THURSDAY, OCTOBER 20, 1910.

RECENT PROGRESS IN PSYCHICAL RESEARCH.

The Newer Spiritualism. By Frank Podmore. Pp. 320. (London: T. Fisher Unwin, 1910.) Price 8*s.* 6*d.* net.

THE recent untimely and tragical death of Mr. Frank Podmore has directed general attention to his writings, especially to the book which, no doubt fully prepared before his death, has been published posthumously.

Mr. Podmore was an early member of the Society for Psychical Research, and he collaborated with Edmund Gurney and F. W. H. Myers in the collection and discussion of that large mass of cases, consisting chiefly of spontaneous apparitions or death-wraiths, which resulted in the publication of the two volumes called "Phantasms of the Living" in the year 1886.

The objectivity of these apparitions of the injured or dying or dead was always doubted or denied by the writers of that book; but inasmuch as the hallucinations were sometimes veridical—that is to say, inasmuch as they corresponded to or represented some actual occurrence, with a precision which, though not complete, was very striking—was found, indeed, on subsequent most careful and conscientious scrutiny, to be immensely beyond any chance coincidence—the writers devised a theory to explain such cases by means of the direct action of one mind on another through some agency not yet recognised in science.

The actual occurrence of such mental interaction, or thought-transference, was investigated by direct experiment, its possibility was considered proved, and a short account of these experimental cases forms part of the standard treatise referred to above. Prof. Barrett, F.R.S., is the leading surviving pioneer in the work of that period. Not only ideas and images could be thus conveyed, but full-blown apparitions of living people could be apparently effected by purposed concentration of mind acting on sufficiently sensitive percipients.

Since that time Mr. Podmore was an enthusiastic supporter of this doctrine of "Telepathy," as the process was conveniently named by Mr. Myers; and subsequent investigation and cumulative experience have gone far to strengthen the belief in it, as a genuine human faculty, among all those who have worked at the subject. So the reality of some unknown mode of communication between mind and mind may now be considered fairly established, notwithstanding that it has not yet received the sanction of high official science.

But it must never be forgotten that the detection of this process as a fact of observation, and the giving it a name for convenience of reference, by no means explains it or reduces it to the level of commonplace. If a fact at all, it must be a fact of exceedingly great importance. For a new or previously unrecognised human faculty is not the kind of thing that may be expected to turn up every century. It has shown signs, indeed, of being but the precursor and most prominent member of a whole group of human faculties, which had been more or less experimented with and more or less believed in, during the course of human history, until the age of science supervened and relegated everything of the so-called magical or occult to the domain of superstition, thereby excluding it from reasonable consideration.

As now contemplated, however, there is nothing superstitious about telepathy. Indeed, it is often employed as the antidote to what may still be called superstition; and Mr. Podmore in particular—so far from regarding it as only the first-discovered member of a series, after the analogy of such a chemical element as Argon—preferred to use it as a master-key wherewith to open a large number of locks, and thereby to let fresh air into chambers which else would be stuffy and obscure. He was apt to forget, I think, that telepathy is itself an obscure and, so to speak, "locked" faculty, inasmuch as no explanation of it has ever been given, or the process explained, either by physicists or psychologists. We do not even know for certain whether it is or is not accompanied by any physical process or stimulus akin to those with which we are familiar in the case of all the ordinary operations of sense-perception. There are some who think it a direct psychical action—that is to say, a direct action of mind on mind; there are others who think that it may be the result of a wider kind of mental interaction than exists among ordinary human beings, and that it points in the direction of the survival of human personality.

Mr. Podmore did not take that view; he does not seem to have pondered deeply on the actual meaning and process of telepathy. He accepted it as a fact, and tried to explain every other occult phenomenon by means of it—showing a tendency, indeed, to accept readily anything that could be thus explained, and to reject, also readily anything that could not. This is not the place for criticism in detail, but it would be easy to select sentences illustrative of this tendency on the part of the author.

Up to a certain limit, indeed, such a method of procedure is legitimate; and undoubtedly the clue furnished by the working-hypothesis of unconscious telepathic communication has rendered easier of belief a great many strange legends and asserted experiences. But to regard it as the only legitimate clue, to test all facts by means of it, and to reject with contumely those which it does not explain, which it can by no contortions be made to explain, is not so legitimate. And if Mr. Podmore has at all fallen into error—as it is only human that he should—it is in this direction that he has erred. I desire to review with extreme delicacy the work of a deceased writer, especially one to whom the subject of psychical research is largely indebted for acute criticism and remarkable industry. Yet I cannot fail to notice in many parts of the book, and, indeed, in his other writings generally, something that may be called *bias* in favour of the supremacy or monopoly of his favourite explanation.

It is true that some of the most recent investigations by members of the society, those which can be

summarised briefly under the title *Cross correspondence*, went some distance towards shaking Mr. Podmore's robust scepticism in everything except telepathy—telepathy, that is, between living persons no matter how distant and disconnected from each other they may be; but though he showed signs of an opening mind in this direction, in many others it remained firmly, and as most will think reasonably, closed. Mr. Podmore was one of those who some time ago had believed too easily and too much—at least so his later self would have claimed—and accordingly he had swung over in the opposite direction; certainly nothing in the nature of what are called "physical phenomena"—a title which is used to summarise a group of cases relating to the movement of objects without apparent contact—could ever find lodgment in his mind.

In this he may turn out to be right, for these so-called physical phenomena are among the most incredible of all; they do not appear to have any immediate or necessary connection with the question of human survival—if true, they appear to be a physiological but extraordinary and, so to speak, ridiculous extension of human faculty—and it would be a great simplification if they could all be relegated to the easy and comprehensive category of fraud. But the evidence will not in my judgment permit this simplification of the problems presented by a hitherto uncharted portion of the universe; and I confess I do not feel that Mr. Podmore's training made him a competent critic of this division of the subject. It is the part of his book which will meet with readiest acceptance, however, inasmuch as it postulates no causes but what are only too well known, such as human deceit, quackery, and gullibility; so it puts no strain on the believing power of the reader, even to the moderate extent of demanding the acceptance of an obscure faculty like telepathy.

But I am bound to say that the treatment here is not as worthy of a careful and responsible critic as is his treatment of subjects more closely allied with telepathy. I would even go so far as to say that his criticism of some experiments, such as those made by Sir W. Crookes, for instance, exhibits clear traces of what I may call conscientious or forensic unfairness; not only because definite assertions are questioned in a way which would undermine the record of any experiment ever made, but because their quotation is preceded by accounts of similar phenomena by over-enthusiastic and incompetent witnesses, whose accounts could not have any weight attached to them, and are only quoted in order to prejudice a fair contemplation of the subject.

If I am wrong in attaching some credence to careful records of unusual physical phenomena, on the strength of actual experience of my own, I wish the statement that I do so to stand as a personal confession in the pages of this scientific journal which will be readily accessible to posterity.

Concerning Mr. Podmore's other scepticisms, however, though I do not by any means in every case agree with them, his criticisms are reasonable and competent; and all the disbelief that he possessed on those subjects he was entitled to, inasmuch as he devoted much time to their consideration, and made a careful scrutiny of the evidence. He was not exactly a first-hand investigator himself, but he diligently studied the work of others. His opinion, therefore, is of weight, and, whether unduly sceptical or not, cannot be lightly estimated like that of persons who pronounce a positive and dogmatic judgment on no evidence at all.

The objection which I sometimes feel to Mr. Podmore's books is that they appear to furnish readers with a succinct summary of the evidence available, whereas they really only furnish selections of that evidence—made to some extent from the point of view of their bearing on his favourite hypothesis. These very readable and in some respects learned books may be useful in opening up the question and arousing interest, provided always that they do not quench it, but they have the flaws inseparable from second-hand testimony. The evidence cannot really be studied in any such volumes. It is probably true that conviction can only be attained by first-hand experience of the facts themselves; but, short of this, the evidence must be scrutinised in the recorded observations of the actual experimenters—such records, for instance, as are contained in the Proceedings of the Society for Psychical Research, and those made by earlier pioneers who in face of much obloquy and ridicule preceded and rendered possible its work.

OLIVER LODGE.

FOSSIL CLUB-MOSSES AND FERNS.

Fossil Plants: a Text-book for Students of Botany and Geology. By Prof. A. C. Seward, F.R.S. Vol. II. Cambridge Biological Series. Pp. xxii+624, with 265 figures and frontispiece. (Cambridge University Press, 1910.) Price 15*s.* net.

IT is twelve years since the first volume of Prof. Seward's important text-book appeared. The progress of fossil botany has never been so rapid as during the interval, and we may congratulate ourselves, with the author, that the delay has enabled him to produce a really up-to-date treatise on some of the most important classes of fossil plants.

The present volume is essentially concerned with the Lycopods and "Ferns"—it is necessary to put the latter word in quotation marks, for in these days nothing is more difficult than to tell whether a reputed fossil fern deserves the name or not.

Two short chapters at the beginning of the volume are devoted to the Sphenophyllales and the Psilotales; the account of the former group given in Vol. I. is here completed by the description of some types of fructification recorded since that volume appeared. The relation of the little family Psilotaceæ to the Palæozoic group of the Sphenophylls is fully recognised, but the author does well to put the former in a class of its own. Some authors have been too hasty in uniting these families, which, though they have important characters in common, are distinguished by features no less striking.

The great class of the Lycopodiales, perhaps the most prominent of all in the Carboniferous flora, occupies a space commensurate with its importance,

extending to about 250 pages. The description of the fossil representatives is preceded by a sketch of the recent members of the group, illustrated by some excellent figures both of the habit and the anatomy. This method, which the author extends to all groups which have living representatives, is eminently suitable for a book which is intended for geologists as well as for those who have had a botanical training. The best known of the fossil Lycopods were trees; recently, however, we have learnt a good deal about herbaceous club-mosses which also flourished in Palæozoic times. These are fully described, and it is interesting to note how closely, in habit and reproductive methods, some of them approached the living genus Selaginella. On the other hand, we still have no proof of the early occurrence of Lycopodium, which on theoretical grounds is regarded as the more primitive type.

The great family of the Lepidodendreæ is admirably treated, with equal regard to external features and internal structure. Some progress has now been made in correlating the two, and the results are sometimes a little surprising. Thus the well-marked anatomical species *Lepidodendron fuliginosum*, Williamson, is shown to correspond to at least three species based on external characters—a Lepidophloios and two species of Lepidodendron proper. Thus the two genera last-mentioned are indistinguishable, even specifically, by their anatomical characters, and it is very doubtful whether their claim to generic rank can be upheld.

Until quite recently we had but little knowledge of the structure of the well-known genus Sigillaria, but now, thanks to the work of Bertrand in France and of Kidston and Arber and Parkin in our own country, we have become acquainted with the anatomy of a number of species. The new evidence, together with the characters of the fructifications, has finally confirmed Williamson's view of the close affinity between Sigillaria and Lepidodendron, and of the cryptogamic nature of both alike. At the same time, facts have come to light which might once have been regarded as favouring Phanerogamic affinities, for in two genera of Palæozoic Lycopods organs closely analogous to true seeds have been discovered; in both cases the plants, one herbaceous, the other probably arborescent, are in all other respects typical members of the Lycopodiales. Their seed-like reproductive bodies are regarded by many palæobotanists as a striking instance of parallel development; the author, however, is inclined to see in them evidence of a genetic connection between the Palæozoic Lycopods and certain Conifers.

The second half of the volume is devoted to the Fern-like plants, and here the effect of recent discoveries makes itself felt in an even greater degree than elsewhere. As is well known, a large proportion of the Palæozoic Ferns, formerly so-called, are now under well-founded suspicion of not having been real Ferns at all, but seed-bearing plants of fern-like habit. In several cases this has been definitely proved, and in a majority of the plants in question all the available evidence points towards their spermophytic affinities. At the same time, the resemblance to Ferns, which for so long misled investigators, is by no means wholly fallacious, but, as shown by anatomical and other evidence, indicates a real relationship to the Fern-stock, while on the other hand the connection with the Cycad type of seed-plant is manifest. The practical difficulty is to distinguish between these "Ferns with seeds" and the true cryptogamic Ferns which no doubt really existed side by side with them; habit is no criterion, anatomy is only available in exceptional cases; even where the sporangia are present it is often impossible to say whether they were cryptogamic sporangia or pollen-sacs. The author takes a moderate and reasonable view of the difficult position; he recognises a considerable group of generalised Ferns, his Cœnopterideæ (the Primofilices of Mr. Arber), in which our knowledge of structure and of reproductive processes is sufficient to establish the Fern kinship; he is further inclined to admit a certain number of Palæozoic Marattiales (highly organised Ferns now only represented by a small tropical family), though here the evidence is a good deal more doubtful.

The Pteridosperms, as such, do not come into the present volume, but the last chapter is devoted to a number of genera of more or less uncertain position, most of which will no doubt prove to be seed-bearing plants, while a few may retain their traditional position among true Ferns. The clearly established types of Pteridosperms will be considered in vol. iii., which is to be devoted to seed-plants. This part of the work will be looked forward to with keen interest, for a number of questions of the utmost importance for the theory of evolution will then have to be considered.

The present volume, in its full and impartial treatment of habit and structure, of morphology and distribution, is beyond question the best handbook extant for the important fossil groups of which it treats. It is abundantly illustrated, and provided with an excellent index, and with a bibliography; the latter, taken in connection with that of vol i., is singularly complete, so far as works of any importance are concerned.

Botanists are certain to appreciate Prof. Seward's work; we hope that it may receive equal recognition from geologists, who, even more than their botanical colleagues, stand in need of a modern text-book of fossil plants. D. H. S.

THE COLLECTED WORKS OF HUYGENS.

Œuvres complètes de Christiaan Huygens. Publiées par la Société Hollandaise des Sciences. Tome douzième, Travaux de Mathématiques pures 1652–1656. Pp. vi+296. (La Haye: Martinus Nijhoff, 1910.)

THIS volume is the second one which contains reprints of published writings of Huygens, the ten first volumes having been devoted to his correspondence. During the years 1652 to 1656 Huygens had still to divide his attention between his scientific work and the study of law, but the extracts from his

note-books given in this volume show how little the law was able to fill his mind. In January, 1652, he began to occupy himself with various geometrical problems leading to equations of the second or third degree, of most of which he gave solutions in his "Illustrium quorundam Problematum Constructiones," which came out in 1654 as an appendix to his work on the quadrature of the circle. Both the rough work and the printed essay are reproduced in the present volume, and it is interesting to follow the stages by which he succeeded in submitting problems to algebraical analysis which Archimedes, Nicomedes, and other Greek mathematicians had treated by pure geometry.

The principal publication from this period of Huygens' life is his book on the quadrature of the circle, by which he took his place among the leading mathematicians of the day. It was a time when circle squarers flourished, several of them men of some distinction, such as Grégoire de St. Vincent, whose bulky work appeared in 1647 and called forth several polemical writings. Huygens entered the field in 1651 with his "Ἐξέτασις Cyclometriæ" (reprinted in T. XI. of the new edition), in which he showed the fallacy of St. Vincent's quadrature of the circle. In 1654 he brought out a larger work, "De Circuli Magnitudine Inventa." In this he developed further the use of the properties of the centre of gravity on the basis of the theorems he had published in 1651, and rigorously proved some propositions used by Snellius without proof, as well as a number of new theorems about sums of polygonal perimeters and various quantities, between which the length of the circumference of the circle is intermediate. Finally he calculated π by means of a 60-sided polygon within the limits of three units of the tenth decimal. The number of decimals is, of course, inferior to that previously attained by Van Ceulen and others, but the result was found without the appalling labours which these had gone through, and the investigation is valuable on account of the theorems proved by Huygens.

The lucidity and force of the arguments in the "Ἐξέτασις" had made its author hope that they had convinced Grégoire de St. Vincent of his mistakes. He exchanged a number of civil letters with St. Vincent, but the latter could never be induced to enter on a discussion of the matter, but always evaded it by saying that some day he would answer all his critics at the same time. But several of his pupils entered the lists for him, among whom was the Jesuit Ainscom, who in 1656 published what he imagined was a refutation of all the adversaries of his master, and did his best to convince people of the truth of the four methods of squaring the circle set forth by St. Vincent, but never put into practice by him. Huygens lost no time in replying; his "Epistola" to Ainscomb was published at the Hague in the same year. It forms the concluding portion of the present volume of his works, and in accordance with the praiseworthy rule of the editors of this most valuable edition of Huygens' works, the part of Ainscom's essay dealing with the attack of Huygens is also reprinted.

