THURSDAY, JULY 16, 1903.

THE UNIVERSITY IN THE MODERN STATE.

IV.

IN previous articles we have pointed out that the penuriousness of our national policy towards the Universities results in the worst form of extravagance, the waste of thought and effort through want of proper tools. Because we will not give more, even what we do give is robbed of its proper fruit. Few institutions could be found which illustrate this more clearly than the three colleges of the University of Wales, in spite of the active work which they are doing.

The earliest of their charters is barely twenty years old, and the University was only founded in 1895, yet they have within their walls some 800 matriculated students pursuing full degree courses, and, roughly speaking, as many more who are either preparing for external degrees or diplomas, like the medical students at Cardiff; or taking some university courses as a part of a professional curriculum, like most of the normal and many of the theological students at all three colleges. The total population of Wales amounts to only 1,700,000, so that a total of some 1500 students makes a proportion of nearly 9 in 10,000, as against nearly 5 in England, nearly 8 in Germany, and nearly 13 in America (see our article of May 14). This is strong evidence of the eagerness with which university education is sought in the Principality, and of the confidence felt in its colleges. And the soundness of their teaching as a whole is indicated both by the names that appear on the list of their teachers and by the successes won by their former students at older Universities and elsewhere.

What, then, is their need to-day? Why can they not continue the work they have begun?

For two reasons. First, because their achievements so far have been attained at too great a cost. The beginning of a new and promising national movement aroused among its first promoters a spirit of enthusiasm and self-sacrifice which has not, indeed, passed away, but which has been sobered by bitter lessons. Those who knew anything of the life of the late Principal Viriamu Jones know that he was literally killed by the burden of too heavy a task; and there have been several other cases of serious overstrain, though none have ended so tragically.

From facts before us it is clear that not merely the principals, but the heads of all the large departments in the colleges, feel that the difficulty of meeting the growing duties of the university without any increase in its endowments has reached an intolerable degree, that is to say, from the outsider's standpoint, it has become incompatible with real efficiency.

In the second place, the cost of university education has risen greatly since the colleges began their work. The developments in education which have taken place in cities like Liverpool and Birmingham—to mention these alone—have created a new demand for men fitted for professorial work; and conditions which twenty years ago, when the work of the colleges was lighter than it is now—and when the Civil Service drew no men from the Universities—were sufficient to attract young men of distinction, no longer seem so desirable.

Nearly all the English colleges have been steadily forced by competition to raise the terms they offer to their staff. We know of two or three instances in which stipends have been specially raised in order to secure some professor who was at the time in the service of a Welsh college.

Even from an English point of view it is clear that this implies that larger funds will have to be found if university education is to be maintained at an efficient level. But in Wales, where it is impossible to raise such funds on any adequate scale, the facts wear a more serious aspect. The colleges feel their needs in three directions, in teaching, in research, and in administration; all alike are unnaturally burdened by poverty. In regard to teaching, perhaps the worst case is that of subjects like geology, botany and economics, which in more than one college are represented only by lecturers; their remuneration varies, but is at best scarcely more than half the professorial stipend. In all the colleges, changes of staff are undesirably frequent.

It seems unkind to point out further that large branches of knowledge like chemistry and engineering, or, on the "Arts" side, English or philosophy, not to mention older subjects, have outgrown the power of any one man to teach properly. This fact has been recognised by wealthier colleges (especially in Germany and America), in which each of these subjects employs several professors.

In Wales, again, the later developments of university study, such as the different branches of commerce, are hardly represented at all.

Finally, under this head, we may observe that in no one of the colleges is there any provision for pensioning their teachers when they reach the limits of effective work, and it is clear that this will shortly become a serious question.

In research we must acknowledge how much good work has been done—the names of Principal Viriamu Jones and Prof. Gray (now of Glasgow) at once suggest themselves in the department of physics alone; and among the present members of the colleges there are men of distinction both in science and letters. But the difficulties they have had to face have always been serious, and of late years have grown greater rather than less.

For want of adequate endowments both the laboratories and the libraries have grown steadily poorer in proportion to the growing demands of study. In one of the colleges the total expenditure on the library for more than twenty subjects, including the cost of periodicals and binding, is some 150*l.* a year! Everyone knows the discouraging effect of finding that some instrument or book of which one is in pressing need is out of reach.

The long vacation, it is true, offers opportunities, but here, again, a man's powers of research are limited by financial conditions. Men who are hard at work examining through most of July and August will not produce a great deal of original work in Septem-

ber, and the administrative work of the colleges now continually intrudes even upon the long vacation. From a general point of view, however, such disabilities of members of the staff would be of less consequence if the younger members of the colleges, honours students, or graduates of promise could secure more favourable conditions. Unfortunately, it is only too obvious that where a professor's chances of conducting original work are meagre, those of his students will, as a rule, be more meagre still. And in spite of the zeal with which the University of Wales has striven to foster original research, in every subject, in the regulations for its higher degrees, it is clear that unless the colleges can be placed in a better position financially, these efforts are doomed to disappointment. In one of the colleges a recent gift of valuable, if not unique apparatus is lying unused, and must do, until funds are found to build and maintain a proper laboratory to contain it.

Thirdly, and perhaps chiefly, the colleges suffer from their present position on their administrative side.

Making bricks without straw is not merely a discouraging, but an extremely difficult operation, and in any institution which attempts it, in the long run the best wits of its staff will be those that are set to the task. The colleges are finding more and more that even their teaching day is honeycombed with business.

Nor is this all. Where money is scarce, the spending of it is apt to be attended with an amount of ceremony which is itself a burden. In one college we are told it needs a series of resolutions discussed by four or five bodies before a new charwoman can be engaged. There could not be a better illustration of the waste of time which poverty entails. All the colleges serve some eight or nine masters in the shape of outside public bodies, who maintain different classes of students, and the necessity of explaining and justifying points of educational policy to so large a number of different popular authorities is a very serious task. At every turn it is necessary to consider not merely what is the right course, but what is the best form in which to secure its adoption. That under such conditions the colleges should have been able to do anything at all is satisfactory evidence not only of the keen interest in the university which is taken generally by the public bodies of Wales, but also of the wisdom with which the colleges, especially their principals, have discharged their task. Whatever may be thought of the policy of a democratic basis for university education, it will be admitted that the burden of the arrangements ought not to fall upon those who are also responsible for the solid work of teaching. In Wales this is largely the case, and both the teaching and the policy of the colleges are likely in the end to suffer.

In the second article of this series (March 12) we saw that the great bulk of the endowments of the German universities was provided by the State, 81 per cent. of the total being so provided in Prussia, and 74 per cent. in Germany as a whole. Wales, happily or unhappily, possesses comparatively few men whose individual possessions could enable them to take part in endowing her colleges in any way commensurate with the need. Of the sums that have been raised for buildings, a great part has been collected, at the cost of healthy but disproportionate effort, from the shillings and pence of artisans and small farmers or traders. It is not surprising, therefore, to find that the colleges and the university depend already mainly upon public funds. The County Council grants to Cardiff and Aberystwyth must in fairness be counted as fees, not endowments, since they are given in return for teaching a definite class of students, and a change of policy in the local authorities might at any time modify or even divert their contributions. The figures are approximately[1] as follows, reckoning the interest on investments, as heretofore, at 2½ per cent., and including in the Government grants those devoted to special objects, such as agriculture, and the training of primary teachers.

Present Enaowment of University Education in Wales.

	Income from Private Endowments.	Income from Government Grants.
	£	£
University College, Aberystwyth	375	6000
University College, Bangor	1225	6000
University College, Cardiff	750[2]	5250
The University of Wales ...	—	4000
Totals	£2350	£21,250
Percentages	10	90

There is only one conclusion. In great cities like Liverpool and Manchester there is accumulated wealth and an accumulated tradition of culture to which their colleges have appealed with some success. In Wales the culture has been for centuries remote from university life, and the wealth, as we have seen, is non-existent. If, therefore, the Government wishes that the 21,000*l*. a year which it now spends in grants to the colleges and the University of Wales shall not be wasted, it is high time that it should face the question of what they really need.

In order to represent these needs in as concrete a form as possible, we have made inquiries as to the sums which, in the opinion of responsible persons at each college, would suffice to place them in a position to discharge their work with real efficiency. In each case we shall mention two capital sums, the one that required to construct or complete the buildings and equipment of the college, the other that required as an endowment for maintenance, the interest in this latter case being reckoned at 2½ per cent. Aberystwyth has from the first been the most fortunate of the three colleges in the matter of buildings, so that its needs under this head are smaller; similarly Bangor needs slightly less towards maintenance as being possessed of somewhat larger invested endowments, Cardiff and Aberystwyth having only very small possessions of this kind; trust-funds for scholarships are, of course, disregarded altogether in the estimate.

The figures assume that the present Government grants will continue, and under both heads state the

[1] The exact figures vary slightly from year to year.
[2] Including the annual grant of 350*l*. from the Drapers' Company for Engineering.

sums needed in addition to all the resources the colleges at present possess.

Funds needed for University Education in Wales.

	A. For Buildings and equipment.	B. For endowment.
	£	£
University College, Aberystwyth	99,800	1,071,500
University College, Bangor	176,500	960,400
University College, Cardiff	162,000	1,176,400
The University of Wales	—	288,400
Totals	£438,300	£3,496,700
Grand total	£3,935,000	

In round figures, therefore, we may say that university education in Wales needs an endowment of four millions sterling to secure its efficiency. This will not be thought an extravagant figure when it is remembered that the need of the Birmingham University was estimated at five millions, and that the Welsh colleges minister to the needs of a far more diverse population. The agriculture, the manufactures, the mining and the over-sea commerce of Wales all demand the enlightenment and intelligence which can only be developed in universities efficiently equipped for their work.

FORMOSA.

The Island of Formosa. By James W. Davidson, Consul of the United States for Formosa. Pp. 646+xxviii+46. (London and New York: Macmillan and Co., Ltd., 1903.) Price 25*s.* net.

CONSUL DAVIDSON'S work on Formosa is a heavy quarto volume of 700 pages, in which the liberal use of small type indicates that its author has tried to pack as much as possible within a given space.

It is not a lap book, but a book for the study table, in which 168 photographs and other pictures give of themselves a liberal education about things Formosan. A coloured frontispiece shows Mount Morrison capped with snow, 13,880 feet in height. This, which is one of the many peaks in the mountain ranges which form the backbone of Formosa, is the highest mountain in the Japanese Empire. Another illustration is that of sea cliffs on the eastern coast. These, which attain heights of 5000 to 6000 feet, are possibly the highest sea cliffs in the world. Orographic features with these magnitudes in an island about half the size of Scotland are certainly remarkable. From other pictures, in which are depicted generals, battles, dismantled forts, Chinese temples, the surrender of the Dutch to Koxinga, the torturing of Dutch by the Chinese, Japanese streets, tea houses and barracks, a Christian church, a police station, a meteorological observatory and railways, it may be inferred that, politically and socially, Formosa has had a chequered history.

The Chinese, who have known Formosa since A.D. 608, tell us that it was created by certain fierce dragons which glided out from the gates of Foochow, and lashed up the bed of the ocean until Formosa was created. The origin of this may rest on the fact that Formosa has, at least in part, resulted from volcanic activity, and in the Eastern mind such activities and dragons were in past ages closely associated. In the early Middle Ages the harbours of this island, which are almost entirely confined to its western shores, were used as clearing houses for trade between China and Japan, and also as homes for pirates. One princely freebooter who settled and married in Japan started life as a Chinese tailor. Before he died, by raids and intrigues he commanded 3000 sail, and was so powerful that he could not be opposed even by the Emperor of vast Cathay. He became a Christian, and was christened Nicholas. His son, Koxinga, born in Japan, was more powerful than his father, and remains one of the most remarkable characters in Eastern history. In 1662 he drove the Dutch (who had supplanted the Chinese) from Formosa, established a court, promoted industries, enacted wise laws, and ruled a nation of exiles and outlaws. China was helpless against him, and but for his sudden death it seems likely that he would have driven the Spanish from the Philippines. His grandson, a weakling, allowed the "Beautiful Isle" to fall back under Chinese mismanagement, and had these original owners only taken steps to award punishment for massacres and murders of shipwrecked crews, chiefly of foreign nations, Formosa might possibly have remained part of the Celestial Empire until the present day.

In 1874, in consequence of an outrage committed on the crew of a Loochooan vessel, Japan undertook a punitive expedition against Formosan outlaws. This was the thin end of a wedge which, after the war of 1895, was driven home, and Formosa was added to the Japanese Empire. It is, however, yet far from being completely under Japanese jurisdiction. The mountainous and densely wooded centre and eastern parts of the island still safely shelter head-hunting savages, whilst the borderland of these pathless jungles is a home for outlaws, and it is particularly against the latter that the Japanese seem helpless. The difficulty is to find them. At night villages may be looted by a howling mob, but next morning the sun rises upon smiling agriculturists.

After describing the tea industry, we are entertained with a long account relating to camphor. The camphor trees are, unfortunately, within the domains of the Aborigines, with the result that the camphor industry, head-hunting and butchery still go hand in hand. The chief victims appear to be the Chinese, the Japanese being but rarely attacked. Other industries are those of sugar and the mining of coal and gold. When speaking of the sulphur deposits, which are associated with geysers and a variety of spiteful volcanic vents, Mr. Davidson tells us that, in order to prevent certain insurgents obtaining material for the manufacture of gunpowder, an Imperial edict arrived from Pekin ordering officials to destroy all sulphur deposits by fire, and to stop up all offending craterlets which produced this substance. Altogether eighty-eight volcanic orifices were discovered, on which for several years officials paid quarterly calls, and with

perseverance, hope, and clods endeavoured to stop their roarings. This was in 1833.

Long lists and descriptions are given of various plants having an economic value, amongst which we note indigo and other dye plants, fibre plants, paper plants, oil plants, tobacco, coffee, &c., together with some account of forest trees.

The description of the savages is derived from the work of Mr. Y. Ino, who devoted several years to their study. Eight groups are referred to, and for each of these an account is given of their dwellings, dress, ornaments, food, diseases, head-hunting, language, and generally on subjects of anthropological interest. All we have bearing upon zoology is a list of land birds by J. D. de la Touche, and a list of mammalia by the late Mr. Robert Swinoe, the latter, unfortunately, only bringing us up to 1872. Meteorology and seismology are referred to in a short appendix, but about geology Mr. Davidson is practically silent.

With this and a few other exceptions the work is encyclopædic in its character, and it may well be recommended to commercial and scientific men who search for information about the island of Formosa.

THE BASIS OF PLANT-SURGERY.

Pathologische Pflanzenanatomie. By Dr. Ernst Küster. Pp. 300, and index. (Jena: G. Fischer, 1903.) Price 8 marks.

THAT plants have their diseases is a truth that has forced itself more and more on this colonial empire of ours, and that the signs of disease frequently express themselves in abnormal structures and outgrowths is well known to those few experts who have to deal with the galls, cankers, pustules, tumours, and other "malignant" tissue-formations, the very names of which remind us of the ills to which flesh is heir.

Moreover, there is a surgery of plants, as well as of animals, and the true basis of this growing art is in both cases a thorough understanding of the pathological, or diseased, as well as of the normal or healthy anatomy of the patient.

This scientific basis of a refined art is the subject of the work before us.

The author of this treatise had already distinguished himself in Münich by his work on the anatomy of galls, and it is with the greatest satisfaction that we find him inaugurating his career at Halle by a thorough exploration of what is to a large extent a practically new theme, and one, moreover, so worthy of the traditions of his present post, for it is remarkable that, while we have several modern books on physiological anatomy and on the pathology of plants, no competent botanist has given us a detailed and comprehensive treatise on this now important and rapidly extending subject.

Küster's book consists of 300 pp. of excellent and clearly-written matter, illustrated by 121 figures not always worthy of his text, though never obscure or irrelevant.

He divides his subject into six chapters, of which five are devoted to technical and special descriptive anatomy as modified from the normal by pathological changes in the life-work of the tissues and cells, while the sixth is told off to do duty as a general account of the pathological processes themselves, and of what little theory we as yet possess on the subject.

Much as we admire the collection of anatomical facts, and the descriptions of morbid anatomy in special cases, comprised in these first five chapters, it must be evident that the subdivisions are somewhat unfortunate. The author himself apparently sees this, as is evinced by the uncertainty as to which heading certain cases shall be placed under, and we believe that the shortcomings are partly due to a somewhat slavish following of the terminology of the animal pathologists.

These headings are:—I. *Restitution*, under which are placed cases in which changes in growth, induced by sections and wounds, lead to the new formation of the cut-off parts, or to proliferations of various kinds.

II. *Hypoplasie*, or arrested development of organs or parts due to various inhibiting reactions, which bring about diminutions in the number or sizes of cells, or otherwise change the tissues so that they stop short of a stage of development which would normally be regarded as complete.

III. *Metaplasie*, or progressive changes due to overstimulations which result in the cells and tissues undergoing structural changes in excess of the normal, though not suffering the enlargements or increase in numbers dealt with under the next and the fifth heading.

IV. *Hypertrophie*, where the cells attain dimensions more or less inordinate, and due to excessive growth while young and turgid. Most galls—in the widest sense—afford examples of these cases, which are extremely common.

V. *Hyperplasie*, or those abnormalities—usually enlargements and distortions—which owe their origin to inordinate increase in the average numbers of cells.

It is, of course, impossible to discuss examples of these various cases of abnormal anatomy here, and we have already expressed our satisfaction with the general subject-matter. We may note in passing that while Miss Dale's beautiful work on "Intumescences" is properly acknowledged, and one of her excellent illustrations suitably used on p. 86, the best results of her ingenious experiments on the kind of light which induces these abnormalities are not adequately given or apparently apprehended in the summary on p. 87.

