrants from Asia depicted on the walls of the tomb of Khnemu-hetep at Beni Hasan was a party of "Hittites." Unluckily, however, these people are Semitic in feature, and the name of their chief, Abesha, is, judging by all analogy, Semitic. Now we are quite certain that the features of the Kheta, and their names also, were non-Semitic. This Prince Abesha, the writers of the letter say, "is entitled the ruler of a foreign (mountainous) land—the Sinaitic deserts, it has been conjectured, to the south of Hebron, where Hittite and Semite had intercourse and intermarriage in the age of the Patriarchs." Here an unwarrantable assumption, and even this is not original, has been made, for there is no proof that the "children of Heth," who in the Bible are said to have lived near Hebron, are of the same race or nation as the Hittim of northern Syria, who are certainly to be identified with the Khatti of the Assyrian records and the Kheta of the Egyptian monuments, who were undoubtedly the builders of the great sanctuaries of Boghaz Köi and Eyuk, and to whom the inscriptions commonly called "Hittite" belonged.

The writers of the letter also show confusion of thought in the following matter. After stating that in the statues of Queen Nefert and Amenemhāt III. a clear Mongolian or Turanian strain is visible, and noting that "she wears on her head a horse-shoe-like attire, he a pigtail to his wig," they go on to say that the statues which the Hyksos made or usurped are Mongoloid, "Turanian on a Semitic stock, Hittite-Semite." The conclusion seems to be that these "Mongoloid" Hyksos had appeared in Egypt, and had assumed its government before the reign of Amenemhāt III., but the statues referred to are well known to belong to the reign of Amenemhāt, and were usurped by the Hyksos; therefore we have no proof whatever from the statues that the Hyksos were Mongols, and from this it follows that the "Mongoloid" Nefert and Amenemhāt III. cannot be proved to be Hyksos-Hittites. Further, the idea that the statues of Amenemhāt's reign are Mongoloid at all is a pure matter of opinion, on which many archæologists would differ from the writers of the letter. The horse-shoe headdress of Nefert is an ordinary Egyptian woman's wig in the fashion of the twelfth dynasty, and Amenemhāt's pigtail is no proof that he was a Mongol; it might just as well be argued that Frederick the Great was a Mongol because he wore a pig-tail.

So much for mistakes. It is a matter for surprise that three writers who thought fit to send a communication to the *Times* on an important archæological matter should have been, as it appears, totally unaware of the long priority of another writer in the whole field of which their letter treats. X.

Telegraphic Disturbances in Spain on October 31.

ON Saturday, October 31, the telegraphic communication was interrupted almost from morning until late at night. The first sign of the perturbation was observed at 9h. 30m. in the morning (W.E.T.) in the form of continuous currents along nearly all the lines that start from Madrid. At first it was thought that some leakage from a cable in the vicinity of the Central Office was the cause of the phenomenon, but on making inquiries it was ascertained that the same occurrence was observed in Cordoba, in the line to Málaga. At the same time the cable from Vigo to Emden was rendered useless, and at Lisbon the phenomenon was observed at some moments in which the situation was normal at Madrid. The maximum intensity took place between 12h. 30m. and 15h.; at 21h. the phenomenon had nearly ceased.

During the first hours of the evening the currents were continuous for periods of twenty to thirty minutes in some of the wires, for instance, in those of Vigo; at 22h. the current in the Coruña wire was continuous during 3m.; at 1h 45m. of November 1 the current was also continuous in the Bilbao wire. At 3h. 20m. the cable from Cadiz to Tenerife in the Canary Islands remained perturbed so strongly that the clerks made the contact with the earth to avoid the discharges.

At 19h. communication between Madrid and Burdeos was re-established; information received at the Central Office stated that the cable from Senegal to Noronha was disturbed. In Spain, in some lines running approximately east and west, the phenomenon was not observed, namely, in the coast of Andalusia, from Málaga to Almeria, but in the line from Málaga to Granada, which runs roughly to the north, the perturbation was very marked, also in the more north-easterly line from Granada to Murcia. These three lines are approximately of the same length. In the centre of Old Castile, in the transversal line from Aranda to Ariza and to Valladolid, nothing abnormal was observed; meanwhile, in the general line that runs north-south, the disturbance prevented all communication. In the provinces of Cuenca and Extremadura, the lines of which run approximately east and west, the communications remained undisturbed.

The night was clouded, so that nothing could be seen of an aurora borealis, even if a display occurred.

AUGUSTO ARCIMIS.

Instituto Central Meteorológico, Madrid, November 3.

The November Leonids.

THERE appears to be little prospect of a brilliant recurrence of the November meteors on about November 15 next, though the moon will offer little impediment, being past the last quarter. The parent comet returned unobserved to perihelion in the spring of 1899, and is now far on its outward journey, beyond the orbit of Jupiter, so that any meteors appearing this year must be at a vast distance from the supposed derivative body. There is evidence, however, that minor groups circulate along the orbit, and that these are sufficiently condensed to produce pretty rich showers in certain years, as in 1879, 1888, &c. The system or stream is no doubt a continuous one, for every year at the middle of November some meteors of the swift, streaking class are seen shooting from the radiant in the "Sickle." It is obviously necessary, as a means to increase our knowledge of the shower, to watch for the display annually, and to record the time of its maximum and the observed horary number of its meteors.

The position of the radiant has been frequently determined in past years by eye-estimated meteor-tracks, and it now remains to obtain some further photographic records so that this feature may be more precisely ascertained. It is curious that the mean place of the radiant resulting from eye observations of meteors is nearly two degrees west of

the centre indicated by four photographic determinations of the radiant, the relative places being :—

	Radiant Point
From eye observations	149°·7+22°·7
From photographic trails	151°·5+22°·2.

Though there are now some hundreds of eye-estimated radiant points of this shower available for comparison, the resulting average place is not likely to be as accurate as the few positions obtained by photography. But even the centres derived from the latter method do not exhibit absolute agreement, the difference amounting to more than one degree in two of the cases.

It is hoped that the shower will be specially looked for on the mornings of November 15 and 16 if the atmosphere is favourable. W. F. DENNING.

Leaf Decay and Autumn Tints.

THE leaves of our forest trees at the period of the autumnal fall are not similar as respects the condition of vitality which they then have reached; that is to say, while some still retain their green colour and drop off, as it were, mechanically, the majority exhibit a change of coloration and are apparently dead or more or less decayed. The relation between these stages of vitality or decay and that of the particular colour (red, yellow, or brown) which the autumn leaves assume may be so far demonstrated by a critical scrutiny of certain constituents of the mineral matters (ash), especially the silica and lime, which they enclose at the very moment when this special and characteristic colour is displayed. In order to present to view this order of thought, the following tables of ash analyses are drawn up, the percentages being calculated on the red, yellow, or brown leaves with their petioles dried at 100° C., and on the ash minus charcoal :—

Leaves which become Red in Autumn.

	Percentage of ash	Constituents of the ash	
		SiO_2	CaO
Norway Maple	10·5	8·7	44
Wild Cherry	7·3	3·3	35·3
Rowan	8·6	3·4	41·4
Scarlet Oak (*Quercus coccinea*)	4·8	3	51
Dogwood	11·3	9·3	45·5
Elder	13·7	4·5	29·9

Leaves which become Yellow or Brown in Autumn.

	Percentage of ash	Constituents of the ash.	
		SiO_2	CaO
Wych Elm	16·8	28·8	40·8
Sycamore	12·1	20·7	41·9
Oak (*Quercus robur*)	6·35	13	44
Beech	6·3	23	32·6
Larch	4·6	19·4	27
Weeping Willow	10·3	10·9	37·5
Poplar	9·7	23	35·2
Hornbeam	12·5	42·2	24·4
Linden	8·9	22·2	35

Assuming that a heavy ratio of total ash and of silica therein is an indication that the life of the leaf is practically exhausted and its physiological energy at an end, we may, in view of the foregoing tables, consider two cases :—(1) where the percentage of silica is under 10 per cent., and (2) where the percentage of silica is 10 per cent. or more. It will be at once observed that every one of the leaves which turn red in autumn belong to the former category, while all those exhibiting yellow or brown tints and shades belong to the latter. This state of affairs would seem to hold good universally, provided only that the other conditions of the phenomena are equal. Hence a few other examples, such as the birch, the leaf of which, generally yellow, is occasionally dashed with red, or the ash-tree, the leaf of which has a small percentage of silica but a high percentage of ash, are omitted from the lists. Once upon a time I found some hazel leaves, which were almost as red as those of a wild cherry, to contain only about 9 per cent. of silica in the ash (whereas, according to De Saussure, it holds even as early as September 20, 22 per cent. silica). With regard to the exceptional instance of the yellow and never red ash-tree leaf, every plant analyst is aware how prone its tannic chromogen is to be, in certain circumstances, the precursor of a very dark brown shade, such as no other tree of our woodlands (except, perhaps, the holly) ever approaches. Eminently interesting and instructive is the contrast shown in the tables between the two maples as well as between the scarlet oak (*Quercus coccinea*), the magnificently tinted denizen of the American forest, and our own British oak (*Q. robur*), yellow and russet in autumn. It is known that the leaves of American maples, &c., cultivated in Europe do not exhibit such marked changes of colour, *i.e.* to rich deep scarlet, orange scarlet, deep rich purple, rich orange, dark crimson, &c., as they do in their own country. The causes of this difference are now pretty much made manifest. The soft, mild and yet glowing climatic conditions of the American woodlands sustain the vitality of the deciduous leaf to a degree not possible with us; we are rarely blessed with an Indian summer in the fall. The mineral matters flowing to the dying leaf flow in a quantity directly proportionate to the decay of its vitality. There is a drainage of substances (especially of silica) from the living portions of the arboreal organism to the dead and dying parts thereof. In such of our leaves as can resist the rigorous climatic severity, their vitality is so far sustained that the normal process of de-assimilation (the development of coloured pigment from tannic chromogen) is not impeded, though never so complete and splendid as in the glorious forests of New England.

Patterdale, Westmorland. P. Q. KEEGAN.

Variation of Atmospheric Absorption.

WITH regard to Prof. Langley's letter on the abnormal atmospheric absorption (p. 5) some observations of a different nature may be of interest.

Both this year and last I was photographing in Switzerland, using a Wynne meter for timing my exposures. In 1902 I found that the time required to darken the sensitive paper on a sunny day, at an elevation of 11,000 feet, was one second. This year the time, under exactly similar conditions, and using the same batch of paper, was three seconds. That the difference was not due to the paper being stale is shown by the negatives being equally good in the two cases.

The maximum sensitiveness of the paper is for blue light; yellow and orange do not affect it; it was exposed under a glass plate about 3 mm. thick. J. TALBOT.

Harrow-on-the-Hill, November 7.

Rocket Lightning.

MR. J. EWEN DAVIDSON (98 Banbury Road, Oxford) has directed my attention to his letter in NATURE, vol. xlvii. p. 582, describing auroral appearances associated with a thunderstorm witnessed by him in Queensland, of which he was reminded by the letters headed "Rocket Lightning" in your issue of October 22, p. 599. Comparison of the two accounts is interesting, but the phenomena appear to me not to have been identical. Mr. Davidson says what struck him most in the recent account was the description of a misty cloud above the low bank of thick cloud. In his own case there was a very thin misty condensation over the thunderstorm, extending to an altitude of 40° or 45°, and "the rosy light phenomenon and the streamers only shot up to the upper edge of this misty condensation." He says, "I did not mention the misty condensation in my letter to NATURE, as I did not then connect the two, but thought it was a mere coincidence, the one slightly veiling the other; but that there is a connection is now evident." "Both observers were practically looking upon the upper edge of a thunderstorm at a distance, and in both cases there was the misty appearance above it, with the comparatively slow upward moving light phenomena." J. D. EVERETT.

11 Leopold Road, Ealing, W., October 29.

Explosive Action of Lightning.

THE following particulars of the circumstances attending a lightning flash are perhaps worth recording.

A cedar tree (deodar) 50 feet high stood at a distance considerably less than its own height from a house at Englefield Green. The lady of the house was sitting watching the storm, but in such a position that she could not see the cedar, but could see a large part of an Araucaria (the common "monkey puzzle") just outside her window, and only 30 or 40 feet from the cedar. While watching this tree the lady saw, as she thought, a "rod" or "stick" of fire come crashing down through its branches —beating them down so that she distinctly saw them rebound. This was accompanied by a fearful noise as of a thousand pistol cracks, beside which, however, the lady had an impression of hearing the branches of the Araucaria beating together, and immediately afterwards a cloud as of steam rose from the lawn on which the trees stood. It was found that the cedar tree had been wrecked entirely. About 15 feet of the top was broken off, and apparently fell straight down—sticking in the ground almost vertically—close to the stump of the tree. The main portion of the trunk, to about 4 feet from the ground, was roughly split in two—falling right and left—one half being further burst into several pieces. There was the usual "smell of sulphur," but no sign of scorching on either of the trees.

A gentleman who saw the flash from a distance of about one-third of a mile noted that it was a straight (non-forked) flash from a small cloud low down. Other observers noted flashes of a similar character during the same storm.

The cedar tree was in vigorous growth, full of sap, and well above its *immediate* surroundings, but there were elms and a lime tree of greater height within fifty yards of it.

The movement and the "fire" in the branches of the Araucaria seem to me to suggest an electrostatic effect—a side splash—rather than the mere reflection of the flash which struck the cedar. Could the beating down of the branches be explained as the result of the sudden pulse in the air? What produced the cloud of "steam"? It would be interesting to have the opinion of an authority on lightning discharges with regard to these points.

R. A. WEST.

Ordnance College, Woolwich, October 27.

The "Sky-coloured" Clouds.

DURING this summer I have seen only one display of the "sky-coloured" clouds, or "night-shining clouds" as the late Herr O. Jesse used to call them. It was on July 8, and was a bright display, the brightest I have seen for some years. It is rather singular they did not appear on other occasions so far as I have observed, and no mention of them has been made in your periodical. It may be that now Herr Jesse is deceased there has not been such a good and systematic watch maintained as formerly, or else, if they have been observed abroad, notices have not been copied into English papers. Whether the brilliancy of this one display was connected with the eruptions in the West Indies is a matter of conjecture. The volcanic dust continues to be very visible in the sky in producing the great corona round the sun all day. T. W. BACKHOUSE.

West Hendon House, Sunderland, October 28.

THE GEOLOGY OF VANUA LEVU.[1]

VANUA LEVU, one of the two principal islands in the Fiji archipelago, according to Mr. Guppy's summary of previous investigations, has received less notice than Viti Levu, or even some of the smaller islands. The late Prof. Dana made a small collection of its rocks in 1840, and published some observations on its geology. It was visited in 1878 by Mr. J. Horne, of Mauritius, but no collections were made by him, by the *Challenger*, or by investigators under the direction of Prof. A. Agassiz, so that it offered a very promising field of research, which occupied Mr. Guppy for two years. The results, so far as concerns its geological and general physical features, and the petrology of its rocks, are described in the present volume, with reproduced photographs and other illustrations.