J. L. E. D.

A PRIMER ON COAL MINING.

First Steps in Coal Mining. For Use in Supplementary and Continuation Classes. By Alexander Forbes. Pp. viii+320. (London, Glasgow, and Bombay: Blackie and Sons, Ltd., 1910.) Price 2*s.* 6*d.*

THE present adds one more to the already long list of primers on coal-mining that have been produced so freely of recent years, and unfortunately it cannot be said that it is sufficiently an improvement upon some of its predecessors to justify its publication. It is difficult to see to what class of student such a book as the present one can address itself, or which it can expect to benefit; if it is intended for the instruction of youths actually engaged in mining operations, such definitions as "the men engaged in the excavation of the material are termed *sinkers*," "the portion of the twenty-four hours during which each set works being called a *shift*," "the extreme end of the road . . . is called the *face*," &c., are surely superfluous, as these expressions must be familiar to every boy about a pit. If, on the other hand, the book is intended for those who have no personal knowledge of coal-mining, the amount of information afforded upon the majority of mining operations cannot possibly be sufficient to enlighten them; for instance, it is hopeless to expect that the subject of coal-cutting by machinery can be adequately taught in three pages; in the same way, only twenty pages are devoted to the whole subject of shaft-sinking, including all the special methods, entirely out of place though these are in an elementary book.

Just about one-third of the book has been devoted to an outline of geology, and this is the most, if not the only, satisfactory part of it. The remainder is made up of "scrappy" chapters on the various departments of mining, with some fragments of elementary chemistry and physics distributed amongst them. Not content with this wide range, the author has not hesitated to include even mine surveying, to which he devotes nearly four pages! Of what use he imagines that these can possibly be to anyone it is hard to conceive, even though he has inserted an illustration, without a word of description, of an old-fashioned theodolite, possibly with the object of giving an air of completeness to his index. Had the author contented himself with writing an elementary text-book of geology for the use of miners, he might probably have produced a work of greater use than the more ambitious effort now before us; at the same time, it cannot but be admitted that not even in the geological section has the author displayed the faintest evidence of originality in thought or treatment. This want of novelty throughout the book is shown very strikingly in the illustrations, every one of which appears to have been published before in other works. Their selection has, moreover, not always been a happy one, as witness the picture of the theodolite already referred to. For sheer futility it would be difficult to surpass some of the illustrations to the chemical section, such, for example, as Fig. 129, which represents water being poured out of a jug.

The very best thing that can be said of the book is that it is comparatively free from serious mistakes.

OUR BOOK SHELF.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part i., October. Pp. xvi+88. (London: Gurney and Jackson, 1910.) Price 2*s.* 6*d.* net.

A THOROUGHLY up-to-date and scientific account of the mammals of the British Isles, written in such a style that it may be acceptable to the field-naturalist as well as to the specialist, has long been a desideratum. So far as it is possible to judge from the first part this want promises to be supplied, at all events, from the scientific aspect, by Major Barrett-Hamilton's work, which is to be published in twenty-four monthly parts, so arranged as, when complete, to form three volumes, of which the first is to be devoted to the bats, while the third is to include the whales and dolphins, with an appendix on extinct and domesticated species. Whether the work will appeal with equal strength to that section of the general public interested in natural history remains to be seen. A distinctly popular element is, however, supplied by the twenty-seven coloured plates, reproduced from sketches made for the work by that accomplished artist-naturalist, Mr. E. A. Wilson. The plate in the present part is a group of dormice in a sloe-bush, which we hope will prove the least successful of the series, as the two uppermost figures are scarcely satisfactory, while the eyes of all the individuals appear too small and lacking in prominence.

Except for an instalment of the introduction to the Chiroptera and the general account of the family Vespertilionidæ, the present part is devoted to the noctule and Leisler's bat, each of which has an appalling list of synonyms. The only fault we have to find with these lists is that, beyond a statement on an earlier page (6) to the effect that the generic term Nyctalus was applied to the group by Dr. K. Andersen in 1908, there is no clue to the authority for the names *Nyctalus noctula* and *N. leisleri*. It is true that these names do not actually appear in Dr. Andersen's paper in the "Annals" for the year cited, but reference to that paper ought certainly to have been made in the lists. The work has our best wishes for success. R. L.

Bacteriology for Nurses. By Isabel McIsaac. Pp. xii+179. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 5*s.* net.

WHILE agreeing with the proposition that the nurse should have a clear and definite knowledge of the principles of the germ theory of infective diseases, we doubt if this book will really aid her to attain this end. It is too much an elementary text-book of bacteriology, and does not contain sufficient of the practical application of bacteriological principles in the every-day routine of the nurse's work. The greater part of the book is occupied by descriptions of the causative organisms of the various infective diseases, but far too little is said about the why and the wherefore of surgical cleanliness and the means of attaining it, and the methods of preventing the spread of infection in the ward and household. Thus the section on sterilisation and the use of disinfectants occupies a bare nine pages, and the principles of antiseptic and aseptic surgery are almost omitted, yet these subjects constitute almost the beginning and the end of the surgical nurse's work. In the section on malaria, while the importance of protection from mosquitoes as a preventive is fully recognised and the "screening" of houses recommended, not one word is said of the mosquito net, which may often be the only means available for carrying out any form of "screening."

These instances of omissions might be multiplied. While, therefore, the book may prove a readable elementary text-book of pathogenic bacteriology for the general public, including the nurse, we cannot but regard it as lacking in many of the bacteriological details which are so essential to the intelligent work of the nurse for whom it is avowedly written.

R. T. H.

The Inherent Law of Life: A New Theory of Life and of Disease. By Dr. Franz Kleinschrod. Translated from the German and edited by Louise C. Appel. Pp. vii+214. (London: G. Bell and Sons, Ltd., 1910.) Price 3*s.* 6*d.* net.

DR. KLEINSCHROD is a vitalist of the order of his celebrated countryman, Dr. Hans Driesch. He holds that life is not explicable from a mechanistic point of view. It has its own laws, beyond all physical and chemical formularies. Moreover, as we know life better—at closer quarters, so to speak—than inorganic nature, it is absurd to explain the former by the latter. "All our ideas of nature are obtained directly from the law of life; are vitalisms, as Prof. Lipps, the psychologist, so aptly terms them. Force, energy, gravitation, pressure, &c., are ideas derived from life and transferred to the lifeless world." It is more sensible to interpret the inanimate from the standpoint of the living than conversely.

Disease and healing are, equally, life-processes. A true remedy is a remedy which calls forth the healing processes, and does not merely suppress symptoms, as in the application of ice to inflamed parts. The thing to do is to stimulate function. Digitalis does not increase cardiac strength; it merely whips up the action, and uses up life-force too fast. Graduated exercises really strengthen the heart. Similarly with other pathological conditions. Less drugging, more "nature-cure."

There is much that is debatable in this book, but it is certainly suggestive. On its practical side it is in accord with the trend of modern practice, and the author sensibly admits the *auxiliary* uses of surgery and drugs, thus steering clear of the extremes into which some nature-cure propagandists are apt to rush.

Philosophies. By Prof. Ronald Ross, F.R.S., C.B. Pp. viii+56. (London: John Murray, 1910.) Price 1*s.* net.

THE title of this brochure is rather unhappily chosen, for, coupled with the author's scientific and academic distinctions, it may give an untrue impression. As a matter of fact, the book is a collection of short poems, written in the leisure time of a busy and useful career. All are tuneful and satisfying to the ear, and many have the genuine inspiration which distinguishes poetry from mere verse—*e.g.* the "Vision of Nescience," and many a line in the longer poem, "In Exile." Prof. Ross is, of course, best known by his researches on malarial fever, and his discovery of the part played by mosquitoes in carrying infection. The results of his work are world-wide. It seems probable that, largely in consequence of his discoveries, many uninhabitable districts may be rendered fairly healthy; this is already being done in parts of Brazil. The following couple of verses, written at Bangalore, admirably portray the pity in a noble worker's mind, and the pathos of suffering humanity. The title is "Indian Fevers."

"In this, O Nature, yield I pray to me.
I pace and pace, and think and think, and take
The fever'd hands, and note down all I see,
That some dim distant light may haply break.
The painful faces ask, can we not cure?
We answer, No, not yet; we seek the laws.
O God, reveal thro' all this thing obscure
The unseen, small, but million-murdering cause."

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.]*

Early Burial Customs in Egypt.

As the subject of early burials has been raised in NATURE with reference to the results of my excavations (pp. 461–2), I suppose some reply will be expected.

The whole question lies in a nutshell. Many thousand graves have been examined by one party of observers, and certain results repeatedly found. Many thousand graves have been examined by another party of observers, in other localities, and such customs are not found. Many people accept the results of both groups; Dr. Elliott Smith will only accept one group. To take an exactly parallel case: by one group of observers a dozen vases with figures of boats have been found among these graves, but by the other group (as I am informed) no examples have been found. The negative evidence of the latter cannot prove the uniformity of customs throughout the country.

To repeat here the statements of most careful observations already published would be a waste of space and attention. All the possible causes named on p. 462 for the accidental shifting of bones were fully before myself and other observers, as we together examined skeletons in unplundered graves; the cases were considered at length before shifting a single bone; and our most careful observations of facts cannot be disproved by differences of ancient custom in other places.

The custom of unfleshing is well known in early Italy and Europe, and practised to this day (with ceremonial anthropophagy) in Africa. It is not surprising that it should also be present in Egypt. Indeed, the references to early anthropophagy in Egyptian ritual and myth would point to its being known, even apart from any physical evidence.

This year, again, we found two unquestionable examples showing the unfleshing and wrapping of every bone separately in linen, without leaving any flesh or skin except a little on the skull. If the corpse had been buried entire—as Dr. Elliott Smith suggests—and subsequently plundered of valuables, no relatives would have then honoured it by breaking it entirely to pieces to rebury it. The unfleshing must have been a primary burial ceremony; and these bodies were of the highest nobles of the third dynasty, and not merely of barbarous peoples. These were published, and the specimens subsequently exhibited for a month in London. I regret that Prof. Elliott Smith did not examine them, nor, indeed, honour our excavations by a single inspection during the years when he was in Egypt.

W. M. FLINDERS PETRIE.

Lord Morton's Quagga Hybrid and Origin of Dun Horses.

MAY I be allowed to return to the two suggestions made in NATURE of September 15, viz. (1) that Lord Morton's quagga hybrid was not a hybrid at all, and (2) that the dun colour in horses is not a reversion?

The first of these was based upon Prof. Cossar Ewart's statement in "The Penicuik Experiments" that "in their body colour none" of his zebra hybrids took after their zebra sire, and on the theory, now well proved, that chestnut is recessive to all other horse colours. It thus seemed impossible that Lord Morton's hybrid, which, according to its portrait, is undoubtedly a bay, could be the progeny of a quagga horse and a chestnut mare.

Some years ago I saw half a dozen of Prof. Ewart's zebra hybrids, and, although I did not observe them as closely then as I would now, they all impressed me as having the colour of their dams *plus* the striping they had got from their sire the zebra. A few days ago Prof. Ewart very kindly showed me over his stud again, and showed me also the skins of some zebra-horse hybrids, and these skins follow the dams in colour. A brown skin had a brown dam, a bay skin a bay dam, a chestnut skin a chestnut dam, and so on. The chestnut skin was highly rufous, but it was still chestnut. There were also two brown-looking skins, yellowish below and about the flanks, belonging to the progeny of a zebra mare and a horse, which Prof. Ewart had not bred; but in this case, I understand, the colour of the horse is unknown.

In support of the first contention, I said it was very unlikely a quagga with whitish "points" and a chestnut mare should have a foal with dark points such as are seen in the portrait of Lord Morton's hybrid. Prof. Ewart points out that "crosses between zebras and ponies have, usually, dark patches at the fetlocks." That may be; but my point was that this would not occur if the dam were a *chestnut*. Every other colour but chestnut might be expected to give foals dark at the fetlocks.

The second suggestion, that dun is not a reversion, was based upon work of my own published last spring. At the time I had only few data with regard to dun, but it indicated dun to be dominant to chestnut, black, bay, and brown, and recessive to grey. Since then I have collected more than 200 matings concerning dun; and leaving out creams (which seem a variety of dun), dun roans, and cases in which the colours of the second parent were unknown, the following table shows the results of mating dun with itself and with the other five usual colours:—

Colours of Parents	Colours of Foals					
	Chestnut	Plack	Bay	Brown	Dun	Grey
Dun × Chestnut...	3	—	4	—	9	—
Dun × Black ...	—	4	—	—	4	—
Dun × Bay... ...	4	3	21	3	8	—
Dun × Brown ...	—	—	2	7	8	—
Dun × Dun ...	1	—	1	—	6	—
Dun × Grey ...	3	4	7	5	16	10

That dun is recessive to grey is shown by the fact that it gets no grey foals unless mated with grey, while its matings with the other colours, as well as with grey, show that it is dominant to, *i.e.* contains, them all. In addition, there are two matings of grey with grey producing duns, and two of grey with black producing duns.

It follows from the above that a dun foal can only be got when one parent is either dun, dun roan, or grey, and that dun can be a reversion, if it can be called such, to grey only. But it could not be expected that among 200 cases there would be no exceptions to the rule. However, I have found only four in which a dun foal had neither a dun nor a grey nor a dun roan parent. But these exceptions help to emphasise the rule, for in each of them one of the two parents was a bay—the second parent being brown in three cases and bay in one—and bay and dun are occasionally mistaken for each other. These cases may, therefore, be taken as misdescriptions.

The Przewalsky horse is a case in point. He has been called dun; but he is not such. He is a bay, a sandy bay, with a large bright nostril patch such as is found among light bay, sandy bay, and "yellow bay" Clydesdales.

I have just come upon the following in Darwin's "Animals and Plants under Domestication" which is *apropos* of the present discussion:—"I have endeavoured, but with poor success, to discover whether duns, which are so much oftener striped than other coloured horses, are ever produced from the crossing of two horses, neither of which are duns. Most persons to whom I have applied believe that one parent must be a dun."

JAMES WILSON.

Royal College of Science, Dublin, October 3.

THE colour of Lord Morton's hybrid may not suggest its mixed origin, but this is sufficiently indicated by the mane, tail, and conformation.

A white-legged Iceland pony produced a brown hybrid with dark "points" to a Burchell zebra (Matopo) white below the knees and hocks, and a chestnut Iceland mare produced a bay hybrid to a Przewalsky stallion. Why should not a chestnut mare produce a bay-dun or bay, hybrid to a white-legged quagga?

Lord Morton's quagga was more a bay than a dun, and there are good reasons for assuming that both the quagga and the Burchell zebras are descended from ancestors in colour like the wild horse still surviving in Mongolia. Of three zebra hybrids out of a chestnut mare, two are

rufous (or chestnut), but one is fawn-coloured and has dark "patches at the fetlocks." Doubtless dun may contain bay, brown, and black, but on one occasion I obtained a striped dun by crossing a black Shetland pony with a striped bay Arab—an Arab which mated with a yellow-dun Connemara mare produced a pure black. These may only be exceptions that prove the rule.

J. C. EWART.

Tests for Colour-Blindness.

I AM surprised to see in the review of my book in NATURE of September 1 the statement:—

"We do not see that Dr. Edridge-Green has furnished us with any increased security, or indeed that any better security is needed, than is obtained from Holmgren's test when this is employed in the precise manner directed by its originator."

In this issue of my book I have devoted nearly nine pages to the detailed condemnation of the Holmgren test, and this portion remains as it was in the 1891 edition. The statements there have been confirmed by numerous observers, amongst whom are some of the ablest scientific men the world contains. In fact, at the recent International Physiological Congress I did not meet with a single man who was satisfied with the Holmgren test.

I will only refer to the statements of Prof. Nagel, who has done so much in connection with colour-blindness.

I pointed out that normal-sighted persons were rejected by this test, and this is abundantly evident by the number of men rejected by the Board of Trade who get through on appeal.