To most readers, however, it will be the subject-matter of chapter vi. which will prove most attractive, though there is disappointment in store for anyone who expects anything beyond the most sketchy survey of the factors concerned in ætiology and development and their bearing on pathology. The sections on stimuli and reactions seem to us particularly weak, and the conclusion that any tissue can give rise to any tissue element—"aus jeden Gewebe kann alles werden"—may appear too lightly arrived at unless the reader is acquainted with the somewhat voluminous literature. The same, perhaps, applies to Küster's conclusion that tissue-elements quite foreign to the

species may arise in a pathological structure, though in our opinion he establishes his contention.

The book is undoubtedly a stirring contribution to botanical science, and ought to stimulate research in many directions, and although it escapes the responsibilities of being a great work, it is certainly one that must be on the shelves of every investigator of first rank who has anything to do with the anatomy or pathology of plants. We cordially welcome this interesting book as a pioneer work of what will grow to be an immense subject.

COMETS AND THEIR TAILS.

Comets and their Tails, and the Gegenschein Light. By Frederick G. Shaw. Pp. 70. (London: Baillière, Tindall, and Cox, 1903.)

THE theory of comet's tails has not yet arrived at its ultimate destiny, which we suppose is that of becoming an orthodox branch of applied mathematics; and consequently it still possesses a fascination for the world at large. True, the phenomena have been discussed by Prof. Bredichin, in a succession of papers that now go back nearly thirty years; but the origin of the forces required for Bredichin's theory is very obscure, and the net result is to excite rather than to remove conjecture. During the last few years the general mental ferment over the new views of the constitution of matter has given a fresh stimulus to speculators in this part of astronomy, and a considerable literature has already gathered round the suggestions of J. J. Thomson, Arrhenius and Deslandres.

Mr. Shaw, whose book now lies before us, is not a follower of any of these schools; he holds that the comet's tail is caused by the rays of the sun being altered (by concentration and refraction) by their passage through the cometic atmosphere, and thus rendered more capable of being reflected from the meteoric matter in the neighbourhood. In other words, the tail does not really exist; it is merely a local illumination of the general circumambient dust of space. The idea bears some resemblance to the now frequently accepted explanation of the lighting-up of the Nova Persei nebula.

After stating this theory, and offering a general justification, the author proceeds to examine the records of the great comet of 1858 in the light of it. For this purpose he uses G. P. Bond's monograph to a considerable extent, a mistake which occurs in the first plate of the Harvard astronomer's account being unfortunately twice reproduced; the point chiefly dwelt on is the sympathy between the phenomena of the nucleus and those of the tail.

The work as a whole is brief, its tone is very modest, and it is not claimed that the theory has been worked out in detail. It is therefore scarcely fair to blame the author for the difficulty which one finds in attempting to explain by causes of this kind the singularly complex character of cometary appendages. But any theory of the kind must offer some explanation of their most constant and remarkable features, such as the multiplicity of tails, their curvature, and the "broken" appearances often seen; and it may be doubted whether the author's theory in its present state is capable of meeting these demands. "So-called secondary tails, &c.," he accounts for "by irregular ebullitions of gas from the comet," presumably giving rise to special fields of refracted rays.

But at the root of the whole matter lies the question of whether refraction in the cometic envelope is likely to take place at all on a scale comparable with that required by Mr. Shaw's hypothesis, and at present observation seems to negative this possibility.

The latter part of the book is devoted to the Gegenschein, for which a similar explanation is given—the refraction being in this case produced by the earth's atmosphere, and the phenomenon being due to the reflection of this refracted light from meteoric dust. An interesting criticism of Barnard's views is given.

OUR BOOK SHELF.

Physical Chemistry for Physicians and Biologists. By Ernst Cohen. Authorised Translation from the German by M. H. Fischer. Pp. ix+343. (New York: Henry Holt and Co., 1903.)

PHYSIOLOGISTS and pharmacologists have from the first been ready to adopt and apply the recent theories of physical chemistry. Indeed, the eagerness with which these theories have been received by biologists has frequently led to their misapplication, inasmuch as the conditions existing in the animal organism are so widely different from those for which the theories were developed, that direct adoption of purely physico-chemical results is in nine cases out of ten inadmissible. In the book before us we have a series of seventeen lectures delivered by an energetic worker in pure physical chemistry to an audience of physicians. The physicochemical principles bearing on biological problems are expounded, the chief methods of experiment adequately described, and, what is of most importance, a critical account is given of many of their applications. These applications include, for example, disinfection in the light of the theory of electrolytic dissociation, the pharmacology of complex mercury salts and of uric acid solvents from the same point of view, the taste of dilute solutions, osmotic analysis, and the toxicity of electrolytic solutions. The book is admirably adapted to its purpose, and may be heartily recommended.

Trapper "Jim." By Edwyn Sandys. Pp. ix+441; illustrated. (New York and London: Macmillan and Co., Ltd., 1903.) Price 6*s.* net.

ALTHOUGH, as indicated by its title, this admirable little volume is devoted rather to sport and trapping than to natural history, yet it contains scattered through its pages such excellent descriptions of the wild life of the United States that the naturalist cannot fail to find much valuable information with regard to the habits of many of the mammals and birds mentioned. Specially interesting are the notes on the various species of American hares, and it will come as a revelation to many that the so-called "jack-rabbit" (*Lepus callotis*) is probably the fleetest member of all its tribe. Many references are made to the need for the cultivation of a true sporting instinct among hunters, that is to say, to the enjoyment of the sport itself, as distinct from making a "big bag." The name of Mr. Sandys is too well known as a writer on the sport and popular natural history of North America to stand in need of any commendation on our part, but we may safely say that his popularity will certainly be enhanced by his latest effort. R. L.

Das Gesetz der Translation des Wassers. Von T. Christen, Oberförster. Pp. viii + 179; with one lithographed plate. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1903.)

MUCH has been written about the flow of water in pipes, channels, and rivers, considered from the point of view of the hydraulic engineer, and many attempts have been made to obtain empirical formulæ for purposes of numerical calculation. In this volume the author proposes the formula $v = k\sqrt[3]{(QI)}/\sqrt[4]{B}$, where v is the mean velocity, Q the total flow per second, I the gradient as a sine, and B the half-breadth of the channel. A comparison of the results of the author's formulæ is made, both with the results of experiment and with those of other writers, especially Bazin, and calculations are given of the velocity curves for different sections and under different conditions. Reynolds's critical velocities are also discussed. The book contains a bibliography, tables of coefficients, and a diagram of the author's experiments and of velocity curves.

The new laws are admittedly only empirical, and the author indicates that many points might with advantage be discussed at greater length, but he has certainly succeeded in including a large amount of important and suggestive information in a book of small compass, and his theories will be read and discussed with the greatest interest by hydraulic engineers and experimenters who have worked in the subject.

Colloquies of Common People. By James Anstie, K.C. Pp. 530. (London: Smith, Elder and Co., 1902.)

THE English language contains few good specimens of the philosophical dialogue, perhaps none except the masterpieces of Berkeley. In attempting to revive this most difficult form of composition Mr. Anstie has ventured on a daring task, and I fear cannot be said to have achieved a great success. Like others before him, he forgets that a dialogue is intolerable unless its author is dramatist enough to confer individual character on the interlocutors; nothing is heavier reading than wedges of disquisition by mere puppets. Of the variety of topics handled by Mr. Anstie's puppets it is impossible to give any summary, as they appear to begin their discussion anywhere and to argue anyhow. They seem, however, in the course of his five hundred odd pages to touch on most of the current topics of ethics and psychology. The reader should at least have been assisted to follow their excursions by a table of contents and an index. A. E. T.

A Country Reader. II. By H. B. M. Buchanan, B.A. (Cantab.). Pp. viii+233; with illustrations. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.* 6*d.*

As Mr. Buchanan says, a child is much more likely to learn to read fluently and with intelligence if his reading book is concerned with subjects falling within his everyday experience, and from this point of view the set of readers, of which this is the second, will prove useful and popular in rural primary schools. The various sections of the book deal in simple, interesting language with the characters and uses of the goat, the donkey, the cat, our common reptiles, the fish of our ponds and streams, pastures and grasses. The illustrations are numerous and exceptionally good, though it is a pity the author has omitted to indicate the scale of the drawings; there is some fear, for instance, that quite a wrong idea of the relative sizes of the carp and minnow will be obtained by the pupil from the pictures which face one another on pp. 96 and 97.

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.]*

Gases Occluded by Radium Bromide.

RUTHERFORD AND SODDY (*Phil. Mag.*, 1902, p. 582; 1903, p. 453 and 579) pointed out that the almost invariable presence of helium in minerals containing uranium indicated that that gas might be one of the ultimate products of the disintegration of the radio-elements. Rutherford, moreover, determined the mass of the projected particle which constitutes the "α-ray" of radium (*Phil. Mag.*, 1903, p. 177) to be approximately twice as great as that of the hydrogen atom, an observation which points in the same direction. These α-particles are readily absorbed by solids, and should accumulate in the solid salts of radium and in the radio-active minerals.

We have been engaged for some months in examining the spectrum of the "radio-active emanation" from radium, and during this work the opportunity presented itself of examining the gases occluded by 20 mgrs. of radium bromide which had been kept for some time in the solid state. These gases, which are continuously generated, have already been partially examined by their discoverer, Giesel, and by Bodländer (*Ber. deutsch. chem. Ges.*, 36, p. 347), and found to consist mainly of hydrogen and some oxygen. We have found that after removing hydrogen and oxygen from the gases evolved from 20 mgrs. of radium bromide, the spectrum showed the presence of carbon dioxide. On freezing out the carbon dioxide, and with it, a large proportion of the radium "emanation," the residue gave unmistakably the D_3 line of helium. This was confirmed by sealing off the tube, and comparing its spectrum with that of a helium tube. The coincidence of the two lines may be taken to be at least within 1/10th of the distance between D_1 and D_2, or say 0·5 of an Ångström unit.

This observation, if confirmed, substantiates the theory already mentioned, and brings ordinary methods to bear on the changes occurring in radio-active bodies.

WILLIAM RAMSAY.
July 10. FREDERICK SODDY.

P.S. (July 13).—We have repeated the experiment with 30 mgrs. of fresh radium bromide, kindly placed at our disposal by Prof. Rutherford, which had probably been kept for several months in the solid state. Entirely new apparatus was constructed for the purpose, and better precautions were taken to exclude from the spectrum tube carbon dioxide and the emanation. The spectrum was practically that of pure helium, with the addition of two new lines. The lines identified are:—

Red	6677	Green-blue ..	4932
Yellow (D_3) ...	5876	Blue	4713
Green	5016	Violet	4472

The additional lines are one in the red and one in the green; these we have been unable to identify.

The Extirpation of Culex at Ismailia.

I BEG to enclose for publication the translation of a report received from the general secretary of the Suez Canal Company regarding the effects of the anti-malaria campaign at Ismailia since the visit of Sir William MacGregor and myself last September. While it is obviously too early to speak definitely regarding the result on the malaria rate, the secretary is able to announce that mosquitoes of the genus Culex "ont été supprimés d'une manière presque

absolue." Under the term Culex, I think he means to include also gnats of the genus Stegomyia.

I have received confirmatory evidence from a gentleman in Egypt, who says that he was recently able to sleep at Ismailia without mosquito nets.

The campaign against Culex at Ismailia originally promised to be a difficult one, owing to the large number of sewage-cisterns under the houses, and the result shows how easily a simple and obvious idea like that of diminishing mosquitoes by dealing with their breeding places can be acted upon by an intelligent and effective executive which sets to work at once, instead of wasting time on useless discussions—as, for the most part, we have been doing in British possessions during the last four years.

It is to be hoped that, following the work of Gorgas at Havana, and Logan Taylor at Freetown, the result at Ismailia will be accepted as clinching the proof of the fact that Culex, at least, may be materially diminished in tropical towns. RONALD ROSS.

Liverpool, July 11.

TRANSLATION of letter, dated July 2, from M. le Secrétaire général de la Compagnie universelle du Canal maritime de Suez, Paris, to Major Ronald Ross, Liverpool School of Tropical Medicine:—

"Sir,—I have the honour to inform you that, following your mission of last September, numerous works of drainage and filling up of ditches have been effected, and that a permanent department has been created for the purpose of oiling cisterns and pits and suppressing marshes and pools of water amongst the habitations of Ismailia. Moreover, measures of prophylaxis, consisting of the gratuitous distribution of quinine and arsenic, commenced in the month of April, 1902, are continued without interruption.

"Since last December, the number of cases of fever has very sensibly diminished by comparison with previous months and with the corresponding period of last year, and this decrease is maintained until to-day.

"Owing to the time at which the sanitary works were undertaken, the complete disappearance of the Anopheles is not yet realised, but it can be stated that recently captured insects have not been infected—which can perhaps be attributed to the fact that the number of cases of fever have been considerably reduced.

"On the other hand, it is interesting to note that, thanks to methodical *petrolage*, and to the incessant surveillance of the breeding-places of mosquito larvæ, the mosquitoes called Culex have been suppressed in a manner almost absolute, and that, in the hottest period of the year, it has been possible to abandon the use of mosquito nets.

"Regarding the consequence of these measures, a definite statement cannot be made until after August to November next, the principal malaria season. We have every ground for hoping that the efforts with which you have been so usefully associated will end in the complete extinction of malaria in the town of Ismailia, and we will communicate with you when we receive definite information on this interesting subject."

Another White Spot on Saturn.

ON July 9, at 14h. 4m., I observed another large white spot in the northern hemisphere of Saturn, and on the central meridian of the planet. The spot was quite bright in contrast with the dark belt adjoining it, and a tolerably easy object. I saw the spot again on July 12, when it shone with a bright pearl-like aspect, and was estimated on the central meridian at 12h. 50m. The marking is much distended in longitude, and this makes it rather difficult to note its central passages accurately, but the motion of the object seems decidedly swifter than the rate usually adopted for the rotation period of Saturn.

The following end of a bright extension on the eastern side of the spot was on C.M. at 13h. 35s. on July 12, and a dusky patch between the N equatorial belt and the polar shading followed at 14h. 1m.

The markings above alluded to are quite different from the bright spot seen by Barnard on June 23, and by myself on July 1. The present disturbance on Saturn seems to have affected a very large area, and I have never observed anything of the same conspicuous character on the planet in past years. W. F. DENNING.

Bishopston, Bristol.

The Thunderstorm of May 31.

MR. C. H. HAWKINS, of Croydon, has sent me a copy of a photograph of a lightning flash taken by him at "Addiscombe," Croydon, on Whitsunday morning, May 31, at 2.30 a.m.

The upper part of the main flash and the side flash both show reduplication, and the photograph exhibits so many

Lightning discharge photographed at Addiscombe, Croydon, on May 31, at 2.30 a.m. Direction N.N.W.

characteristic features that its reproduction may be of service for comparison with other photographs.

I therefore enclose a copy with Mr. Hawkins's permission.

Meteorological Office, S.W., July 7. W. N. SHAW.

THE LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.

THE system of wireless telegraphy which Sir Oliver Lodge and Dr. A. Muirhead have been developing for some years has, within the past few months, been brought to a degree of perfection which justifies the inventors in the belief that it is now of practical commercial value. Thanks to the courtesy of Messrs. Muirhead and Co., we have had an opportunity of seeing the system at work at a small experimental installation which has been put up in a field adjoining Messrs. Muirhead's works at Elmers End, Kent. At this station signals were being transmitted to and received from a similar installation at Downe. The distance between the two stations is only six or seven miles, but the chalky nature of the Kentish soil and the fact that the station at Elmers End lies in a hollow make this distance equivalent to eight or nine times as much over water. Experiments which have been made under the conditions which would obtain in the practical application of the system for maritime work and also over the Admiralty sixty-mile range have shown that, with the same power and the same adjustments as are required between Elmers End and Downe, thoroughly satisfactory communication can be maintained across sixty miles of ocean. Considerations of distance are, however, of secondary importance in estimating the merits of wireless telegraphy systems, for the recent work of Mr. Marconi and others has made it clear enough that, given sufficient power, almost any range can be attained. Trustworthiness, clearness, the design of circuits and apparatus, and the possibility of successful syntonisation are factors of greater importance. Looked at from this point of view, the Lodge-Muirhead system presents several novel and interesting features which show that, though it may be one of the latest to come into the field of practical wireless telegraphy, it is likely to prove one

of the most efficient. Most noteworthy feature of all is the remarkably delicate coherer which has been finally evolved from numerous experiments, a coherer which not only promises to be accurate and trustworthy in practical work, but also possesses several advantages from an experimental point of view, a characteristic of no small importance in a piece of apparatus which has to be employed in an art in which there is so much to be learnt.

In general outline the Lodge-Muirhead system does not differ materially from other wireless telegraph systems, a fact which is not remarkable when it is recalled how much other systems owe to the pioneering work which Sir Oliver Lodge has carried on ever since the earliest days of Hertzian waves. In fact, if we retrace the development of Hertzian telegraphy from Maxwell's theory of light, the name of Sir Oliver Lodge is singularly prominent, and must be associated with all the more important advances. The connection begins in 1888, when he read a paper on the velocity of electromagnetic waves along wires at the meeting of the British Association, at which Prof. Fitzgerald directed attention to the work that Hertz had accomplished; a little later he discovered, in its simplest form, coherer action, and it is interesting to note that after long trial of the filings coherers derived from the discoveries of Branly, there seems to be a tendency on all sides to return to simpler designs much more closely resembling Lodge's original single contact coherer. To Lodge also belongs the credit of having been the first to insist upon the importance of tuning, and of having pointed out how this might be possibly attained by the proper use of self-induction and capacity. Moreover, it was, we believe, he who suggested using a transformer in the aërial circuit at both transmitting and sending stations instead of connecting the spark gap or coherer direct to the aërial; this device is now in general use for tuned systems. It will readily be realised, therefore, that a system which has been designed by Sir Oliver Lodge is likely to be one of the most promising of wireless telegraph systems, and that this is all the more likely to be the case in the present instance, as Sir Oliver has had the cooperation of Dr. Muirhead.