The long irregular outline of Vanua Levu contrasts strongly with the comparatively rounded one of Viti Levu. Its length is about 98 miles, with a breadth averaging 15 to 20 miles, its estimated area being about 2400 square miles, nearly equal to that of the county of Devon, while its maximum elevation is almost 3500 feet. Both this island and Viti Levu rise from a submarine plateau, in shape a broad irregular ring, broken in one place. An elevation of less than 100 fathoms would convert the whole area into one great mountainous island, pierced on the southern side by a fjord more than 200 fathoms deep. This platform Mr. Guppy considers to have been built up from the deeper ocean floor by submarine lava flows and associated deposits, and Vanua Levu as a composite island, formed, during a long period of emergence, by the union of a number of large and small islands, the products of submarine eruptions. The process probably began in the later Tertiary period, and volcanic eruptions have now ceased, but hot springs are not uncommon, though limited to regions where basic rocks occur. They are also restricted in vertical range, for they have not been found above the 300 feet contour line. Their temperature mostly ranges from 100° to 150° F., reaching 180° only in one case, the latter group precipitating siliceous sinter. Mr. Guppy thinks these springs are largely supplied by the "soakage" of the heavy rainfall in the mountains; if so, there must be rapid local rises in the underground temperature. A submergence of 300 feet would bring the sea over a considerable tract, chiefly basaltic plains, which are obviously continuous with the submarine plateau. One of 1000 feet would greatly reduce and indent the remaining axis of the island, while 800 feet more would convert it into a few scattered islets, which would represent the nuclei of the present composite Vanua Levu. This mode of building accounts for the irregularities of its physical structure, in which respect it contrasts markedly with the other large island, Viti Levu.

Proof of this great elevation is found in the occurrence of muds and tuffs with marine organisms up to at least 2000 feet above sea-level. Shelly and foraminiferal limestones, composed, as so often in tropical islands, partly of reef débris, partly of more or less broken shells of Mollusca, partly of Foraminifera, occur up to a height of 1100 feet, and they sometimes overlie palagonite tuffs and clays, also foraminiferal. Pteropod ooze, containing a large amount of palagonitic débris, is found up to about 500 feet, but volcanic muds, which are very abundant on the basaltic plains in association with the lava flows, reach the former elevation, while tuffs, sometimes agglomeratic, may be traced up beyond 2000 feet—all these containing Foraminifera. An instance of these deposits is shown in the illustration. Raised coral reefs are not very common, and appear to be limited to a vertical range of about 100 feet above sea-level, so that in this respect Vanua Levu contrasts strongly with Viti Levu. But Mr. Guppy thinks this scarcity to some extent the result of denudation, for he has found silicified corals, representing reef-forming types, lying about on the surface, abundantly in some places, together with nodules of chalcedony and other siliceous concretions. These, however, do not more than double the vertical range, so that during the actual building of the island circumstances were not favourable to reef-

[1] "Observations of a Naturalist in the Pacific between 1896 and 1899." By H. B. Guppy, M.B., F.R.S.E. Vol. i. Vanua Levu, Fiji. Pp. xix+392; illustrations and map. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1903.) Price 15s. net.

formation. It is possible, as Mr. Guppy explains, that the island even now is slowly rising.

A considerable part of the volume is devoted to the petrology of Vanua Levu. Plutonic rocks occur, though on a smaller scale than in Viti Levu. These are norites (hypersthene-gabbros) and a few diorites (without augite). The rest of the igneous rocks are volcanic, consisting of olivine-basalts, augite-andesites with and without hypersthene, and acid andesites passing into dacites, in which sometimes the ground-mass exhibits a felsitic structure. Mr. Guppy's careful study of these is a valuable addition to knowledge, though the volcanoes of Vanua Levu have not yielded any rock of exceptional interest. But we think he lays too much stress on varietal details, and that his "orders, suborders, genera and subgenera" have often no more than a specific value, and that he attaches too much classificatory importance to the presence or absence of memory, for they introduce the perplexities of gibberish without attaining the simplicity of mathematical symbols. Palagonite is very abundant at Vanua Levu, "from the sea border to the mountain top." Mr. Guppy discusses at some length the origin of this substance, coming to the conclusion that it is usually associated with basalt of an ophitic or semi-ophitic habit, is likely to be formed extensively on the surface of submarine basaltic flows, and is a vitreous condition of magma that remains fluid after the mass of the rock has solidified. An exceptionally hydrous state of a basic magma would probably be very favourable to the formation of palagonite, but whether the proposed petrological relation will hold generally good is perhaps doubtful.

But in expressing dissent on a few points, which are really of minor importance, we gratefully acknowledge that Mr. Guppy has accomplished a very laborious and often difficult, if not dangerous, task, and that his book, when completed by accounts of his botanical and other work, will be a most valuable addition to our knowledge of this group of islands and to the past geological history of a large area in the Pacific Ocean.

T. G. BONNEY.

FIG. 1.—Mbenutha. Agglomerates on tuffs, &c., containing Foraminifera and Pteropods, now 1100 feet above sea-level.

phenocrysts (to follow him in using this modern petrological slang-word). They have an important relation to the history of the rock, but not very much to its chemical composition, and thus to its position among the magmatic products of the earth. A porphyritic rock is a "rock with a past," which a non-porphyritic rock either is free from, or successfully conceals. Mr. Guppy has "gone one better" than most modern terminologists. Throughout his descriptions he talks of felspar-lathes, meaning thereby the microliths, generally called lath-like. In English a lath means a long blade-like strip of wood, used, for instance, in ceilings, and not inaptly designating microliths of felspar, especially plagioclastic, while a lathe is a machine for turning wood, &c. We doubt also whether the formulæ which Mr. Guppy employs to summarise the characters of his rocks will be any real help to the

ELECTRIC CONVECTION.[1]

THIS paper closes in a satisfactory manner an important controversy. It follows from the views of Faraday and Maxwell that a charge of electricity when in motion produces a magnetic field in its neighbourhood. It is this effect on which the modern

1 "Recherches Contradictoires sur l'Effet magnetique de la Convection électrique." Par MM. Harold Pender et Victor Crémieu. (*Journal de Physique*, September, 1903.)

electron theory of electric action rests; its experimental verification is vital to the theory, and, indeed, to the whole of the recent views, of the origin of electric and magnetic forces.

A method of testing the existence of the effect is given by Maxwell in his "Electricity and Magnetism," and was first put into practice, with some modifications, by Rowland in 1876. The experiment, carried out in Helmholtz's laboratory, proved to the satisfaction of Helmholtz and of Maxwell that the effect existed; this consisted in rotating a charged disc of gilded ebonite near an astatic magnetic needle and observing the deflection. This was very small, from 5 to 7·5 mm., but it agreed with the amount expected from the theory. In 1883 Lecher attempted to repeat these experiments, but with negative results; Röntgen, however, in a research having another object, obtained the same effect from a moving charge as Rowland had done. In 1889 Rowland and Hutchinson took the matter up, and, modifying the apparatus, obtained results which appeared to establish the convection of an electric charge on a moving conductor without a doubt.

In 1897 Crémieu began his experiments. If a charged moving conductor produces a magnetic field, a charged conductor at rest in a varying magnetic field should be subject to mechanical force. Crémieu failed to detect this force in an experiment arranged for its measurement, though, according to calculation, it ought, if existing, to have been easily measurable. He then attempted Rowland's reverse experiment, the detection of the magnetic field, but modified entirely and in an ingenious manner Rowland's arrangement. Imagine a coil placed in close proximity to the rotating disc, the planes of the two being parallel, and let the ends of the coil be connected to a galvanometer. On charging the disc a magnetic field is produced near the coil, if the Faraday-Maxwell views be true; thus a current is induced in the coil, and a throw of the needle of the galvanometer is the result. Then by arranging to charge and discharge the disc alternately, and by means of a commutator to reverse the galvanometer connections suitably, the throw becomes a permanent deflection the amount of which can be calculated. These experiments Crémieu carried out with consummate care, and the result was negative. The needle remained at rest; there was no such thing as electrical convection. This fact he verified apparently by several ingenious modifications of his apparatus and his method, always with the same result; and when at the Glasgow meeting of the British Association he gave an account of his work, probably no one in the room except himself accepted his results, but no one, and the critics were both acute and numerous, could find the flaw.

Meanwhile, Rowland had returned to the defence of his position; it was almost the last piece of work he undertook, and just at the time of Crémieu's visit to Glasgow, September, 1901, there appeared a full account of experiments in the Johns Hopkins Laboratory by Pender, who, adopting Crémieu's induction method, again verified Rowland's result. From the observations a value can be found for the velocity of light, and Pender found it to be $3{\cdot}05 \times 10^{10}$ cm. per second, a value sufficiently near to the truth to establish beyond a doubt the theory of the measurements. This was verified by further work published early this year; meanwhile, Crémieu continued to obtain his negative results.

Such was the position when Pender was invited to Paris to repeat, in the splendid laboratories of the Sorbonne, and in conjunction with Crémieu, the experiments he had made in Baltimore. Funds were provided, in part by the Carnegie Institution, in part by the Institute of France, and the two experimenters set to work together, and with the same result.—Pender verified the Faraday-Maxwell theory, Crémieu disproved it.

Experiments were then made on the direct magnetic effect, repeating, but with some modifications to meet objections of Crémieu, Rowland's original experiment. These, again, led to the result that a charged surface moving in its own plane produces a magnetic field; the very sensitive and permanent astatic system employed in this experiment will be found useful elsewhere, but reference must be made to the original paper for an account of it. Finally, Crémieu was convinced; it remained only to account for his negative results.

It was observed that in all cases he had covered the charged conducting surfaces with a thin layer of some dielectric other than air, usually india-rubber or mica, and there seemed some reason to suppose his failure was due to this, and so it was proved to be; the removal of the dielectric coating from Crémieu's apparatus enabled him to observe the convection effect, while by coating the discs used in Pender's induction experiment with mica, the convection effect was reduced by some 90 per cent.

How the dielectric acts is still a mystery; it is satisfactory, however, that the two experimenters are in agreement. The thanks of physicists are due to those who suggested and rendered possible this somewhat novel collaboration; it is satisfactory to the great French physicists who have aided Crémieu with advice and assistance that the matter should be settled at Paris; it is satisfactory to Pender that he has established conclusively and finally the result which was the beginning of Rowland's brilliant fame.

At the same time, the question, What does the dielectric do? remains an interesting one, especially as Vasilesco-Karpen, in a paper which follows the one we have been discussing, finds that it has no effect on the result. He modified Crémieu's arrangement by introducing a condenser into his circuit of coil, commutator and galvanometer, in which induced currents are set up by the alternating charge and discharge of the rotating discs. By suitably arranging the period of this circuit he was able to intensify the efforts considerably, and obtained a reasonably satisfactory agreement between his results and theory. The disc, as was the case in most of Pender and Crémieu's experiments, moved between condensing plates, and Vasilesco-Karpen made the following four series of experiments:—(1) Disc bare, condensing plates bare; (2) disc bare, condensing plates covered with glass 4 mm. in thickness; (3) disc covered with a thin layer of caoutchouc, condensing plates bare; (4) disc as in (3), condensing plates as in (2).

He states as the result that, so long as the speed and the charging voltage are kept constant, the magnetic effect is the same in all these cases. This result is opposed to that of Crémieu and Pender, who found that coating the disc with a thin layer of rubber destroyed the convection effect, and so the matter rests at present. The magnetic effect due to the motion of an electron is confirmed; some of its secondary consequences remain obscure.

NOTES.

THE list of birthday honours includes the following names of men known in the scientific world:—Prof. C. Le Neve Foster, F.R.S., has received the honour of knighthood. Colonel D. A. Johnston, director-general of the Ordnance Survey, has been appointed a Companion of the Order of the Bath. Dr. Robert Bell, F.R.S., acting director of the Geological Survey of Canada, has been appointed a Companion of the Imperial Service Order. The

Hon. A. C. Gregory, formerly surveyor-general of Queensland, who has done much for exploration and the promotion of science in Australia, has been promoted to the rank of K.C.M.G.

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received His Majesty the King's approval:—The Copley medal to Prof. Eduard Suess for his eminent geological services, and especially for the original researches and conclusions published in his great work "Das Antlitz der Erde"; a Royal medal to Mr. Horace T. Brown for his work on the chemistry of the carbohydrates, and on the assimilation of carbonic acid by green plants; a. Royal medal to Sir David Gill for his researches in solar and stellar parallax, and his energetic direction of the Royal Observatory at the Cape of Good Hope; the Davy medal to M. Pierre Curie and Madame Curie for their researches on radium; the Hughes medal to Prof. J. Wilhelm Hittorf for his experimental researches on the electric discharge in liquids and gases.

WE are informed that Dr. Charles J. Martin, F.R.S., has now entered upon his duties as director of the Lister Institute of Preventive Medicine, and in future the administrative work of the Institute will be under his control.

THE annual course of Christmas lectures at the Royal Institution, specially adapted to young people, will be delivered by Prof. Ray Lankester, F.R.S., whose subject is "Extinct Animals." The first lecture will be given on Tuesday, December 29.

AN application has been made by the German Meteorological Office for daily telegraphic reports from the Ben Nevis Observatory, with the view of applying them in forecasting the weather of north-western Europe. The directors of the observatory have agreed to send the telegrams asked for.

MANY biologists will regret to know that Mr. I. C. Thompson, well known as a naturalist, and especially for his work in connection with the Liverpool Marine Biology Committee, died suddenly on November 6.

PROF. RAPHAEL PUMPELLY, of Newport, R.I., and Prof. W. M. Davis, of Harvard, have returned from a journey in Turkestan, made under the auspices of the Carnegie Institution, to study the ancient human occupation of the region in relation to its physiography. *Science* states that the expedition proceeded from Baku to the end of the main line of the Central Asiatic Railway at Tashkent. Prof. Pumpelly, with one party, then made an excursion south-eastward across the Alai range and valley to Lake Karakul on the northern Pamir. Prof. Davis and his party went north-east, crossing the western Tian Shan ranges to Lake Issikul.

IT is reported in some of the daily papers that Dr. Otto Schmidt, of Cologne, has succeeded in isolating and cultivating a parasite from cancer, and in preparing an antiserum for the disease. So many positive statements of the isolation of a cancer-parasite have been made during the last few years, and have subsequently proved to be incorrect, and so many capable men have been investigating cancer without result, that reports of this kind cannot be accepted without further proof. The publicity given to matters of this kind is much to be deprecated; in the majority of instances false hopes are raised which must end in disappointment for many sufferers.

LIEUT.-COLONEL BRUCE, who has been investigating sleeping sickness in Uganda, has returned to England, having confirmed and extended the observations of Castellani upon the presence of a trypanosome parasite in this disease. The trypanosome was found to be present in practically every case in the cerebro-spinal fluid, and also in the blood. From analogy with nagana or tsetse fly disease of horses and cattle, it was surmised that a species of tsetse fly might carry the infection in sleeping sickness, and along the shores of the Lake Victoria Nyanza, where the disease is especially rife, large numbers of a tsetse fly (*Glossina palpalis*) were found, and were demonstrated by experiment to be capable of carrying the trypanosome. Moreover, freshly caught flies in infected areas were in some instances found to harbour trypanosomes. It is further suggestive that this fly is confined to certain well-defined areas which correspond absolutely with the distribution of sleeping sickness; in regions where no *Glossina palpalis* is found there is no sleeping sickness. These investigations therefore point to the conclusion that sleeping sickness is a human tsetse fly disease.