Prof. Nagel in 1898 found thirty-nine cases (2·75 per cent.!) in 1420 examinations in which typical dichromic (red-green blind) mistakes were made with the Holmgren test, and yet when examined by other and more trustworthy methods, as, for instance, the spectroscope, were found not to be dichromics.

I stated that the test green was not the best colour for a first test. Nagel says the same thing. In the reports of the Board of Trade it will be seen that many have passed the green test and failed with the rose test. It may be noted that the Board of Trade have never at any time used the test in strict accordance with Holmgren's instructions, because they have used all three test skeins, whereas Holmgren stated that when the green test had been passed the person might be regarded as normal sighted. Nagel points out the varieties and number of colour-blind persons who are passed by the Holmgren test, and gives the reasons, which are similar to mine.

F. W. EDRIDGE-GREEN.

The Institute of Physiology, University College,
London, October 7.

IN 1890 or 1891 the Royal Society appointed a very strong committee, of which Lord Rayleigh was chairman, and it included, among other "able scientific men," Lord Kelvin, Sir George Stokes, Sir William Abney, and Prof. Michael Foster, to report on the general subject of colour-vision and on the tests proper to be used in connection with it. Dr. Edridge-Green gave evidence before this committee, stated fully his objections to Holmgren's test, and displayed the methods which he recommended in lieu thereof. His book was published before he gave evidence; and, as his original objections to the Holmgren test are reprinted *verbatim* in the 1909 edition, it is fair to suppose that no fresh evidence in support of them has been obtained during the intervening time. Besides hearing many witnesses, the committee carried out an extended series of practical investigations, and on April 28, 1892, it unanimously recommended the Holmgren test for adoption by railway companies, ship-owners, and the Board of Trade. The committee pointed out that variations in the amount of deficiency in colour-perception are numerous, and, "when small, are often difficult to classify." No one claims for the Holmgren test that it affords a sufficient basis for a minute classification, but it does afford the surest and most convenient means of excluding from certain industries the small number of persons who could not engage in them without danger to the community.

THE REVIEWER.

Water Vapour on Mars.

THE statement attributed to Director Campbell on p. 317 of NATURE for September 8, to the effect that the nights in September, 1909, on which his spectrograms of Mars were taken, "were as perfect for the purpose as could be wished," is open to question. Though the sky may have been clear and the surface humidity low, this does not prove that the aqueous vapour in the upper air was small in amount. September is the month when the total vapour-content of the atmosphere is a maximum, and February is the month when the vapour-content is a minimum, in north temperate latitudes. This is well shown in the curves of energy in the infra-red solar spectrum for February 19, 1903, and September 14, 1903, in the article on "The Absorption of Water Vapour in the Infra-red Solar Spectrum," by F. E. Fowle, jun. (Smithsonian Miscellaneous Collections, quarterly issue, vol ii., part i., p. 1, 1904, Plate i.). The ratio of the intensities of the bands of aqueous absorption {(Mars+earth)/earth} will be greatest when the total absorbent column of the earth's atmosphere contains least water, that is, other things being equal, the ratio may be expected to be smallest in September and largest in February. Director Campbell has chosen the worst month, and Dr. Slipher, who observed in January and February, the best months for making the experiment.

The statement that "with a nearly evanescent α band, the more water vapour one attributes to the terrestrial atmosphere the less remains attributable to that of Mars" is, of course, true, and because the water vapour of Mars is not great in amount it is not desirable to attempt to observe it at a time when the feeble Martian absorption band is swamped in a more powerful terrestrial band.

The depths of the aqueous absorption bands in Mr. Fowle's figure (*loc. cit.*) is many times greater in September than in February; but this does not express the degree of unfavourableness of the September observation adequately, for it is increasingly difficult to detect an increment of absorption due to the addition of a constant amount of vapour, as the total absorption grows greater, and this for the reason that many of the absorption lines have reached a maximum intensity already, so that any further increase of the depth of the absorbent only affects the feebler lines. It should be understood that, with the low power employed, the band is not resolved into its separate lines in the Martian spectrum.

Through the favour of Dr. Percival Lowell I have been permitted to measure the spectra of Mars and the moon photographed by Dr. Slipher at the Lowell Observatory in January and February, 1908. The seasonal gain from lower temperature and diminished moisture in the upper air in winter at Flagstaff is more than an equivalent for any gain in this respect to be obtained by even a double altitude in summer. I have made quantitative measures of the absolute intensity of the little α band in both spectra. The ratio, α(Mars)/α(moon), obtained from six different plates on as many nights, varies from night to night as changes in the terrestrial atmospheric humidity may determine, but all of the plates unite in telling the same story, and show that little α is stronger in the spectrum of Mars.

One of Dr. Slipher's plates, which is, unfortunately, not the best one photographically, although it is better in this respect than any of Director Campbell's, was taken under almost ideal conditions, the air at the surface having a dew point of $-14{\cdot}8°$ C., and the exposure on Mars being equally divided on either side of the lunar exposure with both bodies at the same altitude (40°). The result is conclusive, and shows that the Martian band on this occasion was two and one-half times as intense as the telluric one. Still larger ratios were obtained from other plates.

Similar consistent measures have also been made of the oxygen band, great B, showing that it is in like manner stronger in the spectrum of Mars, although the measurement is a difficult one, because the earth's atmosphere is much denser than that of Mars, and the further small addition of absorbent has but little effect.

FRANK W. VERY.

Westwood Astrophysical Observatory, Westwood,
Massachusetts, October 1.

A Caution.

FELLOWS of the Zoological and other scientific societies, museum officials and others, are warned against an individual representing himself as a consumptive and asking for a recommendation to a hospital and temporary help.

The *modus operandi* is to call upon you with a bogus introduction from another fellow of your society or someone known to you, and to mention a few other well-known persons as interested in his case.

The individual is rather tall, thin, of wan appearance, and has a dark moustache. His manner shows some refinement and education, and is also persuasive, as proved by the number of those known to have, unfortunately, been victimised by his false representations.

E. A. S.

Dr. John Peile: A Correction.

OWING to the omission of a comma (which is doubtless due to my faulty and hasty writing) in the article in your last issue on the late Master of Christ's, the personages of Prof. Percy Gardner and the President of Queens' College have been merged into one.

Prof. Percy Gardiner is, of course, the professor of classical archæology at Oxford, and the President of Queens' (which should be spelt with the apostrophe *after* the "s," it having been founded by two queens) is the physicist, the Rev. T. C. Fitzpatrick, chairman of the board of physics and chemistry at Cambridge.

I need hardly say that the list of those who were at Christ's College under Dr. Peile was confined to those who acquired a position in certain branches of science. An equally strong list could be drawn up of those who have achieved success in other walks of life.

October 14. THE WRITER OF THE ARTICLE.

THE CENTENARY OF BERLIN UNIVERSITY.

A BRIEF account of the first day of the centenary festival at Berlin, and of the notable utterance of the German Emperor at its opening *Festakt*, was given in last week's issue of NATURE. The celebration lasted over three days (October 10–12), with some sporadic entertainments on the fourth. Unter den Linden, from the Brandenburg gate to the royal castle and the cathedral, showed the chief, if not the only, signs that something unusual was in hand. For Berlin, as one of the academic orators remarked, is not a university city; it is a city containing a university. The well-known building itself, with its statues of the Humboldts and Helmholtz, was decked with garlands, and flags fluttered about the opera square and the new *Aula*, which is the old library. Figures in evening dress, or uniform, or quaint university costume, flitted here and there among the city crowds, and students in the caps and colours of their *corps* drove in open carriages along the wide alleys of the central avenue of Berlin. But except when the torch-light procession was in motion, or the Emperor with his guards passed swiftly along, the hurrying population was little stirred, and traffic followed its usual course.

At noon on Monday, October 10, the delegates met at the University to receive instructions. Each was presented with a commemorative bronze medallion bearing the Kaiser's image, and with two massive volumes of the history of the University, and a useful guide to "Berlin in Wissenschaft und Kunst," prepared by Dr. W. Paszkowski. Those of each nation were requested to choose one of their number to speak for them at the presentation of addresses next day. The venerable Lord Strathcona, Chancellor of Aberdeen and of McGill University, Montreal, was acclaimed the representative of the British delegation. One orator was to be appointed to reply at the festival banquet to the toast of the whole of the non-German delegates, and the choice fell upon Dr. Mahaffy, of Dublin. When the time came, be it said, the versatile Irish scholar played his part in fluent German amid universal applause.

In the evening a solemn thanksgiving was held in the new cathedral. Court-preacher Dryander led the service, which was richly choral, and the sermon was preached by Dr. Kaftan, dean of the theological faculty. His theme was diversity in unity, "many members and one body." On leaving the cathedral, the congregation found the streets lined with soldiers and police, and cheerful crowds awaiting the students' torchlight procession. A large and informal company gathered in the halls and balconies of the University building to welcome the students as they passed in long and well-kept lines, dressed in all the bravery of their *Burschenschaften*. The rector magnificus, Dr. Erich Schmidt, met the students' leaders, who, through their spokesman, Studiosus Heyl, pledged their faith to Alma mater, and raised a thundering cheer for "His Magnificence" and his colleagues. The 3000 members of the procession then dispersed, to spend the night in the time-hallowed ceremonies of the *Kommers*. The professors and their guests promenaded the halls of the University, where a light collation was served in every room. Acquaintances were made and renewed in easy and unceremonious fashion, and a lively conversazione was kept going for several hours.

Next morning (October 11), the more formal celebration began at an early hour in the *Neue Aula*, the centenary gift of the Ministry of Education to the University. The guard of the Alexander regiment was drawn up in front. The corridors and staircases and the hall itself were lined with uniformed students carrying swords and banners. Delegates in strange academic robes, nobles, courtiers, and statesmen, in full-dress and gleaming with decorations, filed into their places. By the time that the Emperor and Empress, accompanied by a number of princes, the Imperial Chancellor, and a brilliant Court-party, entered to the sound of trumpets, the hall presented a dazzling display of military and academic pomp. The rector ascended the rostrum and greeted the assembly in a sonorous oration. Objective science with individual culture, he set forth as the aim of the University from its first foundation. The Emperor nimbly mounted in the rector's place, and amid tense silence delivered an energetic discourse, the substance of which was given in last week's NATURE. When he announced his intention to found an imperial association for the foundation and maintenance of institutes for scientific research, with an initial capital of some half-million pounds sterling, the audience broke into long and clamorous applause.

The rector expressed the thanks of the nation in moving words, and called for a *Hoch* for the Emperor, which was given with full-throated enthusiasm, the students clashing their swords and waving their banners in time to the shrill strains of bugles and trumpets.

The Minister of Education, and the Oberbürgermeister Kirchner, next spoke for the governments of state and city, the latter presenting the rector with the deeds of a municipal endowment of 10,000*l.* for the establishment of travelling scholarships for university students. Then followed the presentation of addresses by delegates of home and foreign universities and academies. Those of each nationality came forward in a group, the countries being called up in alphabetical order. The speeches of the respective leaders were supposed to occupy not more than three minutes each, but some at least stretched far beyond that limit. Each delegate as he passed bowed to their Majesties, announced his uni-

versity, handed in his document, and was greeted by the rector. This part of the proceedings went forward quietly, though at intervals applause broke out as well-known personages were recognised. Thus Poincaré, of Paris, Sir J. J. Thomson, of Cambridge, Lord Strathcona, of Montreal, Macan, of Oxford, Mittag-Leffler, of Stockholm, and Hadley, of Yale, were specially cheered.

Thereupon the prorector, Dr. Kahl, read a long list of jubilee gifts and benefactions. They included one of 5000*l.* from Frau von Wildenbruch for scholarships, a large but unnamed sum from friends of the University for the foundation of students' hostels or residential colleges, 7500*l.* from Dr. Hans Meyer, of Leipzig, for the endowment of a chair of colonial geography, and a multitude of other donations in money and kind. For all of these grateful acknowledgments were expressed, and then, by the whole assembly, the Emperor leading, the *Gaudeamus igitur* was intoned as a finale. The ceremony had lasted over three hours.

Immediately after the ceremony, it was officially announced that the titles of Excellency and full Privy Councillor had been bestowed upon Prof. Harnack, royal librarian; Prof. Diels, philologist; Prof. Wilamowitz-Möllendorf, classical scholar; Prof. Emil Fischer, chemist; Prof. Brunner, jurist; and that a host of decorations of all grades had been conferred upon other officers of the University. Even the chief janitor or *bedellus* was not forgotten.

At three o'clock a banquet for six hundred was served in the hall of the exhibition park. The feast and the speeches lasted until nearly eight in the evening. Prince Rupert of Bavaria, Prince August William of Prussia, the Chancellor von Bethmann-Hollweg, formerly a Berlin professor, and the Minister of Education, Count von Trott zu Solz, were among the guests. The Chancellor and the Minister spoke for the German Government; the Prorector and Dr. Wilamowitz-Möllendorf for the University and its staff; Rector Hölder, of Leipzig, and Prof. Mahaffy, of Dublin, for the Teutonic and non-Teutonic guests respectively; the President of the Gymnastic Association, "Arminia," for the students. To him Prof. Harnack replied, thanking the undergraduates *utriusque sexus*, and draining the newly presented loving-cup to their welfare. Some ominous head-shakings among the professors were observable as the one lady student present, Miss Ilse Tesch, of the faculty of medicine, came up to join in the pledge. The situation was saved by Prince August William, himself a Berlin student, who promptly shook hands with his "Commilitonen" *utriusque sexus*, and solemnly shared the cup with them. The assembly dissolved in laughter and loud applause. Presently the company reassembled at the Royal Theatre, where, in the presence of his Majesty and the Court, a festal performance of Mozart's "Marriage of Figaro" was given in honour of the University and its guests.

On Wednesday morning, October 12, the new *Aula* was the scene of the second *Festakt*. The Emperor was represented by his son, and the place of the courtiers was taken by the city fathers and other representatives of municipal institutions. But in other respects the gathering resembled that of the preceding day. Prof. Lenz, the historiographer of the University, delivered an eloquent and impassioned address on its origin, evolution, and present position. The ideas of its first sponsors, Fichte, Schleiermacher, and William von Humboldt, had been realised or surpassed. Even in the dark days of the Fatherland, the University had not despaired. Hundreds of its members had given their labours and laid down their lives for the unity of Germany. Based on that unity, now once for all achieved, the University had risen triumphant to its present glory. Its watchword was "freedom of research"; its guiding conviction that knowledge is the power that conquers.

Then followed the academic ceremony of conferring honorary degrees. In accordance with German custom, the list of graduands had been kept a secret. For days before the newspapers had speculated regarding the recipients, but, except in a few instances, the current guesses appear to have been wide of the mark. The precedence of the faculties in Berlin rests with divinity; it is followed by law, medicine, and philosophy. It was therefore at once surmised that something abnormal was about to happen when the dean of the law faculty came first to the dais. In a few words of German he explained his mission, and then in stately Latin proceeded to create, pronounce, and proclaim the Emperor himself a *doctor utriusque juris, cujus auctoritate juris civilis Germanorum codex post sæculi labores prodiit*. The announcement brought the assembly to its feet; a loud fanfare, and cheer after cheer, welcomed the new graduate. The dean of the faculty of theology followed, in a formal and courtly protest, waiving his precedence for that occasion only. He, by resolution of the Senate, and with the approval of his Majesty, proclaimed some fifteen or sixteen doctors of divinity. The Burgomaster of Hamburg, a distinguished merchant, and Dr. James Hope Moulton, of Cambridge and Manchester, were among the number. The dean of the law faculty reappeared, and conferred the LL.D. degree on Prince Rupert of Bavaria, Judge Oliver Wendell Holmes, of New York, Prof. Vinogradoff, of Oxford, the Burgomaster of Berlin, and a long series of professors and high officials holding office in the German civil service. In medicine, professors of philology, philosophy, and law were promoted, side by side with Poincaré, de Vries, Richards (Harvard), the painter Thoma, the musician Reger, the humorist Raabe, of Brunswick, and the master of ceremonies, Knesebeck. It needed all the dean's ingenuity to relate the functions of the honorary doctors of medicine to those of his faculty.