We do not propose to give a general description of the system, for, as we have said, other systems are similar in general outline, and with these most people are by now familiar. In the installation working between Elmers End and Downe there is no earth connection. The precise utility of an earth connection has been often in dispute, most people maintaining that it merely serves to introduce the earth as the second plate in a large condenser, the first plate being represented by the aërial wire and any capacity connected to it. In the system under consideration, a second capacity is provided which lies upon but is insulated from the earth; in the Elmers End station the capacity was beneath the floor of the instrument shed, and was connected to one terminal of the spark gap (or transformer), the other terminal being connected to the aërial, which has an open wire cage serving as a suitable capacity at its upper end. We need not enter here into the various ways in which the circuits can be connected up; the relative positions of coherer, spark gap, capacity and self-induction, the employment or not of the transformer, &c., offer a number of solutions to the problem of designing a complete station each of which has its special merits for particular purposes. In principle, all result in the same thing—a very large Hertz radiator transmitting into space a succession of untuned or carefully tuned electromagnetic waves. The two questions of primal importance are how to produce those waves, and how to detect them at the receiving end.

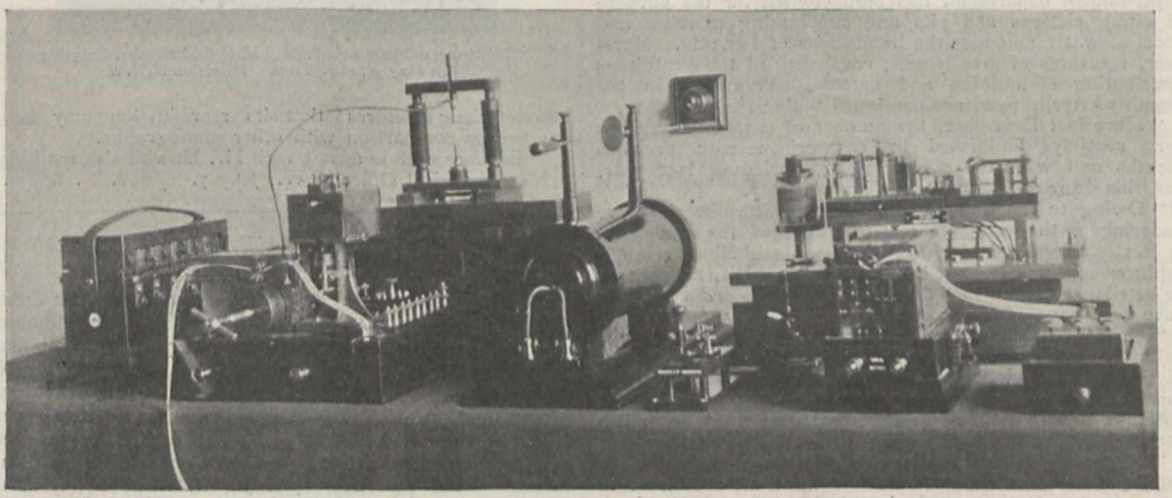

FIG. 1.—Complete Lodge-Muirhead Apparatus.
From left to right as follows :—Battery, receiver, spark gap, induction coil, signalling key, buzzer (at the back), automatic transmitter, and perforator.

The production of the Hertzian waves presents several difficulties. Even for moderate ranges of transmission fairly powerful sparks have to be used; these are obtained from a special induction coil and spark gap (Fig. 1). Here again one notices in the simple spark gap between two rods a return to less complicated apparatus; in the early days of wireless telegraphy a spark gap between polished balls in oil or vaseline used to be regarded almost as essential. In using this apparatus for syntonic work a very great deal depends upon the spark. It is necessary, in the first place, to obtain a regular succession of sparks for every depression of the signalling key. The ordinary forms of make-and-break used with induction coils have not been found satisfactory, and a special form of interrupter or "buzzer," as it is called, has been designed. This is seen at the back on the right of Fig. 1. It consists of an ordinary mercury break operated by two cross-connected telegraphic sounders. The first of these sounders works in the same manner as an ordinary electric bell, the arm vibrating to and fro when the signalling key is de-

pressed and the circuit closed; the vibrating arm opens and closes the circuit of the second sounder, to which is attached the dipping rod of the mercury break. It is said that this arrangement gives a more regular succession of sparks than is obtained with one sounder only. An automatic transmitting apparatus has also been worked out by Messrs. Lodge and Muirhead. This is shown at the right of Fig. 1, in front of the buzzer, and consists of two pieces of apparatus, a perforator and a transmitter, which are used in conjunction with the buzzer, &c., in place of the ordinary signalling key.

A regular succession of sparks having been thus obtained, still only part, and that the simpler part, of the difficulty has been overcome, for it is not the period of the sparks but the period of the oscillations in the spark which has to be syntonised. When one considers how short is the train of waves from each individual spark and how long comparatively the interval between two successive sparks, it is easy to see the importance of getting the best results possible

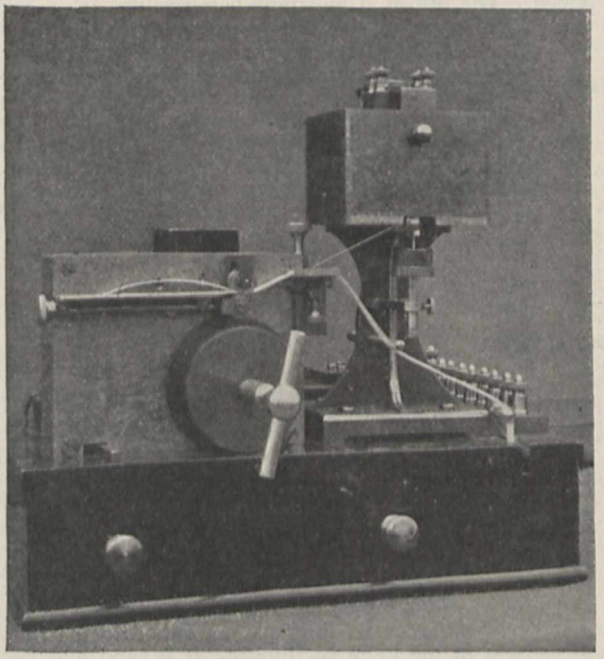

FIG. 2.—Receiving Apparatus.

from each spark. Herein, indeed, seems to lie one of the chief unsolved problems of wireless telegraphy—the problem of obtaining a really continuous series of undamped oscillations. It seems doubtful whether, even with the best possible design and arrangement of apparatus, a satisfactory solution will ever be found by means of disruptive sparks. Perhaps we must look to some quite different method of setting up the oscillations. The method that gives most promise of ultimate success is some application of the principle of Mr. Duddell's musical arc, as suggested by Mr. Duddell at the Royal Institution last year (see also the *Electrician*, May 1, vol. li. p. 84). It certainly seems that from this discovery may be developed a means of producing a continuous series of undamped oscillations of high frequency, and if this should prove to be possible a change amounting almost to a revolution would be effected in the practice of syntonic wireless telegraphy.

We may pass now to a consideration of the receiving instruments which are shown in Fig. 1, and in more detail in Figs. 2 and 3. Fig. 2 represents the complete receiving instrument. The instrument looks at first sight much like a Morse recorder; the coherer is mounted behind the box which contains the clockwork for feeding forward the tape and rotating the coherer wheel. Its construction can be seen from Fig. 3, which shows a coherer by itself. It consists of a small steel disc with a fine razor edge which dips into a little pool of mercury in an ebonite cup. The mercury is covered by a thin film of oil, and the disc is adjusted so that under normal conditions the oil serves just to insulate it from the mercury. When oscillations are set up in the coherer circuit, this thin layer of insulation is broken down, and connection established between the disc and the mercury. The disc is slowly rotated by means of the notched wheel seen clearly in the illustration, which gears with a similar wheel at the back of the clockwork box. Connection is thus no sooner established between the disc and mercury than it is broken again by a fresh oily portion of the edge coming round; there is consequently only connection during the time the oscillations are actually arriving and the

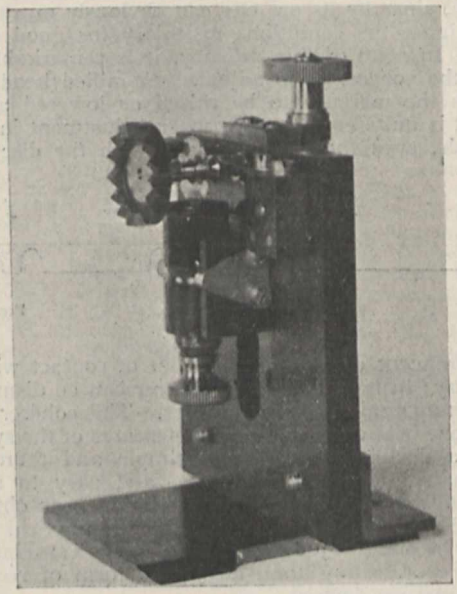

FIG. 3.—The Coherer.

coherer is self-decohering and requires no tapping back. In some respects the device recalls a suggestion made by Rupp five or six years ago, who proposed mounting a filings coherer so that it was rotated slowly by the Morse tape. The Lodge coherer is, however, a far more mechanical contrivance than a filings tube however the latter may be decohered. In order to keep the edge of the disc clean a pad of felt is pressed lightly against it; this can just be seen on the left near the top of the disc; contact is made by a spring pressing against the shaft on which the disc is mounted. The coherer will only work with a very small potential difference—a fraction of a volt—between mercury and disc; it is therefore connected in series with a potentiometer, which reduces the voltage from the cell.

Another feature of the receiving circuit is the absence of any relay; the coherer and potentiometer are directly in series with the recording instrument, which takes the form of a simple syphon recorder. This is seen on the right of the clockwork in Fig. 2; the pen consists of a fine glass syphon tube suspended from the galvanometer coil, one end dipping in a cup of ink

and the other resting on the tape. When no signals are being received the pen draws a fine line on the paper, but when a signal arrives it is deflected. The result can be seen from the specimen of tape in Fig 4. There is an arrangement by which the amplitude of the deflection can be controlled by making the syphon come up against a stop. It is obvious that the tops of the humps in the line representing dots and dashes are not needed for reading the message, since it is easy to see from the length of the break in the base line whether the signal is a dot or a dash. The tops of these humps have, however, a special interest. It will be noticed, on examining them closely, that they are not smooth, but are slightly irregular. These irregularities represent the sparks, and it is possible therefore to see from the form of the humps whether the sparking at the transmitting end is good or bad. A particularly bad spark is seen at the beginning of the third signal (the second dot) in the letter *l*, and a careful examination, of the dashes more especially, shows quite clearly the nature of the sparking at the transmitting station seven miles off. This not only points to the great sensitiveness of the coherer, but shows that it should prove particularly useful in research, since by its use one can obviously much better investigate the conditions necessary for good signalling. In spite of this delicacy, it is remarkable how easy the coherer is to adjust. A milled head screw allows the mercury to be raised or lowered at will, and it is quite easy to get proper adjustment in a few seconds, even though one starts with the disc either

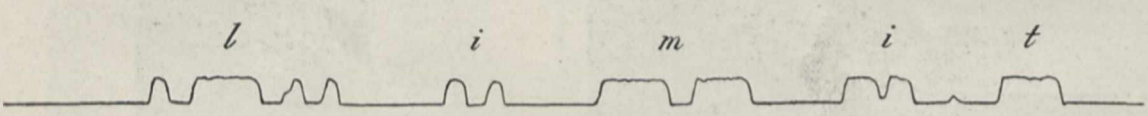

FIG. 4.—Facsimile of Tape.

in permanent contact or right out of contact with the mercury; in fact, the whole coherer can be dismantled and set up again in a few minutes. This coherer seems to us one of the most promising features of the system; it is a device at once quite simple and thoroughly mechanical, easy to reproduce, and easy to adjust, and, judging by the results which have been obtained, is both sensitive and trustworthy in practical work. So far as one can judge without lengthy experiment, it is more promising than any other form of receiving apparatus yet devised.

We may add that the system has been adopted by the Eastern Extension Telegraph Company on its two new cable ships, and is reported to be giving every satisfaction. In conclusion, we should like to express thanks to Messrs. Muirhead and Co. for showing us the system at work, and for lending the photographs from which the illustrations to this article have been made. MAURICE SOLOMON.

THE ALLIED COLONIAL UNIVERSITIES CONFERENCE.

A STRONG committee—Sir Gilbert Parker being the moving spirit—addressed the following circular letter to the universities of the United Kingdom on May 30:—

In order to facilitate the proceedings at the Allied Colonial Universities Conference, to be held at Burlington House on July 9, I shall be very much obliged if you can assist me with information upon the following points:—

(*a*) Whether, and if so in what way, the conditions under which degrees are given by the University of —— are modified in the case of persons who have studied in or taken the degrees of colonial universities.

(*b*) Does the University of —— afford any special facilities for post-graduate study (in particular with regard to applied science) to the graduates of colonial universities? Does the university reward special post-graduate students by bestowing upon them degrees, and on what conditions as to residence or tests of fitness are such degrees bestowed?

(*c*) Does the University of —— possess any special endowments for the encouragement of colonial students; or are colonial students habitually aided by any endowments not under the control of the university?

(*d*) What is the average number of colonial students studying in the University of ——?

The colonial universities (with the exception of the universities of India) had meanwhile been asked to appoint delegates to represent them at the conference, with the result that, when the conference opened, almost every university within the Empire was directly represented.

The actual session occupied one day only, but a good deal of hospitality was exhibited during the week, and whatever view may be held as to the value of the business actually transacted, there can be no question as to the quality of the entertainment provided. The informal meetings between the delegates, both before and after the session day, constituted probably the most important part of the conference; the opportunity for interchange of ideas was absolutely unparalleled in the history of British education, for not only were the delegates drawn from practically every university within the Empire, but they were, on the whole, exceptionally well qualified for their duties. It is not possible to set down in writing a precise estimate of the advantage to be drawn from informal conversations between those who are interested in the same things but have few opportunities of discussing them; the British Association, however, affords a proof, repeated annually, that there is a very important advantage to be gained in this way. Those engaged in carrying on university work in new countries and in communities where the importance of that work is not always properly understood, are apt to wonder now and again whether they are really on the right track, whether their work is, after all, as important as they have been in the habit of thinking it is, and whether their methods are sound and progressive. To such men the stimulus of a conference such as the one just over is invaluable, and the chance of learning at first hand what others are doing is also invaluable.

To come to the conference itself. The chairman, Mr. Bryce, called the meeting to order with commendable punctuality, and explained in a scholarly way—though in the most general terms—how universities might cooperate to their mutual advantage. The Vice-Chancellor of Cambridge then proposed the first resolution:—

"That in the opinion of this conference it is desirable that such relations should be established between the principal teaching universities of the Empire as will secure that special or local advantages for study, and in particular for post-graduate study and research, be made as accessible as possible to students from all parts of the King's dominions."

This was supported with businesslike brevity by various delegates both from the United Kingdom and from Greater Britain, and was finally passed without dissent. From the discussion the following principles finally emerged:—

(1) There must be no thought of attempting uniformity of regulation—each university must decide for itself how it should treat post-graduate students from other universities.

(2) The question at issue was, for practical purposes, to be limited in the first instance to the consideration of post-graduate facilities. In this connection it was shown by Sir Henry Roscoe that the scholarship system of the Commissioners of the 1851 Exhibition had proved itself to be a great success, and Prof. Ewing showed that the Cambridge "research tripos" had also succeeded beyond all expectation.

Cambridge appears to be the only university which, so far, has provided satisfactory machinery for post-graduate students of other universities, and one of the objects of the conference was to induce other universities to show themselves as liberal as Cambridge in this respect.

(3) It appeared that more scholarships on the lines of the Commissioners of the 1851 Exhibition were needed, and could be worthily allotted.

(4) The magnificent hospitality of the University of France and of the universities of Germany at present attract a large number of British students. It was felt that, though this might be regretted on sentimental grounds, the only legitimate manner of dealing with it was to provide within the King's dominions at least as great freedom and facility for study as could be obtained abroad.

It was abundantly clear that the delegates, as a whole, were extremely well informed on educational subjects. For instance, it was practically taken for granted by all the speakers that there can be no serious education which does not embrace a certain amount of research work; the only speaker who did not appear to endorse this view being Prof. Mahaffy, of Dublin, who was witty on the subject in the well-known mid-Victorian manner. Since Germany has given to our disadvantage a definite experimental proof of the success of research as an instrument of education, the delegates probably felt that the matter had gone beyond the range of academic discussion.

It was also interesting to note that the principle of "examination by the teacher" appeared to be fully admitted on all hands.

The afternoon session was devoted to a quite similar discussion on a motion for the appointment of a standing committee. The committee so proposed did not explain in any way what steps it intended to take, nor did any speaker ask it to do so, or make any very distinct suggestion as to its duties, so that future developments must depend entirely on personal initiative within the committee. It would have been better, probably, had the committee been less reticent.