AT the Royal Geographical Society on Tuesday Commander Peary gave an address on his "Four Years' Arctic Exploration, 1898–1902." In the year 1899 he obtained the material for an authentic map of the Buchanan Bay, Bache Peninsula, Princess Marie Bay region, crossed the Ellesmere Land ice-cap to the west side of that land, established a continuous line of caches from Cape Sabine to Fort Conger, and familiarised himself and party with the entire region as far north as Cape Beechey. During the journey in 1900 Commander Peary determined conclusively the northern limit of the Greenland archipelago, or land group, and practically connected the coast south-eastward to Independence Bay, leaving only that comparatively short portion of the periphery of Greenland lying between Independence Bay and Cape Bismarck indeterminate. The non-existence of land for a very considerable distance to the northward and north-eastward was also settled, with every indication pointing to the belief that the coast along which the party travelled formed the shore of an uninterrupted central polar sea extending to the Pole, and beyond to the Spitsbergen and Franz Josef Land groups of the opposite hemisphere. In 1901 Commander Peary left Conger for another northern trip, but on reaching Lincoln Bay it was evident that the condition of men and dogs negatived the possibility of reaching the Pole, so the party returned to the *Windward* at Payer Harbour. In 1902 a start was made from Payer Harbour for the northern journey, and latitude 84° 17′ 27″ N. was reached, but the party had to return, and in the autumn of the year the *Windward* steamed southward, arriving at Sydney, C.B., on September 17, 1902, after an absence of four years, three months, and ten days. Referring to his future plans, Commander Peary said he hoped to start north next July, and if the season was favourable he would have his ship by September 1 on the northern shore of Grant Land, near the *Alert's* winter quarters. Wintering there, he would start with the first of returning daylight in the following February to make a journey across the polar pack to the Pole and back again.

MAJOR RONALD ROSS read a paper on malaria in India and the colonies at the Royal Colonial Institute on Tuesday. In the course of his address he pointed out that scientific research has established three great laws concerning malaria:—first, that it is caused by numbers of microscopical parasites which live and propagate themselves in the blood; secondly, that these parasites are carried from sick persons to healthy ones by the agency of a genus of

mosquitoes called Anopheles; thirdly, that these kinds of mosquitoes breed principally in shallow and stagnant terrestrial waters. Four years have elapsed since these facts were established, and a vast mass of information has been accumulated regarding the actual working of the preventive measures which have been based upon them. Major Ross described the State measures for the repression of malaria that have already led to successful results in Sierra Leone, Havana, Lagos, Ismailia, the German colonies, Hong Kong, and other places. It has been proposed that permanent sanitary commissioners should be appointed for some of the colonies, but Major Ross said that Mr. Chamberlain has suggested to him an alternative scheme, namely, that several learned societies should periodically be asked to send out special commissioners for the purpose of examining and reporting upon the sanitary affairs of specified tropical Crown colonies, and that such reports, after editing by the societies referred to, might then be submitted to Government for consideration. Commissioners of this kind would cost less, and, not being servants of Government, would be able to give entirely unprejudiced opinions.

A DEMONSTRATION was given last week at the works of Messrs. Johnson and Phillips of a new electrical process for the preparation of peat-fuel. The process aims at extracting the large percentage of water in peat, partly by mechanical and partly by electrical means; the freshly cut peat is packed into rotating cylinders, and whilst fans beat out part of the moisture, a strong current of electricity is passed through the mass which heats it and thereby helps the extraction of the water. It is claimed that a first-class fuel can be produced in this way, but no particulars as to the cost of production, or results of tests of the fuel by competent engineers, are given in the pamphlet describing the invention.

THE Nagri Sabha established in Benares has, we learn from the *Pioneer Mail*, interested itself in making additions to the Hindi literature, but the difficulty of translating English scientific works, on account of the absence of suitable Hindi equivalents for the English technical terms, has been an obstacle in the way of authors. The Sabha, therefore, resolved to remove this difficulty by compiling, with expert aid an authoritative dictionary of scientific words and phrases met with in the English scientific works, and separate glossaries were ready last year and circulated for criticism among men of science in India. In order finally to approve and pass the tentative lists, the Sabha appointed a committee from among its members, and invited the various local Indian Governments to nominate representatives. Criticisms have been received from men of science in various parts of India.

THE medical officer of health for the City of London states in his last report that a case of enteric fever has been notified from Paddington as having in all probability been caused by mussels sold in Billingsgate Market. The mussels were found to have been obtained from a dealer at Leigh-on-Sea, and in consequence samples of mussels and cockles from the same source were submitted to Dr. Klein for bacteriological examination. Dr. Klein reported that both the cockles and the mussels were polluted with sewage, some of them to a dangerous extent, and that the cooking of the molluscs had been very imperfectly carried out. This state of affairs having been brought to the notice of the Fishmongers' Company, the sale of cockles from Leigh has been prohibited in the London markets. Some months ago the Leigh cockles were found to be polluted, and warnings were issued and directions given for a minimum period of boiling to be adopted, which seem to have been disregarded.

A VERY interesting lecture, entitled "Allerlei Methoden, das Wetter zu prophezeien," delivered by Prof. J. M. Pernter, director of the Austrian Weather Service, before the Society for the Diffusion of Scientific Knowledge, Vienna, has recently been published by that Society. As the title suggests, the author deals with all kinds of methods employed for weather prediction from the earliest to the present time. After doing full justice to the usefulness of local weather signs, such as the appearance and movements of clouds, the formation of caps on hills, the colour of morning and evening skies and the like, often successfully interpreted by agriculturists and others, he gives particular attention to *a priori* theories based on cycles, the phases of the moon, and the motions of planets, and points out their general untrustworthiness, and the great difference between such theories and the empirical inductive methods adopted by the meteorological central offices. By these latter means only can any advance be made. With the knowledge which at present exists, however, he holds out little hope of being able to forecast the weather for more than one day in advance. To improve upon the results now obtained, the author points out that a more minute investigation is required (1) of each point of every form of distribution of barometric pressure; (2) of the rate and direction of travel of each depression over Europe; (3) of the manner in which a certain type merges into another form; and (4) of the change in the weather caused by the various modifications of each form of barometric distribution. By a careful study of such details the author thinks that the percentage of total successes of the forecasts may be gradually raised.

IN the *Proceedings* of the American Academy of Arts and Sciences, Prof. R. W. Wood discusses the anomalous dispersion, absorption, and surface colour of nitroso-dimethylaniline. This substance is interesting as filling the gap that exists between the aniline dyes and ordinary transparent substances.

M. CH. FÉRY describes in the *Journal de Physique* a convenient method for determining the constants of lenses. It depends on the principle that if a ray falls on a lens in a direction parallel to the axis, and at a distance d from it, it will undergo an angular displacement α, the tangent of which is d/f, where f is the focal length, and by observing α, f can be found. Moreover, by calculating the values of f corresponding to different values of d, the aberration can be calculated.

MANY attempts have been made to give purely dynamical proofs both of Maxwell's law and of the second law of thermodynamics, but nearly every one of these deductions has, on closer examination, been found to involve some assumption or other, and not to be a result of mathematical reasoning alone. In two recent communications to the *Philosophical Magazine* (August and October) Mr. S. H. Burbury discusses the late Prof. Willard Gibbs's treatise on statistical mechanics and Mr. J. H. Jeans's theory of gases, and his criticisms go to show that these investigations form no exceptions to the rule.

THE *Scientific American* for October 10 contains two papers of interest in connection with the problem of "aviation." M. Émile Guarini describes some experiments by Prof. Bertelli for studying the action of air currents on curved surfaces such as may be taken to represent birds' wings, and a new aëroplane machine, con-

structed by Messrs. Groombridge and South, is described, which is stated to be 80 feet long and 60 feet wide (the figure of the "full-sized model" hardly corresponds to these dimensions), and is to be supported on two sets of superposed aëroplanes, one at the front and the other at the rear of the machine.

In his fifth report on seismological investigations presented to the British Association at Bradford, Prof. Milne directed attention to the connection between large earthquakes and variations of latitude indicated by a comparison of the statistics for the period 1895–1898. Mr. Adolfo Cancani has published in the *Bolletino* of the Italian Seismological Society the corresponding figures for 1899–1902, and the results tend to confirm Prof. Milne's hypothesis. The figures for 1895 and 1896 give a smaller number of earthquakes satisfying the conditions laid down by Mr. Cancani than would be required on the hypothesis of such a connection, but this the author attributes to the fact that the arrangements organised by Prof. Milne for recording seismological observations were not completed in the two years in question.

We have received from the makers—Messrs. Newton and Co., 3 Fleet Street—an extremely simple device called the "Boyla" tube, which has been designed for the purpose of demonstrating all the phenomena attendant upon the processes of ebullition and condensation. It consists of a strong glass tube about four inches long and three-eighths of an inch in diameter, in which a readily vaporisable liquid is hermetically sealed. When held over a very small flame the liquid boils, and when its temperature reaches the critical point the surface rises and becomes ill-defined; then the liquid vaporises and forms clouds in the upper portion of the tube, which in turn condense and form drops that fall through the space above the liquid in the form of rain. Thus the whole process of ebullition and condensation may be shown to a number of students at one time, and in a much more convenient manner than is at present in general use. The tube is bent round at the top in the form of a hook, so that it may be readily suspended over the flame, and, in the absence of accidents, it may be used over and over again *ad libitum*.

The author of the article on "Botany at the British Association" in Nature for November 5 writes to say that the last line of the paragraph dealing with Miss Sargant's paper on the origin of the Monocotyledons (p. 18) should read, "it was more like a Dicotyledon than a Monocotyledon." In his report he inadvertently transposed the words Dicotyledon and Monocotyledon.

The September issue of the *American Naturalist* contains a continuation of Prof. Morse's synopses of North American invertebrates, this section dealing with the parasites of the genus Trichodectes, which infest mammals.

In the October number of the *Zoologist* Mr. J. L. Bonhote records the existence of a British example of the mouse-coloured bat (*Myotis murinus*), taken at Girton in 1888. The specimen was probably brought over from the Continent with plants or other produce. The only other record of the species in our islands is afforded by some specimens taken in the grounds of the British Museum previous to 1855.

A paper in the October issue of the Zoological Society's *Proceedings* on "The Marine Fauna of Zanzibar and British East Africa," by Mr. F. F. Laidlaw, deals with the planarians of the Zanzibar district, in which, out of a total of nine species collected, eight are described as new, four of them being referred to new genera. Apparently no shore-haunting species have hitherto been recorded from the eastern side of Africa, except in the Red Sea and Cape Colony, hence the high percentage of novelties.

Under the title of "Cold Spring Harbor Monographs," the Brooklyn Institute has commenced the issue of a series of short animal biographies after the plan of the well-known "L.M.B.C. Memoirs." Of the two issues before us (forming the first and second of the series), the one, by Miss Smallwood, deals with the beach-flea or sand-hopper (*Talorchestia longicornis*), while the second, by Mr. Davenport, is devoted to the local representatives of the insects of the group Collembola, with special reference to the movements of the section included in the family Poduridæ. Both memoirs are illustrated with plates, which are perhaps a little rough in execution.

Dr. O. Abel, in the *Sitzungsberichte* of the Royal Vienna Academy, describes certain isolated molars of anthropoids from the Leithakalk. One of these, for which the name *Griphopithecus suessi* is suggested, indicates a new generic type, while the other is assigned to Dryopithecus, with the title *D. darwini*. It is also pointed out that the name *Arthropodus*, proposed by Dr. Schlosser last year for certain anthropoid remains, is preoccupied, and the name *Neopithecus* is suggested in its place. In the same journal Dr. F. Werner describes the reptilian and amphibian fauna of Asia Minor. Special attention is devoted to the true lizards (Lacerta), which are illustrated in three coloured plates, one form being described as new, under the name of *L. anatolica*.

A recent *Bulletin* of the New York State Museum is devoted to an account, by Dr. J. L. Kellogg, of the feeding habits and growth of *Venus mercenaria*, commonly known as the "little-neck clam." In his introductory remarks the author directs attention to the rapid diminution in the number both of that species and of the true "clam" (*Mya arenaria*), both of which form important articles of diet in New York. "Clam-farming" would undoubtedly long ago have taken the place of "clam-digging" were it not that beaches and sand-flats are public property to which everyone has the right of access. The little-neck clam, although it will also flourish between tide-marks, grows most abundantly below low-tide mark, where it is taken with tongs. "Much of the shallow bottom about Long Island, in which clams were formerly taken, has been leased to oystermen. The profit from oyster culture is much greater, acre for acre, than that derived from the taking of hard clams, which are left to propagate by the natural method. The areas left to clammers are now limited, and the great part of the supply used in the canning industry comes from the southern coast. At the same time clams are rapidly diminishing in the available beds."

The new cone of Mont Pelée and the gorge of the Rivière Blanche, Martinique, are dealt with by Mr. E. O. Hovey (*Amer. Journ. Science*, October). He directs special attention to the new "spine" or obelisk of which an illustration was given in Nature for October 1. Mr. Hovey remarks that no one can say exactly what the nature of the spine is, but probably it is largely pumiceous. Another striking feature is the filling of the gorge of the Rivière Blanche with calcined rocks, dust, and ashes which have been poured out of the crater by numerous eruptions.

The National Transcontinental Railway is planned to extend to the north of the Canadian Pacific Railway, from New Brunswick through Quebec and Ontario to Winnipeg, in Manitoba. There it meets the Canadian Pacific Railway, and diverges again to the north, through parts of

Assiniboia, Saskatchewan, Alberta, and Athabasca, and across British Columbia to the neighbourhood of Port Simpson. In aid of this enterprise a concise report on the resources of the line of country between Quebec and Winnipeg has been drawn up by Dr. H. M. Ami, of the Geological Survey of Canada (Sessional Paper, No. 143). The physical geography, geology, soils and economic minerals, and the natural history generally are described.

IN some notes on the geology of the Hawaiian Islands (*Amer. Journ. Science*, October), Mr. J. C. Branner directs attention to the striking series of canyons in the volcanic rocks on the northern coast of Hawaii. There are bluffs with an elevation of a thousand feet, and enormous gorges that extend inland with almost perpendicular walls, some of which are said to be 2000 feet in height. The gorges are nearly or quite as deep near their upper ends as at the lower ends, and they have flat bottoms. They were formed as V-shaped gorges on the land, and have sunk until their lower ends were occupied by the sea, forming deep fjords which were soon filled by material derived partly from the sea and partly from streams. Other interesting features are dealt with by Mr. Branner.

A FULL account of the life and work of the late Prof. Cornu is contained in the *Revue générale des Sciences* for October 30. The appreciation is from the pen of M. C. Raveau.

THE lecture on the periodic system of the elements delivered by Sir William Ramsay at the recent meeting of the German Association at Cassel (see NATURE, October 15, p. 586) has been published in pamphlet form by the firm of J. A. Barth, Leipzig.

AMONG articles dealing with scientific subjects contained in the November reviews and magazines, we notice two dealing with recent experiments on radium. One is by Mr. J. B. Burke on the radio-activity of matter, and is contained in the *Monthly Review*, the other, on the riddle of radium, is by Mr. A. S. M. Hutchinson, and is published in *Pearson's Magazine*. The latter magazine gives considerable prominence to science this month, for in addition to the article mentioned, there is one on "Our Descent from Monkeys," by Mr. S. S. Buckman, illustrated by photographs showing habits and characteristics that link man to monkey forms, and also descriptive accounts of the Waimangu geyser, New Zealand, and the habits of woodcocks.

A PAPER read by Mr. Edmund McClure at the Church Congress held at Bristol last month is a satisfactory indication of the sympathetic attitude which the churches now show towards scientific research. Mr. McClure's paper was entitled "The Aids which Science gives to the Religious Mind," and in it, after referring to Mendeléeff's periodic law and the recent work of Sir W. Crookes and Sir W. Ramsay, he asks:—"Does not the religious mind, which lives and moves in the sphere of the unseen, find an aid in such an extension of the reach of the mental eye?" It is encouraging to know that scientific work and thought can inspire reflections on the relation between the visible and invisible universes.