The list of the philosophical faculty, which includes all the departments not covered by the other three, was of considerable length. Some forty names were read out, and a few words were said on each. Prof. Ashley, of Birmingham, Dr. Arthur Evans, of Oxford, and Dr. Lazarus Fletcher, of the British Museum, represented British learning; and the Presidents of Harvard, Yale, and Columbia were selected for the United States. The Imperial Chancellor and the President of the Reichstag, with many other exalted personages, military and administrative, and one lady, Frau Cosima Wagner, of Bayreuth, were included. It gave rise to some remark that none of the British delegates, though Lord Strathcona, Lord Reay, Sir William Ramsay, Sir J. J. Thomson, and Sir Joseph Larmor were among them, received any academic recognition.

The solemnities of the seniors were thus accomplished. But the junior members of the University had festivities of their own to celebrate. The afternoon was occupied by a popular *Gartenfest* in the exhibition park, where students in the costume of 1810 and earlier, old alumni, professors, citizens, and somewhat bewildered guests, held high carnival. The halls of the exhibition, and the arches of the railway viaduct that spans the grounds, were thronged by thousands of cheerful spectators of the numerous entertainments, organised by the students' committee. As the public were admitted on payment, the crowds made sightseeing difficult, and conversation well-nigh impossible. As the evening fell, the

academic element receded altogether, and the park assumed a bank-holiday aspect.

At night a vast *Kommers* of the entire body of students took place in the Zoological Gardens. There, under the strict regulations which tradition prescribes, the ceremonies of the *Biercomment* were performed for the edification of the initiated and the entertainment of the foreign visitors. But the present writer had to leave by the midnight express, while the ordered revelry was at its height.

The foreign university delegates included Principal G. Adam Smith (Aberdeen), Zeeman (Amsterdam), Sir J. J. Thomson (Cambridge), Mahaffy (Dublin), Sir Donald MacAlister (Glasgow), Chwostow (Kasan), Brögger (Christiania), Sir W. Ramsay (London), Lord Strathcona (Montreal), President Hadley (Yale), President Butler (Columbia, New York), Macan (Oxford), Poincaré (Paris), Grünert (Prag), Blaserna (Rome), Mittag-Leffler (Stockholm), Bernatzik (Vienna), and A. Meyer (Zurich). Among the representatives of foreign academies and societies were Thomsen (Copenhagen), Johannessen (Norway), Lord Reay (British Academy), Sir J. Larmor (Royal Society), Keen (Philadelphia), Montelius (Sweden), Miura (Tokyo), and Böhm-Bawerk (Austria). The German universities and academies were represented for the most part by their rectors or presidents.

TOWN-PLANNING.

TOWN-PLANNING has always had a fascination for the sociological amateur, and the creation of a model town is one of the most pleasing and least harmful of Utopian dreams. Mr. Burns's Town Planning Act is well-intentioned; under the conditions this is enough, for in the evolution of a town the method of trial is inevitable, the problem *solvitur ambulando*. The one thing needful is the guiding idea, the working principle.

The discussions at the Town Planning Conference have been full of interest. There have been felicitous analogies, ingenious suggestions, and brilliant forecasts. But it is a commonplace that the permanent institutions are those which have not been planned, but have grown by a sort of felicitous adaptation, an unconsciously purposive concurrence of atoms. Throughout the conference it was taken for granted that the town of the future will be evolved from the town of the present by small, continuous modifications. Here is a curious analogy to Darwin's view of the evolution of a new species, by the summation of small variations. Again, throughout the conference there has emerged no master-principle, no architectonic impulse, for the guidance of those who will apply the Act. Still less possible was the emergence of any universal and permanent plan.

What is to be our plan, and what our principle for the evolution of the town of the future? Is the ideal town to be a garden city, with factories in the country, or a combination of gardens and factories? Mr. Lanchester has ingeniously explained the "West End" tendency by suggesting that in the evening, when work is over, one's steps naturally turn to the region of the setting sun, and that this quarter therefore is unconsciously chosen as the place of home and relaxation. Or is the ideal town to be an aërial maze of skyscrapers, overhead ways and wires, somewhat as imagined by Mr. Wells? Will this have roof-gardens? Will different forms of traffic be confined to different levels? Or, again, will the city be half underground? Such questions would be futile, were it not necessary that the working plan of the town-planner must allow for all such eventualities.

It is argued by many that plan must precede structure. As applied to individual units, this is a truism, but it can hardy be applied to a complex growth like a town. It involves the Platonic notion that there is a pre-existing idea of a town. But the idea, that is, the plan, of a town develops with its growth as surely as it originated with its inception. The moral of this is that the plan which every body of town-planners must work upon must be a *dynamic plan*; a moving, shifting, developing, and shrinking, growing and changing plan, the germ of which is to-day's town conditioned by its environment.

There has been, and will be for a time, much useless talk about town-geometry. The straight line and right angle with which street-plans commence, to be varied by curves, other angles, circles, and triangles, according to the circumstances, are fundamental. Æsthetic play with these elements is misguided in the case of streets and areas, no less than in the case of individual houses and blocks. For architectural beauty should be a by-product of adaptation of structure and function. Town-planners need to keep an eye on traditional architecture, which has long lost this essential principle. There is a real danger, in the enthusiasm of a new movement, that the conventional architect may create a body of useless expenditure if allowed to indulge his unscientific ideal of ornament for ornament's sake. He is really more dangerous than the jerry-builder. In the one sphere where he may seem harmless, if not desirable, the designing of public buildings, he is really unnecessary. At the conference, engineers were conspicuous by their absence, but in the town-building of the future the engineer will be the main adviser and collaborator of the builder.

As for a guiding principle in the working of a dynamic plan, there is none, unless we say—science. In the town, as in the house, ease of communication, light, air, and sanitation are the essential needs which scientific building has before it. There are no other components of a golden rule. Continuously applied when circumstances permit, these considerations will gradually improve our cities as science advances. One or two details are useful for discussion. It has long been established that urban populations tend to be more intellectual but physically more degenerate than the rural. Yet East End populations, though degenerate in some respects, have developed a high power of resistance to insanitary conditions. Again, there is some evidence that the town populations of Sweden, once a feeble race, have become, through physical training and scientific environments, physically superior to the country populations, and as fine a race as any in Europe. Parks and open spaces will be permanent blessings, supplying a touch of nature for the soul of the town dweller, though we may come to realise that we have over-estimated the value of light, and may some day artificially purify our air. Such suggestions as a great ring-road round London —certainly concentric communication is defective—and the removal of the great railway termini to one small central area, must be balanced by the possibility of the evolution of other methods of locomotion. Some day London may need great open spaces for aëroplane stages.

Town-planning is a continuous process, and its results are in the future, and themselves to be superseded. But there is one sphere, more or less untouched at the conference, which admits of immediate attention. One of the great obstacles to progress is the slowness with which new inventions are brought into the personal environment of the mass of the population. A striking example of this is the average house. But in the case of house-building, which, after all, is the most important function of

architecture, and the one supreme concern of the town-planner, invention has done less than in any department of material civilisation. Only in the matter of artificial lighting, and in sanitation, if in that, is the average house of to-day superior to the average house of two thousand years ago. In the matters of hot-water supply and plumber's work generally, of cooking apparatus, cleaning arrangements, heating, and ventilation, the modern house is a disgrace to a scientific age. What has been done for centuries towards the improvement of door and window mechanism? Even the external material of houses is the same as was used five or six thousand years ago, and is no more damp-proof now than it was then.

Take care of the houses and the town will take care of itself. Here is a work, of vital importance for the welfare of the race, which may well be the first care of those who apply the Act.

A. E. CRAWLEY.

THE MELANESIANS OF BRITISH NEW GUINEA.[1]

IN this volume is presented for the first time an adequate account of the sociology of a portion of the people of British New Guinea. The material which it embodies was collected during two visits of the author to New Guinea, and he has been ably assisted by various members of the Government and of the missions resident in the island. The book is a conspicuous example of what may be achieved by expert inquiry combined with local knowledge.

Dr. Seligmann uses the term Papuasian to signify all the inhabitants of New Guinea and the adjacent archipelagoes. These form two distinct groups. For the taller, darker, and more frizzly-haired people of the west he retains the term Papuan. The smaller, lighter-coloured peoples of the eastern peninsula and islands, in which the true Melanesian element is dominant, are called Papuo-Melanesians. With these Dr. Seligmann deals in the present volume, the Papuans being only alluded to when their physical characteristics or customs refer to the subject of discussion. Following Dr. Haddon's suggestion in the "Decorative Art of New Guinea," the author divides the Papuo-Melanesian peoples into two main groups, the western Papuo-Melanesians and the Massim of the east.

An introduction gives a succinct account of the general sociology and culture of the two groups. These agree in certain physical and cultural characters, which clearly differentiate them from the Papuan, but differ in many respects from one another. The amount of variation among the western Papuo-Melanesians is much greater than that found among the Massim peoples. The greater uniformity of the latter is regarded by Dr. Seligmann as due to a geographical factor. The small islands and peninsulas of the eastern district afforded less shelter for fugitives than the swamps and forests of the west, so that the Melanesian conquest was there more rapid and complete. Owing also to the slower mingling of the Melanesians with the original populations of the west, Dr. Seligmann considers that there is not only a considerable Papuan element in their composition, but that they have also in some cases adopted Papuan languages differing from each other as do the Papuan languages spoken by Papuans. If the Papuan elements were sufficiently strong to impose their language upon their conquerors, they must have been sufficient to have imposed their customs, or, at least, to have modified those which the invaders brought with them.

With the Motu of Port Moresby and the neighbourhood, who are the best known of the western Papuo-Melanesians, the author associates the Koita. The latter speak a Papuan language, and have for generations inter-married with, and built their villages adjoining, the Motu. The fact that the Koita language shows no trace of Melanesian influence, and has names for indigenous plants and animals, which are unnamed by the Motu, presents a difficulty which Dr. Seligmann has not discussed. From the latter, too, they have adopted certain customs and arts. The Ikoro, Gaboni, and Sinaugolo tribes, which closely resemble the Motu, occupy the district inland from Kapakapa and the basin of the Kemp Welch River. All these people are distinguished by the use of the open ceremonial

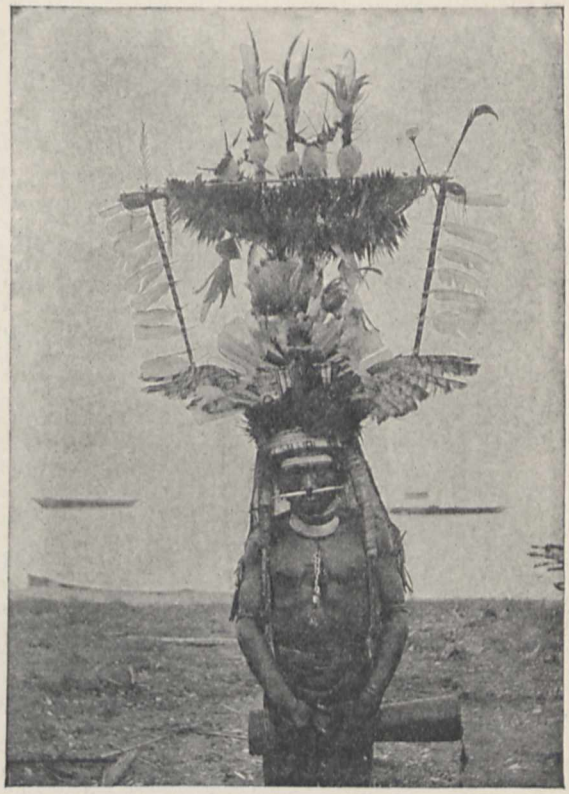

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FIG. 1.—Feather ōaōa of the Roro-speaking Tribes. From "The Melanesians of British New Guinea."

platform, or *dubu*. Eastward from Hood Peninsula the coast is occupied by a rather different tribe, among whom the *dubu* gives place to the *koge*, or steeple-house. All three groups have a general likeness in culture and sociology. There is a clan organisation and patrilinear descent. The first sixteen chapters of Dr. Seligmann's work deals in detail with the Koita regulation of public and family life, customs, trade, and religion, and includes an interesting account by Capt. F. R. Barton, of the *Hiri* or annual trading voyage made from Port Moresby to the Papuan Gulf. Another colony of Papuo-Melanesians (Mailu) dwelling around Milport Harbour and Port Glasgow, and speaking a Papuan language, are not discussed in detail by the author, neither are the Koiari and similar people of the hinterland, whom he regards as possessing more Melanesian than Papuan blood.

[1] "The Melanesians of British New Guinea." By Dr. C. G. Seligmann, with a chapter by F. R. Barton, C.M.G., and an appendix by E. L. Giblin. Pp. xxiv+766. (Cambridge: The University Press, 1910.) 21*s*. net.

The most western group of the immigrant Melanesians are the Roro and Mekeo people of the St. Joseph River, with whom are closely related the Pokao and Kapatsi between Hall Sound and Cape Suckling. In chapters xvii.–xxxi. the social relations and family life of the Roro are detailed, with an account of the clans and village organisation of the Mekeo, and a note on Pokao. This region is characterised by the greater importance attached to the right than to the left side in ceremonial matters, and by the prominence of geometrical design in the decorative art. Among the Mekeo there are traces of mother-right, though descent is patrilineal. A prominent feature in the

FIG. 2.—Popungapi *ufu* of Rarai Village. From "The Melanesians of British New Guinea."

Mekeo village is the highly decorated *ufu*, or club-house.

The Massim people of the east are more homogeneous than the western Papuo-Melanesians. Dr. Seligmann makes two divisions, the northern in the Trobriands, Marshall-Bennet, Woodlark, Laughlan, and some smaller islands, the southern in the south-east peninsula of New Guinea between the south shore of Milne Bay and Goodenough Bay, with some of the Louisiades. Each division has its distinctive features. In the north there is a higher cephalic index and cranial capacity, a hereditary chieftainship, and absence of cannibalism. Both sections are remarkable for the building and use of large sea-going canoes, and the characteristic Massim decorative art reaches its highest development in the ornamental prows of these vessels in the north. The author's account of the sociology of the southern Massim includes a collection of folk-tales. The people live in hamlet-groups, the inhabitants of which are more or less closely related by birth or marriage. There is also a peculiar form of totemism in which the members of a clan have as totems a series of associated animals or plants, as, *e.g.* a bird, fish, snake, and plant, the number and nature of these varying in different places.

The northern Massim are described in similar detail as regards the Trobriands, Marshall-Bennets, and Murua. Shorter accounts are given of the Louisiades and Mukaua on the southern and western borders.

The volume is exceedingly well illustrated. There are seventy-nine plates from photographs or native drawings. Most of the former are exceptionally good. In addition there are fifty figures in the text drawn by Mr. Norman H. Hardy, a good map, a glossary of native words, and a very useful index. Dr. Seligmann has produced an interesting, trustworthy, and scholarly work on a most interesting section of the Melanesian people.

S. H. RAY.

THE CENTENARY OF FILIPPO CAVOLINI.

THE first centenary of the death of Filippo Cavolini, the great Neapolitan naturalist, was celebrated on September 12–13, the function having been arranged by the Society of Naturalists in Naples. Citizens, as well as the scientific and the political authorities, answered enthusiastically to the appeal of the society. The municipality and the University united, formed a powerful honorary general committee, the patronage of which was assumed by King Victor Emmanuel III. The chairman of the ordinary committee, composed of members of the Society of Naturalists, was the president of the society, Prof. F. S. Monticelli. The committee published an attractive booklet, giving a *résumé* of the life and works of F. Cavolini.

On September 12 the *aula magna* of the University was thronged by delegates of the Italian and foreign universities, by members of the International Zoological Congress, and by others who had been invited. Amongst the many supporters, apart from the Italian Ministries of Public Instruction and of Agriculture, we note those of many academies and universities of Europe and America, and also the Prince of Monaco.

Prof. Pasquale del Pezzo, rector of the University,

thanked the Ministry of Public Instruction, and greeted all who took part in the commemoration in honour of Filippo Cavolini. Commander Rodino presented a welcome from the municipality of Naples, and thanked the Italian Sovereign, patron of the commemoration. Prof. Paladino spoke on behalf of the Royal Academy of Sciences and Letters, recalling at length the personality of Cavolini as citizen and man of science. Prof. Camerano, rector of the Turin University, made an appropriate speech, and Prof. Apàthy, representing the Hungarian University of Kolozsvàr, offered the greetings of the foreign men of science. Dr. F. S. Monticelli, ordinary professor of zoology at the Naples University, then delivered a speech in which, having alluded to the life of Cavolini, and summarily traced his scientific work, he concluded:—"Filippo Cavolini was a biologist in the true and modern sense of the word, both in observation and in experiment; his work marked a new direction in the study of life, a direction that has been corroborated in later times, a direction which Cavolini, in his day, professed and practised."