On the whole the conference must be regarded as having met with a quite unanticipated measure of success. There was an enthusiasm and go about it throughout which was most stimulating, and of the best possible augury for the future of English-speaking university education. If secondary education could be brought up to a corresponding standard, we should be much better off than we are.

The proceedings culminated in a huge dinner of about 500 people at the Hotel Cecil on the evening of July 10, with Mr. Balfour in the chair, and at his best in proposing the toast of the evening afterwards.

The conference was excellently managed throughout, and it is fair to say that a good deal of the success attained must be attributed to the exertions of the honorary secretary, Mr. Kinloch Cooke. A conference for which no precedent exists requires, in the words of Lord Palmerston, "a lot of bottle-holding," and Mr. Kinloch Cooke appeared to be equal to all the demands made upon him. R. T.

MR. BALFOUR ON ACADEMIC AND SCIENTIFIC EDUCATION.

We reprint from the *Times* of July 11 the report of the speech made by Mr. Balfour in proposing the toast of the evening, "The Universities of the King's Over-Sea Dominions" at the Allied Colonial Universities' dinner on Friday last:—

We are here, if I may venture to say so, a remarkable gathering in the individual capacity of the members who compose it. But I think we are still more remarkable taken in connection with the central idea which has brought us together. It is not merely, or simply, or chiefly that there are in this room the representatives of scholarship and science, of all the great spheres of activity in which modern thought is indulging itself. It is that we are here representing what will turn out to be, I believe, a great alliance of the greatest educational instruments in the Empire—an alliance of all the universities that, in an increasing measure, are feeling their responsibilities, not merely for training the youth which is destined to carry on all the traditions of the British Empire, but also to further those great interests of knowledge, scientific research, and culture without which no Empire, however materially magnificent, can really say that it is doing its share in the progress of the world. I think that we who in this room belong to the old country, and who were educated in the older universities of England, of Scotland, or of Ireland, have great reason to be proud of those who may be described as our educational children—I mean the universities of the other portions of the Empire.

We boast of community of blood, of language, of law, of literature; but surely we may also boast, and with not less reason, that the ideals of education which are working a great work in the old country are now doing their work among its younger children, and are carrying on in all the self-governing nations of the Empire work like that which they perform in the parent country. Now, my lords and gentlemen, I have mentioned two subjects already in the few sentences I have uttered which, each separately, has been exercising the minds, at all events, of people on this side of the Atlantic—the ideals of education and the ideals of Empire. We have been quarrelling—it would, perhaps, not be too much to say we are still quarrelling—over both. I ask you to consider them in conjunction, but I hope that the two elements brought into this chemical composition will prove less explosive than they do in their separate and individual character. At all events, I am certain that nothing I shall say will hurt the sentiments even of the most ardent opponents of the Education Act passed through Parliament last year, or will in the smallest degree anticipate that interesting discussion upon tariff reform with which it is promised us that the autumn is to be occupied. I mean to talk of education, and I mean to talk of Empire; but I hope and believe I shall tread upon nobody's toes, and that is partly because I think I am justified in treating very lightly on an occasion like this that part of the great educational problem which touches upon secondary education. I confess that, as far as I am concerned, I have never been able to make a theory satisfactory to myself as to what is or is not the best kind of education to be given in those great public schools which are the glory of our country, and which, in their collective effect upon British character, I think cannot be overrated, but which are subjected, and perhaps rightly subjected, to a great deal of criticism as to that portion of their efforts which is engaged on the scholastic and technical side of education.

I cannot profess myself to be satisfied with the old classical ideal of secondary education; and yet I am not satisfied—perhaps I ought to put it more strongly and say I am still less satisfied—with any substitute I have seen for it. I have heard the old system defended on the ground that the great classical languages contain masterpieces of human imagination which have never been surpassed; and, of course, that is true. But I do not think we can defend classical education in the great public and secondary schools on that ground alone. You have only got, after all, to make a simple statistical calculation, which perhaps we cannot put down in figures, but which every man with

the smallest experience, perhaps with the smallest memory of what he was and what his school fellows were at the age of seventeen or eighteen, can make, to know that the master of the dead languages of a kind which enables them to enjoy those great works with their foot on the hearth, which is the only way to enjoy any work of literature, the number of boys who leave the great public and secondary schools with that amount of knowledge is a very, very small percentage. You cannot keep up a system of education for a very, very small percentage; and, if that is the only defence of classical education, I think it will have to be abandoned except for the few who are qualified to derive all the immense advantages which to the few they are capable of imparting. But when I turn to the other side and ask what the substitute is, then I confess I am even less happy than when I consider the classical ideal; for I am quite sure—no, I am not quite sure, but I think—you will never find science a good medium for conveying education to classes of forty or fifty boys who do not care a farthing about the world they live in except in so far as it concerns the cricket field, or the football field, or the river—you will never make science a good medium of education for those boys; for only a few are capable at that age, and perhaps at any age, of learning all the lessons which science is capable of teaching. I go further. I never have been able to see, so far as I am concerned, how you are going to get that supply of science teachers for secondary schools who have both the time to keep themselves abreast of the ever-changing aspects of modern science and to do all the important work which the English schoolmaster has to do, which is that not simply of teaching classes, but of influencing a house and impressing moral and intellectual characteristics on those committed to his charge.

I do not know whether it was Lord Kelvin's presence which inspired me to say something which I was afraid he would not like. I did not mean to deal with this topic at any length. I only meant to say that while, as far as I am concerned, I think we have not yet arrived at the ideal system or the ideal character of our secondary and public school education, I do think that, so far as this assembly is concerned and the universities are concerned, we are on much more solid ground when we come to the education with which they have got to deal; and especially and chiefly do I say that we are on absolutely secure ground when we are dealing with that post-graduate education which, I hope, will be the great practical result, or one of the great practical results, of the meeting which I am addressing to-night. We know exactly what we want when dealing with post-graduate education, and it is our business to see that the students who desire it have it, and that the opportunity of those who do desire it is augmented so far as our influence will go. I daresay that many of us have looked back with a certain regret, and a certain feeling of shame, to the medieval passion for learning without fee and without reward—with no desire to make the universities stepping-stones to good places or to successful mercantile or industrial undertakings—but with an ideal which made thousands of students from every country in Europe undergo hardships which would be regarded in these softer days as absolutely intolerable, for the sole purpose of seeking, and it might be finding, the great secret of knowledge. We despise, and we perhaps rightly despise, their methods. We know that they were not in touch with the actual realities of the world in which they lived. Yet, after all, we have something to learn from them; and if we in these days could imitate their disinterested passion for knowing and for extending the bounds of knowledge, surely we, with our better methods, and our clearer appreciation of what we can know and what we cannot know, might accomplish things as yet undreamed of. Now, what did they do? They moved from university to university, from Oxford to Paris, from Paris to Padua, from country to country, in order that they might sit at the feet of some great master of learning, some great teacher who might lead their thoughts into undreamed of paths. I hope that in the universities of the future every great teacher will attract to himself from other universities students who may catch his spirit—young men who may be guided by him in the paths of scientific fame; men who may come to him from north or from south; and who, whether they come from the narrow bounds of this island or from the furthest verge of the Empire, may feel that they have always open to them the best that the Empire can afford, and that within the Empire they can find some man of original genius and great teaching gifts who may spread the light of knowledge and further the cause of research.

I have said that they were to find this—I have suggested, at all events, that they should find this—within the limits of the Empire. I hope that in putting it that way I have not spoken any treason against the universality of learning or the cosmopolitan character of science. I quite agree that the discoveries made in one university or by one investigator are at once the common property of the world; and we all rejoice that it is so. No jealous tariffs stand between the free communication of ideas. And surely we may be happy that that is the fact. And yet, though knowledge is cosmopolitan, though science knows no country and is moved by no passion—not even the noblest passion of patriotism—still I do think that in the methods and machinery of imparting knowledge, as there always has been in modern times, so there may still continue to be some national differentiation in the character of our universities, something in our great centres of knowledge which reflects the national character and suits the individual feeling, and that an English-speaking student and a citizen of the Empire, from whatever part of the world he may hail, ought to find something equally suited to him as a student, and more congenial to him as a man, in some university within the ample bounds of the Empire. If that be our ideal, we have to ask ourselves whether we have accomplished it, or whether we are in process of accomplishing it. I am afraid it is too clear that we have not accomplished it. But that we are in process of accomplishing it, and that we can accomplish it—of that I do not entertain the smallest doubt. The movement which has begun with the inter-university meeting, of which this is the culmination, that movement is not destined to finish with this evening's proceedings. It is but the beginning and the seed of far greater things. And I feel confident that, if the representative men whom I see here gathered together from all parts of the world should by good fortune meet a few years hence in this metropolis of the Empire, they will be able to say, and to say with confidence, that the work begun to-night has not been unfruitful; that the machinery for interchanging ideas between our great academic centres has worked admirable good, not merely for the individual student, and not merely for the cause of knowledge, but for the cause of Empire itself. And while learning ought never to be perverted to the cause of faction, or to the cause of separation between the different sections of mankind, yet nevertheless it will be true that this intercommunication of the highest thoughts between the leaders of academic training in every portion of the Empire to which we belong will have furthered not merely sound learning, but sound patriotism. It is in that faith that I have been proud to share, however humbly, the work on which you are engaged. It is this, I think, that will make memorable in academic history the undertaking which my friend, Sir Gilbert Parker, more, perhaps, than any man in this room, has set himself to accomplish; and it is in the cause of education, of learning, of research, of science, and of Empire that I now ask you to fill your glasses and drink to the toast of the universities of the King's over-sea dominions.

NOTES.

IT is proposed to change the name of the Jenner Institute of Preventive Medicine to the Lister Institute of Preventive Medicine. A memorandum which has been sent by the governing body to the members of the institute states as one reason for the change of name that there is in London a commercial firm trading under the name of "The Jenner Institute for Calf Lymph," with a prior legal claim to the name of Jenner Institute. So great has the inconvenience become on account of the confusion between the two institutes, that the governing body has determined to seek the sanction of their members and of the Board of Trade to change the name of the institute to the Lister

Institute of Preventive Medicine, though it is only fair to Lord Lister to say that this name was chosen by his colleagues against his own strong personal wish.

AT a meeting of the Wilts County Council last week, it was decided not to take over the powers and duties of the Amesbury Rural District Council in regard to the alleged rights of way to Stonehenge. Steps are being taken to ensure that the question of right of way shall be brought before a legal tribunal for decision, as the negotiations between the Government and the landowner for the purchase of Stonehenge have come to an end.

THE *Times* correspondent at Cape Town reports that on July 9 a slight earthquake was felt there at 11.37 a.m., followed by a second shock at 12.6 a.m., the latter being the heaviest known at Cape Town for twenty years. No damage was caused.

IT is proposed to hold an International Exhibition at Manchester in 1905. At a meeting recently held in that city, a committee was appointed to take such steps as they consider necessary to ascertain the views of those likely to be interested in such a project.

IN reply to a question asked in the House of Commons on July 8, Mr. Balfour stated that the King had expressed the wish that the Celtic gold ornaments declared by the judgment in the Court of Chancery to be treasure trove, and therefore the property of the Crown, should be presented as a free gift to the treasurer of the Irish Academy. The ornaments will therefore be taken from the British Museum and sent to Ireland.

THE whaler *Terra Nova* has been bought by the Admiralty to be sent to the relief of the *Discovery* in the Antarctic. The *Terra Nova* left St. John's for the Tay on July 9, and is to be fitted out, by instructions of the Admiralty, by the Dundee Shipbuilders' Company, who constructed the *Discovery*.

A PARIS correspondent writes:—Last week a visit was paid to the Moisson Aërodrome by the scientific committee of the Aëro Club, when the Lebaudy balloon made a successful performance, controlled by M. Juchmès and two assistants. During about twenty minutes the balloon travelled at an altitude of about 300 metres, and travelled in different directions for about a kilometre, in spite of a wind blowing at a measured rate of 6 to 7 metres in a second. The influence of the motion of the air was perceptible only by a great diminution of this velocity and large vibrations testifying to the effort exerted.

AMONG the subjects of resolutions adopted in general conference of the International Fire Prevention Congress, held in London last week, the following are of interest:—that in all reports dealing with questions of fire-resistance and tests, the metric system of measurement, weight, and temperature shall be adopted, as well as any local system; that there should be established testing stations for fire-resisting materials, and a universally recognised method of testing adopted; that courses of study should be provided in universities, technical colleges and schools, for the instruction of engineering and architectural students in the fire-resistance of building materials and the methods of construction as based on investigation; that having regard to the neglect of precautions against damage caused by lightning, the subject should have the serious consideration of the Government and local authorities, the technical professions, and the fire service.

MR. H. C. RICHMOND, of Southport, appreciating the highly interesting work of Jeremiah Horrox, is endeavouring to have erected to his memory some suitable memorial in Southport. Doubtless Mr. Richmond feels that the forthcoming meeting of the British Association in that town will awaken some scientific interest, and make easier the task to which he has applied himself. We can wish him all success in his praiseworthy effort to keep alive the memory of one whose genius has been the admiration of successive generations, and whose early death lent a pathetic interest to his work. Already a suitable tablet to the memory of Horrox exists in the Church of S. Michael in Liverpool, a window and memorial chapel commemorate his scientific zeal in the church at Hoole, and on the walls of Westminster Abbey there is other acknowledgment. Is another tablet precisely the form which the memorial should take? It would be just as fitting, and productive of more lasting benefit to the community, to found a Horrox scholarship for astronomy in the new University of Liverpool.

DR. E. C. HOVEY gives reasons in *Science* why the now celebrated volcano on the island of Martinique should be called by the French name Mont Pelé, and not the Anglicised Mount Pelee, in which there is little suggestion of the true pronunciation of the name.

MR. WALTER ROSENHAIN has sent a reprint of a paper read before the Optical Society of London on June 15, on some properties of glass. It deals with the crystallisation of glass due to heating, the effect of light on the colour of glass, the chemical instability of many of the most desirable optical glasses, and the thermal properties of glass, with especial reference to production of internal strains.

M. F. WORMS DE ROMILLY, whose funeral took place on May 3, has bequeathed to the French Physical Society a sum of 150,000 francs, together with his library and the whole of his apparatus. His telescope, the silvered glass mirror of which was made by Léon Foucault, is either to remain the property of the society or to be given to the National Observatory.

THE electrophorus is such a convenient apparatus for producing electricity for class experiments that the unsatisfactory explanations of its action given in many text-books are to be regretted. Dr. Otto Geschöser, in the *Beitrage* of the Oels Gymnasium, describes simple experiments tending to show that the action of the electrophorus is to be attributed to "electromotive force of contact" between the resin disc and the metal plate, and that, so far from these acting as the plates of a condenser, the efficiency of the apparatus depends on the perfection of the contact between them. A modified form of electrophorus, in which the contact is made between silvered glass as a dielectric and copper as a conductor, is described.

THE *Bulletin* of the French Physical Society announces the opening of the new Laboratoire d'Essais du Conservatoire des Arts et Métiers. This laboratory has been founded with the assistance of considerable endowments from the Chamber of Commerce, for the purpose of undertaking measurements and determinations for commercial purposes. It consists of five sections, namely, physics, metals, building materials, machines, and vegetable products. M. Perot is director of the laboratory, and M. Raveau head of the physical department. Among other objects of the laboratory may be mentioned the testing of thermometers, and the standardisation of weights and measures where great precision is not required.

IN the *Proceedings* of the Royal Philosophical Society of Glasgow, Mr. R. F. Muirhead discusses a generalisation of Lord Kelvin's statement of the formula for direct refrac-

tion through a thin lens depending on the introduction of the term "divergence." Mr. Muirhead defines the *divergence* of a pencil of rays with regard to a refracting surface as the reciprocal of the effective distance (*i.e.* actual distance ÷ refractive index) of the surface from the apex of the pencil, and the divergivity of the surface as the divergence it produces on a pencil of rays originally parallel. Lord Kelvin's rule that "divergence after refraction equals divergence before refraction plus divergivity" then applies to refractions at single surfaces, and not merely to thin lenses in air.

SEVERAL articles on the subject of aërial navigation have lately reached us. Early in the year M. W. de Fonvielle discussed the general problem in the *Revue des deux Mondes*, with especial reference to the Bradsky disaster of October, 1902, and urged the desirability of not abandoning ordinary balloon experiments in favour of attempts with motor-driven balloons. In *Cosmos* for May 23, Lieut.-Colonel G. Espitalier gave an account of the new German balloon station at Renickendorf West, the installation of which includes a hangar 50 metres long, 25 metres wide, and 20·5 metres high. Finally, we have before us a paper by Mr. W. Rickmer Rickmers, entitled "Die Beherrschung der Luft" (Vienna), in which the author condemns as contrary to natural laws the attempts made to navigate the air by mechanically propelled balloons.

PROF. J. HANN presented to the Vienna Academy of Sciences on April 2 a treatise on the air-currents at the summit of the Säntis (2504 metres) and their yearly period. The investigation is based upon the anemometrical observations for fifteen years, and the author has calculated the values of the four wind components for each month, and separately for three five-yearly periods. It was satisfactory to find a considerable agreement of the yearly period of the components in each of the three lustra. The northerly component attains its greatest value in January and February, and its smallest value in July and August. The easterly component has nearly the same yearly period as the northerly, but the maximum in winter is more pronounced, and the minimum is from June to September. The contrast between the winter and summer half-year is very marked. The southerly component has a still more marked yearly range, with a maximum in October and November, and a minimum in June. The yearly period of the westerly component is less regular, but there is a decided maximum in July and August, and a similar minimum in April and especially in May. Among other interesting problems the author also endeavours to trace the relations between this yearly variation of the wind components and the distribution of air-pressure at sea-level. These are, on the whole, well marked, so that the distribution of pressure at a height of a mile and a half cannot differ much from that at the sea-level. The S.-N. component reaches its smallest value in May and its greatest in October; the W.-E. component has also its minimum in May, but its maximum in July and August. The resultant is W. 29° S., and varies but little during the year.