MESSRS. TOWNSON AND MERCER, of Camomile Street, London, have submitted to us for examination a form of extensimeter designed by the Rev. G. B. Lavelle, of Waterford. The method of measuring linear expansion upon which the construction of the apparatus depends, is already well known in physical laboratories, and the apparatus is an elaborate form of one described in elementary books on practical physics. The instrument consists of a brass cylinder half a metre long, with side tubes for the ingress and egress of steam. The half-metre metal rod of which the linear expansion is to be determined rests on the bottom of the cylinder, and its other end passes through a hole in a movable metal cap to the cylinder. Temperatures are measured by thermometers introduced through india-rubber stoppers in the side tubes, and the spherometer is supported on a brass plate with a hole in the centre, the plate being so supported that it and the spherometer can be moved away from any issuing steam. A dry cell and electric bell are supplied with the apparatus to provide for greater accuracy in determining the instant of contact between the spherometer and the metal rod, but this seems an unnecessary elaboration.

HIGH vacua for distillation under reduced pressure can be rapidly produced by filling the apparatus with carbon dioxide and condensing this with liquid air. Liquid carbon dioxide cannot be used, as it contains 0·75 per cent. by volume of dissolved air, but carbon dioxide snow gave good results; the dissolved air, like that dissolved in water, contains an excess of oxygen, the proportion being 24·1 per cent. by volume. The most convenient method is to prepare the gas from marble and hydrochloric acid, and to exhaust to 30 mm. by means of a water-pump; this operation is repeated four times, and on cooling with liquid air a vacuum of 0·1 mm. is produced. The lowest pressure recorded was 0·026 mm. when rubber connections were used, but in a vessel made wholly of glass the vacuum required for the production of kathode rays could be obtained. Ernst Erdmann, in describing this method in a recent number of the *Berichte*, adds that in London liquid air costs less than fivepence per kilo.

THE additions to the Zoological Society's Gardens during the past week include a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Lady Campbell; a Grey Seal (*Halichoerus grypus*) from the West Coast of Ireland, two Meyer's Parrots (*Poeocephalus meyeri*) from South-east Africa, two Yellow-billed Cardinals (*Paroaria capitata*) from Chili, five Bungoma River Turtle (*Emyda granosa*), three Roofed Tortoises (*Kachuga tectum*), three Indian Eryx (*Eryx johni*), four Conical Eryx (*Eryx conicus*) from India, a Four-lined Snake (*Coluber quatuorlineatus*), South European, deposited; a Polar Bear (*Ursus maritimus*) from Nova Zembla, purchased.

OUR ASTRONOMICAL COLUMN.

REVISION OF ROWLAND'S WAVE-LENGTHS.—In view of the extreme importance to workers in astrophysics of having a perfectly trustworthy system of standard wave-lengths, Prof. Hartmann reviews, in No. 3, vol. xviii., of the *Astrophysical Journal*, the methods used by Rowland in constructing his wave-length tables, and points out their sources of error. He shows that Rowland made the metallic arc wave-lengths given in his "New Table of Standard Wave-lengths" coincide with those of the solar spectrum by applying purely empirical corrections which cannot now be found. In a series of tables Prof. Hartmann also shows that differences, amounting in some cases to 0·03 unit, exist between the solar and metallic wave-lengths, and suggests that further experiments should be performed, on similar lines to those pursued by Michelson and Fabry and Perot, for the purpose of determining a general factor—the F of Fabry and Perot—by which the whole of Rowland's table might be reduced to a rationalised standard from the equation $\lambda = (F \text{ and } P)Fo$, where (F and P) is the absolute wave-length found by the French observers, and Fo is the factor mentioned above. This would produce an errorless wave-length on Rowland's scale for each of the thirty-three lines measured by Fabry

and Perot, which would vary but little from Rowland's values, and yet be free from their systematic errors.

Prof. Hartmann has already done this for the part of the spectrum on which Fabry and Perot worked, and has obtained a correction, C, which, when applied to the values given in Rowland's "Preliminary Table," rids them of the errors discussed by him. Not having the necessary facilities for pursuing this important work himself, Prof. Hartmann appeals to those spectroscopists who have them to complete the work commenced by Michelson, Jewell, and Fabry and Perot for the whole of Rowland's tables.

PARALLAX OF β CASSIOPEIÆ.—In a note to No. 3910 of the *Astronomische Nachrichten*, Herr S. Kóstinksky, of Pulkowa, discusses the results of three separate determinations of the parallax of β Cassiopeiæ. The first of these was obtained by Prof. Pritchard, using the photographic method, at Oxford in 1888, and gave the value $\pi = +0''{\cdot}15 \pm 0''{\cdot}02$; the second, obtained by Herr Kóstinksky himself, using the transit instrument in the prime vertical, gave a mean value of $\pi = +0''{\cdot}14 \pm 0''{\cdot}03$, whilst the third was recently obtained by Mr. A. S. Flint, of the Washburn Observatory, from meridian-passage observations, and produced as the mean result $\pi = +0''{\cdot}10 \pm 0''{\cdot}03$.

On considering these three values, obtained by three different methods, Herr Kóstinksky arrives at the conclusion that the absolute value of the parallax of β Cassiopeiæ is with great probability very near to $+0''{\cdot}1$, and rather a little greater than less.

ASTRONOMY IN SCHOOLS.—Mr. W. W. Payne contributes an interesting article to No. 108 (October) of *Popular Astronomy*, in which he strongly advocates the introduction of practical yet simple astronomical observations into the ordinary higher grade school's curriculum. He points out the absurdity of the general opinion that large instruments and expensive equipments are necessary in order to render observational astronomy a truly educative subject, and shows that a large amount of real training of the observational powers might be given with a small telescope. As examples of the type of observation he would suggest, he mentions the recognition of the brighter stars by name, and the keeping of methodical records of their light and colour characteristics and their occasional changes. Then, with quite a small telescope, a large amount of useful work—from an educative point of view—might be performed in observing and methodically recording the characteristics of some of the finer examples of multiple stars.

UNIVERSITIES: THEIR AIMS, DUTIES, AND IDEALS.[1]

VARIETY OF TYPES OF UNIVERSITIES.

ONE remark of a general kind must be made before proceeding to a synthesis of the purposes of universities. It is a platitude, yet not unimportant, to the effect that they will not be (and cannot be expected to be) uniform in character. Old universities have their traditions, sometimes the growth of centuries; and though they have to review their ideals from time to time and to revise their practice to meet the challenges and the demands made by the growing needs of the nation, changes are made only gradually, and the main character tends to persist through the changes. On the other hand, new universities arise in response to new demands of diverse kinds, and their character is bound to be shaped by their origin, their circumstances, and their growth. In the later Middle Ages, the philosophy of the schoolmen yielded before the onset of the study of the humanities—a study which has largely determined the character of our oldest universities. The physical sciences, by their growth during the last century, have modified the range of education and have influenced profoundly some of the older universities, while they have had no small share in dominating the form of newer foundations. The needs of applied sciences and practical sciences in our own day are stirring ideals of education widely removed from those that reposed upon the humanities, and they are leading to the establishment of learned institutions of types hitherto unknown. Sometimes between one university and another, sometimes within the limits of a single university, there will be what is almost a struggle among the subjects in their historical assignment to courses of study. Fundamental questions are being asked. Should the study of modern languages displace that of the ancient languages? Will applied science diminish the attention paid to pure science? Will practical needs direct the study of applied science? Must the acquisition of so-called useless knowledge be renounced in favour of so-called useful knowledge? Can it still be possible to maintain the process of a liberal education in the presence of the demands for technical instruction and commercial instruction? These and many other questions will arise in practically every university. They must be answered when they arise, and the answers will vary, perhaps from time to time, certainly from body to body. Yet diversity of character, of circumstances, and of practice, will not exclude a certain community of spirit and a certain similarity of obligation.

WHAT IS A UNIVERSITY?

What is a university? Is it a building, or a set of buildings? Is it a federation of schools? Is it an aggregation of faculties? Is it a corporation of individuals, formally devoted to a common purpose? Is it an examining body with power to grant degrees? In each of these senses, and doubtless in several others, the word university has been vaguely used at different times and of different bodies. In its earliest use in regard to the kind of institution under consideration, a university appears to have been a sort of scholastic guild; there were societies of masters, as there were societies of students, and each of these was called a university. There were two places where these guilds grew into greater importance than elsewhere at the close of the twelfth century; one was Paris, mainly a university of masters, the other was Bologna, mainly a university of students. Indeed, so supremely important were these two universities, even while they were so distinctively different in character, that most of the older European universities have conformed to one or other of these types in many (if not in most) essential features. Thus Oxford and Cambridge are modelled on the master university of Paris; it is the graduates who have the power of electing the acting chief of the university. On the other hand, the ancient Scottish universities are modelled on the student university of Bologna; it is the undergraduates who have the power of electing the acting chief of the university. There have been variations in the detailed developments of the different universities. Most of them had several faculties, though not all of them had the same faculties. Thus Salerno, at the zenith of its fame towards the end of the eleventh century, was simply a medical school (having, it may be mentioned, several women among its teachers and writers). Bologna had a faculty of law only; Paris had faculties of theology and arts; Saragossa had one of arts only. The notion that a university was a school in which all branches of knowledge are represented was one that sprang up later, and had a considerable vogue; this Literary Society will readily recall Dr. Johnson's description of a university as "a school where everything may be learnt." The conception of a university as a centre for the cultivation of universal knowledge and the teaching of universal knowledge undoubtedly propounds a stimulating ideal, and the realisation of the ideal is as nearly imperative in modern times as anything almost impossible can be. At any rate, I know of no instance in which that conception of a university is justified by actual facts; and there is on record one instance in which the conception was completely falsified by actual facts, in that no teaching of any kind of knowledge whatever was done—the old university of London, now modified into a university that not merely examines, but also teaches.

CHARACTERISTICS.

What, then, should be taken as the working conception of an ideal university? To my mind, it is a corporation of teachers and students, banded together for the pursuit of learning and the increase of knowledge, duly housed, and fitly endowed to meet the demands raised in the achievement of its purposes. In the prosecution of its academic

[1] Part of an address to the Southport Literary and Philosophical Society, delivered on September 17 by Prof. A. R. Forsyth, F.R.S.

aims, the university should be free from all external censorship of doctrine; it should also be free from all external control over the range, or the modes, or the subjects, of teaching. Above all, thought should be free from fetters of official type: whether political, from the State; or ecclesiastical, from the churches; or civic, from the community; or pedantic, from the corporate repressive action of the university itself. In its establishment, the amplest powers that wisdom can suggest should be conferred upon it. In working out its intellectual salvation, the exercise of those powers should be vested in select bodies of fit persons, sufficiently small in number to be efficient, yet large enough in number to prevent degeneration into an intellectual clique, changing sufficiently from time to time to prevent the dominance of merely personal policies, and representative enough to be in touch alike with the experience of the past and with aspirations for the future so far as these have taken shape or have acquired definition.

Access to the facilities of the university should be open to all duly qualified persons, without consideration of sex, without consideration of station in life, without consideration of intellectual beliefs, whether theological, political, or otherwise. The university should have the power of requiring both a minimum of qualification and a variety of qualifications to be satisfied by an applicant before admission to the status of student. Some test of qualification had to be imposed upon mediæval students, for Latin, then still something of a living language, was the one language of learning—and workers in science can sigh that it ever ceased to be so. That some test of qualification still is desirable probably is obvious to anyone who accepts my view of what university education should be. In my view, the school should prepare for the university, and education in the university should be, not something distinct from the school education, but rather its development, its amplification, and (on some issues) its complement. Briefly stated, the preliminary training should have been finished, and only those whose attainments show that they are qualified to profit by further training should be admitted to the courses of university study.

Qualification of Students.

As this limitation is important, will you be patient with me while I make a digression from my main topic and indicate the kind of minimum of qualification that I, if an autocrat, should exact in order to have one security (necessary, though not sufficient) that the students shall be not unworthy of a seat of learning? Besides the usual elements of reading, writing, and arithmetic (and I would add drawing to them), his studies should have included subjects that would train and develop some power of expression, some power of reasoning, some power of observation. To give him some power of expression, I would use his own language in the first place, initiating him into the mysteries of grammar and analysis through it alone, giving him some acquaintance with selections from the best of its literature, and, above all, practising him regularly in the art of composition in his own language. Then, after a certain stage, and in order to give him, while still at school, a more accurate literary training, he should be drilled in at least one foreign language, so as to be able to read it with ease and accuracy; the contrast of the two languages in idiom, diction, method, and manner, should emphasise his critical appreciation of his own, and increase, therefore, his control over it. If he can spare time for only one foreign language, my choice would be a modern language; if he can spare time for two foreign languages, let Latin be one of them; if he can spare time for more, he is in the way of being a scholar, and he needs none of my presumptuous directions on this head. To give him some power of reasoning, I would use the elements of mathematics; his algebra should be built upon his arithmetic, without the fatuous artificialities that disfigure text-books and examinations, though happily in a lessening degree; above all, he should have a training in geometry, beginning with experimental work so as to familiarise him with the matter, and gradually introducing the processes of geometrical reasoning; and if he can be taught the elements of mechanics, beginning also with an experimental basis, so much the better. To give him some power of observation, I would use some of the experimental sciences; my own choice would be the rudiments of experimental physics or inorganic chemistry. But more than all these are wanted; all the studies thus far prescribed are for the purpose of sharpening his wits, and, in the process, they will develop his intelligence. The latter must be developed also in other ways, and to my mind one of the best of ways is to give him a general knowledge of the history of his country, a general knowledge of the geography of the world, and (if possible) some rudimentary knowledge of the modern history of neighbouring countries.

Such a programme provides the elements of a liberal education. A youth, so educated, is ready for the technical training now needed for so many of the occupations of life, and even if he does not devote more time to the continuance of his studies, he is provided with the elements of such intellectual interests as should make him an intelligent man and an intelligent citizen. Also, such a programme is practicable for the average boy; no exceptional ability is needed to have completed such a course at the age of fifteen or sixteen. I am not prepared to say that the average boy at any school in England will have achieved this programme before he is sixteen; if I may judge from some not entirely laudatory criticisms that are openly expressed from time to time and remain unrebutted, it seems to be the fact that the average boy at a public school does not achieve such a programme or its equivalent before he is sixteen. But I am optimistic enough to believe that, in the future as in the past, improvements can come even in English education, and meanwhile I am content to claim that the programme of training which has been sketched is not merely possible, but is practicable also, within the time allowed.

Groups of Students.

Let us assume, therefore, that we have an ample supply of average students who have undergone some not inadequate preliminary training, and, as hopeful assumptions are encouraging, let us further assume that there is more than a sprinkling of students with abilities well above the average. In coming to our ideal university, which is eager to receive them, the students are actuated by varied kinds of needs and desires. Some—many of them, I should like to think—mean to devote themselves to one or other of the different forms of practical business, not intending to use their university education professionally, but preparing to take their part in maintaining and elevating the tone of the community. All the professions and callings, whether learned or technical, are to be recruited from among the students when once they have been trained. Some have the intellectual ambition, more or less defined as yet, ultimately to devote themselves to a life of learning in their own university by preference, yet, if not there, then in some other. There are men intent upon the ministry of religion; there are men intent upon the public service of the State. Last in this enumeration, there are the men of genius, as yet unproclaimed, who are to find in the university that training which will gradually reveal to them their powers, and that stimulus which will inspire them to the highest service of mankind as the discoverers and the thinkers of their generation. To all these men the university must give the means and the opportunities of obtaining the knowledge adapted to their several intellectual needs.