"The perusal of his works, which will be re-edited by the committee, fully proves that a century ago he, precursor of the present time, experimented on the same lines as those of the present day. This man, to whom, with patriotic pride, we must accord the honour of the scientific discoveries which he first revealed, well merits the remembrance of his fellow-citizens in to-day's centennial festivities, in order that they, not forgetting our ancient culture, should recollect that in times less fortunate for Italy's destiny, Filippo Cavolini, honouring his country, maintained his country's name in science."

The rector afterwards held a reception in the great academic hall. In the evening the Society of Naturalists received the delegates in the Galleria Vittoria. The following day the delegates and congressists were invited by the committee to join an excursion by steamer to Capo Posillipo, to the Villa de Mellis, once Cavolini's property. President Monticelli, in the presence of a large gathering, consigned to the representative of the municipality a commemorative marble tablet, which had been fixed to the house in which the great naturalist achieved his work.

JOHN WILLIS CLARK.

BY the death of John Willis Clark, on October 10, the University of Cambridge has lost one of its best known and best loved members. Failing health had quite recently induced him to send in his resignation of the office of registrary of the University, as from the end of September. The interval allowed by statute for filling up this important post is only fourteen days, and it thus happened that his successor was elected on October 12, the day before his funeral took place.

J. W. Clark was to an exceptional extent a product of Cambridge, and the circumstances of his birth and training combined to give him, from early youth, an intimate knowledge of the University. He was born in Cambridge on June 24, 1833. His father, the Rev. W. Clark, fellow of Trinity College, was professor of anatomy from 1817 to 1866. His uncle, Robert Willis, fellow of Gonville and Caius College, held the Jacksonian professorship of natural experimental philosophy from 1837 to 1875. J. W. Clark was thus brought up in an environment which made him familiar with the University at an age when his contemporaries in academic standing of later years had not yet commenced their acquaintance with Cambridge. He was educated at Eton, and from there proceeded to Trinity College, of which he became a scholar, and later a fellow, having obtained a first class in the classical tripos of 1856.

On the death of Prof. Clark, in 1866, a professorship of zoology and comparative anatomy was founded, and the first occupant of the chair was Alfred Newton. At about the same time the zoological specimens which had been contained in the museum of anatomy, some of them dating from the time of Sir Busick Harwood, professor of anatomy from 1785 to 1814, were placed in a museum of their own, reinforced by the collections of the Cambridge Philosophical Society. J. W. Clark was the first superintendent of the new museum of zoology, and he acted in that capacity from 1866 to 1891, when he resigned the office on being elected registrary. During his tenure of the superintendentship, his own efforts, combined with those of Prof. Newton and Prof. (later Sir George) Humphry, gave the museum a character which was eminently suited for the instruction of students of zoology, and made it an educational instrument of the greatest value. Throughout these years Clark was on terms of intimate friendship with Prof. (later Sir William) Flower, at that time conservator of the museum of the Royal College of Surgeons. A series of specimens illustrating the comparative anatomy of vertebrates was formed by a mutual arrangement between the two museums, of such a nature that, for instance, the limb-bones of one side of a particular animal found their way into the museum of the College of Surgeons, and those of the other side into the Cambridge comparative series. Clark was fully impressed with the importance of illustrating the structure of animals in his scheme of exhibits, and the collection over which he presided was distinguished by possessing preparations both of vertebrates and invertebrates, which placed it far in advance of the majority of provincial museums.

During the whole of his period of office at the museum, Clark had, however, wider duties to perform. He found time to act as secretary to the Museums and Lecture Rooms Syndicate, a body which is charged with the care of the buildings, and, to a large extent, with the finance of the scientific and other departments. This was a highly critical period in the history of natural science in the University, since it coincided with the remarkable growth of scientific studies which was so marked a feature of Cambridge at that time. Clark's wise and capable management of affairs, and in particular the interest he took in supervising the planning and erection of the buildings required to provide accommodation for the new studies, have earned for him the well-deserved gratitude of all who have had the scientific interests of the University at heart.

The duties in connection with the museum and with the growth of the scientific departments generally would have been enough to find full scope for the energies of an ordinary man. But this was only one side of Clark's remarkable character, and some of his most notable achievements lay in entirely different directions. His highly valued services to the University as a member of innumerable syndicates and boards must be passed over without comment. The work by which he is best known to many students was connected with the history of the University. The monumental "Architectural History of the University of Cambridge," by the late R. Willis and J. W. Clark, was published in 1886, in four large volumes. It originated in a lecture given by Prof. Willis in 1854, and it was based in the first instance on the materials which had been accumulated by him. The work was taken over by Clark at Prof. Willis's death; and the volumes, as finally brought out by him, are a mine of information in all matters con-

nected with the growth of the University and its colleges, as well as of Eton College. Four years later, in 1890, "The Life and Letters of Adam Sedgwick" was published by J. W. Clark, in collaboration with Prof. T. McKenny Hughes.

As an antiquary, Clark was specially concerned with libraries, and he was an acknowledged master in matters relating to their furniture and fittings. Some of his results in this line of investigation were published in 1901, under the title of "The Care of Books." His interest in libraries took a practical shape in the work he devoted to the University library, as shown, for instance, by his success in raising, within the last few years, a sum of 20,000*l.* in order to place the finances of that institution on a more satisfactory basis. The Fitzwilliam Museum is another institution to which Clark devoted much of his time, and to which he rendered innumerable services. He was a member of the council of the Cambridge Antiquarian Society for forty-nine years, and he read more than fifty papers at meetings of the society.

As a zoologist, Clark's principal interests were connected with marine mammals, as is exemplified by the fine collections of Cetacea, Sirenia, and Pinnipedia which he made for the museum of zoology. His best-known zoological publications refer to these groups of animals, and special reference must be made to his papers on eared seals, published in the Proceedings of the Zoological Society in 1873 to 1884.

During the last nineteen years of his life, Clark was fully occupied by the duties devolving on him as registrary of the University. In this capacity his extraordinary knowledge of the early history of Cambridge and of its forms and ceremonials, his ability in the care and publication of documents, and his acquaintance with procedure were all of the greatest service to the University.

It is difficult to speak dispassionately of Clark's singularly attractive personality, and of the ready sympathy he showed with all sorts and conditions of men.

Advancing years did not take from him the capacity of making new friends, many of whom were chosen from among the younger members of the University.

> "Gracious and apt to win the youngest heart,
> Yet keep the oldest true!"

These words, written of him by his friend, Mr. A. C. Benson, will express the affectionate regard felt for him by many with whom his loss leaves a blank that cannot be filled. SIDNEY F. HARMER.

PROF MAURICE LÉVY.

IN NATURE of last week the death was announced of M. Maurice Lévy, sometime inspector-general of the Ponts et Chaussés, and professor at the Collège de France. An interesting account of Levy's investigations in pure and applied mathematics and mechanics is given by M. Émile Picard in an address to the Académie des Sciences, read on October 3 (*Comptes rendus*, cli., 14).

In infinitesimal geometry, Lévy obtained the doctorate in 1867, for an essay on orthogonal coordinates embodying several new and important results. His investigations in this subject also included the study of spiral surfaces. His treatise on graphical statics, of which the first edition appeared in 1874, practically initiated the study of this important branch of applied mathematics in France. The notes at the end of the first edition really constitute original papers on the tension of elastic rods, and on the systems of maximum strength with given amount of material; in them the author discusses the advantages of structures without superfluous connections. A second and enlarged edition appeared in due course, and the completion of a third edition has been unfortunately cut short by Lévy's recent death.

The subject of elasticity occupied a large share—perhaps the main share—of Lévy's attention. After he entered the École polytechnique in 1856, at the age of eighteen, he indicated a new and simple method of investigating the resistance of continuous beams. The problems presented by systems, one of the dimensions of which is small compared with the others, greatly interested him, and a long memoir was published by him on the flexure of elastic plates. M. Picard speaks in high terms of the ingenuity and ability displayed in this essay, while remarking that a more complete solution of the difficulties occurring in this problem is to be sought elsewhere.

A second problem in elasticity was afforded by the stability of rods or prisms under end-thrust, and Levy extended the investigation from straight to circular rods, obtaining extremely interesting conditions of stability by means of an analysis involving elliptic functions. To M. Lévy is assigned the credit also of obtaining for the first time the general equations for ductile bodies strained beyond the limits of elasticity, thus responding to the question put by Saint Venant, arising out of Tresca's experiments.

Hydrodynamics formed the subject of Lévy's second paper, dealing with rectilinear vortex motion. In this, the author took a leaf out of Cauchy's theory of optical dispersion in his application of the higher differential coefficients in studying the mutual action of two vortices.

A development of a more practical character was M. Lévy's investigation of the equilibrium of earth and the strength of masonry supporting walls. Starting with the laws of friction, Lévy found the differential equation of the lines of rupture in limiting equilibrium, and showed that, contrary to Coulomb's results, the surfaces of rupture for a prismatic mass of earth are not in all cases planes parallel to the edges of the prism.

It will thus be seen that M. Lévy played an important part in applying analytical methods to the solution of problems of practical interest, and his works constitute a heritage from which workers in applied science cannot fail to benefit greatly.

NOTES.

THE council of the Royal Scottish Geographical Society has resolved to award the society's medal to Prof. James Geikie, F.R.S., for his numerous contributions to geographical research and his great services to the society; and the Livingstone gold medal to Sir John Murray, K.C.B., F.R.S., in recognition of his oceanographical work, and more particularly in commemoration of the completion of the bathymetrical survey of Scottish freshwater lochs.

WE regret to see the announcement of the death, on October 14, of Dr. Sydney Ringer, F.R.S., at seventy-six years of age.

ACCORDING to a Reuter message from Santiago de Chile, official returns show that the world's consumption of nitrate during the past year amounted to 43,996,966 quintals, an increase of 8,000,000 quintals as compared with the previous twelve months.

PROF. HOWARD C. BUTLER, of Princeton, has just returned to that University with an encouraging report of the archæological expedition he has been directing at Sardis, in Asia Minor. The discoveries include a part of the pavement of the ancient city, and the substructure of a large temple of the fourth century B.C. In the necro-

polis across the river from the city the explorers have discovered fragments of statuary and many gold ornaments of much beauty.

THREE members at least of the Yale faculty have lately returned from exploring tours which have occupied them during the long vacation. Prof. C. Schuchert, curator of the Peabody Museum, has investigated the geological formations of southern Labrador, and brought back a ton of specimens. Prof. R. S. Lull has spent several months in Europe studying mainly the European equivalents of the American dinosaurs. Mr. G. G. MacCurdy, curator of the anthropological collection, has been engaged in researches in the Indian antiquities of southern Mexico.

THE Home Secretary has appointed a committee to consider the organisation for rescue and aid in the case of accidents in mines, and to frame proposals for the making of an Order or Orders under the Mines Accidents (Rescue and Aid) Act, 1910. The members of the committee are:—Mr. C. F. G. Masterman M.P. (chairman); Mr. R. A. S. Redmayne, H.M. Chief Inspector of Mines; Mr. W. N. Atkinson, H.M. Inspector of Mines; Mr. E. M. Hann; Mr. W. C. Blackett; Mr. John Wilson, M.P.; and Mr. John Wadsworth, M.P. The secretary of the committee is Mr. A. Maxwell, of the Home Office.

IN a letter published in the *Times* of October 17 Mr. J. Reid Moir, of Ipswich, announced his discovery of worked flints beneath undisturbed deposits of Crag in the neighbourhood of Ipswich and elsewhere in eastern Suffolk. The flints occur on the eroded surface of the London Clay, at the base of Pliocene deposits, and associated in some cases with phosphatic nodules and fossil bones. It is inferred that the ancient clay surface was inhabited by "pre-Crag man," whose implements, on submergence of the land beneath the Pliocene sea, became covered with Red Crag. The handiwork on the flints is of a more advanced character than that of the eoliths. Two types, at least, of the early East Anglian flints may be recognised; and it is notable that though they must be, if Pliocene, very much older than the Great Ice age, some of them exhibit on their worked surface deep striæ suggestive of glacial action.

IN a letter to the Press, Lord Braye and Mr. Frank Hedges Butler state that it is proposed to erect a pillar as a memorial to Percy S. Pilcher, who was killed at Market Harborough on September 30, 1899, while making a flight with his soaring machine or aëroplane. Pilcher was the first Englishman who put into practice the project of gliding through the air with rigid wings, and he had the intention of propelling with a motor the machine he had made. Many who knew him and appreciated his self-devotion and zeal in promoting aviation may like to contribute to the proposed memorial, near the spot where he fell. Subscriptions should be sent to the Pilcher Memorial Fund, Messrs. Barclay and Co. (Gosling Branch), 19 Fleet Street, E.C.

THE name of Thorvald Nicolai Thiele, professor emeritus in the University of Copenhagen, has been before the astronomical public for many years, and by his lamented death on September 26 science has lost an able and original worker distinguished in several branches of natural knowledge. As a pupil of D'Arrest and as director of the Copenhagen Observatory he gave much, but not undivided, attention to astronomy, and was known for his careful discussion of double-star observations, and particularly for his criticism of Otto Struve's measures. The problem of the theory of errors in its many applications interested him, and he will be remembered for his discussion of special cases of the problem of three bodies. Outside astronomy he wrote much on insurance problems and statistics connected with tables of mortality. On these subjects he was a recognised authority, and on account of his pre-eminence was one of the few foreigners elected into the Institute of Actuaries. As a teacher he preferred to lecture on the more abstruse problems of astronomy, and never attracted a large class; consequently, his pupils were few and his influence small in comparison with his reputation, but those who were willing to penetrate deeply found in him an encouraging and illuminating master.

THE Board of Agriculture is understood to have applied to the commissioners appointed under the Development Act for an annual grant of 50,000*l.* for the purpose of research work in agriculture and for giving technical advice to farmers. A number of agricultural institutions have sent in applications for financial help, but the Board and two of the commissioners—Messrs. A. D. Hall and Sydney Webb—are engaged on a comprehensive scheme that shall ensure the best use being made of the present material. The Board has appointed a special advisory committee, including the Duke of Devonshire, Lord Reay, Sir Edward Thorpe, Dr. Dobbie, Mr. S. U. Pickering, Prof. J. B. Farmer, Lieut.-Colonel Prain, Drs. Teall, Harmer, MacDougall, and Wilson, and Messrs. Davies, Middleton, Staveley-Hill, and Stockman to help generally in the work. Details of the scheme are not yet available. The occasion is a critical one for agricultural science. The amount of money is considerable, and much will be expected in return for it; if those engaged in agricultural research can justify its expenditure they will be rendering good service, not only to agriculture, but to science in general.

NOMENCLATURE occupies a necessary part of scientific activity, and in no branch of science are the difficulties of nomenclature so great as in zoology. The greatest of these difficulties is occasioned by the rules of priority, since if these were strictly applied, many familiar names would fall into disuse, and great loss of time, misunderstanding, and trouble would result. The British Association and the eastern branch of the American Society of Zoologists have recently appealed for support in a movement to exempt animal names of long standing from change under the rule of priority, and have presented a proposition on the subject to the Commission on Nomenclature of the International Zoological Congress. This commission has just issued its triennial report, the chief interest of which lies in a reference to this matter. The secretary (Dr. C. W. Stiles, Smithsonian Institution, Washington, D.C., U.S.A.) now asks all zoologists to send him a list of 100 generic names (with their authors' names) for consideration in connection with this proposition by November 1, together with a list of standard text-books used in zoological or palæontological courses of study. Specialists are also asked to furnish a list of 100 type-species, with full references to their names as determined by Art. 30 of the international rules. All zoologists who wish to preserve the older nomenclature would do valuable service by sending in such lists without delay.