DR. J. W. KIME, in an article contributed to the *Scientific American* of June 20, gives details of some experiments that show that sunlight will penetrate in a comparatively short time through a considerable thickness of flesh. He bound together a small negative and a gelatino-bromide plate of the ordinary kind (that is, not specially sensitised for colour) and put the combination between the teeth and the cheek of the subject, taking suitable precautions that no light should enter at the mouth. The cheek was then exposed to direct sunshine in February for forty seconds, and in every case it proved that the image was developable. Reproductions of the results of five experiments are shown, each with a different person. One man had a thick, short black beard, and this lessened the exposure effect somewhat. Another was a negro, with a thick, dark cheek; here the diminution in the light transmitted was still more marked. No steps were taken to interfere with the circulation of the blood, and Dr. Kime considers that his experiments show that it is not necessary, as has been stated, to compress the parts to free them from blood as far as possible when light is used as a surgical agent. Dr. Kime also states that his experiments show why red light is valuable in the treatment of small-pox. "They prove that no chemical light of any consequence reaches the patient" when red curtains are fixed over the windows, &c., and so irritation is prevented and subsequent disfigurement lessened. But as the photographic plates used were not sensitive to red light, the soundness of this deduction from the experimental results may be doubted.

IT is stated that the radium rays have been successfully applied in the treatment of a case of cancer by Prof. Gussenbauer, of Vienna. The tumour completely disappeared as a result of the application, radium bromide being made use of as a source of the rays. The early publication of these details in the public Press before there has been time to test the method effectually is much to be deprecated.

PROF. FINSEN, of Copenhagen, in a note upon the light treatment of lupus (*Acad. des Sciences*, Paris, June 22), points out that it is necessary to employ light of the greatest intensity in order to obtain penetration of the tissues, and states that his results have been much better since employing arc lamps, using a current of 60–80 amperes, than previously with 40 ampere lamps, the former penetrating in 20–25 seconds to a depth which formerly occupied 4–5 minutes.

DRS. DUTTON AND TODD, of the Liverpool Trypanosoma Expedition to Gambia, have just returned to England. They state that the disease occurs frequently both in natives and Europeans, and that it is distributed from the sea to the Upper Gambia. Besides the human disease, there is also an affection of the horse in the same region, caused by a trypanosoma, and resembling somewhat the "tse-tse" fly disease, but being more chronic. This is in all probability a disease distinct from the "tse-tse" fly disease. A mass of material has been brought home which will necessitate some time to work through.

MR. B. TIMOTHY sends us from Waterford an abnormal corolla formed by the union of several flowers, found growing on the apex of the stem of a foxglove, and surrounding the stem entirely. A botanist to whom we submitted the specimen remarks in reply that this abnormal development of a foxglove is "a case of *peloria*, that is, a change or revision from an irregular to a regular condition of the flower; in this instance there is an additional abnormality, since the pistil has proliferated, *i.e.* instead of carpels an inner flower has been formed which bears stamens, but inside the carpels again have produced vegetative structures, the bracts."

A FINE sample of the Okapi (*Ocapia johnstoni*) has recently been acquired by the Hon. Walter Rothschild for his collection at Tring. The modelling has been entrusted to Mr. Rowland Ward.

IN vol. lxxiv. part iii. of the *Zeitschrift für wissenschaftliche Zoologie*, Mr. R. Weinberg publishes the first of a series of articles on the brains of fossil vertebrates, dealing in this case with the small Tertiary perissodactyle

Anchilophus desmaresti. The brain of this mammal, it appears, although essentially primitive, exhibits all the characteristic ungulate features, with a marked approximation towards the modern perissodactyle type.

To the June number of the *Zoologist* Mr. Lydekker contributes a note on the probable use of the bilobed canine tooth of the giraffe and its allies, which forms the outermost of the four pairs of lower front teeth. It has been observed that, when browsing, a giraffe (unlike a deer or an antelope) strips the leaves from the branches without biting off the twigs, and it is inferred that the complex structure of the canine is designed to aid in this "combing" action.

THE June issue of the *Economic Proceedings* of the Royal Dublin Society is devoted to an account, by Mr. G. H. Carpenter, of injurious insects and other animals observed in Ireland during 1902. Special interest attaches to two excellent illustrations, one showing the caterpillar of the ghost swift moth (*Hepialus humuli*) feeding on the roots of wheat, and the other the injury done to young wheat by the maggot of the wheat-bulb fly (*Hylemyia coarctata*). Reference is made to the new fern-weevil (*Syagrius intrudens*) recently described by Mr. Waterhouse on the evidence of imported specimens found in the fern-houses at the Royal Botanic Gardens, Glasnevin.

THE Cairo Survey Department has recently published a preliminary description, by Messrs. Andrews and Beadnell, of the remains of a giant land tortoise (*Testudo ammon*) from the Eocene of the Fayum district. The especial interest of this form is its antiquity, which far exceeds that of all other known members of the group. Dr. Andrews thinks it probable that *T. ammon* is the ancestral form of the giant tortoises met with in several European Tertiary horizons, and that the existing African *T. pardalis* may be a small survivor of the group, to which the Siwalik *T. atlas* and *T. cautleyi*, and the existing *T. sumeirei* (the well-known giant tortoise of Port Louis) may also pertain.

IN the current number of the *Zeitschrift für physikalische Chemie* Prof. F. Kohlrausch gives a summary of the work which he has carried out during the last thirteen years on the electrical conductivity of saturated solutions of slightly soluble salts. In all forty-one such salts have been investigated, and the electrical conductivities determined at different temperatures. The data are to be used for the calculation of the solubilities of the various salts, and the numbers, which must be of considerable value to the analytical chemist, are to appear in a later paper.

THE results of a careful investigation by Dr. Freundlich on the precipitation of colloidal solutions by electrolytes are published in the current number of the *Zeitschrift für physikalische Chemie*. The capacity of different electrolytes for precipitating the colloids is dependent, in a large measure, on the valency of the ions, this capacity increasing with increase of valency. For colloids which show anodic convection under the influence of an electric current, the nature of the anion is without influence, whilst for those which exhibit kathodic convection the precipitation is independent of the nature of the cation.

AN interesting account of the behaviour of chlorine towards benzene under the influence of various catalytic agents is given by Mr. Slator in the *Journal* of the Chemical Society. With iodine chloride as catalytic agent, about 70 per cent. of the reacting chlorine is used up in the production of chlorobenzene, while the remaining 30 per cent. disappears in the formation of the addition compound benzene hexachloride. When tin tetrachloride and ferric chloride are employed as catalysers, the whole of the chlorine is used up in the substitution reaction. On the other hand, when chlorine interacts with benzene under the influence of light, addition only takes place.

FOR many years past it has been the practice of the Iron and Steel Institute to republish from time to time rare and interesting papers relating to the history and manufacture of iron and steel. With the permission of the council of the British Association, the institute has now added to the series the report presented by Bunsen and Playfair to the British Association at Cambridge in 1845, on "The Gases Evolved from Iron Furnaces, with Reference to the Theory of the Smelting of Iron." This research has long been looked upon as a model of the application of the methods of scientific investigation to the elucidation of industrial problems.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Miss Gayner Rowland; two Bristly Ground Squirrels (*Xerus capensis*) from South Africa, presented by Mr. H. J. Palmer; a Ruddy Ground Squirrel (*Xerus rutilus*) from Burao, East Africa, presented by Mr. Bennett Burleigh; a Brazilian Tapir (*Tapirus americanus*), a Red Brocket (*Cariacus rufus*) from Manáos, Brazil, presented by Mr. Charles Booth; a Grand Galago (*Galago crassicaudata*) from East Africa, presented by Captain C. Mylton Thornycroft; three Fat-tailed Desert Mice (*Pachyuromys dupresi*) from Egypt, presented by Dr. H. P. Keatinge; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, a Goldfinch (*Carduelis elegans*), European; a Red-bellied Waxbill (*Estrelda rubiventris*) from West Africa, a Yellow-bellied Liothrix (*Liothrix luteus*) from India, presented by Mrs. Halsey Ralph Ricardo; a Punjaub Sheep (*Ovis cycloceros*) from North-west India, two White-necked Cranes (*Anthropoides leucacheu*) from Japan, four Demoiselle Cranes (*Anthropoides virgo*) from North Africa, purchased; a Burrhel Sheep (*Ovis burrhel*), a Sambur Deer (*Cervus aristotelis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1903 *c*.—A new ephemeris, calculated from new elements by Herr M. Ebell, is given in Kiel *Circular* No. 62. It extends to a later date than the one previously published by M. Fayet, and also varies slightly from that one. The following data are given for the four last dates included in the new ephemeris:—

Ephemeris 12*h*. (*M.T. Berlin*).

1903	α h. m. s.	δ	log Δ	Brightness
July 17	18 41 11	+62 2′·2	9·4324	14·6
,, 19	17 7 44	+67 35′·1	9·4553	14·2
,, 21	15 22 3	+68 36′·0	9·4906	13·1
,, 23	13 59 5	+66 17′·8	9·5327	11·7

The following observations of this comet are recorded in No. 3882 of the *Astronomische Nachrichten*.

Dr. Meyermann, using the Kreutz micrometer on a 6-inch comet-seeker, and Prof. Ambronn, with the Repsold heliometer, record that on June 23 the comet was 2′ in diameter and had a faint tail, whilst for June 24 the latter observer records that in difficult "seeing" a faint tail extending towards the south was seen.

Prof. Hartwig, using the Bamberg heliometer, records that on June 23 the nucleus was between the tenth and eleventh magnitudes, and the tail was of the divided form, having a mean position angle of 250°, whilst the coma was about 10′ in diameter.

Prof. Millosevich, observing at Rome with a 39cm. equatorial and a filar micrometer on June 23, recorded a 9·5 magnitude nucleus, and a very short tail, which extended in a S.S.W. direction.

SEARCH-EPHEMERIS FOR COMET 1896 V. (GIACOBINI).—A further instalment of the ephemeris of this comet is published in the *Astronomische Nachrichten*, No. 3881, by Herr M. Ebell.

The following is an extract from the ephemeris, which takes June 22·5·1903 as the time of perihelion passage :—

Ephemeris 12*h*. (*M.T. Berlin.*)

1903	α	δ	log *r*	log Δ	Brightness.
	h. m. s.	° ′			
July 16	1 59 36	+17 33·9	0·1697	0·1065	2·55
,, 24	2 20 51	+18 16·6	0·1749	0·0970	2·60
Aug. 1	2 40 51	+18 41·6	0·1814	0·0874	2·64
,, 9	2 59 22	+18 49·1	0·1889	0·0776	2·67
,, 17	3 16 7	+18 39·7	0·1975	0·0676	2·69
,, 25	3 30 50	+18 14·0	0·2068	0·0573	2·70
Sept. 2	3 43 15	+17 33·2	0·2168	0·0468	2·70
,, 10	3 53 10	+16 38·3	0·2272	0·0364	2·70

The continuation of this ephemeris indicates that, after the last-mentioned date, the comet will slowly decrease in brightness.

THE LIMITS OF UNAIDED VISION.—Lick Observatory *Bulletin* No. 38 gives an account of some interesting observations made by Mr. Heber D. Curtis, at Prof. Newcomb's suggestion, on the inferior limit of magnitude obtainable in naked-eye observations.

A preliminary examination of previous naked-eye catalogues showed that the mean magnitude of the faintest stars included in Ptolemy's Almagest was 5·38 on the scale of the Harvard Photometric Durchmusterung, whilst Houzeau in his "Uranométrie Générale" stated that stars of the sixth magnitude were constantly seen in a clear atmosphere, and those of magnitude 6·7 could be seen at intervals; the latter value corresponds to 6·40 on the Harvard scale. Gould, in the introduction to the "Uranometria Argentina," states that 6·5 was the average limit at Cordoba, but on exceptionally clear nights the seventh magnitude was possible. These two values are respectively equivalent to 6·16 and 6·71 on the Harvard scale.

In his own observations Mr. Curtis used two large blackened discs to screen off the diffused sky-light, these two discs being attached to the 12-inch telescope at a distance of 178 inches from each other, and the front one pierced by a circular hole half an inch in diameter, the rear one by a quarter-inch hole. By this arrangement he was able, on a night when a 6·53 magnitude star could be seen without using the discs, to see the following stars in the regions about T Virginis and T Ursæ Majoris respectively :—

Bonn DM. number	Declination	Magnitude	
	° ′		
3219	− 4 40	7·31 HP[1]	Seen quite easily.
3459	− 5 23	8·3 H[2]	Seen with considerable difficulty.
3463	− 5 37	8·1 H	Seen without difficulty.
1413	+60 18	8·3 H	Seen with difficulty.
1415	+60 13	8·5 H	Glimpsed at intervals; very doubtful.
1457	+59 30	8·2 H	Seen.

Mr. Curtis found that the screening off of the diffused light was even of more importance than knowing exactly where to look for the object.

AN ETHNOGRAPHICAL EXPEDITION TO BRITISH NEW GUINEA.

THERE are few areas of equal extent that present so many interesting sociological and cultural problems as British New Guinea. It is necessary these should be studied on the spot, and that, too, with as little delay as possible, for, even there, the remorseless activity of the white man is rapidly making itself felt.

We know there are various cultural provinces in British New Guinea which, in certain respects, are markedly distinct from each other; for example, we recognise districts that may, for the present, be conveniently distinguished by the geographical terms of Western, Fly River, Papuan Gulf, Central, South-Eastern, and North Coast, and some of these districts are capable of further subdivision. In most cases it is possible to tell within comparatively narrow limits the provenance of a decorated object by its form, technique, and the motive of its ornamentation. Although these general facts are well known to ethnological experts, there is still lacking an immense amount of detailed information of even these relatively superficial data that can be acquired only in the field. It is one thing to know what an object is and where it comes from, but it is much more important to understand the meaning of its form and decoration, and arm-chair musings, or even comparative study in museums, will be of little avail in this inquiry; on the contrary, they are liable to lead one astray.

It is becoming more and more recognised that the religion of primitive peoples is manifested in their arts and crafts, and that it is itself a reflex of their social condition. A student begins by being interested in patterns, is led into a study of comparative religion, and ends in sociology. In British New Guinea these several subjects have a peculiar interest. The decorative art is rich, varied, and distinctive. Concerning the religion very little is known; we are aware that true totemism occurs in the west, and it is probable that all stages, from animal reverence, through a hero-cult to an actual hierarchy of gods can be traced from the Netherlands boundary to the bight of the Papuan Gulf. The recognition of personal powers superior to man seems to be lacking in the Central District, and in the South-east District totemism again appears, and there is, or has been, a regard for the frigate bird, which in any case is probably not now totemic, but of the significance of this probable cult of the frigate bird we have at present not a particle of evidence. As to sociology, we have indications that British New Guinea possesses many varied and interesting aspects, and there is every reason to suspect a gradation in social structure will eventually be revealed that will illustrate some important phases of social evolution.

These are but one or two of the many promising fields of inquiry that British New Guinea affords to the ethnologist. At present we have but enough knowledge to appreciate the fact that there are these unsolved problems—the information being merely sufficient to emphasise our ignorance. It was his appreciation of this fact that led Major W. Cooke Daniels to organise an expedition to British New Guinea which will leave this country in August.

Major W. Cooke Daniels served in the United States Army during the Cuban campaign as Adjutant-General of Division. He has travelled extensively in British Guiana and elsewhere, and has consequently had much experience of travel and of organisation. He proposes to make observations in experimental psychology, and will undertake ethnological investigations. Dr. C. G. Seligmann, of St. Thomas's Hospital, was a member of the recent Cambridge Anthropological Expedition to New Guinea and Sarawak, and consequently has had considerable experience in anthropological field work. As the representative of the Cancer Commission on the expedition, he will investigate the question of the prevalence and incidence of tumours, especially those of a malignant type. He has care of the health of the expedition, and will help in the ethnological inquiries.

Dr. W. Mersh Strong, of Trinity College, Cambridge, will be responsible for the geographical and geological observations, and will undertake pathological and medical research as opportunity offers.

Preparations have been made for the taking of a very large number of photographs, including kinematograph records; this department is in charge of Mr. A. H. Dunning.

Major Daniels is sending to Australia for the expedition's use a schooner yacht fitted with auxiliary power; a sea-going launch is being taken out for river work. The expedition is fitted with a large amount of scientific equipment, so that all departments of anthropological research can be prosecuted. The majority of the surveying instruments have been lent by the council of the Royal Geographical Society. The Government Grant Committee has shown its appreciation of the expedition by giving a small grant, and the Royal Society has furthered its objects in various ways. The expedition is also recognised by the Cancer Commission.

It will be seen that the Daniels Ethnographical Expedition to New Guinea is thoroughly equipped, and we wish it the success it deserves.

[1] HP = Harvard Photometric Durchmusterung.
[2] H = Hagen's "Atlas Stellarum Variabilium."