Spirit of University Training.

Of course, every person would be prepared to acknowledge that a university education includes more than even the most industrious and praiseworthy absorption of knowledge, and much of the influence of a university depends upon the spirit and the circumstances in which knowledge is given and received. There is an education of character as well as of mind, and the two can be achieved simultaneously by the due conduct of studies. Thoroughness must be the dominating quality in every study; difficulties which arise must be solved, not evaded; proofs must be sternly examined and only accepted if found valid and clearly comprehended; truth, and not merely comfortable or convenient doctrine, must be the object of search; and all must be done in a spirit that would scorn dishonesty or shuffling about the affairs of the mind as contemptuously

as one scorns dishonesty or shuffling about the property of one's neighbour.

Nor is it less important that the imagination should be stimulated. Some stimulus will come from every study, honestly and thoroughly pursued; according as it is greater or less, so is the greater or the smaller advantage to the student—not then alone, but throughout his life, as affecting his power, his influence, his usefulness. Above all, it is important to have what may be called the play of intellect between the teachers and the students, and, more particularly, in all liberty among the students themselves; it makes for force of character, for steadiness of character, for command over powers, for fairness, for soundness of judgment, for proper confidence in one's self, for proper consideration for others, for toleration, for knowledge of men, and for the seriousness of life. This phase of education is more important than mere instruction, and a university in which it is not secured provides but a maimed and stunted education. It stirs, it moves, it creates, the sentiment felt to the university; its operation has something of the air of spiritual romance, something also of elusive mystery. It cannot be secured by regulations or endowments; it is a product of the spirit of the place and the spirit of the time, difficult to establish as a custom, a treasure beyond value when once established as a tradition.

Each university in its own manner must evolve its own method of establishing this influence; the utmost that its formal regulations can achieve is the due provision for the intellectual needs of all classes of students.

Range of Instruction.

To discharge this duty, fraught with issues so grave to the good of the community, one necessity for the ideal university is that her courses of possible instruction should cover the whole field of human thought and intellectual activity, so that she can take her part in the diffusion and the extension of knowledge. She should possess such a collection of teachers that a student could obtain instruction in any department of knowledge, and could be trained in the use of any method by which knowledge is obtained. All sources of knowledge must be open to all students as they want them; all aids to learning must be provided. She must foster the liberal studies where "nothing accrues of consequence beyond the using"; she must foster the useful studies where the revenue to be produced is of essential consequence. In every art, in every science, in any study which is neither an art nor a science, the spirit of inquiry should be encouraged; and the only dogma permitted to the teacher should be his guiding advice based upon knowledge and experience.

To those who are acquainted with the working of actual universities, my claims may be deemed excessive. But it is to be remembered that I am dealing with an ideal university, and there is no doubt that, in this form of human activity as (I imagine) in all other forms, working practice will be derived from the too lofty ideal by the omission of some of its constituents. Moreover, the omissions may reflect the wishes, the preferences, even the prejudices, of the founders and the supporters; they may also be some index of the neediness of the university in actual work. Whatever their cause, they will tend to vary from one centre to another, and thus each working university will acquire its individual character, and monotony of character will be avoided.

Making this passing concession to the limitations that inevitably cramp the initial stages of great undertakings and sometimes shallow their whole course, let me return to my ideal university where all departments of knowledge are represented, and attempt some classification of these departments so as to give greater clearness and precision to some of its activities. They are set out in the order in which they arose naturally to me when considering them—no other significance, either of preference or importance, is implied in the order.

Position of Theological Studies.

As a preliminary let me deal with a matter which must be settled in the case of each university specifically and particularly—the attitude towards theology. The older among our foundations include its study within the curriculum; the tendency of most of our new foundations is to exclude its study. My ideal university is to make provision for every department of knowledge, and, as theology is undoubtedly a branch of knowledge, she must make provision for the teaching of theology. But in my university, thought is to be free from all fetters of official type, including those imposed by the churches, and the spirit of inquiry is everywhere to be encouraged. These conditions exclude all that part of theology which is expounded definitely on the basis of dogma, and, so far as I see, admit all else. Thus dogmatics, apologetics, pastoral theology, would be excluded; exegesis, ecclesiastical history, the characteristics and distribution of religions, and the history of religion, would be included. Provision would have to be made for the teaching of these latter subjects, and it is more than probable that each of the teachers would have some definite dogmatic position. But of the intrusion of dogmatic views into the exposition of the retained subjects I am no more afraid than I should be of the intrusion of party politics into the academic exposition of history or (what is to be stirred into passionate interest in England in the very near future) into the academic exposition of economics. Nor to my mind is there any arbitrary quality in the action which would include a portion of theology and leave the rest to be obtained, presumably in some theological school of the appropriate dogmatic hue. My ideal university is to include the whole field of human knowledge; but it is not to include everything based on human belief or beliefs, any more than it is to include everything based on human activity, and I do not require it to make provision for the whole training of a dogmatic theologian any more than to make provision for the whole training of (say) a surgeon or an engineer.

Branches of Knowledge, Subjective to Man.

Having now expounded this opinion as frankly as is consistent with the brevity imposed upon me by circumstances, I pass to a review of other activities of the university which usually do not give rise to contentious difficulties. As a beginning must be made somewhere, let us begin with man. We may regard him as engaged in the conduct of his own existence, possessed of mental faculties, directed by certain tastes, exercising mental activities, standing (either as an individual or as one of a group) in multifarious relations with other men; he is placed amid a universe, and there are the phenomena of that universe, living or inert, outside him. Each of these qualities, if they may be so styled, gives rise to a branch or to several branches of knowledge.

Our first quality of man as an existing being has regard to his conceptions of the general nature of knowledge and existence as such, and to the theory of his conduct of his own existence; the branches of knowledge related to those conceptions and that conduct are most simply described by the titles of metaphysics and of moral philosophy or ethics.

His next quality pictured him as possessed of mental faculties. The range of these faculties, their detailed activities, their modes and methods of working, to mention only some of their features, give rise to the branches of knowledge described by the titles of psychology and logic. In theory, there are close relations between logic and mathematics; in practice, particularly the older practice, mathematics as a subject has usually been derived from the study of nature.

Man then was indicated as directed by certain tastes; in this indication, it is mainly his æsthetic faculty that is contemplated. The branches of knowledge associated with the æsthetic element in man are conveniently summarised in the title of the fine arts, meaning thereby the arts of music, architecture, sculpture, and painting, alike in their industrial and their intellectual aspects.

When we contemplate the quality of man as connected with the exercise of his mental activities, not in the mode of the exercise but in its results, we are practically face to face with the intellectual creations of all individuals in the aggregate. The section of knowledge which thus arises is so vast that there is difficulty in finding a single title to describe it. Taking account of such limitations upon the range of this knowledge as are implied in the other activities of man which have been explicitly recited, I shall perhaps most simply describe it as literature.

When we contemplate the quality of man as standing in relations with other men, either as an individual with other individuals, or as a member of a community with other communities, or as a citizen of a State with other States, the branches of knowledge arising through these relations are languages, law, economics, and history.

Thus far, every branch of knowledge indicated has arisen through the consideration of qualities directly appertaining to the individual man, either to himself alone or in association with others. But his circumstances have to be considered. He is placed in a universe, and before there can be any real approximation to a fit understanding of man and his surroundings, the phenomena of the universe must be studied in their facts, their laws, their orders, their significance, their influence. These studies are vast and varied; they are concerned with all the knowable relations of nature, alike animate and inanimate, and they give rise to that immense and ever-increasing ordered body of knowledge, usually called science in general. It includes all the particular sciences, and these may be ranged broadly in the three classes of mathematical sciences, physical sciences, and biological sciences, the first two of which have closer relations with one another than (as yet) either with the third.

Ramification of Studies.

Provision has to be made for the adequate teaching of all these branches of knowledge, and it will be seen that my ideal university is growing at an alarmingly rapid rate. Yet the growth will have to be much greater, in respect even to these branches of knowledge, than the statement can outline, exacting as it seems. Branches of study have been indicated as originating mainly in some one source or other, but any study, once definitely introduced into an ordered scheme of knowledge, may develop into issues vastly wider than its initial purpose. Examples occur at every turn. Languages arose in my enumeration through the relations between man and man; presumably, therefore, they arose for their use in oral communication. But they can be studied for other than utilitarian purposes. They may be studied organically, that is, for their accidence, their syntax, the sources of their words, the analogies and the differences in their methods, their growth and their mutations, their influence upon one another; these, and similar aspects of languages, constitute the science of philology, and provision will have to be made for its teaching. Further, I would make the mild remark that languages, ancient and modern, are the vehicle of literature in the widest meaning that can be given to the word, and a mode of teaching them, which is neither utilitarian (in my sense) nor philological, will be required for appreciation of the best treasures of thought, for comprehension of the records of development of nations, for intelligent understanding of the civilisations of the world.

As for languages, so for history, another of the subjects that in my enumeration arose through the relations between man and man. It may begin in our scheme as the record of the doings of particular peoples; it must develop into the history of mankind to which that of particular peoples is ancillary. The history made up of acts is not more important, rather it is less important, than the history of movements and the development of political thought. Account must also be taken of the fine arts, moral philosophy, religious thought, scientific thought, in that continuous succession which also is their history. For all these, and for the corresponding amplifications of other branches of knowledge introduced initially in the simplest of elementary demands, provision must be made in the university.

Other Branches of Knowledge.

When all this is recognised, and when all the demands thus made are acknowledged and met, then it might be imagined that the necessary provision of the university is complete and that she is fully equipped to discharge all her duties. Far from this being her happy reality, she must afford opportunities for another group of classes of knowledge of an entirely different kind. In the gradual elaboration of the scheme, many useful branches of knowledge have been established; yet in their inception they have been established rather as pure knowledge, and they do not attain their full significance until they have been so organised that the amplest utilitarian tax has been levied on their riches. There thus must be (to use the ancient word) a faculty of theology, a faculty of law, a faculty of medicine and surgery; though just as not all theology can be taught in the one faculty, for dogmatics have been excluded, so neither all the practice of law nor all the clinical elements of medicine and surgery can be taught in their respective faculties in the university.

Nor is this all. These practical organisations have been selected as being subjective to man, but they are not complete even within that categorical limit. Growing academic thought has discovered that other organisations of knowledge can fitly be framed; Birmingham now possesses a department of commerce, Cambridge has just established a new curriculum in economics, and not in one university alone has provision been made to meet a growing sense of the need for a department in the history, the theory, and the art, of education itself.

The tale of demands is not yet full. Only those branches of useful knowledge have thus far in the scheme been selected for utilitarian organisation which are most closely associated with man's health and man's human relations. There still remain those other branches of useful knowledge which, fitly organised and selected, will train men to wield the forces of nature for the advantage of the community. Perhaps the most conspicuous example of such a group of branches of knowledge is provided by the school of engineering which certainly must exist in our ideal university, to include instruction in electrical engineering, in mechanical engineering, and in naval engineering; and other examples, following the wisdom of recent establishments, will be given by a school of agriculture, a school of tropical diseases, and departments of particular industries depending largely upon the locality of the university. It lies with the future gradually to work out the balance between practice and training, and to settle the proportion between experiment and experience, in the equipment for professions of the newer order as has been done for the professions of medicine and surgery. And let me add two warnings. While the earlier stages in any such process continue, there is more than a probability that old ideas as to what constitutes a university education will receive rather rude shocks, and may occasionally be staggered. I would, very respectfully, urge a caution against the exclusion of any subject of new technical knowledge from the university, either actual or ideal, if only because no man can foretell its possible tribute to even abstract theories; I would suggest that its prudent reception in a not too unsympathetic spirit is a preferable mode of exercising the caution of academic wisdom. On the other side, the fiery and occasionally arrogant advocates of devotion to the newest learning would do well to temper their vehemence with intellectual charity. Before they came upon the scene, thought had propounded problems which their sciences cannot touch; after they shall have left it, thought will continue to propound problems equally unamenable to their sciences.

Extension of Knowledge: Research.

Hitherto, I have spoken of the university as a treasury of all ascertained knowledge which is to be given without stint to all qualified students coming for its wealth, and those who distribute this wealth are the professors and other teachers. But that duty, no matter how excellently discharged, is not the sole duty of these officers in respect of knowledge; if it were, the university would only be a rather glorified secondary school. It is true that we have not supposed our ranges of study to be confined to antique knowledge which is crystallised; on the contrary, all knowledge is to find its home in our university and, at the fitting stage, the students will be brought into contact with living knowledge, growing, increasing, and in its very vitality proving the greatest stimulus to the ardent mind. You would not be content that the estimates of literature should only be those of some bygone generation. The last word in judgment of painters and painting had not been uttered when Ruskin finished his great book. Almost from day to day, a chapter in the history of civilisation anterior to the Greeks is being opened up by the discoveries in Crete. Not all the problems of history are solved, and their solution will add to the knowledge of the past, perhaps to the

comprehension of the present. After the past week, you will not need to be told in detail how, in every direction, the sciences, abstract, concrete, practical, are advancing by leaps and bounds. Progress is the condition, it is the essence, of living knowledge; it should be the very breath of life of the university.

How is this progress to be secured, and the knowledge of it made available? It is manifestly the duty of the professors to assimilate new facts as they come, and to submit them to those critical refining and concentrating processes which make the surviving product some contribution to truth. But is there to be nothing else on the part of the professors? Is it to be "all take and no give"? all absorption and no production? Are they to profit by taking toll of all the thought of the world, and to contribute nothing for toll in return? I hold it to be the highest duty of a teaching professor that, up to the limits of his powers, he should strive to contribute to the increase of knowledge and the advancement of truth.

Now I know that all professorial spirit is not the same spirit. There is a spirit which devotes itself to administration; its works deserve grateful acknowledgment, and they are undoubtedly indued with the exercise of power, so dear to many souls. There is a spirit which devotes itself to the humanising and social influences that should be a feature in the life of a university; its labours are blest in a quickened vitality that affects the whole community. But the spirit of research must also be there; not alone the quest of facts, but the quest of truth, which is higher than facts; not alone the love of novel thought, but the love of wisdom, which is the crown of thought. You cannot secure it by regulations; a professor will devote himself to research in proportion as he likes it, not because it is an expected duty. You cannot exact it from every professor; but there must be a substantial amount of research produced by the aggregate of professors, or their corporation will fail to contribute its share to the advancement of learning. Moreover, in the absence of research, the university will fail in other respects, for it will be unable to exercise the profoundest of all influences upon the most earnest of its students whose later duty it will be to carry on the torch of learning—I mean the influence of stimulus and inspiration.