THE *Times* of October 7 contains an interesting account of recent Norwegian explorations in Spitsbergen carried out by an expedition under Captain Gunnar Isachsen, which returned to Christiania on September 18 last. The chief land-work of the expedition was done in the north-western part of the main island, the most striking result being the discovery of a not long extinct volcano and hot-

springs in Bock Bay, a branch of Wood Bay (not Wijde Bay, as first reported). When the brief announcement of this discovery first reached Europe two months ago some doubt was felt as to the recentness of volcanic action in this quarter, but the details now given seem to prove that the volcanic cone is at any rate of Quaternary age and later than the general glaciation of the region. The cone, about 1650 feet high, is described as consisting partly of lapilli; it occurs in lat. 78° (? 79°) 28′ north, and long. 13° 28′ east (Greenwich), in the vicinity of a north-south fault, which brings Devonian sandstones into juxta-position with granite. The expedition encountered unusual and difficult ice-conditions, and reports that Bell Sound, in the south-west of the island, was already blocked up by ice toward the end of August, and that hunting sloops are now there frozen up. The weather was very fine until the middle of August, but afterwards there was scarcely one clear day in the western part of Spitsbergen. The large Geological Congress party that visited Ice Fiord under the leadership of Prof. G. de Geer early in August are evidently to be congratulated on their good fortune in having chanced upon the finest weather of the season.

In *Travel and Exploration* for October Mr. A. de C. Sowerby, in the service of the United States National Museum, describes the exploration of a hitherto little known district in China, the country drained by the Fen-ho, a large tributary of the Yellow River, running north and south through the western part of the Shansi Province. He was successful in procuring a number of new or uncommon specimens, such as moles, polecats, striped hamsters, pikas, and other quadrupeds, but there were practically no birds except bustards, crows, and larks. Sport is abundant; and Mr. Sowerby, who was accompanied by his wife, seems to have been well received by the people.

The increasing importance of the museum of the University of Pennsylvania has encouraged the director, Mr. G. B. Gordon, to commence the issue of a quarterly journal, of which we have received the first number. The past history and condition of the museum, and several new and interesting acquisitions, have been here described by the sectional officers. It illustrates the liberality of American citizens towards scientific institutions, and the value which they attribute to museums as factors in educational work, that the director now appeals, with confident hopes of success, for the collection of an endowment fund which will give an annual income of seventy-five thousand dollars, which will, it is estimated, meet immediate requirements.

In the September number of the *Quarterly Journal of Microscopical Science* (vol. lv., part iii.) Mr. A. M. Carr Saunders and Miss Margaret Poole discuss the development of *Aphysia punctata*, with special reference to the origin of the kidney, heart, and pericardium, concerning which very different opinions have been expressed by previous writers. This paper illustrates well the great accuracy in the determination of cell-lineage which is expected of the modern embryologist, and by which alone such problems can be solved. The necessity for such accurate observation is also clearly brought out in a short controversial paper, published in the same number, by Prof. Hubrecht, who endeavours from the study of very early stages in the development of Galeopithecus and Tarsius to demonstrate the untenability of Mr. Assheton's theory of the hypoblastic origin of the mammalian trophoblast. The extremely early segregation of the trophoblast cells in the types referred to certainly seems to afford strong support to Prof. Hubrecht's contention.

In the *Centralblatt für Bakteriologie, Parasitenkunde, &c.* (Originale Band 53, 1909), Dr. C. Elders describes and figures a trypanosome found in the blood of a patient in Sumatra. It was observed that at the beginning of the rainy season the Javanese coolies on a rubber plantation situated near the edge of the virgin forest often suffered from a sickness characterised by "continuous, atypical attacks of fever, with painful enlargement of the spleen, liver, and lymphatic glands, sometimes with œdema pedis, often with aches in the head, back, and limbs, and always with increase of the large mononuclear leucocytes." It was in a smear of blood from one of these patients that a single specimen of a trypanosome was found, which appears to differ in its characters, and especially in its small size (8 μ in length), from the African *Trypanosoma gambiense* or the Brazilian *T.* (*Schizotrypanum*) *cruzi*, of which an account was given recently (August 4) in NATURE. Should this discovery be confirmed, this species (which is not yet named) will be at least the third distinct species of trypanosome parasitic on human beings.

A memoir entitled "Flagellaten-studien," by M. Hartmann and C. Chagas, in the *Memorias do Instituto Oswaldo Cruz*, vol. ii., part i., is a very important contribution to the cytology of the Flagellata. The authors have studied the relations between the nuclear and flagellar apparatus, both in the resting condition and during mitosis, in a number of species of this class of Protozoa, and they distinguish four types of flagellar insertion, as follows:—(1) the flagellum takes origin directly from the centriole contained in the nucleus (Rhizomastigina); (2) the flagellum arises from a basal granule or secondary centriole, connected by a filament or rhizoplast with the primary centriole in the nucleus (Protomonadina and Phytomonadina); (3) as in (2), but the basal granule of the flagellum is connected with the centriole of a special kinetic nucleus, and the organism is binucleate (trypanosomes and allied forms); (4) the basal granule (secondary centriole) of the flagellum is connected by a rhizoplast with a centriole of the third order, lying outside the nucleus altogether, and distinct from the primary centriole contained in the nucleus (Euglenoidina). A natural classification of the Flagellata is put forward, based principally on the above-mentioned differences of structure. In this connection it may be mentioned that, as pointed out by Minchin, the two primary subdivisions of calcareous sponges, in the "natural" classification of this class, also exhibit, amongst other characteristic points of difference, distinct types of flagellar insertion in the collar-cells.

The nomenclature of some of the species indigenous to or visiting the United Kingdom is discussed by Dr. Hartert in the October number of *British Birds*. Among other items, we are told that the thrush "must henceforth be called" *Turdus philomelos*, while the redwing is to be known as *T. musicus*. Nevertheless, in the recently published "Guide to the British Vertebrates in the British Museum" the latter name is retained for the thrush, as is *Turdus iliacus* for the redwing.

In the Transactions of the Lincolnshire Naturalists' Union for 1909 Mr. G. W. Mason completes his list of the Lepidoptera of the county, while Messrs. Thornley and Wallace continue their synopsis of the local Coleoptera, dealing in this instance with the family Staphylinidæ. In the presidential address we are informed that measures were to be taken for a malacological survey of the county with the view of publishing a complete list of the land and fresh-water molluscs.

Despite the usual insufficiency of funds, supplemented in this instance by an inadequate staff, lack of space, and

absence of proper show-cases, the Rhodesia Museum at Bulawayo is stated in the report for 1909 to be making continued and in some respects rapid progress. A considerable amount of original research was carried out during the year by various members of the staff. The report concludes with an appendix on the gold-bearing rocks of Rhodesia, and a second on the minerals of the district, both by Mr. A. E. V. Zealley.

GREAT credit is due to the staff of the Exeter Museum for the rapidity with which they have prepared and arranged for public exhibition the fine series of about 4000 species and 20,000 specimens of land-shells received towards the latter part of 1909 as a bequest from the late Miss Linter. According to the terms of the will, the collection was to be made accessible to the public within a specified period, and this heavy task has been successfully accomplished. Lack of space prevented, however, the whole collection being shown at once, and it has accordingly been arranged to exhibit it in sections. In the October issue of the *Museums Journal* Mr. Rowley describes the manner in which this was done, and likewise the methods of mounting, which he thinks may prove useful to other museums.

WHILE Great Britain has produced many brilliant examples of self-educated men who have won for themselves more or less distinguished positions in science, Ireland, according to the October number of the *Irish Naturalist*, can lay claim to only one such hero of the highest type. This was Samuel Alexander Stewart, who was born in Philadelphia on February 5, 1826, whence he came in 1837 with his father to Belfast, where he eventually worked as a miller. Details of his life and work are recorded in two separate articles in the serial quoted, the former being described by the Rev. C. H. Waddell and the latter by Mr. R. L. Praeger. Most of his papers were devoted to botanical subjects, although local zoology and botany likewise claimed a share of his attention. Mr. Stewart died on June 15 last as the result of a street accident.

THE relation of palæobotany to plant-phylogeny forms the subject of an article by Prof. Penhallow, of McGill University, in the October number of the *Popular Science Monthly*. Although considerable progress has been made in the matter of tracing the descent of plants through the geological ages, many gaps remain to be filled. The bryophytes, for instance, which, from their low organisation, ought to date at least from the Silurian, are unknown before the later Tertiary; in this instance the deficiency in their past history may perhaps be attributed, at least in part, to the "imperfection of the geological record," and if this be so the need of caution in making generalisations in this and other cases is self-evident. In conclusion, the author observes that "if palæontology teaches us anything, it is that each great phylum, as well as its various subdivisions, finally reaches its culmination in a terminal member from which no further evolution is possible. But that from some inferior member, possessing high potentialities, a side line of development arises." In an earlier paragraph it is stated that although evolution is still in progress, the possibilities of its continuation are steadily diminishing, and will eventually come to an end.

IN part i. of vol. xli. of *Travaux de la Société Impériale des Naturalistes de St. Pétersbourg* Mr. K. Derjugin gives a summary of the contents of a forthcoming memoir on the fauna of the Kola Fjord, in the Arctic Ocean, based on the survey carried on by the yacht *Alexander Kowalevsky* during the summer of 1908. The investigations were carried on by dredging and surface netting, especial attention being directed to the mouth of the fjord, into which both the Kola and the Tulima discharge, and the line of division between the fluviatile and marine faunas determined. The interesting forms included the isopod *Limnoria liguorum*, the mollusc *Xylophaga dorsalis*, and certain bryozoans, such as Loxosoma and Stomatopora, while the plankton contained a rare and remarkable type of Sagitta. In the same issue Mr. W. Schitz directs attention to the northward extension of the range of blue roller and the thicknee. Nests of the former were observed during the past summer in the governments of St. Petersburg and Novgorod, where they had never previously been seen, while in the summer of 1909 the latter bird was noticed near Lake Celigner, in the government of Twer.

MESSRS. JOHN WHELDON AND CO., 38 Great Queen Street, have recently issued a catalogue of general and economic botanical publications, including a few early herbals and works of Linnæus.

THE report for 1910 of the Lichen Exchange Club of the British Isles contains the report of the secretary, Mr. A. R. Horwood, and notes on critical specimens. Two species new to science are recorded under the genera Lecidea and Arthopyrenia.

THE Department of Lands in New Zealand is responsible for the management of the State nurseries and plantations and for the operations connected with scenery preservation, for which separate reports for the year 1909–10 have been published. The output of five nurseries amounted to 12,000,000 young trees, of which 8,000,000 were planted, largely by prison labour, on seven plantations. It is surprising to find that nearly all of these are European trees, chiefly the larch, *Pinus laricio*, the spruce, and *Pinus ponderosa*; of the eucalypts, *Eucalyptus Stuartiana* has proved to be a fast grower and is being planted, while the only reference to indigenous conifers states that, owing to failures, it has been decided to discontinue raising plants of *Podocarpus Totara*. It is also noted that deciduous trees and mixed plantations have for the most part proved unsuccessful. The report on scenery preservation indicates that additional areas amounting to 1500 acres were reserved during the year.

A VOLUME (Publication No. 129) emanating from the Carnegie Institution of Washington is devoted to an account of field observations near the desert laboratory at Tucson, Arizona, and experimental cultures in connection with the conditions of parasitism in plants. Dr. W. A. Cannon has discovered parasitism, apparently facultative, in two species of Krameria, a genus assumed to be autotrophic. The species, *Krameria canescens*, was found attached to several hosts, most frequently to *Covillea tridentata*, probably on account of a similar growth habit. The experimental work conducted by Dr. D. T. Macdougal was directed towards inducing dependent nutrition by the insertion of prepared slips into a host plant. The selected hosts were succulents, as Opuntia, Echinocactus, and the "xeno-parasites"—to use the author's name—were species of Cissus, Agave, and others. In the more successful cultures, the xeno-parasites formed roots and showed some degree of development for a year or longer. It was found that a superior osmotic activity on the part of the parasite is an essential. The pamphlet closes with a discussion on the origination of parasitism.

WE have received from Mr. E. Leitz a booklet on "Some Hints on the Use of the Sliding Microtome," which contains a good description of the operations of

imbedding an object in paraffin, trimming the block, making the "ritzer" lines on one face of the block, and cutting it into sections. The causes of curling, splitting, and wrinkling of the sections, and of sundry other troubles which confront the beginner, are pointed out and the remedies given. Most workers use xylol after dehydration of the tissue to replace the alcohol and to act as the paraffin solvent, but the author advocates the use of toluene; he also recommends dammar as a mounting medium in preference to balsam.

AN anonymous contributor to *Symons's Meteorological Magazine* for September communicates an article on "The Meteorological Outlook in South Africa." He points out that this pre-eminent vantage ground for the study of that science has not been utilised as it might have been, and expresses the hope that the new Union Parliament will favourably consider the matter. There are only some half-dozen of the more important stations, and some of these are poorly equipped; in nearly all cases the sites are not satisfactory, and have been chosen with a view to astronomical observations, and none can hope to undertake good magnetical work. A single service for the whole country is advocated, instead of separate services for each State as at present. The writer recommends the establishment of a series of first-order observatories suitably distributed geographically, *e.g.* in one line from Durban to Port Nolloth, and in another line from Bulawayo to East London; also a systematic discussion of all the observations at present in existence, and particularly of the anemometric records kept at some of the ports. Attention is also directed to the necessity of uniformity of times of observation and of the measures used in publications.

THE results of the Italian aëronautical experiments near Zanzibar during the last week of July, 1908 (the period selected for international balloon ascents), are published in the *Annali* of the Central Meteorological Office (vol. xxx., part i.). The Italian Government lent the cruiser *Caprera* for the purpose, and deputed Prof. L. Palazzo to superintend the work. The weather during the whole of the time was unfortunately unfavourable; only two successful ascents were made with registering balloons, and ten ascents of pilot balloons could only be observed in the lower strata of the atmosphere. Some useful observations were, however, made with the latter, and showed that the wind direction during the summer monsoon was practically southerly, with more or less easterly components. On July 30 the registering balloon reached an altitude of 4940 metres; at 1500 m. and 3500 m. a small inversion of temperature was observed, both in ascending and descending. The lowest temperature, −2·8° C., was registered at 4690 m. during the descent. In the ascent of July 31 the altitude of 6630 m. was reached; the minimum temperature, −12·0° C., occurred at 6610 m., during the descent. There was a tendency to an inversion at 3500 m., and a more decided one at about 6200 m., both in ascending and descending.

IN the October number of the *American Journal of Science* Mr. A. McAdie directs attention to the urgent necessity of replacing the present bewildering diversity of systems of notation in meteorology by an international system. The work now in progress with the help of kites and the rapid strides which the art of aviation is making both point to an early extension of our knowledge of the properties and motions of the atmosphere, and it is important that the results should be expressed in a form readily understood by all. With Dr. W. N. Shaw, the author advocates the expression of pressures in terms of the barie of one million dynes per square centimetre, which is the pressure at a height of 106 metres in the atmosphere. Temperature to be expressed on the absolute scale, reckoned from −273° C.; humidity in terms of the weight, in grams, of water vapour in 1000 cubic metres of air; and the direction of the wind in degrees from the north towards the east.

THE *Revue scientifique* for October 1 reproduces a lecture given by Prof. Jean Becquerel on modern ideas as to the constitution of matter. Although no mathematical symbols are used, the author succeeds in giving a clear and interesting account of the steps by which, since the discovery of the kathode rays, physicists have been driven to the conclusion that, like matter, electricity is atomic in constitution, that the kathode rays are, in fact, streams of atoms of negative electricity. In virtue of their motion these atoms possess an inertia equal to one two-thousandth part of that which an atom of hydrogen would possess, and it seems possible that they form one of the primordial elements out of which matter as we know it is built. How each atom of matter is constructed remains to be discovered, but if the above view is correct it is no longer possible to conceive of the atoms of the chemists as immutable; we must, in fact, turn alchemists.

WE learn from an article in *Engineering* for October 14, dealing with the annual report of Lloyd's Register of Shipping, that the Diesel oil engine is now being fitted to three fairly large vessels being built on the Continent under the supervision of the surveyors of Lloyd's Register. One set is being constructed on the older principle of the four-stroke cycle with single-acting cylinders, and will be of about 450 indicated horse-power. A two-stroke cycle, in which the reversal is effected in the engine itself, the crank-shaft being directly coupled to the screw-shaft, has been successfully adopted. A single-acting set on the two-stroke cycle is being fitted to a twin-screw vessel, the power being about 900 indicated horse-power on each shaft. The third set is being made on the two-stroke cycle double-acting system, each cylinder providing two impulses per revolution. This will also be fitted in a twin-screw vessel, the total power being about 1800 indicated horse-power.