ON A PROBABLE RELATIONSHIP BETWEEN THE SOLAR PROMINENCES AND CORONA.[1]

IN a previous number of this Journal (NATURE, vol. lxvii. p. 569, April 16) an account was given of the results which had been deduced from a minute investigation of the percentage frequency of prominences as determined from observations made by Secchi and Tacchini at Rome, and Ricco and Mascari at Catania and Palermo. It was there shown that the chief centres of prominence action, that is, the zones in which the greatest percentage frequency of prominences occurred, indicated movements in heliographic latitudes, the general tendency of these being in a direction towards the solar poles, and not towards the equator, as is the case with the spots. Attention was also directed to the fact that these centres of prominence activity were not restricted to a narrow zone like the spots, which only occur between the latitudes $\pm 5°$ and $\pm 35°$, but that at times they were numerous in such high latitudes as $\pm 80°$, and even higher.

The present article contains an account of the results of a general survey that has been made regarding the connection between the changes of position of these centres of prominence action and the various forms of the corona as observed during total eclipses.

It has been suggested, and the idea is generally accepted, that the various forms of the solar corona are intimately connected with the variation in the spotted area of the sun's surface. Thus, generally speaking, at about the epochs of sun-spot maxima, the corona is apparently very irregular in shape, there being little or none of the exquisite tracery at the sun's poles which is so evident at the epochs of sun-spot minima, while the streamers are less confined to mid-solar latitudes and the region near the equator than they are at the minima.

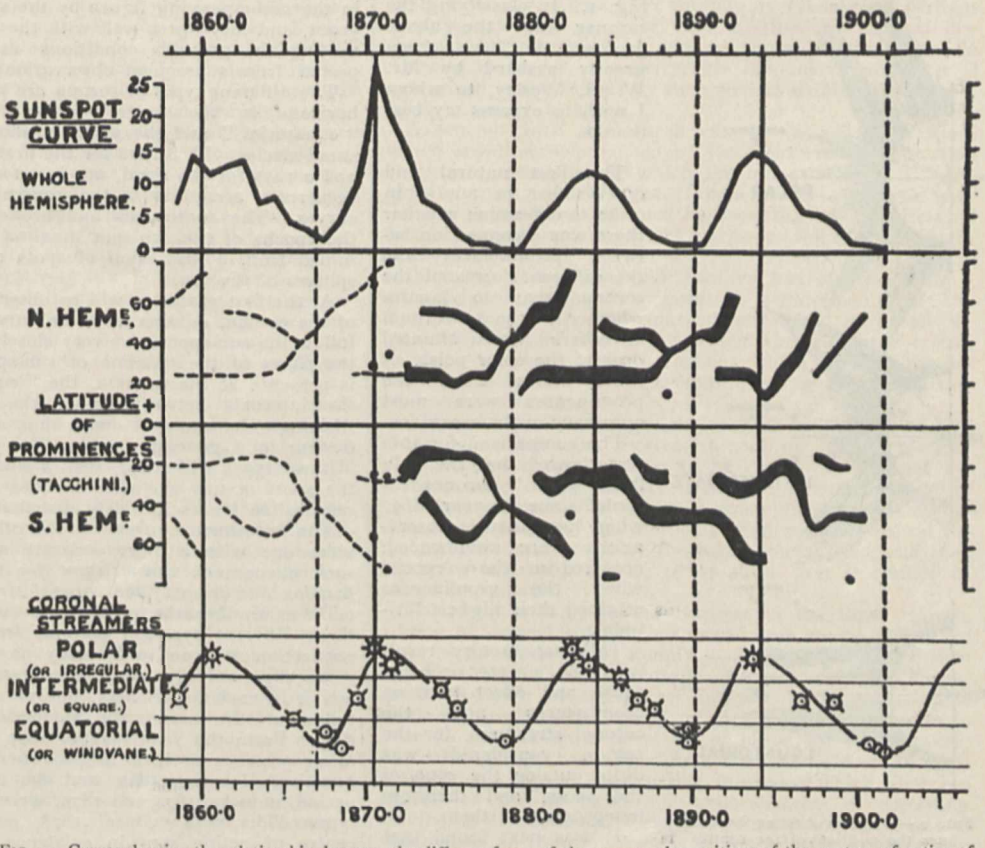

FIG. 1.—Curves showing the relationship between the different forms of the corona, the positions of the centres of action of prominence phenomena and the general sun-spot curve. The continuous and broken vertical lines indicate the epoch of the maxima and minima respectively of the last mentioned curve.

The facts that sun-spots do not appear nearer the poles than latitudes $\pm 35°$, and that large coronal streamers and prominent rays are sometimes visible in much higher latitudes than these—in fact at times near the poles of the sun, and consequently outside the regions of spot activity—suggested that the occurrence of prominences, very important factors in the mechanism of the solar atmosphere, might be closely connected with them.

In the present general inquiry, the forms of the coronas that have been observed since the year 1857 have been divided into three main types, and this classification, which is not new, is one into which most of the coronas, with the exception of two, namely 1865 and 1885, can be easily placed. Since the forms of coronas are dependent chiefly on the positions of the coronal streamers, the three different types here adopted refer in the main to the positions of these streamers in relation to the solar equator and poles.

In the first, or "polar" group as it has here been called, since streamers are found near the solar poles, all those coronas are included which seem to have no regular form. The typical features of this group are that the polar rifts are absent, being replaced to a great extent by streamers at, or very close to, the poles, and the streamers are numerous in nearly all solar latitudes; also there is no definite equatorial extension. To this class the following coronas belong, 1860, 1870, 1871, 1882, 1883, and 1893.

In the third, or "equatorial" group, since the streamers are in lower latitudes, and consequently more equatorial, the form of the corona is very regular. The polar rifts have a great spread in latitude and are well defined, while the large streamers are restricted to the regions near the equator; in fact, the great equatorial extensions are best seen in this type. This form generally takes the shape of a "wind vane," and is often referred to as such. The coronas which come into this category are those of 1867, 1868, 1878, 1889 January, 1889 December, 1900 and 1901.

The second group of this classification may be termed the "intermediate" type, as the streamers are about half way or intermediate between the poles and the equator. In this group the polar rifts are present, but they are not so extensive in latitude as in the "equatorial" class. The coronal streamers also approach nearer the polar regions than in the "equatorial" class, but not so close as in the "polar" group, while the equatorial extensions are not in such great evidence. Generally speaking, this form of corona is due to a large streamer in each quadrant, which gives the corona the appearance of a square, hence the name "square corona," which has been often used.

The coronas which fall under this heading are 1858, 1869, 1874, 1875, 1886, 1887, 1896, 1898. It may be stated

[1] Abstract of a paper recently communicated to the Royal Astronomical Society by Dr. William J. S. Lockyer.

that the "polar" and "equatorial" coronas are always followed by "intermediate" types, the order being polar, intermediate, equatorial, intermediate, polar, &c.[1]

The "intermediate" type may sometimes approach in form a "polar" or an "equatorial" type, according as the epoch of the occurrence of the eclipse occurs nearer or further from the epochs of occurrence of polar prominences.

Further, the "intermediate" type preceding a "polar" type will differ to some extent from one immediately following a "polar" type, because the latitudes of the centres of prominence action in each case are different, as can be seen from the accompanying figure.

Two coronas which have not yet been classified are those of 1865 and 1885. The former of these is of a type between the "intermediate" and "equatorial," while the latter falls between the "polar" and "intermediate" groups. These have been inserted on the dividing lines in Fig. 1. In classifying the coronas into the above groups, I have been greatly assisted by Mr. W. H. Wesley, to whom I wish to express my best thanks.

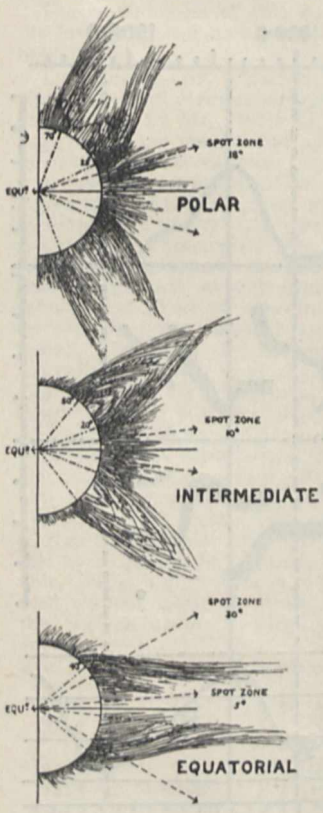

FIG. 2.—Diagram showing by radial lines the positions of the centres of prominence action and their relation to the chief features of individual coronal streamers and to the general form of the corona. The positions of the sun-spot zones are also indicated.

The first natural and crucial test to apply, in order to determine whether there was a connection between prominences and the different forms of the corona, was to inquire whether the coronal streamers were situated nearest the solar poles, at those times when the prominences were most numerous in those regions.

The comparison for this test showed that the only five "polar" coronas recorded since the year 1869, when prominence observations were commenced, occurred at those epochs when the prominences attained their highest latitudes.

This satisfactory result indicated a very probable cause and effect between prominences and the coronal streamers, for the region considered was quite outside the zone of the spots, and therefore independent of them.

It was next found that the other two types of coronas were closely associated with the number and latitudes of the centres of prominence action. Thus the "equatorial" type only occurred when there was *one* definite centre of prominence action in each hemisphere, while the "intermediate" type has been recorded at those times when *two* centres of action in each hemisphere were in progress, neither of which were in very high latitudes.

The accompanying illustration (Fig. 1) shows the relationship between the sun-spot curve for both hemispheres together, the latitudes of the centres of action of the solar prominences for each hemisphere, explained in detail in a previous number of this Journal (NATURE, vol. lxvii. p. 569, April 16), and the times of occurrence of all the eclipses that have occurred since the year 1857. When two eclipses of a similar type occur in the same, or two successive years, they have been inserted either one above the other or obliquely, respectively, to avoid overcrowding. A curve is also drawn through the different types showing their relation to the sun-spot curve.

Since the systematic prominence observations only commenced in the year 1872, the dotted portions of the curves previous to that date are intended only to give a rough idea of the variations as based on a general repetition of the observations of 1872 to 1885.

Fortunately for the present inquiry, Respighi made some very valuable prominence observations during the years 1870, 1871, and 1872, which are sufficiently numerous to indicate the positions of the centres of prominence activity for these years. These showed that during the years 1870 and 1871 there were two well-marked prominence zones in each hemisphere, and that the latitude of one of the zones was very high. The positions of these zones are indicated in the accompanying figure by the small dots against these years, and they agree well with the suggested curves representing the probable conditions as might have been expected from subsequent observations.

The different types of corona are plotted in three different horizons in the order "polar," "intermediate," and "equatorial," and the symbols adopted for each, namely, small circles with 8 rays for the first, 4 rays for the second, and 2 rays for the third, are inserted at the epochs of their occurrence according to the general time scale for all the curves. The continuous and broken vertical lines denote the epochs of the sun-spot maxima and minima, as determined from a discussion of spots recorded on both hemispheres of the sun.

At the first glance it will be observed that the three types of the corona, as seen from the curve drawn through them, follow the sun-spot curve very closely, that is, that at about the times of the maxima of sun-spots, the "polar" type is present; at the minima, the "equatorial" type; and at the intervals between these, the "intermediate" type. Although the sun-spot curve thus affords a means of predicting in a general manner the epochs about which any of these types will occur, such a small restricted zone which the spots occupy excludes the idea of their presence being responsible for such widely distributed coronal phenomena.

The prominence curve, on the other hand, not only provides one with a more accurate method of forecast, but such phenomena *can account for the general changes of position and form of the coronal streamers.*

By examining the prominence curves in relation to the three different types of coronas from the year 1869, this connection is seen to be very close. Thus, during the years 1870 and 1871 there were two centres of prominence action in each hemisphere, one of which was in high latitudes, and the coronas for that period were of the "polar" type. From the year 1872 to 1877 there were two centres of prominence activity in each hemisphere, both in comparatively low latitudes, and the two eclipses during the period, namely, 1874 and 1875, were of the "intermediate" type. The next eclipse, 1878, occurred when only one centre of action was in existence, and the form of the corona was of the "equatorial" type.

As these centres of prominence action reached their extreme polar limits (about $\pm 80°$), and a new centre had in the meanwhile commenced in lower latitudes ($\pm 25°$), the eclipses of 1882 and 1883 were of the "polar" type.

The next two eclipses, of 1886 and 1887, which were "intermediate," occurred when there were again two centres of prominence action in each hemisphere, but none near the poles. When the centres became single, as they did in the years 1889, 1890 and 1891, the two coronas observed in the year 1889 were of the "equatorial" type. With the movement of these centres to high latitudes in the years 1892, 1893, 1894, the eclipse of 1893 was of the "polar" type.

The two eclipses of 1896 and 1898, which were "intermediate" in type, occurred when there were two chief centres of prominence action, while the two most recent eclipses of 1900 and 1901 were good examples of the "equatorial" type, and were concurrent with only one centre of prominence activity in each hemisphere.

If the eclipses observed between 1856 and 1870 be compared with the dotted prominence curves for the same

[1] It may be here remarked that the "intermediate" type between an "equatorial" and "polar" type has only once (1869) been recorded during the period here under investigation, and this is due to the absence of observed eclipses during the two short available periods since that date, namely, 1879–81 and 1890–92.

period, it will be seen that a similar connection seems to exist between the latitudes of the centres of action of the prominences and the three types of coronas.

The investigation seems to indicate that it is the *sum total of prominence action* in the different zones which produces the largest coronal streamers, and not any particular prominence at any particular moment; it is for this reason that the form of the corona is not a fleeting phenomenon changing every minute or hour, but one lasting over several months, and sometimes as much as a year or more. That the general form of the corona does undergo comparatively slow changes is borne out, to a great extent, by the similarity of coronas which are observed at eclipses which occur close together, such as those in 1900, 1901, the two eclipses in 1889, &c.

It is of great interest briefly to note the connection between the centres of prominence action when either two or one of them exist in each hemisphere. In the first place a well-defined large coronal streamer apparently originates, as many photographs indicate, not from disturbance at the *centre* of its base, but near the two ends. Such a streamer is generally made up of groups of incurving structure, termed previously "synclinal" groups, and this structure is, in many cases, very distinct. When there are *two* centres of prominence action in one hemisphere, the coronal disturbances resulting from each trend towards each other, and constitute a large streamer with an apparent "arch" formation. If the two centres of prominence action exist in comparatively mid-latitudes, one large streamer is formed in each quadrant, and the form of the corona is of the "intermediate" or "square" type.

When one of the centres is near the region of the poles and the other in comparatively low latitudes, the tendency is still for the two disturbed coronal regions to trend towards each other, but they constitute either a large streamer of an "arch" formation nearer the solar poles with a very extended base, or two separate streamers which combined have a fish-tail appearance.

With *one* centre of action of prominences in each hemisphere, the resulting coronal disturbances in both hemispheres curve towards the solar equator, and form apparently a large equatorial streamer; the "equatorial" type of corona is here formed.

The accompanying sketches (Fig. 2) illustrate in diagrammatic form the general relationships between the latitudes of the spot zones, the latitudes of the centres of action of the prominences, and the suggested resulting positions and origin of structure of the coronal streamers for each of the three types of coronas here discussed. It will be noticed that in the case of the "polar" and "intermediate" types, when the sun-spots are numerous, the zones in which they occur have apparently little connection with the coronal streamers. When the latitudes of the spot zones do approximate more nearly to the bases of the coronal streamers, as in the "equatorial" type, and might be considered as being the origin of their existence, the spots at these epochs are near a minimum, that is, are very few and small in size, and have the least power of action.

WILLIAM J. S. LOCKYER.

SOME PRESENT AIMS AND PROSPECTS OF MATHEMATICAL RESEARCH.[1]

IT may be doubted on the whole whether any completely scientific and permanent dividing lines for the classification of modern original work of pure and applied mathematics can be drawn.

The nearest approach is perhaps an arrangement according to motive. Thus a first class may be constituted of those investigations which aim at discovering and establishing the foundations of the subject, and obtaining rigorous proofs of theorems already known; such work as that which Peano and Russell are doing in their symbolic notation for the general principles of mathematics, or Pieri and Veronese for the axioms of geometry, or Picard for the existence theorems of differential equations, or Vallée-Poussin for the differentiation of definite integrals.

[1] From an address by Mr. E. T. Whittaker on "Some Present Aims and Prospects of Mathematical Research," delivered before the University College Mathematical Society on June 25.

Although the primary aim of such papers is that of imparting a strict logical rigour to the theory discussed, yet the most surprising and unexpected new results are constantly arising in them; as an instance, I may mention Fano's discovery of a space which consists only of 15 points, and which satisfies all the conditions for an ordinary projective space except the condition that each part is to be distinct from its harmonic conjugate; or the remarkable result that a projective geometry of two dimensions cannot be obtained without the supposition that the two-dimensional space is contained in a three-dimensional space; or the well-known theory of Fourier series and integrals which can represent different analytic functions in different parts of their domain of existence. It is a notable fact that this type of research seems peculiarly congenial to the mind of the Latin races. Undoubtedly much work of the kind has been done in Germany during the nineteenth century, but the honour of its foundation must be assigned to Cauchy, and its home has always been in France and Italy. In this country it has never thoroughly taken root, perhaps because, as someone said, the Englishman cannot distinguish between a proof and an appeal to the jury. In America, however, a considerable amount of attention is now given to the subject by such writers as Moore, Osgood, Bôcher, and Huntington.

A second class of research can be formed from those which are directly provoked by some observed phenomenon of nature, researches of which the immortal type is Newton's discovery that if the planets move in ellipses with the sun in one focus, it must be because they are attracted to the sun with a force which varies as the inverse square of the distance.