Will you let me be reminiscent for a few moments? When I was an undergraduate at Cambridge studying mathematics in all the earnest and kindly rivalry that is frankly and easily possible among young men who are friends, there was, among the professors, a group of four men of supreme eminence, Stokes, Cayley, Adams, and Maxwell. We were not (or we thought we were not) sufficiently qualified by our attainments to attend their lectures in our earliest days; but our teachers could tell us of their powers, their genius, something of what they had done or were doing, and we knew that they stood among the great men of the world. Do you think it was a little thing to young men at the opening of life that they belonged to a university which possessed such illustrious pioneers of learning? I can tell you that, though the young men then knew themselves hardly worthy of entrance even into the court of the Gentiles in the temple of new knowledge, the mere presence of the great men stimulated them and inspired them along the paths which led to the temple. I have spoken of one group of professors, great men in the domain of knowledge that was our special pursuit; I would mention another group of professors possessed by Cambridge at that time, equally great in another domain, that of theology. They were Lightfoot, Westcott, Hort. To theological students I suppose that they stood for as much as did the mathematical group to us; but even to those of us who were not theological students their achievements made the university a more stimulating home of study, though we knew nothing in detail of their work. All these men are dead, the oldest of them all only a few months ago; their bodies are buried in peace, but their names live for evermore, a treasured inheritance and the proud possession of the university of which during their lives they were an ornament, a glory, and an inspiration.

This deviation into personal reminiscence is undoubtedly an interruption of my main line of argument. Yet these particular examples of fact may do more than any ordered sequence of reasons could do for the establishment of my contention that a healthy university must contribute not merely to the diffusion of knowledge, but also to the advancement of learning.

Concluding Remarks.

I have spoken at length of some of the aspects of universities, and have incidentally alluded to others, and some have been omitted entirely. It is time, however, that my remarks should draw to a close, and so I leave the subject with you at this stage. Earlier in the evening I confessed that the receipt of the charters of the Universities of Manchester and of Liverpool suggested my subject. But the real reason for its selection was a desire on my part to do something by way of concentrating your thoughts, and, through you, the thoughts of others, upon the significance of university education, for I believe that a vigorous university can exercise a most beneficent influence upon the life of a nation. It certainly can play its part in so training men that they can contribute to the commercial success and the material welfare of the people among whom it is placed. But it can do more. The greatness of a people is not to be measured solely or even mainly by its commercial success, or the extent of its empire, or the vigour of its fighting powers. Thought has its part in life, no less than action; frequently it dominates action; often it is more potent than action in its influence upon the course of civilisation. In estimating the position of a nation in the scale of the world, not a little weight ultimately is attached to its devotion to learning. The spread of learning makes for the clearer understanding of the nations by one another, and consequently assists towards developing feelings of comity and invoking the spirit of peace. Universities can do much as agents in the achievement of these aims as of others that are more utilitarian. They give to their people a wider range of knowledge and a higher standard of culture, and they can organise the genius and the ability of a nation so as to feed the living springs of action and enable it to make no unworthy contribution to the growing thought of the world.

ASTRONOMY AND METEOROLOGY AT THE BRITISH ASSOCIATION.

THE proceedings of the department of Section A which was devoted to astronomy and meteorology were conspicuous this year on account of the meeting of the International Meteorological Committee, which was held during the Association week, and brought to Southport not only representative meteorologists from the United States, France, Germany, Austria, Russia, Sweden, Norway, Denmark, Holland, and the Azores, but also a very notable gathering of British meteorologists. The muster at the meteorological breakfast, which was organised by Dr. H. R. Mill, was not less than sixty-two.

International Committee Meetings.

The meetings of the International Committee, under the presidency of Prof. Mascart, and of the Subcommittee for International Telegraphy, under the presidency of Prof. Pernter, were so arranged that the members could attend the meetings of the department. Several of them made communications to the section and took part in the discussions. The variety of language added to the interest of the proceedings, which were in gratifying contrast with the rather depressing occasions represented by the meteorology days as they used to be before the formation of a special subsection for cosmical physics.

Before going on to the work of the subsection, a word or two may be said about the work of the International Committees. First, for the subcommittee on weather telegraphy: its duty is to consider all matters which concern the efficiency of the arrangements for daily weather maps. In Europe these arrangements are of the most complicated character, and require the cooperation not only of a number of independent meteorological services, but also of an equal number of independent telegraphic services bringing messages, not as a rule from the centres of business, but from the most remote and exposed positions on the European coasts to the various central offices. The relations between

the several services are partly by way of exchange and partly by way of payment for services rendered, and complication is inevitable.

Considering the difficulties to be overcome, and the divergent interests of the different offices, the results already achieved, as represented in the weather maps of Europe, are a remarkable witness to the spirit and capacity with which the predecessors of the present committee have approached the subject. There are still some questions outstanding, for which a solution is obviously desirable, connected with the hours of observation and the time occupied in the transmission of the despatches. But questions of the observations and their transmission are so mixed up that they are as much matters for the telegraphic services as for the meteorological offices. Accordingly, the tendency of the committee, after prolonged consideration of many details, was towards a conference with the International Telegraphic Convention, and the work was devoted to formulating the questions which might be profitably raised in such a conference.

The International Committee itself is somewhat informal in its proceedings. It begins formally enough by recording changes in the personnel, which may have been already arranged by correspondence, and receiving reports from its Subcommittees. On this occasion these included, besides the report of the Telegraphic Subcommittee already mentioned, an important and final report from the Committee on cloud observations, the results of which were subsequently given to the Association by Prof. Hildebrandsson, and an account of the work of the Aëronautical Committee, of which results have been already published by the German Government, and which were also referred to subsequently in the proceedings of the section. To this was added, as a supplement, an account by M. Teisserenc de Bort of the Franco-Scandinavian aëronautical station in Jutland, established by him in 1902 with the cooperation of the meteorological authorities of Denmark, Sweden, and Norway. Other work in connection with the exploration of the upper air was mentioned.

The committee then went on to consider various proposals for the extension or improvement of observations, referred to the committee or made by individual members, among which were to be found proposals for the organisation of observations of atmospheric electricity referred by the Academy of Science of Saxony, the institution of regular observations of solar radiation, and various other matters of a more or less technical character; an account of these details will be given in the official report of the proceedings. An English translation of the report will be published as usual by the Meteorological Council.

Two important resolutions, one appointing a subcommittee to organise a committee for dealing with simultaneous solar and terrestrial changes, and the other directing the attention of the British Association to the inconveniences of the present practice of having different systems of units of measurement for meteorological observations, are referred to later on.

At the close of the meeting of the committee, at which a cordial vote of thanks was passed to the Mayor and Corporation of Southport for the use of the committee room of the Town Hall for the meetings, the following future international assemblies were announced:—In 1904, a meeting of the subcommittee for terrestrial magnetism at Cambridge, and a meeting of the aëronautical subcommittee at St. Petersburg; in 1905 a conference of directors of meteorological offices and observatories at Innsbrück.

Meetings of the Department for Astronomy and Meteorology.

Meetings of the subsection of the Association devoted to astronomy and meteorology were held on Friday, September 11, and the following Monday, Tuesday, and Wednesday. During part of the session of Monday and on Tuesday meetings of the remainder of the section were held, simultaneously with those of the department, for the discussion of papers on mathematics and physics.

The proceedings on September 11 commenced with the chairman's address, which has already been printed in these columns. Arising out of a vote of thanks proposed by Prof. Schuster, there came what may prove to be an important suggestion, that the time has now arrived when meteorologists of all countries should adopt a uniform system for the measurements of pressure and temperature. Those quantities have certainly been measured long enough for men of science to be able to agree as to what is the most scientific and the most practical way of expressing them. The result of Prof. Schuster's suggestion appeared first as a communication from the International Committee, and subsequently as a resolution upon the subject by the General Committee of the Association. The address was followed by a discussion of simultaneous solar and terrestrial changes, introduced by the president of the Association, Sir Norman Lockyer, in a paper which gave a short account of the history of the various measurements that have been made bearing upon the subject. In association with this paper, a paper by Dr. Buchan on the distribution of rainfall in Scotland in relation to the sun-spot period was taken, and a general discussion followed, in which Dr. Hellmann, of Berlin, referred to the work done in Germany upon the subject, and Father Cortie, of Stonyhurst, opposed the view that the connection between solar prominences and terrestrial phenomena is directly one of cause and effect. When the subject was subsequently considered by the International Meteorological Committee, a subcommittee was appointed to carry on its further development. The original members named are Mr. Shaw, Prof. Pernter, Sir Norman Lockyer, Prof. Langley, and M. Angot. Upon these now devolves the duty of organising the subcommittee for the furtherance of the object in view. After the discussion, M. Teisserenc de Bort read a paper in French, "Sur les dépressions barométriques," in which he traced in detail the vertical structure of barometric depressions as determined by observations of the upper air. In the afternoon Messrs. Grossmann and Lomas exhibited some interesting pictures illustrating the origin and forms of hoar frost obtained in a refrigerating chamber.

On Monday, September 14, the proceedings opened with a paper in German by Prof. Pernter, of the Austrian Meteorological Office, upon the use of the hair hygrometer in place of the psychrometer for purposes of ordinary observations of humidity. The contention of the paper was that both instruments required empirical graduation, and that if the same trouble were devoted to the empirical graduation and management of the hair hygrometer as is now required for the psychrometer, the results would be more satisfactory. Prof. Pernter exhibited a specimen of the instrument in which no pulley was used, and one important cause of objection to the hair hygrometer was thus avoided. He also exhibited a very interesting photograph from the Sonnblick of a portion of a halo which had been predicted on theoretical grounds, but had never been observed before, as it is formed below the horizon line. Attention was next turned to astronomy by a paper of Prof. Turner's on the question, "Was the new star in Gemini shining previously as a very faint star?" On photographs of the region taken by Dr. Max Wolf at Heidelberg and by Mr. Parkhurst at Yerkes, a faint star is shown very near the place of the Nova; but the evidence was on the whole against identity, and this conclusion was confirmed by a letter from Prof. Barnard, received on the morning of the meeting, announcing that he had observed the faint star shining beside the Nova. The subsection then reverted to meteorology, and listened to a very important paper by Prof. Hildebrandsson, of Upsala, upon the results of the international cloud observations and their effect upon the general theory of the circulation of the atmosphere. Prof. Hildebrandsson first exhibited a reproduction of a drawing illustrating James Thomson's theory of the general circulation, which is practically similar to the scheme of general circulation adopted by Ferrel. He then showed a series of diagrams representing the motion of the upper atmosphere as determined by the motions of cirrus clouds deduced from cloud observations in all parts of the world. In some cases, also, the motion of the lower clouds was given. The general system of circulation thus established was shown to differ in most important particulars from the calculated circulation of Thomson and Ferrel. In the discussion an interesting point was raised by Prof. Hergesell as to the extent to which the motion of air could be inferred from the motion of clouds, clouds only being formed in certain states of the atmosphere; but the question was not solved.

The subject of kite observations and the general investigation of the upper atmosphere was then taken up. It was introduced by Mr. Dines, who gave an account of the work of the kite committee of the Association and of the difficulties met with in carrying out the continuation of the observations in the summer of this year off the west coast of Scotland. Dr. A. L. Rotch followed with an account of the kite observations at Blue Hill in the years 1900–2, and Prof. Hergesell added an account, for the most part in German, of the work of the International Aëronautical Committee. He concluded in English with an eloquent appeal to the science of this country to take a part in this important investigation. The three papers mentioned were followed by a general discussion, which had not concluded when the morning sitting of the section was adjourned. It was accordingly postponed until the following day, and then continued by Profs. Schuster, Turner, and M. Teisserenc de Bort. The matter was subsequently brought before the committee of Section A, and at their instance the General Committee at their final meeting adopted a resolution urging the council to take steps to secure the means of joining this international enterprise. The papers in the afternoon were one on photographs of the Orion nebula, by Mr. W. E. Wilson, showing what could be done by screening to bring out in a positive detail of the central overexposed regions of the negative, while preserving the faint extensions; on the spectra of lightning, by Dr. W. J. S. Lockyer, which formed a suitable companion to the author's fine collection of photographs of lightning in the meteorological exhibition, and which was further elucidated by a photographic spectrum of lightning from Yerkes Observatory; and also a paper by Mr. D. Burns, attributing some of the unexplained phenomena accompanying volcanic eruptions in the West Indies to electrical action.

On Tuesday, September 15, Prof. Milne, whose ill-health during the meeting of the Association unfortunately prevented his taking much part in the proceedings, read the report of the seismological committee, and gave an account of his conclusions on the present state and properties of the interior of the earth. That was followed by a number of astronomical papers. Prof. Hale sent from the Yerkes Observatory a series of very fine photographs made with the new Rumford spectro-heliograph mounted on the 40-inch refractor. By setting the slit in different parts of the K line he is able to photograph the distribution of calcium vapour at successive heights above the photosphere, and to show how the calcium "flocculi" expand as they rise and spread out over the spots. He announced also the existence of *dark* hydrogen flocculi and of occasional dark calcium flocculi. Prof. Schuster contributed a very important paper on radiation from a foggy atmosphere, finding in the "scattering" of light by molecules an explanation of the fact that a star may show the hydrogen series partly bright and partly dark. A paper by Prof. Sampson announced some of the results of the eclipse observations of Jupiter's satellites upon which he is now engaged; and one by Father Cortie on solar prominences and terrestrial magnetism went to show that no direct relation in detail could be traced between individual prominence outbursts on the sun and terrestrial magnetic storms. The conclusion was that both depend on some deep-seated common cause, and not directly one upon the other. There followed a paper by Dr. Paulsen, of Copenhagen, in which the spectrum of nitrogen was compared with the spectrum of the aurora obtained by long exposure in the Arctic night of Iceland. Dr. Buchan gave an account of the results of an investigation of the variation of temperature in the water of the Levant, which regularly gains temperature during one part of the day and loses it all again within the twenty-four hours. This gain and loss Dr Buchan attributed to the effect of absorption and radiation. The decision between that hypothesis and the alternative suggested by Mr. J. Aitken, that it might be accounted for by convection, was left as an attractive subject for further consideration.

The work of the day concluded with some magnetic papers, Prof. Schuster reading for Dr. Bauer, first an account of the progress of the magnetic survey of the United States, and secondly an attempt to compute the secular variation of the earth's total magnetic energy. The report of the committee of the Falmouth Observatory, to which the Association is giving a liberal subsidy, in order to maintain a self-recording station free from the electrical interference which has destroyed the usefulness of the Kew observations, until a new national magnetic observatory is established, was merely formal.

The subsection continued its labours up to the end of the available time of the Association. On Wednesday, Dr. W. J. S. Lockyer read a paper on the relation between prominences, sun-spots, and coronæ. Dr. Buchan produced the twenty-first report of the committee on Ben Nevis Observatory, which concluded with a summary of the results as bearing on forecasting. Prof. Callendar gave an account of the electrical self-recording instruments designed by himself, and pointed out their advantages over those in general use. There are so many points in connection with the practical use of self-recording instruments to which it is desirable that attention should be directed that it is to be regretted that the limited time of the section did not permit more extended discussion of the general question. Dr. A. L. Rotch gave an account of the results of his experiments at Blue Hill upon the effect of meteorological conditions upon the audibility of sounds between a high-level and low-level station. The results were of a negative character on the whole; no specific effect could be attributed to differences of meteorological condition. The business concluded with a paper by Dr. Mill on some rainfall problems, in which he discussed some practical difficulties arising in the construction of accurate rainfall maps. The usual vote of thanks concluded the proceedings.

Exhibition of Objects of Interest in Meteorology, Terrestrial Magnetism, &c.