IN the same report of Lloyd's Register are described several novel features possessed by a set of internal-combustion engines which is being constructed in this country, under the society's survey, for a vessel of about 260 tons. Gas for the engines is to be produced on board from anthracite coal. The cylinders are to be of comparatively small size, and the engines are intended to run at a high rate of revolution, and will not be reversible. The connection with the screw-shaft will be made by means of a hydrodynamic transformer, in which a turbine pump driven by the engine delivers water to another turbine coupled direct to the screw-shaft. The arrangement is such that the screw-shaft will rotate at a much less rate of speed than the engines, and provision is also made for reversing its direction of rotation. The experience which will be obtained from these four applications of the internal-combustion engine is being looked forward to with great interest, and will provide data of great value.

MESSRS. E. B. ATKINSON AND CO., 24 Dock Street, Hull, have sent us a copy of their new catalogue of balances and weights. In addition to containing particulars of the balances of their own designs, the catalogue provides prices and details of all other well-known makes of balance and accessories which Messrs. Atkinson and Co. are prepared to supply.

WITH the close of the year 1909 the hundredth volume of the *Chemical News* was completed; and as these volumes cover a period of fifty years' progress in chemistry and physics, the announcement that a general index has now been prepared, and is in the press, will be widely welcomed. The price of the general index on publication will be 2*l.*, but to subscribers who order it before the date of publication the price will be 1*l.* 15*s.*

THE first part of an important work on "The Birds of Australia," by Mr. G. M. Matthews, will be issued by Messrs. Witherby and Co. next month. The author has lived all his life in Australia, and has been a devoted student of its avifauna. He has secured the active assistance of a large number of field-ornithologists in all parts of Australia, and his work will incorporate all the available information upon the subject with which it deals. There will also be hand-coloured plates depicting all the known species of Australian birds. The edition of the complete work is limited to three hundred numbered sets.

OUR ASTRONOMICAL COLUMN.

A BRIGHT PROJECTION ON SATURN.—In No. 4445 of the *Astronomische Nachrichten* Signor M. Maggini describes a brilliant projection which he observed on the west limb of Saturn at 23h. 36m. (Cent. E.M.T.) on September 29. The observation was made at the Ximeniano Observatory, Florence, with a 350 mm. Calver telescope, and the projection was seen in profile against the shadow cast by the planet on the ring. It was also seen to be near a large whitish spot at the edge of the south equatorial band. The phenomenon remained visible until the whitish spot left the terminator, and was last seen at oh. 20m. September 30.

SPECTRUM AND RADIAL VELOCITY OF ϕ PERSEI.—The spectrum of ϕ Persei is a peculiar one, in which a dark, narrow, Hγ absorption line appears to be bordered by very bright lines, and as this is the most prominent line on which radial-velocity determinations have been made, the values of the line-of-sight motion have not been in full agreement.

An investigation carried out by Dr. Ludendorff has explained some of the anomalies, and the results now appear in No. 4442 of the *Astronomische Nachrichten*. Photographs were taken at Potsdam on which other faint lines, which could be identified with solar lines in Rowlands's tables, were measurable, and the radial velocities have been determined from these independently. Among other results, Dr. Ludendorff finds that the intensities of the components of the Hγ line oscillate, so that when the emission lines are faint the absorption line is strong, and *vice versa*, but he has been unable to discover any law for the complementary oscillations. The variation curves and the departures from them during several revolutions show that the conditions in the system of ϕ Persei are very complicated and unusual.

METCALF'S COMET, 1910*b*.—Observations of Metcalf's comet, made by M. Quénisset at the Juvisy Observatory, are placed on record in the October number of the *Bulletin de la Société astronomique de France*. On August 24 the comet was seen as a tenth-magnitude nebulosity having a well-marked condensation and a tail about 4′ long in position-angle 120°; with an exposure of sixteen minutes, using a portrait lens working at *f*.3, a tail 45′ long was shown on the photograph.

New elements and a daily ephemeris for this comet are published by Dr. Kobold in No. 4445 of the *Astronomische Nachrichten*. The elements give the time of perihelion passage as September 16, and, according to the ephemeris, the brightness is now slowly declining from magnitude 11·8. The comet is now travelling northward slowly through Serpens, its position for October 20 being given as $\alpha = 15$h. 28m., $\delta = +19°\ 12{\cdot}5'$.

COMETS AND ELECTRONS.—In an address to the Royal Academy of Science, Bologna, Prof. Righi discussed at length the functions of electrons in producing cometary phenomena; this address now appears, with a French translation, in No. 16, vol. viii., of *Scientia*. Prof. Righi outlined the several theories which have been evolved to account for the various phenomena, paying special attention to the experimental proof of light-pressure, and then showed how the electrons emitted by the sun could produce ionisation, which in turn would lead to such repulsion as would cause the development of a tail. In concluding, he described the results of some experiments carried out at Bologna during the earth's passage through the tail of Halley's comet on May 19. No remarkable variations in the atmospheric potential were recorded, but a greater degree of ionisation than usual was found to exist. The existence of radiations capable of travelling through black paper to a photographic plate was also demonstrated, but this experiment alone is not considered definite enough to warrant the assumption that these radiations could be ascribed to the proximity of the cometary matter.

MEASURES OF DOUBLE STARS.—In No. 4445 of the *Astronomische Nachrichten* the measures of double stars made by Mr. Sellors at the Sydney Observatory during 1897–1900 are published. Notes appended to many of the sets of measures give important information as to changes in position-angle and distance during definite periods, &c. No double-star observations were made at Sydney during the years 1901–8.

RECENT RESULTS IN SOLAR PHYSICS.—As an extract from the *Atti della Società italiana per il progresso delle scienze* we have received a brochure in which Prof. Riccò gives a very interesting, important, and comprehensive *résumé* of the results obtained from the study of solar physics during recent years. After briefly summarising the earlier researches, Prof. Riccò directs attention to the importance of correlating solar and meteorological phenomena, and refers briefly to the results obtained by Meldrum, Köppen, Lockyer, Bigelow, Nordmann, and others. Then he describes the different organisations which deal with solar research, and passes on to the spectroscopic results. This leads to a long discussion of the spectroheliographic results, and finally to the knowledge obtained from eclipse work.

THE NINTH INTERNATIONAL CONFERENCE ON TUBERCULOSIS.

THE International Conference on Tuberculosis held its ninth series of sessions at Brussels on October 5–8 under the patronage of King Albert of Belgium, who throughout took a very keen interest in the conference. The first day, October 5, was devoted to the meetings of the council and to the organisation of permanent commissions, some dealing with entirely new subjects, others with subjects already under consideration. To six of these commissions are referred questions of a more or less scientific character; to another six questions in which social elements predominate.

In the first group predisposition occupies the first place. In this group also are the commissions dealing with channels of infection; milk; methods of treatment, scientific and vaccinal; international method of notation; and the action of the solar rays.

In the second group are included the part played by women in the crusade against tuberculosis; child life and school hygiene; prophylaxis and the part played by the dispensary; the cure (?) of tuberculosis; public measures to be taken against tuberculosis; and the statistics concerning tuberculosis.

On these commissions are represented, so far as possible, the different nationalities taking part in the work of the congress.

On Thursday morning, October 6, the opening ceremony of the conference was under the presidency of M. Berryer, Minister of the Interior, who in a thoughtful and well-informed address compared the Tuberculosis Congress to the great Peace Congress at the Hague, "both inspired by the same profound thought and both wishing to obtain the same results," the former, indeed, helping the latter, "the warring of man against man being gradually replaced, thanks to a more humane sentiment, by a bringing together of all men in common action against the universal ills, vice, misery, disease, and death," a sentiment that

was echoed most eloquently by M. Bourgeois, the president of the conference.

Prof. Landouzy, introducing the first subject for discussion, the influence of predisposition and heredity, claimed that these were almost as important from the practical point of view as was the bacillus of Koch itself. He maintained that the tubercle bacillus in the parent might act in one of two ways, either by direct passage from the parent to the offspring, or by some toxic action on the ovum or upon the fœtus. He pointed out that these two sets of conditions were necessarily perfectly distinct, but maintained that the latter was of far more importance than the former, and that it accounted for the peculiar tubercular diathesis so frequently met with in patients. His thesis was that the subjects of this diathesis are degenerates who may "come into the world before their time, are under weight, short in stature, with thin, delicate bones, flattened chests, a skin delicate and soft, small extremities, pale and sickly face, veins very transparent, hair prematurely developed, long eyelashes, glands easily enlarged, aspect weakly." Such characteristics he has found specially amongst his tuberculous patients, and, curiously enough, this is exactly the type taken by the Venetian masters for their models, in whom we see silky golden or red hair, pale, transparent, and delicate freckled skin. This Venetian type, *vir rufus*, he maintained, was specially subject to tuberculosis. Moreover, animals with non-pigmented coats appeared to be more susceptible to tuberculosis than those of darker skin. In the discussion that followed it was agreed that tuberculosis was seldom communicated directly from mother to child, but that a certain transmitted functional debility might leave the child open to the ready invasion of various causes of disease and death, and that in this transmission the mother played a more important part than the father. It was suggested, however, that it was a very difficult matter indeed to demonstrate experimentally any predisposition, native or hereditary, to tuberculosis, though this was a matter that required further consideration.

The natural portals of entry were considered to be the lungs, the mucous membranes of the throat, the tonsils, the intestinal mucous membrane, and the epidermis, whilst the lymphatic glands were looked upon as playing a great part in sifting out and destroying the bacilli, though as they become lowered in vitality and no longer able to cope with the tubercle bacilli they may be broken down, and the scrofulous condition results.

Prof. Calmette, in speaking of the special susceptibility of children of tuberculous parents, said that this receptivity was not specific as regards tuberculosis, but applied generally to various infections and intoxications. The predisposed of the clinicians, he maintained, are very often the subjects of infection already. They are, he thinks, more or less gravely affected, especially as regards the lymphatic glands, and in almost all cases react positively to the various tuberculin tests. Moreover, he finds that if in place of tuberculin he injects mallein, he obtains a marked loss of weight. The stigmata of tuberculosis appearing at certain ages are, he thinks, the result of earlier infections, for he found that of children coming up to be vaccinated 90 per cent. of those from the town of Lille are already infected with the bacillus of tuberculosis even in cases where no definite lesions are developed, whilst in one lunatic asylum he found no fewer than 87·68 per cent. of the patients giving the skin reaction, so that if they were not already tuberculous they were already the bearers of the tuberculous germs.

Other speakers laid stress on tissue predisposition; on the marked respiratory changes that occur, not only in tuberculosis, but in other acute diseases; on the low arterial tension observed in those predisposed to tuberculosis; and on the importance of the observation that in cases where recovery took place pigmentation was both rapid and complete, whilst in those that succumbed such pigmentation did not occur.

One speaker, M. Piery, agreed that the offspring of tuberculous parents are undoubtedly specially liable to tuberculosis, and that the types of the disease in these patients are very varied, but on the other hand he thinks that a certain proportion of such offspring are actually immune, and that these patients, immune to a grave tuberculosis, are just the types in which the so-called stigmata of hereditary predisposition are present. Moreover, he believes with M. Calmette that many of the patients with these "stigmata of hereditary susceptibility" are really already suffering from the disease.

It seemed to be the general opinion that small numbers of slightly virulent tubercle bacilli taken into the alimentary canal might in certain cases act as immunising agents, but that in larger numbers and in virulent form they might set up typical lesions, especially in susceptible animals; that both immunity and predisposition might arise from the same cause, the bacilli in the one case setting up a kind of negative phase, in the other a positive phase, and that until the conditions under which these two phases are produced had been settled it was difficult to determine the part played by heredity in immunising or predisposing to the action of the bacillus.

Of the English delegates, Dr. Nathan Raw said that, as the result of an analysis of 232 cases of tuberculosis that had terminated fatally, he found that pulmonary tuberculosis was most frequently brought about first by direct inhalation of the *Bacillus tuberculosis* into the bronchioles; secondly, by extension from a bronchial gland to the parenchyma of the lung, this being specially associated with or following an attack of some acute infective fever such as measles, scarlatina, or diphtheria; by extension upwards from the abdomen by the diaphragm to the bronchial glands, and then to the lungs; by extension downwards from the glands of the neck directly to the pleura, and then to the apex of the lung; and, finally, by a general infection of the circulating blood, as in acute miliary tuberculosis.

Dr. C. Theodore Williams, following, insisted upon the importance of predisposition and on the wisdom of trying to ascertain the conditions of the human system which cause disposition to tubercle, and, conversely, those which confer immunity from tubercle. Analysing 1000 cases of consumption that occurred in the upper classes, he finds that the age of attack is earlier amongst females than amongst males, and that amongst males affected by hereditary predisposition it is earlier by three years than among those free from hereditary predisposition, and in females by six and a half years. Similarly analysing 400 consumptive cases seen in the out-patient department of the Brompton Hospital, he found that his former conclusion as regards the age of attack being hastened on by family predisposition was confirmed, though here the relative influence on the two sexes differs greatly from what was noted in the richer classes. Among the out-patients, the age of attack was about the same for male as females, the males being attacked earlier than among the rich, the females later. The age of attack in those free from family taint was later in both sexes, and the predisposition influence greater in the male than in the female.

One or two of the later speakers were of opinion that although many of the points raised that afternoon were of undoubted interest and of great importance to the individual, it was somewhat inadvisable to lay too much stress on this question of predisposition, except in so far as it pointed to the necessity to keep these patients out of the range of the attack of the tubercle bacillus. Of course, it was useful in connection with both prognosis and treatment, but at present the campaign must be carried on on a large scale against the tubercle bacillus and to remove the conditions under which it does its work most effectively, the predisposition being taken up specially in connection with the raising of the standard of health and of improving general hygienic conditions. There seemed to be some danger that the importance of the *rôle* of Koch's bacillus might be overshadowed in the popular mind, and it appeared to be necessary to insist that, although the tubercle bacillus does not always set up tuberculosis, no tuberculosis is ever set up without the presence of the tubercle bacillus. If heredity and predisposition are to be put so prominently forward, those who are dealing with the question might sometimes lose heart. At the same time, the acknowledgment that they may play a part should be followed by a call to the physician to look after the building up and strengthening of the patient. Then, again, it was always well to point out that on the one hand many blondes escape tuberculosis, whilst those richer in pigment, the negroes, are often affected, sometimes evincing even a high predisposition.

The morning sittings on Friday, October 7, were devoted entirely to tuberculosis in the child and in the schools, and in the afternoon to women's work in connection with tuberculosis. Mrs. Nathan Raw and Dr. J. Walker both took part in the discussion, stating the case for England. Perhaps the most interesting contribution of the afternoon was that made by Dr. Hermann von Schrötter on the action of sunlight and high altitudes, and their relation to the treatment of tuberculosis. It was of all the greater interest to English workers in that he had collaborated with Dr. Barcroft, who had been sent out to do similar work at Teneriffe. Some of his observations on the pigmentation of the skin seemed to bear out Prof. Landouzy's thesis. Dr. Schrötter believes that the pigment is formed by the cell, probably by the nucleus, that it does not come directly from the blood, and that the capacity to form pigment under stimulation gives some information as to the activity and stability of the cells. He also spoke of the effect of light, especially the ultra-violet rays, and high altitudes upon respiration, circulation, and metabolism, and is decidedly of opinion that not only is tuberculosis a disease of obscurity, but that it is a disease of concentration of population.

Saturday morning, October 8, was devoted to the nomination of committees and to the reports brought by the various foreign delegates. From these reports it may be gathered that not only in England, Ireland, and Scotland, but in many Continental countries, especially Sweden, tuberculosis is a gradually diminishing factor in both mortality and morbidity.