In work of this kind our country has always borne a distinguished share; the greatest achievements of the English school of mathematical physicists must all be included in it, and even at the present time no paper excites so much interest among us as one which gives a mathematical explanation of the Zeeman effect or the second law of thermodynamics.

A third class of investigations may be made to consist of those in which the motive is not in some external phenomenon, but in what may be called the internal expansive force of the subject itself, the inherent capability of extension, which is latent in every theorem of mathematics, the desire of the mathematician who has solved the quadratic equation to solve the cubic and quartic, and then either to solve the quintic or to show that it cannot be solved by radicals.

This, which is by far the largest of the three classes, admits of several subdivisions, according as the successful issue of the work is due mainly to the author's geometrical imagination, as in the writings of Cremona and Chasles, or to his power of algebraical analysis, as in much of the work of Jacobi and Cayley, or to his having brought to bear on the subject a novel set of ideas, as, for instance, in Fuchs's papers on linear differential equations, or to what may be called pure constructive intuition, which does not depend on the extension and generalisation of preceding results, as for instance, Euler's expression for the gamma-function as an infinite product, or his solution of the many types of differential equations.

The second of these subclasses, namely, that in which the successful management of highly complicated symbolic work is the most prominent feature, has flourished perhaps more than any other branch of non-physical mathematics in our own country.

It may be questioned whether this is not in part a consequence of the traditional English mode of training, which includes far more working of hard examples than is customary abroad, and thereby gives the mathematician that algebraical power which comes of much practice: but no one can see such work as that of Cayley or Forsyth without feeling that it is largely due to an inherent algebraic power with which our distinguished fellow-countrymen have been endowed. The introduction of new algorithms and new concepts is, on the other hand, a German characteristic; a notable instance is furnished by the invariant-theory, which, after its first development by Cayley and Salmon on purely algebraical lines, was transformed by Aronhold's introduction of the symbolic notation. The *Mengenlehre* of Cantor, the Ausdehnungslehre of Grassmann, numerative geometry and the theory

of algebraic numbers, are instances of subjects the inception of which we owe to the Germany of the nineteenth century.

While, as we have already remarked, the English have shown a considerable interest in some branches of research, it is often said, and I think with truth, that our record in the history of modern mathematics is not worthy of our place among the nations. It is, at any rate, a fact that a considerable number of men spend the greater part of their student life in the special study of mathematics, and after a successful college career are appointed to teaching posts which leave them a fair amount of leisure for the pursuit of their chosen subject, and that, nevertheless, their life is barren of contributions to learning. This state of things, which we must admit to be much more general in this country than on the Continent, is, perhaps, the gravest feature in the situation at present, and it becomes deeply interesting to attempt to trace its course.

The explanation which I personally favour places the origin of the evil back in student days, and in our methods of instruction. The most casual reader of text-books cannot fail to be struck by the fact that English text-books treat their subjects in much greater detail than is customary on the Continent; innumerable side-issues are raised, trifles are elaborated, and examples are multiplied a hundredfold. Moreover, topics which have now become comparatively unimportant, or even positively obsolete, are always retained, and each text-book differs from its predecessor only in a further increase of prolixity.

The result is that even the best men cannot, in a student course of many years, wade through this mass of material to the frontier of existing knowledge, and the unfortunate student finds his college career over and his teaching life begun before he has gone anything like far enough to begin independent research.

I can scarcely conceive a greater benefit to the study of mathematics in this country than a series of short text-books holding closely to the main lines, casting away the rubbish and the trifles, and carrying a student to the furthest boundary of learning in a three years' university course.

Although the evil relates chiefly to college text-books, it would not be difficult to mention branches of higher learning the progress of which has been arrested for a long period simply by the publication of unreadable accounts of them.

In order that our research may be the worthy centre of a life-work, it is needful to have not merely the equipment of a full knowledge of the past, but also a clear and well-defined idea as to which are to be considered the chief and which the minor objects of investigation. For the next worse thing to doing no research at all is to spend one's time on matters that are of very little consequence.

This point is all the more important because there is every indication that we are now at a critical point in the history of mathematics, and that the twentieth century will see progress in somewhat different directions from those which characterised the last half of the nineteenth.

Let me recall the fact that, from the time of Newton to the death of Cauchy in 1857, the main progress of mathematics was in the realm of analysis—the science which is based on Newton's infinitesimal calculus, and which was enriched by all the greatest masters, Euler, Lagrange, Laplace, D'Alembert, the Bernouillis, Taylor, Legendre, Fourier, Gauss, Abel, Jacobi, and Cauchy.

The latter half of the nineteenth century saw, however, a notable change. As in the hands of these giants even the inexhaustible mine of analysis seemed to be worked out, new subjects came into prominence, such as invariants, the theory of groups, the Mengenlehre, analysis situs, quaternions, and non-Euclidean geometry; the theory of functions developed itself on lines quite foreign to the older analysts, and the demand for rigorous proofs led many even of those who remained in the domain of analysis, as Du Bois Reymond and Pringsheim, to devote themselves rather to a careful investigation of the foundations than to an extension of the superstructure. Now, however, we seem to be on the threshold of a change. The branches of mathematics the introduction of which we owe to the last generations of German mathematicians are already beginning to show signs of exhaustion—by which I mean that further work in such a subject as the invariant-theorem along the present lines does not promise to yield any great increase of mathematical power; the process of underpinning the edifice has now been, to a great extent, accomplished, and the work of upbuilding can be recommenced, while the interest of the theory of functions has largely passed over into topics of a distinctly analytical character, such as the theory of automorphic functions, the theory of expansions convergent within a given region, and the theory of summable series.

All the indications seem to point to the conclusion that pure mathematics is in the process of its natural evolution returning to the old path, and that a new phase of advance in the analysis of differential equations and functions is about to come upon us.

But though the same, it will be changed; the work of the last fifty years has given rise to ideas and methods the application of which must necessarily extend the older subjects in altogether new directions, and perhaps lead to an era worthy to be compared with that of Euler and Lagrange.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Joule studentship, founded "to assist research, especially among younger men, in those branches of physical science more immediately connected with Joule's work," will shortly become vacant through the termination of the tenure of Dr. Ulrich Behn, who was nominated by the K. Akademie der Wissenschaften of Berlin in 1901. On this occasion the nomination of a student rests with the president and council of the Royal Society, who will make their selection in October next. The studentship is of the value of 100*l.* in all. Information may be obtained from the assistant secretary of the Royal Society.

WE regret to see the announcement of the death of Sir Joshua Fitch at the age of seventy-nine. The country has thus lost one of its foremost authorities on educational theory and practice. Sir Joshua Fitch was for thirty-one years connected with the Education Department, and the wide and varied experience which he acquired give exceptional weight to his views on educational subjects, expressed in many articles, books and addresses. Since his retirement from official life in 1894, he has taken an active part in the formation of sound public opinion upon educational questions. He recognised that the important point to bring before the people was "that education ought to be a national concern, that it should not be left entirely to local, or private, or irresponsible initiative." This principle must be accepted before any substantial provision will be made for educational progress. Sir Joshua took an active part in the reorganisation of the University of London as a teaching university, and throughout his career identified himself with movements which had for their object the coordination and development of the educational forces of the country.

OF the Education Vote of 11,249,806*l.* agreed to by Committee of the House of Commons last Thursday, only half a million belongs to secondary education. In the course of a speech made in introducing the vote, Sir William Anson expressed the fear that the traditional educational work was being destroyed, and was not being replaced with anything of a really substantial character. He was especially alarmed at the condition of the smaller grammar schools. "In these schools much attention is now being given to science, with results that are not altogether satisfactory. The classical languages are almost disregarded, and history and geography are neglected." Mr. Balfour spoke to much the same effect in the speech at the Allied Colonial Universities dinner which appears in another part of this issue. The suggestion is that science is not such a good educational instrument as the study of dead languages. It does not need much consideration to see that these conclusions are unsound. For centuries our grammar schools have been training grounds for teachers of Greek and Latin, and it would be strange if efficient methods had not been evolved. Every encouragement has been given to the humanities both in school and university, and the masters who have controlled the curriculum or guided the studies have been, with rare exceptions, men distinguished for

their attainments in classical fields. It is scarcely too much to say that few of these men have welcomed the introduction of science into the school curriculum. But, for the sake of recognition by county councils, and the consequent grants, science has been given a place in grammar schools as a paying guest. In many cases the headmasters know nothing of science, and care less; and the teachers in charge of the science work receive little encouragement to do anything but push on promising pupils to scholarship examinations. It is, of course, impossible to discover the educational value of scientific studies under these conditions, when no provision has been made for the supply of qualified teachers, and while the idea still prevails among many masters that text-books and lectures are the most important means of imparting scientific knowledge. It would be strange if the results of such teaching were satisfactory. If Mr. Balfour and Sir William Anson will examine the matter a little more closely, they will see that no fair comparison can yet be made between the merits of classical and scientific studies. Everything depends upon the method by which the subject is taught, and the spirit which inspires the teacher.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 14.—"The 'Elasmometer,' a New Form of Interference Apparatus for the Determination of the Elasticity of Solid Substances." By A. E. H. **Tutton**, D.Sc., F.R.S.

The apparatus is designed to measure the amount of bending suffered by a thin plate of the substance investigated, when supported near its ends against a pair of platinum-iridium knife-edges, under a known weight applied at its centre. It consists of an elaborate apparatus for the support and adjustment of the plate and knife-edges; a measuring microscope, reading in two rectangular directions by a new method to the thousandth of a millimetre, for measuring the dimensions of the plate *in situ*; a specially constructed form of balance, one end of the beam of which carries an agate point, through which a pressure is applied under the centre of the plate equal to the weight in a pan suspended from the other end; a delicate control apparatus, which only permits the weight to operate extremely slowly; an interference apparatus, of which the two reflecting surfaces concerned in the interference are (1) the lower surface of a colourless glass disc supported on a tripod in rigid connection with the knife-edges, and (2) the upper surface of a smaller black glass disc forming the top of a counterpoised rocker, arranged to move with the centre of the plate and thus to transmit its motion. The amount of diminution in the thickness of the air film between the two glass surfaces, consequent on the bending of the plate, is given by the number of interference bands which pass the centre of reference, as seen in the micrometer eye-piece of the observing apparatus, multiplied by half the wave-length of the G or F hydrogen light which is employed. The optical apparatus of the dilatometer previously exhibited is utilised for the transmission of the hydrogen light to the interference apparatus, and as observing apparatus.

June 18.—"On the Discharge of Electricity from Hot Platinum." By Harold A. **Wilson**, D.Sc., B.A., Fellow of Trinity College, Cambridge. Communicated by C. T. R. Wilson, F.R.S.

This paper contains an account of a series of experiments on the discharge of electricity from hot platinum wires. The main object of the investigation was to determine the influence exerted by the nature of the gas in which the wire is immersed.

It was found that the presence of traces of hydrogen in the wire enormously increases the leak of negative electricity from it. By taking precautions to remove hydrogen the negative leak was diminished to one part in 250,000 of its usual value. The presence of traces of phosphorus pentoxide was found enormously to increase the negative leak, and it is known that alkali salts have a similar effect. The results obtained lead to the conclusion that the negative leak is due to the presence of traces of hydrogen, or possibly other substances, in the wire.

With a particular wire in air, the small negative leak remaining when impurities have been got rid of, as far as possible, only falls off very slowly with time, and its variation with the pressure of the air, the potential difference, and the temperature can be measured.

It is shown that the variation of the negative leak with the air pressure and potential difference is due to the ionisation of the air by collisions of the negative ions leaving the wire with the air molecules. If the P.D. used is too small to produce ionisation by collisions, the leak is independent of the air pressure.

The variation of the negative leak with the temperature is investigated, and a formula which represents it is deduced from thermodynamical considerations.

The negative leak in hydrogen at various pressures is measured and found to increase proportionally to the pressure at low pressures. It is shown that the negative leak depends on the amount of hydrogen occluded by the wire. The following table gives the negative leaks at 1400° C. at several pressures in hydrogen:—

Pressure.	Current per sq. centim.
133·0 mm.	$1·0 \times 10^{-3}$ ampere.
0·112 ,, ...	$1·2 \times 10^{-5}$,,
0·0013 ,, ...	$2·0 \times 10^{-7}$,,
0·0 ,, ...	$1·2 \times 10^{-10}$,,

The energy required for the production of a gram molecular weight of negative ions is found to have the following values:—

(1)	Thoroughly clean wire in air or vacuum	155,000 calories.
(2)	Cleaned wire in air or vacuum.	131,100 ,,
(3)	Wire in H_2 at 0·0013 mm. ...	120,000 ,,
(4)	,, ,, 0·112 ,, ...	85,900 ,,
(5)	,, ,, 133·0 ,, ...	36,000 ,,

The paper also contains measurements of the positive leak. It is shown that there is no positive leak appreciable on a galvanometer from a clean wire in a vacuum. In air or hydrogen there is a positive leak, which increases with the gas pressure, and which is probably due to ionisation of the gas molecules in contact with the hot platinum.

It is probable that a pure platinum wire heated in a perfect vacuum would not discharge any electricity at all, either positive or negative, to an extent appreciable on a galvanometer.

"Upon the Bactericidal Action of some Ultra-violet Radiations as Produced by the Continuous-current Arc." By J. E. **Barnard** and H. de R. **Morgan**. Communicated by Sir Henry Roscoe, F.R.S.

The experiments described were carried out with the object of determining the effect on the vitality of bacteria, as the result of exposure to the arc spectra of carbon and of various metals.

The organisms experimented with have been the *Bacillus coli communis*, *B. prodigiosus*, *B. subtilis*, *Micrococcus tetragenus*, *Staphylococcus aureus* and *Bacillus tuberculosis*.

The conclusion arrived at is that the bactericidal action of light is almost entirely due to the action of those radiations in the ultra-violet region of the spectrum which are included between the wave-lengths 3287 and 2265. It is, therefore, necessary that any source of light used as a bactericidal agent should be rich in these rays.

Royal Meteorological Society, June 17.—Captain D. Wilson-Barker, president, in the chair.—Dr. W. N. **Shaw**, F.R.S., read a paper on the meteorological aspects of the storm of February 26–27. Between sunset of February 26 and noon of February 27, the British Isles were visited by a storm of unusual severity. Its most impressive characteristic was the amount of damage done to trees and buildings by gales from the south or south-west, particularly in the neighbourhood of Dublin, where very large numbers of trees were uprooted, and in Lancashire. Gales or strong winds were also experienced in many parts of the British Isles. Dr. Shaw exhibited lantern slides showing the path of the barometric minimum and the area over which the destruction extended. He also put forward some general considerations about barometric depressions and storms, dealing more especially with the distribution of winds and

the velocity of travel, and concluded by making some remarks on self-recording instruments and their management.—A paper by Mr. J. **Baxendell,** on the Dines-Baxendell anemograph and the dial pattern non-oscillating pressure-plate anemometer, was read by the secretary. The Dines pressure-tube anemometer is now the accepted standard instrument for recording wind movement, but it does not record the direction of the wind. Mr. Baxendell has endeavoured to overcome this drawback, and in this paper he gives a description of the combined velocity and direction anemometer which he has designed for the Fernley Observatory at Southport. In addition, he has designed a non-oscillating pressure-plate for showing on a dial the maximum pressure of the wind. By using a combined "head" or vane for the Dines anemometer, Mr. Baxendell has been able to arrange for the new instrument to record (1) the velocity, (2) the direction, and (3) the maximum pressure of the wind.

Linnean Society, June 18.—Prof. S. H. Vines, F.R.S., president, in the chair.—New Chinese plants, by Mr. S. T. **Dunn.** In this, descriptions of more than seventy new species are given, founded on specimens collected chiefly in Yunnan by Dr. A. Henry and Mr. E. H. Wilson.—The germination of the seeds of *Davidia involucrata*, by Mr. W. Botting **Hemsley,** F.R.S. The fruit has an exceedingly hard, bony endocarp or "stone," enclosing usually a number of seeds, and causing wonder how they can free themselves for germination. Under the influence of moisture, a portion of the back of each cell (carpel) separates and falls away in the form of a valve or shutter, revealing a portion of the seed. The radicle soon begins to grow, and in due time reaches the ground, when the upper part of the plantlet frees itself and commences an independent existence.—Rudimentary horns in horses, by Dr. G. W. **Eustace.** Two thoroughbred horses showed bilateral osseous prominences, casts of which were shown; in both the left or near boss is the larger. The occurrence of these is extremely rare, but the pedigree of all known instances being traced back, it is found that they are all descended from the Darly Arabian, bought at Aleppo, and shipped to England in 1705; further, all are descended from Eclipse. The only reference to this phenomenon is that noted by Darwin, "Variation of Animals and Plants," vol. i. p. 52. The author shows that these bosses are not mere exostoses due to disease, and draws the conclusion that they are instances of the reappearance, in a rudimentary condition, of structures which once existed in a functionally perfect condition.—Scottish fresh-water plankton, part i., by Mr. W. **West** and Prof. G. S. **West.** The paper deals with plankton-material from lochs in different parts of Scotland and the Outer Hebrides. The Scottish plankton is found to differ considerably from that of the western part of continental Europe; it is remarkably rich in Desmids, which are of a distinctly western type, and the most abundant are species of Staurastrum. The scarcity of free-swimming Protococcoideæ is striking, but Diatoms are fairly represented. A noteworthy feature is that both Diatoms and Desmids display long spines or processes; this excessive development is ascribed by the authors to the assumption of a purely free-swimming habit.—On the anatomy of the leaves of British grasses, by Mr. L. **Lewton-Brain.** The paper is the result of testing the classification of leaf-structure devised by Prof. Marshall Ward. Four main types are recognised:—(1) leaves in which the upper surface is flat or nearly so; (2) the upper surface marked by distinct though not very high ribs; (3) the upper surface marked by very distinct and high ribs; and (4) the upper surface reduced to a mere fold in an almost solid leaf.