In connection with the meeting of the International Committee, an exhibition of objects of interest in meteorology and allied subjects, terrestrial magnetism, solar physics, seismology, &c., was organised. The preliminary arrangements were made by a committee which met at the Meteorological Office, and consisted of representatives of the Meteorological Council, the Royal Meteorological Society, the Scottish Meteorological Society, the president of the Association, the Astronomer Royal, the director of the National Physical Laboratory, and a number of others interested in the subjects represented. The result was the collection of a large number of very interesting exhibits from the following exhibitors:—

The Admiralty, Hydrographic Department, magnetic apparatus; the Astronomer Royal, historical instruments, magnetic and meteorological records; the Meteorological Council, books, maps, diagrams and automatic records; the National Physical Laboratory, Kew Observatory, McLeod's sunshine recorder, cloud apparatus and photographs, records and diagrams illustrating meteorology, magnetism and seismology; Prof. A. A. Rambaut, Radcliffe Observatory, barograms showing disturbances due to volcanic eruptions, and diagrams of the results of earth temperature measurements; the Royal Meteorological Society, Glaisher's balloon apparatus and other objects of historic interest; the Scottish Meteorological Society, photographs of Ben Nevis and special rainfall maps; Sir Norman Lockyer, F.R.S., Solar Physics Observatory, diagrams of solar phenomena and of the secular variation of pressure in different parts of the earth; M. Teisserenc de Bort, records of unmanned balloon ascents etched on metal sheets; Mr. John Aitken, F.R.S., dust counters and koniscope, with a map exhibiting some results obtained, and an apparatus illustrating certain phenomena of cyclonic storms; Mr. J. Baxendell, new self-recording apparatus for temperature and for wind direction combined with wind force, diagrams and records from the Fernley Observatory, Southport; Mr. F. F. Blackman, apparatus for demonstrating and measuring the evaporation of water from the leaves of growing plants; Mr. F. J. Brodie, diagram of gales; Dr. Buchan, F.R.S., meteorological atlas; the Cambridge Scientific Instrument Company, Callendar recorders for temperature and sunshine, and Blakesley's portable barometer; Captain E. W. Creak, R.N., C.B., F.R.S., magnetic charts; Mr. W. H. Dines, tornado cloud apparatus and kite records; Mr. F. L. Halliwell, new self-recording rain gauges; Mr. F. W. Harmer, diagrams of suggested isobaric distributions in the Glacial

epoch; Mr. J. J. Hicks, various apparatus, including a standard thermometer without any error shown in the Kew table of corrections between 32° and 212°; Dr. W. J. S. Lockyer, photographs of lightning and of the spectrum of lightning; Dr. H. R. Mill, rainfall maps; Mr. R. W. Munro, new pressure plate anemometer by Dines; Messrs. Newton and Co., altimeter; Prof. J. M. Pernter, new self-registering electrometer and anemometer, also hair hygrometer and photometeorometer; Mr. A. Lawrence Rotch, instrument for determining the velocity of wind at sea, kite investigation exhibits, photographs of high-level stations and of the figures of the winds from the Horologium at Athens; Dr. R. H. Scott, F.R.S., Russian climatological atlas; Dr. W. N. Shaw, F.R.S., Galton's "Meteorographica" and other historical exhibits, lantern slides, apparatus and diagrams illustrating the motion of air in circular storms, and apparatus illustrating the circumstances of the formation of cloud in free air; Prof. F. T. Trouton, F.R.S., gravimetric recording hygrometer, and an electrical dew-point hygrometer; Mr. C. T. R. Wilson, F.R.S., experiments on ionisation; Commander Wilson-Barker, R.N.R., cloud studies—photographs; Dr. W. Mansergh Varley, for Mr. P. Y. Alexander, *ballons sondes* records; Mr. A. Lander, new sunshine recorder, anemometer, and thermograph.

It is difficult to particularise in a short notice the exhibits which deserved or those which received the greatest attention. Not the least interesting was the one representative of the connection of meteorology with botany, exhibited by Mr. Blackman, an apparatus which showed the rate at which water evaporated from the leaves of the branch of a tree. From the point of view of meteorology, probably the most important exhibits were the comparatively inconspicuous sheets of metal or paper on which were recorded the results of balloon or kite ascents by M. Teisserenc de Bort, Mr. Rotch, Mr. Dines, and Dr. Varley, one of the records exhibited by the last-named gentleman extending to the height of 70,000 feet. The opportunity of seeing the working of Mr. Aitken's dust counters, Mr. Wilson's experiments on the effect of the electric field upon condensation of water particles, with other noteworthy experiments, the collection of weather maps of all countries, of magnetic apparatus old and new, and of the diagrams bringing together the results of observations from all parts of the world, will probably remain among the most satisfactory recollections of the meeting in Southport. The local exhibits by Mr. Baxendell, of the remarkably well equipped Fernley Observatory, and his assistant, Mr. Halliwell, were admirable examples of the best kind of progress in meteorological instrument making, and a word ought to be said for Mr. Lander, of Canterbury, who exhibited some self-recording instruments of his own construction, among others a sunshine recorder which keeps the record of sunshine for a month on a half-plate sheet of photographic paper.

An interesting exhibit, which could not be confined to the four walls of a building, was a specimen of the mortars used in southern Europe for bombarding the clouds, as described in the columns of NATURE, vol. lxiv. p. 159. The apparatus was brought and exhibited by Prof. Pernter, being placed at his disposal by the makers for the demonstration of the remarkable vortex rings which are produced by the discharge of the mortar, which is provided with a large funnel-shaped attachment. The discharges were directed horizontally, and though the rings did not carry smoke enough, as a rule, to be easily followed by eye, some of them showed their structure and others could be heard hurtling along the promenade for a considerable distance.

Finally, mention should be made of the arrangement carried out in connection with the exhibition by the Meteorological Council for the preparation at Southport of a weather chart of north-west Europe with remarks and forecasts in the same manner as those of the daily weather report of the Meteorological Office. For this purpose the reports of observations received in London were sent on by telegraph to Southport, and there charted and dealt with; the evening information of which account has always to be taken in preparing morning forecasts was sent by post and charted in readiness for the arrival of the telegrams.

A special feature of the Southport edition was found in maps of the distribution of maximum and minimum temperatures, sunshine and rainfall for the previous twenty-four hours, which replaced the three supplementary maps of the daily weather report.

The primary object of the arrangement was to enable the members of the British Association to examine for themselves the method adopted by the Meteorological Council for dealing with daily weather information, but it was also an experiment by which one can estimate the conditions necessary for carrying out a system of distributing telegraphic information to local centres to be there dealt with independently of, but in association with, a central office. At present in this country there is only one centre for the preparation of reports and forecasts, although the local conditions of the three kingdoms are very complex. The trial of the preparation of independent reports from the same data is therefore of more than temporary interest.

In the chapter of accidents it came about that the Southport week exhibited remarkably typical examples of British weather, including the rapidly travelling circular storm of September 10, with accompanying heavy rainfall, and the persistent anti-cyclone of the following week, with its autumnal mornings and atmospheric effects. Unfortunately all the types were cold, and the visitors from over sea were more impressed with the meteorological interest of the week's weather than with its geniality. The series of maps remains a very interesting group of specimens for weather study.

W. N. SHAW.

ARCHÆOLOGY OF THE COAST OF NORTH-WEST FLORIDA.[1]

MR. CLARENCE B. MOORE has concluded his thorough archæological survey of the coast-line of north-west Florida. Although this district had not previously been investigated, many mounds had been opened by treasure seekers and curiosity hunters, and thus valuable data have been lost to the students of American archæology. This irresponsible exploitation of mounds for spoil has caused great loss to science in America, but the loss in the Old World has been infinitely greater, and too often this ignorant digging has been carried on under the auspices of "learned" institutions.

By far the greater portion of Mr. Moore's finds consists of pottery which has been added to the noble collection that this enthusiastic archæologist has given to the museum of the Academy of Natural Sciences at Philadelphia. Indeed, there are in the various museums of the United States enormous collections of pre-Columbian and more recent pottery, comparatively little of which has been studied or published. It is to be hoped that ere long one of our American colleagues will give us a monograph on American ceramics as a whole; a work on this subject is much needed at the present day, and it could not fail to be of very great interest.

There is so much variety in the vessels so numerously and beautifully figured by Mr. Moore that it is difficult to give an idea of the pottery of the district investigated. Many vessels are composed of several cups or receptacles, most are of irregular form and are often provided with animals' heads, a few are perforated, and some are in the form of human effigies; a unique vessel has the form of an inverted truncated pyramid, on one side of which a human figure peering over the edge is modelled in relief. The majority of the vessels are decorated in various ways, usually either by incised lines or by devices or patterns in low relief, many of which look as if they had been produced with a stamp; one simple cylindrical vessel is ornamented with an incised design representing two human hands, but most of the designs and patterns have no obvious significance.

A good many human crania have been found, and these exhibit great antero-posterior flattening, while in some a concave depression gives evidence of early constriction by a band. Captain Bernard Romans, who was familiar with

[1] "Certain Aboriginal Remains of the North-west Florida Coast." Part ii. By Clarence B. Moore. (*Journal* of the Academy of Natural Sciences of Philadelphia, 2nd series, vol. xii., part ii., 1902.)

this part of Florida, writing in the latter part of the eighteenth century, tells us that in his time the Choctaws bound bags of sand to the heads of male children; but skulls of females exhibit the same artificial deformation.

The region investigated by Mr. Moore shows in an interesting manner the influence of other districts. The pottery of north-west Florida is, on the whole, much superior to that of the peninsula, and the author is inclined to believe that the best ware found its way into the latter region through barter, and the comparative rarity of the imported ware may account for the infrequent occurrence of earthenware vessels in the burial mounds of the coast of the peninsula.

In the first part of the report (*Journal* Acad. Nat. Sci., Phila., xi., 1901, p. 439) Mr. Moore noted a mortuary custom prevailing in peninsular Florida, which consisted of knocking a hole in the base of a vessel, presumably to "kill" the pot, that its soul might accompany that of the dead man. The flimsy and "freak" pottery sometimes found in the peninsula, and numerously in the north-west, was made expressly for interment with the dead, and in the base of each vessel a hole had been made previous to the baking of the clay. A new feature in "freak" ware was encountered about St. Andrew's Bay; these vessels

FIG. 1.—Perforated mortuary vessel from St. Andrew's Bay, Florida.

were life-forms, usually, but differed from other life-forms of the same district in that they were inferior to them as to ware and workmanship, and that they had various perforations, made previous to baking, in the body of the vessel as well as the customary one in the base.

Mr. Moore also obtained evidence which suggests that the flesh was removed from the bones of the corpses and burnt; the mass of carbonaceous matter was always found on the eastern side of the mounds. Urn burial was largely in vogue in Alabama and Georgia; it extended into Florida, but practically is not met with further east than St. Andrew's. Inhumation was almost universally practised in Florida; true cremation has not been met with in the peninsula, but it was occasionally practised on the mainland, or north-western portion. These observations confirm the statement of Cabeça de Vaca, who spent some years among the aborigines of the north-west Florida coast; he says that persons there in general were buried, but that doctors were cremated. Mr. Moore is to be warmly congratulated on having brought his labours to so successful a termination, and the Philadelphia Academy of Natural Sciences is fortunate in possessing so liberal a benefactor. It is to be hoped that these instructive collections will be suitably and worthily displayed. A. C. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In accordance with general expectation, Dr. J. N. Langley, F.R.S., has been elected professor of physiology in succession to Sir Michael Foster, K.C.B., F.R.S.

Dr. A. Hill has been reappointed university lecturer in advanced human anatomy. Dr. A. C. Ingle has been appointed university lecturer in midwifery. Mr. J. de Gruchy Gaudin has been appointed a governor of the University College of North Wales, Bangor.

An Allen studentship of the value of 250*l.* for one year, for research in any branch of study connected with medicine, mathematics, physics and chemistry, biology and geology, or moral science, will be vacant next term. Candidates must be graduates of the university and not more than twenty-eight years of age.

Mr. Newall will lecture next week on Hale's recent investigations of the sun's surface, with illustrations obtained from Prof. Hale, of the Yerkes Observatory.

The State Medicine Syndicate reports that during the present year eighty-eight candidates have presented themselves for examination in sanitary science. Forty-one were successful in obtaining the university diploma in public health.

Sir Walter Gilbey has been appointed an additional member of the board of agricultural studies.

A syndicate is to be appointed "to consider what changes, if any, are desirable in the studies, teaching, and examinations of the university, to confer with any persons or bodies, and to submit a report or reports to the Senate before the end of the Easter term, 1904." The members proposed are the Vice-Chancellor, Sir R. C. Jebb, Dr. A. W. Ward, Mr. Austen Leigh, Mr. W. Chawner, Dr. D. MacAlister, Prof. A. R. Forsyth, Dr. J. N. Keynes, Prof. J. J. Thomson, Mr. R. S. Parry, Mr. J. W. Cartmell, Mr. W. Durnford, and Mr. W. Bateson. It is understood that one of the first questions to be considered will be that of "compulsory Greek."

THE War Office has sanctioned the provision of a guard of honour on the occasion of the visit of Lord Kelvin to Cardiff to receive an honorary degree from the University of Wales.

THE Commissioners for the Exhibition of 1851 have offered a nomination for an 1851 science exhibition to the South African College, Cape Town, for 1904, and hope to repeat the offer in 1906 and subsequent alternate years.

DR. C. S. MYERS has been elected to the lectureship on experimental psychology at King's College, London, rendered vacant by the resignation of Dr. W. G. Smith, who has been appointed to a similar post at the University of Liverpool.

THE Prince and Princess of Wales will visit the Battersea Polytechnic on Wednesday, February 24, for the annual distribution of prizes to evening students and the formal opening of a new block of buildings in the women's department.

AT the half-yearly meeting of the governors of the University College of North Wales, held on October 28, the chairman stated that in all probability 5000*l.* would be received from the trustees of the late Dr. Evan Thomas, and that it had been decided to allot that sum to the new building fund.

A NEW Royal college at Posen was opened on November 4 by Herr Studt, the German Minister of Education. Herr Studt, in declaring the building open, referred to the Emperor's deep interest in the education of eastern Germany, to which the new college largely owed its existence. The new foundation was to be a university in the true sense, he continued, for it would serve the needs of all the population, including even that section of the Poles which still held aloof.

THE civic inauguration of the University of Liverpool took place on November 7 in St. George's Hall, Liverpool. The Lord Mayor of Liverpool presented the charter of the university to the Chancellor, remarking that no one had

done more than Lord Derby to further the movement for the establishment of the university. Lord Derby, on accepting the charter, said they could now hope that the new university would become the centre of learning of a great, active, industrious, and well-employed population. Sir Oliver Lodge, who took part in the proceedings, remarked in the course of a speech that something substantial must be done for higher education. Hitherto the country had been content to leave this to private munificence, and private munificence had done well, but unaided it was unequal to the burden. He trusted it was not impolitic for him to say, without regard to party questions, that he regretted that a registration duty which was doing no harm, and was hardly a subject of controversy, should have been flippantly thrown away when no longer needed for the Exchequer, instead of being ear-marked for higher education. That amount would have been sufficient to put the education of the country on a sound, thorough, and, indeed, magnificent basis, and would have enabled them to hold up their heads once more amongst the educated nations of the world. Referring to local support, Sir Oliver Lodge expressed the hope that whatever aid was given by the municipality, they would not abolish fees. It was only just, right, and natural that those who specially utilised the institution should make special contributions to it, but by all means they ought to provide scholarships for unmoneyed ability. His advice was that the scholarships should be provided as little as possible on the basis of competitive examination and as much as possible on the basis of nomination from schools and institutions to which the scholarships were assigned.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"On the Magnetic Expansion of the Less Magnetic Metals." By P. E. **Shaw**, B.A., D.Sc. Communicated by Prof. J. H. Poynting, F.R.S.

Research has been made by various observers, notably Nagaoka and S. Bidwell, on the relation between field (H) and expansion per unit length ($\delta l/l$) resulting from that field of the metals iron, nickel and cobalt. Bismuth also has been tested, but the consensus of opinion is that it shows no expansion under any field so far applied to it. Outside the ferromagnetic group bismuth has the largest susceptibility (k) of any substance, and the tacit assumption seems to have been made that if bismuth shows no expansion, it is vain to look for it in less susceptible metals. But there is no direct relation between k and $\delta l/l$; iron has maximum k six times as much as nickel, and yet expands far less than it for any known field, and so on.

It seems possible, therefore, that there may be appreciable movement for large fields in the case of metals other than the ferromagnetics. This paper gives an account of tests applied to specimens of bismuth, silver, aluminium, copper, zinc, brass, bronze, lead and tin. It is very difficult in working with large fields to avoid movements due to induction and attraction of iron (if any) in the apparatus, or to solenoidal suction or to a straining of the magnetising coil to set itself in the earth's field. These movements are small, but the apparatus is very sensitive, as it measures any movement more than 4×10^{-9} of the length of the specimen (19 cm.). The measuring instrument was the electric micrometer. By great care and repeated change in the arrangement these sources of error were eliminated, and it was found that no movement (more than the amount stated), positive or negative, occurs for any field up to the large one of 1900 C.G.S. No previous tests have been applied to any of these metals except bismuth. Bidwell has tested this metal with a field of 1500 C.G.S., and with a measuring apparatus which would show a movement of $1\cdot4\times10^{-8}$ of the length of the specimen, yet no movement was found. No other test has been so searching as the above. This definite negative conclusion involves two corollaries. (*a*) It is generally supposed that the small impurity of iron occurring in commercial pure metals would produce expansion on its own account which would mask any small expansion of the metal, but these experiments show no such expansion, and do not confirm the simple superposition theory. (*b*) The Maxwell strain $B^2/8\pi M$ cannot exist in the material rods tried, or it would have been easily detected, so we have fresh evidence that there is no mechanical connection, unless an extremely weak one, between matter and ether.

A note is appended to the paper in which Mr. G. A. Schott calculates the correction factor which must be applied to the ordinary expression for field $H=4\pi n\gamma$, when the field is taken over the whole length of the coil used.

Royal Society.—"The Maximum Order of an Irreducible Covariant of a System of Binary Forms." By A. **Young.** Communicated by Major P. A. MacMahon, D.Sc., F.R.S. Received September 26.

CAMBRIDGE.

Philosophical Society, October 26.—Dr. Baker, president, in the chair.—On nutrition and sex determination in man, by Mr. R. C. **Punnett.** Making use mainly of the London census of 1901, the author showed that if the various boroughs were divided into three groups of increasing poverty, the proportion of male to female births was least in the poorest and greatest in the wealthiest of these groups—in other words, the better the nutrition the greater the proportion of male births. It was shown, however, that there are certain factors, *e.g.* infant mortality, birth rate, and marriage age, which influence the above three groups unequally. When allowance is made for these factors it is likely that the proportion of the sexes produced in each group would be nearly identical, from which was inferred the improbability of different conditions of nutrition affecting sex determination in man.—Note on the action of radium rays and light on mercurous sulphate, by Mr. S. **Skinner.**—Note on the pulverisation of *nickel grains* in fuming nitric acid, by Dr. W. A. **Hollis.**—On the specific heat of gaseous carbon dioxide at high pressures under constant volume, by Mr. W. A. D. **Rudge.**—On some minerals from the Binnenthal, Switzerland, by Mr. R. H. **Solly.**—(1) The theory of the multiple gamma function; (2) the asymptotic expansion of integral functions of multiple linear sequence, by the Rev. E. W. **Barnes.**—The expression of the double zeta function and double gamma function in terms of elliptic functions, by Mr. G. H. **Hardy.**—On the kinetic theory of matter, by Mr. H. C. **Pocklington.**

PARIS.

Academy of Sciences, November 2.—M. Albert Gaudry in the chair.—On the non-regeneration of the spheridia in the sea-urchin, by M. Yves **Delage.** The experimental results described are in opposition to the hypothesis that the spheridia are the organs of equilibrium, since the removal of them does not permanently affect the powers of locomotion. Immediately after the removal of the spheridia the sea-urchins turn with more difficulty, but after some time it is impossible to distinguish them from others in this respect. This is not due to the regeneration of the spheridia, as there is no sign of them reappearing, three months after the operation.—Remarks on a communication of M. Raphael Dubois of October 19 last, by M. Edm. **Perrier.** Filippi was the first to state in 1852 that pearls were due to the presence of a parasite in the oyster, but his views were strongly contested. The results of the experiments of M. R. Dubois support this theory, and further confirmation is supplied from the laboratory of Rikitea.—Note by M. **Appell** on the second volume of his "Traité de Mécanique rationnelle."—On new effects produced by the *n*-rays; generalisation of the phenomena originally observed, by M. R. **Blondlot.** The *n*-rays are rays given off by various sources of light, capable of passing through an aluminium screen, and recognisable by their action upon a small electric spark or upon a feebly phosphorescent screen. It has now been found that these rays cause a slight but distinct increase in the luminosity of a feebly illuminated paper screen, and this effect is retained by the rays after reflection at a polished metallic surface.—On the virtual sugar of the blood, by MM. R. **Lépine** and **Boulud.** The carbohydrate present in the blood, measured by its reducing power and expressed as glucose, is frequently more abundant in the blood from the right ventricle than in arterial blood, and this contains more than blood from the veins.—The influence of mineral food upon the production of the sexes in dicœceous plants, by M. Émile **Laurent.**—On left-handed

curves of constant torsion, by M. W. **de Tannenberg.**—On the determination of singular classes of Taylor's series, by M. Émile **Borel.**—On some points in the theory of *ensembles*, by M. Ernst **Lindelöf.**—On the relation between the pressure and the rate of chronometers, by M. Paul **Ditisheim.** It has been found that the variations in the rate are proportional to the differences in the pressure of the air. The action increases as the balance wheel is diminished, but tends towards a limit when the wheel is very small.—Remarks on the preceding paper, by M. Ch.-Éd. **Guillaume.** The effect produced would appear to be due to a small mass of air carried round with the balance wheel.—On the magnetic storm of October 31, by M. Th. **Moureaux.** The extreme amplitude of the variation is 0·0068 C.G.S. units for the horizontal component, and 0·0052 for the vertical component, numbers corresponding to 1/29 and 1/81 of the absolute values of these components.—On a variety of filiform carbon, by MM. **Constant** and Henri **Pélabon.** This form of carbon is formed from heavy hydrocarbons by the action of a very high temperature. It is attacked by fuming nitric acid and potassium chlorate.—On the separation and estimation of iron and phosphoric acid in water, by M. H. **Causse.**—On a method of synthesis of symmetrical dihalogen derivatives of benzophenone, by M. F. **Bodroux.** *p*-Dibromo-benzene treated with magnesium in the presence of dry ether gives $BrC_6H_4.Mg.Br$, and this with carbon dioxide gives a substituted benzoic acid and a ketone. Further examination of the latter has shown it to be symmetrical di-*p*-bromophenyl-ketone. At a very low temperature the acid is the chief product, the proportion of ketone produced increasing with the temperature.—The application of pyridine to the preparation of some amides, by M. P. **Freundler.**—On the use of magnesium amalgam in organic chemistry, by M. Louis **Meunier.** Details of the preparation of diphenylmethane and ethyl derivatives of malonic esters are given.—On ortho-toluic aldehyde, by M. H. **Fournier.** This aldehyde is prepared in the pure state by the oxidation of the corresponding alcohol.—On the coagulation of starch, by MM. J. **Wolf** and A. **Fernbach.**—The olfactory sense of the snail (*Helix pomatia*), by M. Émile **Yung.** The sense of smell is, as a rule, limited to a distance of 2 to 3 cm.—The osmotic regulation of the internal liquids in Echinoderms, by MM. Victor **Henri** and S. **Lalou.** The results show that all the membranes which separate the internal fluids of the sea-urchins from the external liquid are semi-permeable.—On the fatty materials and the acidity of flour, by M. **Balland.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 12.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—On Sequences of Sets of Intervals containing a Given Set of Points: W. H. Young.—On Spherical Curves: H. Hilton.—On the Weddle Quartic Surface: Dr. H. F. Baker.—A Formal Generalisation of Maclaurin's Theorem: Rev. F. H. Jackson.—Diffraction: W. H. Jackson.—A General Theorem concerning Absolutely Convergent Series: G. H. Hardy.—Note on Borgnet's Method of Dividing an Angle in an Arbitrary Ratio: Prof. J. D. Everett.—On an Expression of the Electromagnetic Field by Means of Two Scalar Potential Functions: E. T. Whittaker.—The Propagation of Wave-motion in an Isotropic Elastic Solid Medium: Prof. A. E. H. Love.—Notes on Quaternions, including a Simple Construction for $Va\beta\gamma$: Prof. R. W. Genese.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address by the President, Mr. Robert Kaye Gray.

FRIDAY, NOVEMBER 13.

PHYSICAL SOCIETY, at 8.—(1) Means for Electrifying the Atmosphere on a Large Scale: (2) an Arrangement for driving Mercury Pumps: Sir Oliver J. Lodge and Benjamin Davies.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of Mars in 1903: Rev. T. E. R. Phillips.—Observations of Variable Stars; edited by H. H. Turner: Sir C. E. Peek (the late).—Ephemeris for Physical Observations of the Moon, 1904: A. C. D. Crommelin.—Results of Double Star Measures, 1902: J. Tebbutt.—Systematic Proper Motions of Bright Stars relatively to Faint Stars in the Oxford Zones (+25° to +31°): H. H. Turner.—Measures of Southern Double Stars, 1902–3: J. L. Scott.—Observations of Borrelly's Comet (*c* 1903): Natal Observatory.—Remarks on a Paper by Mr. Cooke on a New Method of Determining Time, Latitude and Azimuth: E. B. H. Wade.—Preliminary Note on the Effect of the Direction of Gravity on Lunar Observations: E. B. H. Wade.—A Spectrographic Study of β Librae: Rev. W. Sidgreaves.—Observations of White Spots on Saturn: A. S. Williams.—*Promised Papers*:—Note on a Method of Photographing the Moon and surrounding Stars: H. H. Turner.—Errors in the Moon's Tabular Longitude from 1750: P. H. Cowell.—On the Large Sun-spots of 1903 October and November, and Associated Magnetic Disturbances. Communicated by the Astronomer Royal: Royal Observatory, Greenwich.—Note on Photographs of Comet *c* 1903 (Borrelly). Communicated by the Astronomer Royal: Royal Observatory, Greenwich.

TUESDAY, NOVEMBER 17.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion of Paper on Tensile Tests of Mild Steel, and the Relation of Elongation to the Size of the Test-bar: Prof. W. C. Unwin, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Note upon the Tongue and Windpipe of the American Vultures, with Remarks on the Inter-relations of the Genera Sarcorhamphus, Gypagus and Cathartes: F. E. Beddard, F.R.S.—On the Mammals of Cyprus: Miss Dorothy M. A. Bate.—Report on the Fishes collected by Mr. Oscar Neumann and Baron Carlo von Erlanger in Gallaland and Southern Ethiopia: G. A. Boulenger, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.30.—Annual Presidential Address: Major Patrick G. Craigie, C.B.

MINERALOGICAL SOCIETY, at 8.—On Sartorite, Anatase, Galena and other Minerals from the Binnenthal: R. H. Solly.—On the Pleochroism of Adamite: L. J. Spencer.

WEDNESDAY, NOVEMBER 18.

CHEMICAL SOCIETY, at 5.30.—Constitution of Ethyl Cyanacetate. Condensation of Ethyl Cyanacetate with its Enolic Form: P. Remfry and J. F. Thorpe.—The Action of Water and Dilute Caustic Soda Solutions on Crystalline and Amorphous Arsenic: W. T. Cooke.—The Union of Carbon Monoxide and Oxygen, and the Drying of Gases by Cooling: A. F. Girvan.—Note on a Double Chloride of Molybdenum and Potassium: G. G. Henderson.—Simplification of Zeisel's Method for the Determination of Methoxy- and Ethoxy-Groups: W. H. Perkin, Senr.—The Action of Benzamidine on Olefine β-Diketones: S. Ruhemann.

GEOLOGICAL SOCIETY, at 8.—On the Occurrence of Edestus in the Coal-measures of Britain: E. T. Newton, F.R.S.—Notes on some Upper Jurassic Ammonites, with special reference to Specimens in the University Museum, Oxford: Miss Maud Healey.

SOCIETY OF ARTS, at 8.—Opening Address of the 150th Session: Sir William Abney, K.C.B., F.R.S., Vice-President and Chairman of the Council.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Great Dustfall of February 21 and 22, 1903, and its Origin: Dr. Hugh Robert Mill and R. G. K. Lempfert.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Miscroscopic Resolution: Prof. J. D. Everett, F.R.S.—The Mouth Parts in the Nemocera and their Relation to the other Families in Diptera: Walter Wesché.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—The Physiological Action and Antidotes of Colubrine and Viperine Snake Venoms: Dr. L. Rogers.—The Cell Structure of the Cyanophyceæ: H. Wager.—On the Rapidity of the Nervous Impulse in Tall and Short Individuals: Dr. N. H. Alcock.—Electrometer Records of Secreto-motor Changes: Dr. A. D. Waller, F.R.S.—On the Nematocysts of Aeolids: G. H. Grosvenor.

CONTENTS.

PAGE

The Scientific Work of the Imperial Institute. By C. Simmonds 25
Babylonian Demonology 26
Line Geometry. By J. H. G. 27
Our Book Shelf:—
Sheppard: "Geological Rambles in East Yorkshire" 27
Cordemoy: "Les Produits coloniaux d'Origine animale (Bibliothèque Coloniale)."—R. L. 28
Strasburger, Noll, Schenck, and Schimper: "A Text-Book of Botany" 28
Conn: "Bacteria in Milk and its Products."—Prof. R. T. Hewlett 28
Finn: "Junior Algebra Examination Papers" 28
Letters to the Editor:—
Hyksos-Hittites.—X. 29
Telegraphic Disturbances in Spain on October 31.—Prof. Augusto Arcimis 29
The November Leonids.—W. F. Denning 29
Leaf Decay and Autumn Tints.—Dr. P. Q. Keegan . 30
Variation of Atmospheric Absorption.—J. Talbot . . 30
Rocket Lightning.—Prof. J. D. Everett, F.R.S. . 30
Explosive Action of Lightning.—R. A. West . . . 31
The "Sky-coloured" Clouds.—T. W. Backhouse . 31
The Geology of Vanua Levu. (*Illustrated.*) By Prof. T. G. Bonney, F.R.S. 31
Electric Convection. 32
Notes 33
Our Astronomical Column:—
Revision of Rowland's Wave-lengths 37
Parallax of β Cassiopeiæ 38
Astronomy in Schools 38
Universities: Their Aims, Duties, and Ideals. By Prof. A. R. Forsyth, F.R.S. 38
Astronomy and Meteorology at the British Association. By Dr. W. N. Shaw, F.R.S. 42
Archæology of the Coast of North-west Florida. (*Illustrated.*) By A. C. H. 45
University and Educational Intelligence 46
Societies and Academies 47
Diary of Societies 48