Geological Society, June 24.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—On a transported mass of Ampthill Clay in the Boulder-clay at Biggleswade (Bedfordshire), by Mr. Henry **Home.** Under 10½ feet of soil and Boulder-clay, the Ampthill Clay was penetrated for 67 feet, resting on Chalky Boulder-clay, fine silty clay, disturbed Gault, and Lower Greensand. The clay is lithologically identical with the Ampthill Clay with its selenite-crystals, and contains *Ammonites excavatus*, often covered with Serpulæ, but no abundant examples of *Ostrea deltoidea*. The boulder was probably an outlier, situated in Oxford Clay at a level high enough to be ploughed into by the agent which formed the Glacial Drift.—The Rhætic and Lower Lias of Sedbury Cliff, near Chepstow, by Mr. Linsdall **Richardson.** The chief portion of the cliff-section described has a direction north-east and south-west; the dip of the beds does not exceed 3° to the south-south-east.—Notes on the lowest beds of the Lower Lias at Sedbury Cliff, by Mr. Arthur **Vaughan.** The two chief points of interest of this section are, the relation of the basal conglomerate to the Cotham Marble and White Lias of neighbouring districts, and the examination of the faunal sequence, with a view of testing the absolute value of ammonite-zones. A diagram is given showing the times of appearance and disappearance, the abundance or rarity, of several fossils within and below the zone of *Ammonites psilonotus*, and on account of the beginning of five forms at a given horizon and the disappearance of several forms immediately below it, this level is chosen as the base of the zone of *A. psilonotus*, rather than the point of appearance of *A. planorbis*, 4 feet higher up. It is hoped that the construction of similar diagrams will be of use in testing the value of a series of ammonite-ages as divisions of relative time.

DUBLIN.

Royal Dublin Society, June 16.—Prof. J. M. Purser in the chair.—Prof. T. **Johnson** and Miss M. C. **Knowles** gave an account of the contents of the British herbarium of the late H. C. Levinge, which had been given to the National Museum in Dublin. The collection contains specimens of nearly all the species of flowering plants and ferns recorded for Ireland; it is especially rich in West-meath plants, and supplies many additions to the records of Irish topographical botany. Mr. Levinge's herbarium of ferns, British and foreign—4000 sheets—had been previously given to the museum.—Prof. J. A. **McClelland** read a paper on ionisation in atmospheric air. This paper deals with the amount of ionisation in free atmospheric air, and the variations of the ionisation at different times. The largest values have been obtained after several hours' continuous rain, which would agree with the known radio-activity of freshly fallen rain. On the other hand, very small values of the ionisation have been found after slight showers, probably because the ions have been removed from the atmosphere by the condensation on them of water vapour.—Dr. Henry H. **Dixon** showed a model for illustrating the part played by the mesophyll cells in transpiration. The model consists of a funnel closed above by two membranes, between which is a lenticular space containing a sugar solution. The funnel and its stem are filled with water, and, when set in an upright position, are supplied with water through a capillary tube. The motion of water in this tube is made apparent by microscopically observing a precipitate suspended in it. In the paper the working of the model is explained, and it is pointed out that the tension set up by evaporation from the surface of the leaf-cells is transmitted, through the solvent in them, to the water in the conducting tracts of the plant, while at the same time the dissolved substances exert an osmotic pressure and keep the cells turgid. The paper also contains the description of an experiment by which the solvent of osmotic cells may be subjected to tension while at the same time the pressure exerted by the solute is apparent.—Prof. A. W. **Conway** read a paper on a new foundation for electrodynamics; a modification of the scheme of Helmholtz was proposed in it, the scalar and vector potentials being multiplied by a factor showing Döppler effect.—Mr. J. T. **Jackson** described a new method of producing tension in liquids; how ordinary tap water, just as drawn from the city supply mains, had been subjected to a tension of 381b. per square inch. Advantage was taken of the principle underlying the working of the common filter pump, Venturi water-meter, spray distributor, &c. The water was forced through a glass tube constricted at one point, and the pressure at the constriction was estimated to fall below two and a half atmospheres negative.

Royal Irish Academy, June 22.—Prof. R. Atkinson, president, in the chair.—On the synthesis of glycosides—some derivatives of arabinose, by Prof. Hugh **Ryan** and Mr. George **Ebrill.** Following the method employed by Ryan

for the synthesis of glycosides (*Jour.* Chem. Soc., 1899, p. 1054; 1901, p. 704), the authors have obtained from the acetochloroarabinose previously prepared by Ryan and Mills (*loc. cit.*) methyl-arabinoside, β-naphthylarabinoside, *o*-cresyl-arabinoside, and carvacryl-arabinoside.—Report on the metamorphosed sedimentary and igneous rocks of the Ox Mountain range in Mayo and Sligo, and of their being probably a continuation of the similar rocks to the west in Mayo and Galway, also that they most likely extend northwards into Donegal and Londonderry, by Mr. A. **McHenry.** Opinions were stated as to the probability that the igneous rocks were contemporaneous in age with the granitic and associated basic rocks of Leinster; that is, that they belong probably to early Devonian time. Also that the sediments into which the igneous rocks of the west and north-west intrude are mainly of Ordovician age, with occasionally Upper Silurian sediments included, as in the case of the Wenlock quartzite of Croagh Patrick Mountain, south of Clew Bay.—On the antipodal relations of the eruptions and earthquakes reported as having occurred since January, 1901, by Prof. J. P. **O'Reilly.** The paper details the principal earthquakes and eruptions mentioned as having taken place since the commencement of 1901, giving the essential particulars regarding the points cited, as also the antipodal relations in each case. It is stated that of the centres of eruption mentioned, between 91 and 92 per cent. lie in the northern hemisphere, giving rise, therefore, to antipodes situated in the southern hemisphere, and for the most part in the Pacific and South Pacific, in the neighbourhood of New Zealand, in the Indian Ocean and the island groups of these oceans, that is to say, in parts of the earth's surface usually considered as being in a state of continued immersion, and so far implying a certain connection between the seats of activity on land and their antipodals in these oceans.—To obtain the cubic curve having three given conics as polar conics, by Dr. J. P. **Johnston.** It was shown that the conditions that the three conics could be transformed by a linear substitution, so as to be the first deriveds of a ternary cubic, gave eight independent linear equations to determine the nine constants of the transformation. A method was then given by which the equation of the cubic could be at once written down in a short symmetrical form. The constants of transformation were seen to be the coordinates of the points of which the conics were the polar conics.—A report on the Irish Hepaticæ, by Mr. D. **McArdle,** forms a *résumé* of all papers on the subject since 1876. 170 species and 63 varieties are enumerated. The arrangement is the same as that adopted in the "Cybele Hibernica," of which it is intended to form part ii. A table of districts shows at a glance the rarity or frequency of each plant.

PARIS.

Academy of Sciences, July 6.—M. Mascart in the chair.—The secretary announced to the Academy the death of Prof. J. W. Gibbs, correspondant for the section of mechanics. (An obituary notice appeared in NATURE of May 7, p. 11.)—Study of the flow of sheets of water, by M. J. **Boussinesq.**—On new syntheses effected by means of molecules containing the methylene group associated with one or two negative radicles. The action of epichlorhydrin upon the sodium derivatives of acetone-dicarboxylic esters, by MM. A. **Haller** and F. **March.** The lactone obtained as the result of this reaction has been esterified with alcohol and hydrochloric acid. The ester was not isolated, since it suffers internal condensation, giving rise to a hydrofurfurane derivative, the properties and reactions of which are described.—The action of human serum upon the Trypanosomes of nagana, caderas, and surra, by M. A. **Laveran.** Human serum, injected into animals suffering from nagana, surra, or caderas, causes the temporary disappearance of the parasites from the blood of the animal. No other method of treatment has been found which causes even a temporary cure of these diseases. No other species of animal furnishes a serum having properties analogous in this respect to human serum, with the exception of a slight effect noticed in the serum from the ape.—Remarks on the formation of pollen in the Asclepiadeæ, by M. L. **Guignard.**—On a rapid method of obtaining a plan of a country by means of photographs taken from a balloon, by M. **Laussedat.** Maps taken photographically from balloons have hitherto required a laborious graphical treatment to reduce them to a plane; a purely optical method of treatment is now described.—Experiments on the resistance of the air, by M. G. **Eiffel.** A heavy mass, 120 kilogrammes, and carrying plates which could be varied in shape and size, as well as means of recording the velocity and air pressure, was allowed to fall freely. The formula usually given for the pressure is KSV^2, where S is the surface, V the velocity, and K a constant 0·125kg. As a result of these experiments, it was found that K increased with the surface, and with equal surfaces, increases with the perimeter p, such that $K = 0{\cdot}032 + 0{\cdot}022\ p$.—Secular variations of secondary importance, by M. Jean **Mascart.**—On the lines of curvature of certain surfaces, by M. E. **Blutel.**—On the groups of Mathieu, by M. **de Séguier.**—On the fundamental functions of Poincaré and the method of Neumann for a frontier composed of curvilinear polygons, by M. S. **Zaremba.**—On the characteristics of the vowels, the vocal scales, and their intervals, by M. l'abbé **Rousselot.**—On a species of oscillation of the chromatic perception, by M. C. **Maltézos.**—Consequences of the theory of nickel steels, by M. C.-E. **Guillaume.** The theory that the anomalous behaviour of nickel steels is due to the transformation of iron from the α to the γ state, and inversely, is applied to the explanation of experiments by Howe, Nagaoka and Honda, and Curie with satisfactory results.—On the diminution of the potential for any spontaneous change in a medium at constant temperature and pressure, by M. **Ariès.**—The action of iodine on thin pellicles of copper, by M. **Houllevigue.** It was found as a result of these experiments, that the smallest molecule of copper capable of reacting chemically with the vapour of iodine is of dimensions of the order of 40 μμ. Its weight is of the order of 5×10^{-13} milligrams.—Simplification of the analysis of silicates by the use of formic acid, by M. A. **Leclère.** After opening up the silicate by fusion with an appropriate base, the use of formic acid in the place of nitric acid is recommended in the subsequent separation of the silica and titanium.—On the conditions of production and stability of thiosulphuric acid, by M. J. **Aloy.** Thiosulphuric acid can be produced by the action of an alcoholic solution of sulphur dioxide on sulphur; the presence of alcohol and of neutral salts increases the stability of the acid.—On the esterification of the hydracids, by M. A. **Villiers.**—On dibromo-acetylene, its purification, cryoscopy, and analysis, by M. P. **Lemoult.** By the action of alcoholic potash upon tribromoethylene, and fractionation in the complete absence of oxygen, pure dibromo-acetylene can be obtained. The formula CBr:CBr was established by analysis and cryoscopic determinations in acetic acid solution.—On lactase, by MM. Em. **Bourquelot** and H. **Hérissey.** Lactase and emulsin are probably two distinct ferments, since emulsin without lactase can be obtained from *Aspergillus niger* and *Polyporus sulphureus,* lactase without emulsin from kephir, and the two together in several species of almond.—The action of sodium on carbon tetrachloride and chlorobenzene: formation of triphenylmethane and hexaphenylethane, by M. Jules **Schmidlin.**—The preparation of primary alcohols by means of the corresponding acids, by MM. L. **Bouveault** and G. **Blanc.** The method of reduction previously described, sodium in boiling alcohol, has been extended to other fatty acids. Aromatic acids with the carboxyl group in the ring resist the reduction.—The internal ethylene oxide of β-cyclohexanediol-1.2, and its derivatives, by M. Léon **Brunel.**—On the amount of acids soluble in ether in wines, considered as a means of differentiation, by M. Ch. **Blarez.**—The heat of neutralisation of hydroferrocyanic acid; the heat of formation of its compounds with ether and acetone, by MM. **Chrétien** and **Guinchant.**—On the fatty acids of egg lecithine, by M. H. **Cousin.** It is shown that egg lecithine contains, besides the derivatives of stearic, oleic, and palmitic acids already known, a derivative of linoleic acid.—The intravenous injection of glycerol; the estimation of the glycerol in the blood and its elimination by the urine, by M. Maurice **Nicloux.** Glycerol disappears very rapidly when injected into the blood, and appears in the urine in notable quantity very soon after injection.—The carbohydrates of barley and their transformation in the course

of germination as carried out on the industrial scale, by M. L. **Lindet.**—Researches on the constitution and structure of the cardiac fibres in the lower vertebrates, by M. F. **Marceau.**—On the suprarenal capsule in amphibia, by M. Ed. **Grynfeltt.**—Experimental pathogenetic segmentation in the eggs of *Petromyzon Planeri*, by M. E. **Bataillon.**—The meriphyte in the Cycadaceæ, by M. H. **Matte.**—On two Cephalopod layers of the Upper Devonian in the Sahara, by M. Émile **Haug.** These fossil-bearing layers present remarkable palæontological affinities with the layers of the same age in central Germany.—On the variations of the Meuse at the quaternary epoch, by M. Paul **Bois.**—On the retrogradation of starch, by M. L. **Maquenne.**—On an oxidising bacterium, its action on alcohol and glycerol, by M. R. **Sazerac.** There exists in certain wine vinegars an oxidising bacterium which differs both in its appearance and cultures from the sorbose bacterium, and which is capable of rapidly oxidising glycerol to dioxyacetone. Its acetifying power is very small.—On the production of glucose under the influence of asphyxia by the tissues of *Bombyx mori*, at various phases of its evolution, by M. F. **Maignon.**—On the production of hydrogen sulphide by extracts of organs and albumenoid materials in general, by MM. J. E. **Abelous** and H. **Ribaut.**—Study of the marine circulation, by M. J. **Thoulet.**

New South Wales.

Royal Society, May 6.—Prof. Warren, president, in the chair.—The president delivered an address on the development and progress of engineering during the last twenty-one years. In the course of his address he remarked that the wonderful progress during that time, and the great activity to-day in all branches of science and engineering, suggests great possibilities in the future. All future progress in engineering must depend upon exact knowledge and scientific thought and work. Our systems of primary, secondary, technical, and professional education must be carefully reconsidered in order to bring them up to the needs and requirements of modern civilisation. The engineer of the future must be a still more widely trained and better educated man than his predecessor of to-day, so that he may be better able to solve the many problems which lie before him in the future.

Linnean Society, April 29.—Dr. T. Storie Dixson, president, in the chair.—Australian fungi, new or unrecorded. Decades iii.–iv., by Mr. D. **McAlpine.** Of the fungi here recorded, fifteen are described as new species, fourteen genera being represented. The orchids, which are generally comparatively free from fungi, contribute two, one of the genera (Amerosporium) being new to Australia.—Notes on Australian Rhopalocera: Lycænidæ. Part iii., by Mr. G. A. **Waterhouse.** This part deals fully with the descriptive portion of the subject and with the nomenclature.—The bacterial origin of the gums of the Arabin group, by Dr. R. Greig **Smith.**—On some new or unrecorded species of West Australian plants, by Mr. W. V. **Fitzgerald.** The following are described as new:—(1) Hensmania, gen. nov., founded upon *Xerotes turbinata*, Endl., of which perfect flowers were previously unknown, and of which Mr. Bentham did not see specimens in fruit. (2) Six species referable to the genera Leucopogon, Conostylis, Centrolepis, Restio, Hypolæna and Cyathochæte, and four to Schœnus. Two species, *Anisacantha* (*Bassia*) *longicuspis*, F.v.M., and *Stipa Tuckeri*, F.v.M., are now recorded from West Australia for the first time.—The vegetation of New England, N.S.W., by Fred. **Turner.** The New England district lies between 29° and 31° south lat., and 151° 20′ and 152° 20′ east long., and has an average elevation of about 3500 feet. Its flora may be described as intermediate in character between the subtropical and in places very dense and luxuriant vegetation of the coastal strip between its eastern boundary and the sea and that of the plains to the west, consisting of trees and shrubs of a more dwarf habit, and generally with less luxuriant foliage, except near water-courses. The census of the phanerogams and vascular cryptogams now brought forward yields a total of 369 genera and 708 species.

May 27.—Dr. T. Storie Dixson, president, in the chair.—Australian Psyllidæ, part iii., by Mr. W. W. **Froggatt.** Sixteen species are described as new, including three fine gall-making species of Trioza—two from Tasmania, and the third from Queensland, which is remarkable for its curious, open, saucer-like galls, in form approaching those of some of the gall-making Coccids.—On a revision of the Eucalypts of the Rylstone District, N.S.W., by Mr. R. T. **Baker.** In a previous paper twenty-two species of Eucalypts were enumerated. As the result of further collecting and study in the interval, the number of species now recognised has been increased by ten, while some of the earlier determinations have been reconsidered and amended.—A slime bacterium from the peach, almond and cedar (*Bact. persicae*, n.sp.), by Dr. R. Greig **Smith.** The organism produces a slime, the essential carbohydrate of which readily becomes converted to an insoluble modification. The carbohydrate is easily hydrolysed to arabinose and galactose, the latter sugar preponderating. The insolubility of the gummy constituent when heated under pressure shows that it does not belong to the arabin group. The soluble gum is coagulated by the acetates of lead, barium hydrate, milk of lime, and aluminium hydrate. The insoluble modification is easily dissolved by dilute acids, but not by dilute alkali. A small quantity of gum behaving to reagents like the bacterial gum was separated from the natural gum of the almond.

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