The social functions held during the conference were almost as interesting as the scientific sederunts. The receptions given by M. Beço, the Governor of Brabant, in the Government buildings of the province, and of the Burgomeister and the Town Council of Brussels in the Hôtel de Ville, were as interesting from the associations of the places in which they were held as from the people one met there. The annual dinner was also a great success, and the speaking was of a very high order. Amongst the congratulations and messages sent to the conference was one from King George dated from Balmoral Castle:—"The Queen joins me in thanking you and the members for your kind telegram. We earnestly pray that successful results may attend your labours, and that a further stimulus may be given to the great international campaign that is being carried out against this terrible disease. George, R. et I." Telegrams were also received from the Queen of Denmark, from the Kings of Rumania, Sweden, Spain, and Norway, from the Emperor of Germany and from President Taft, all of them expressing similar interest in the work of the conference. It may perhaps be held that no outstanding work was brought forward at the conference, but those who were privileged to take part in it could not but feel that these international conferences serve as admirable "stock-taking" occasions, and, as successes and failures are recorded, of determining, or at any rate of obtaining information as to, the best method of carrying on the campaign against the White Scourge. As they are held in a different country each year, they also afford opportunities of seeing how the work is being tackled and how far it is succeeding in various parts of the world.

THE INTERNATIONAL SCIENTIFIC CONGRESS AT BUENOS AIRES.

ONE of the important features of the celebration of the Centenario of the Revolution of May 25, 1810, was the International Scientific Congress. This congress was held in Buenos Aires from July 11 to 25, 1910, inclusive, under the auspices and direct management of the Argentine Scientific Society.

Great interest was manifested in this, as in other portions of the celebration, by the residents of Argentina. In spite of the distance from the populous northern hemisphere, the congress was well attended, there was great interest manifested in all the sections, and it can well be said that it was successful.

The opening session of the congress took place on the afternoon of July 11 in the Colón Theatre, the magnificent playhouse of Buenos Aires. The great popular interest was evidenced by the very large and fashionable attendance at these opening exercises. A short address of welcome was pronounced by the Minister of Public Instruction, Dr. Rómulo S. Naón. The principal address was made by the president of the congress, Engineer Luis A. Huergo, and short addresses by the foreign delegates, the whole being interspersed with excellent music.

The serious work of the congress began on the following day, when the various sections met at the principal scientific headquarters of the city. One of the sections held meetings in the library of the patriot Bartolomé Mitre, whose residence is now preserved as a museum by the city.

The work of the congress was divided into eleven principal sections as follows:—Mathematics, physics, and astronomy; chemistry; geology and geography; biology; anthropology; engineering; agriculture; psychology and pedagogy; jurisprudence and social science; military science; and naval science.

In the limits of a short account such as this it will be entirely impossible to give even the *titles* of all the papers presented. It is necessary, therefore, to refer only to those which appear to be of the greater interest to the general readers of NATURE, at the risk of omitting many of equal or perhaps greater importance.

Several of the delegates delivered public lectures in Buenos Aires and La Plata. A special meeting of the delegates from Spanish-speaking countries was held at the rooms of the Argentine Scientific Society to inaugurate a movement "to purify, to enrich, and to unify" the technology of the Spanish language.

Mathematics, Physics, and Astronomy.

Several interesting papers were presented in the field of pure mathematics, notably those by Volterra upon integral equations and their applications, and by Dr. Franck upon the surface of the second order of Lie and their relations to a point upon any surface whatever. Prof. Torres y Quevedo gave an exposition of the mathematical theory of an electro-mechanical calculating machine. A paper was sent by Prof. L. A. Bauer giving an account of the work done with the new magnetic survey vessel of the Carnegie Institution of Washington, the *Carnegie*. This vessel has proven successful beyond expectation.

In the subsection of astronomy, the observatories of Santiago, Chile, the temporary observatory of the Carnegie Institution at San Luis, La Plata Observatory, and the Argentine National Observatory at Córdoba were represented. The plans for the new Chilean National Observatory were shown by Dr. Ristenpart, as well as photographs of Halley's comet; two charts of the series being prepared by that Observatory from the Cape Photographic Durchmusterung. Prof. Tucker, in charge of the Carnegie branch observatory at San Luis, read a paper dealing with the fundamental system of star positions, which is being prepared by the department of Meridian Astrometry of that institution under the direction of Prof. Boss. Sunrise and sunset tables to 1950 were presented by the La Plata Observatory. Several papers were presented by the Córdoba Observatory dealing with the work in progress there, as well as a series of photographs of Halley's comet which had been obtained there. A proposition was discussed to publish an astronomical ephemeris suitable for the South American countries in place of those now issued by several of the observatories.

Chemistry.

Among the many important papers presented in this section were contributions to the study of Argentine oil, by Dr. Sabatini; composition of the alfalfa and other forages grown in Argentina, by Engineers Lavenir and Negri. These investigators demonstrated the superiority of corn grown in the Argentine. Dr. Quiroga presented a new chemical nomenclature of inorganic bodies.

Geology and Geography.

The principal papers in this section related to the countries of Argentina, Chile, and those adjoining to the east and north. The subject of mines and the laws relating to them, including fuel deposits, occupied a chief place. Engineer Patron presented a paper on the development of geographic and geodetic work of Chile, Prof. Codazzi one on mining in Colombia, Señor Maurtúa on geographical

work in Peru. Engineer Machado presented a paper on petroleum in Chile, Engineer Hermitte and Lieut.-Col. Romero on the petroleum formation of Argentina. The topography and mineralogy of the Andes region was treated of in various papers.

The Argentine Meteorological Office presented a large number of interesting papers, chiefly upon the meteorology of Argentina and the southern ocean. The director, Dr. Davis, presented a paper upon the temperature of Argentina as compared with other portions of the globe. A paper by Prof. Clayton dealt with a new method of forecasting which promises to cover periods much longer than is now possible. Profs. Mossman and Solyom presented papers on the effect of the antarctic currents upon the weather of South America, and the cyclones and anti-cyclones of the South American continent, respectively.

Dr. Knoche presented a paper descriptive of the organisation of the meteorological service of Chile, and Dr. Montessus de Ballore a paper on a convention of the seismological services of Chile and Argentina. Dr. Negri read a paper on two seismical laws discovered by himself.

Biology.

The communications to this section included the following:—The action of the principal alkaloids on protozoas, Prof. Scala; a contribution to the study of some arthropods of Chile-Argentina, Prof. Porter; contribution to the study of sea fishes in Uruguay, Prof. Bouyat; the mosquitoes, gad-flies, and serpents of Argentina, Señor Brethes; the marsupials of Chile, Dr. Wolffsohn; the vegetation of the north-western portion of Argentina, Dr. Seckt; a reclassification of Argentine vascular plants, Dr. Stuckert.

Anthropology.

Two papers were presented by Dr. Ameghino relating to three fossil human skeletons found in Arroyo Siasgo and El Moro. Other papers discussed different characteristics of the Indians and indigenous inhabitants of certain regions of South America, particularly Argentina, and of means of caring for such peoples and preserving accurate data respecting them. The origin of the American races and the languages of different South American races were subjects of investigation. Of especial interest were the results presented by Prof. Mercante of a comparative study of 1200 of the Argentine youth between the ages of six and twenty years, the sexes being nearly equally divided.

Engineering.

Many of the papers in this section dealt with architecture, particularly that of the Latin American countries. Notable among these were the papers of Engineer González. Engineer Selva discussed the advisability of houses for workmen and the best forms of such houses. A sentiment was adopted emphasising the absolute necessity of finding a solution for the question of reducing house rent for workmen and employees of modest salary. The same author also discussed the subject of earthquake construction. The subject of reinforced cement construction occupied the attention of one session. Railway and bridge questions occupied another session. The question of irrigation is a very important one in several of the South American republics, particularly Argentina. Conforming to the importance of the subject, two sessions were devoted to the discussion of the laws and systems of irrigation in Argentina, and with various plans for betterments. Rivers and harbours and their various needs received attention in another session, as did various municipal matters relating to sanitation, transportation, and streets, in another. The engineering section attracted unusual attention.

Agriculture.

Engineer Juan A. Devoto presented a paper detailing his investigations of the micro-organisms of milk. Dr. Wolffhugel read a paper on the zooparasites of the domestic animals of the Argentine Republic. Recommendations were made to protect the guanaco and vicuña. Great interest was manifested in this section, and a large number of papers were presented dealing with the practical details of this branch of science. One which attracted much attention was on the degeneration of the Malbeck, by Señor Suárez.

Psychology and Pedagogy.

In this section Prof. Jakob gave the inaugural address, discussing human beings with defective brains. Among the papers were:—Value of psychological statistics in pedagogy, Señor Mercante; necessity of methodical investigation of the child and all abnormal persons, Dr. Piñero; abnormal psychology and education, Prof. Senet; investigations of the nervous system, Dr. Roveda; the measurement of intelligence, Dr. Vidal; experiments upon the sensitiveness of the human skin, Dr. Duceschi.

RESOLUTIONS.

During the congress a large number of resolutions were adopted by the various sections, which at the close were ratified by the entire congress. The substance of some of the most important is given below.

The necessity of solving the problem of reduced rent for the workman and the employee, so that they may live near their work, which is usually in the centre of the city. It may be remarked in passing that this question is especially important in Buenos Aires, where the population is spread over a very large area in one-story houses, instead of the tall structures of Anglo-Saxon cities.

Reiterating the necessity of prosecuting and accelerating the Pan-American railroad according to a fixed plan.

The advisability of studying the causes which hinder the more general adoption of reinforced concrete constructions

The strong approval of a project for the formation of a "Union Internacional Hispanoamericana de Bibliografía y Tecnología Cientificas." The details of such an organisation were worked out.

Recognising the convenience of a reform of the Gregorian calendar.

Recognising the advantage of adopting the meridian of Greenwich for all American countries and from January, 1911, basing their time on meridians differing by an exact number of hours from Greenwich, as is already in use in the United States.

The urgent necessity of preventing adulterations and frauds in foods.

Recommending the adoption of standards of purity for the potable water of the Republic (Argentina); the necessity of forming an American society of chemists; the establishment of biological stations with a view to the study of marine life and the development of the fish industry; the advantage of legislation which will encourage the development of the petroleum industry and prevent all monopolies in this industry; the study of the German language in science courses along with French and English; the utility of employing the "altazimetro" invented by Rear-Admiral Mansilla, to facilitate nautical calculations; the stereographic method of locating the stars for nautical purposes, proposed by Captain Ballvé; an international American commission of psychological and pedagogical studies and a children's congress of specialists; the formation of agrarian societies modelled after those of France; the greater use of agricultural machinery, and the teaching of the use of such machines; the study of the conditions and regions suitable for the growth of the sugar beet with the view of extending its production; the development of the cotton-growing industry; uniform regulations in all American countries governing the importation and exportation of animals; legislation looking to the protection of working women before and after childbirth, and making compulsory the providing of time and suitable accommodation by employers for the necessary attention to babes.

C. D. PERRINE.

RECENT INVESTIGATIONS ON THE CULTIVATION OF RUBBER.[1]

EXPERIMENTS on the cultivation and preparation of rubber are being pushed forward at several stations, and the results are discussed in the agricultural journals circulating in tropical and subtropical countries. Methods of tapping the tree have been studied in Hawaii, and found to have a marked effect on the yield of latex. Trees

[1] *Tropical Life.*
The *Agricultural News.* (Imperial Department of Agriculture for the West Indies.)
Bulletins of the Federated Malay States, and of the Hawaii Agricultural Experiment Stations.

tapped with a V-cut gave much less than others with a vertical cut, the greater yield, however, being partly due to the fact that the length of the incision in the latter case is greater than in the former. No advantage was gained from the use of four cuts daily instead of two. The effects of nitrate of soda on the flow of latex have also been studied. Fertilisers are in use in rubber plantations for increasing the growth and vigour of the trees, and it now appears that nitrate of soda also increases the flow of latex. In one experiment a group of five trees yielded 0·9 oz. of dry rubber in three days before applying the nitrate, and 1·3 oz. in the three days following its application, each tree receiving half a pound of the fertiliser. How far the method is economical has yet to be determined. All these experiments were made with Ceara rubber trees.

A number of analyses have been made of the latex from the plants growing in the Botanic Gardens, Singapore. A thirty-two-year-old tree of *Hevea brasiliensis* gave at one tapping 27 fluid ounces of latex, of which 61·08 per cent. was water, 2·3 per cent. serum solids, mainly organic matter, and 36·29 per cent. coagulum was obtained by means of acetic acid. Almost the whole of the coagulum was rubber, only a little resin being present. From another variety, *Landolphia Heudelotii*, the dry rubber yielded 89·5 per cent. of pure rubber and 10·5 per cent. of resin.

The question of preparing the rubber after the latex is obtained is of very great importance. Fine hard Pará rubber containing 10 or 20 per cent. of moisture has a higher relative value than the practically pure sheets from the East. It is considered that the difference in value is partly due to the difference in method of dealing with the latex, and a process has recently been devised in which the latex is treated with smoke, creosote, and acetic acid, so that it may coagulate under conditions comparable with those obtaining in Brazil. In this process, steam at a pressure of 30 or 35 lb., mixed with the fumes from strongly heated green palm leaves or other green parts of trees, is forced by a steam injector into tanks containing the strained latex. In about ten minutes the caoutchouc globules coagulate and rise to the surface.

An incidental problem is the most economical way of dealing with a rubber plantation until the trees come into yielding. A Bulletin from the Federated Malay States Department of Agriculture sets out the advantages of *Coffee robusta*. This plant, discovered wild in the Congo region in 1898, grows more rapidly and fruits sooner than the well-known *C. liberica*. When grown in rubber plantations, it yields a small return in the second year and a good return in the third and following years, but after five years it competes so seriously with the rubber that it must be cut out.

THE MINERAL RESOURCES OF THE UNITED STATES.[1]

IN response to the latest of the periodic scares of impending bankruptcy due to the exhaustion of fuel, ore, or soil, the Geological Survey of the United States has been instructed to estimate the national economic mineral resources. Its report (Bull. No. 394), dealing with quantities on a continental scale, may excite the envy of the single countries of Europe; and though the factors are uncertain, the available supplies of most minerals are sufficient to render political restriction of output unnecessary. Thus, in the case of coal, Pennsylvania is known to have enough to last for 492 years at the rate at which the material was being exhausted in 1907. Ohio has only used 0·9 per cent. of its proved supplies, and at the rate of production in 1907 they will last for two thousand years. In Maryland the coal will last for another 948 years. Mr. Gannet, in a general summary of the extent of the coal reserves, estimates that only one-third of one per cent. of the known and easily accessible supply was mined during the last century.

In regard to the other fuels, the future is less assured for natural gas and petroleum. Assuming that petroleum generally comes from beds 5 feet in thickness, and with 10 per cent. of pore space, an acre would yield 5000 barrels of 42 gallons each. The extent of proved oil land in the States is enormous. Thus, it is expected that the State of California alone will supply 5,000,000,000 barrels. There has been a steady increase in the yield from 2000 barrels in 1859 to 166,000,000 in 1907. The yield, however, has fallen in many of the States, including Pennsylvania and New York, where, according to Dr. Day, it will be negligible ten years hence. The yield has fallen in Ohio, West Virginia, Kentucky, Colorado, Indiana, Texas, and Louisiana; but it has risen in California, Illinois, and Kansas. Dr. Day concludes that if the present production is not increased, the available supply will last the States for ninety years; but if the demand increases as rapidly as during the past few years, the end may come in 1935. He therefore suggests that oil should be limited to the purposes for which it is indispensable, such as lighting in scattered houses and as a lubricant. As half a pint of oil is used in an engine for every ton of coal burnt, the exhaustion of cheap lubricants would be an industrial disaster.

Dr. Day reports on the supplies of natural gas. In most cases the wells have a short life, and 1,000,000,000 cubic feet are still being wasted daily. Much of the waste is said to be unavoidable, as the gas cannot be saved economically from wells from which oil is being pumped; but legislation to prevent unnecessary waste is recommended. After a well has ceased to yield gas under high pressure, a supply can be obtained for years by pumping.

A mineral famine in the United States is most often predicted for iron, as the ores of present value are restricted in depth. The estimates compiled by Mr. Hayes show that there is no immediate fear of the end of the Iron age. He estimates the ore supply now available in the United States at 4,788,000,000 tons. If the present rate of increase in the consumption of iron be maintained, this quantity would, however, be used during the next thirty years; so that before 1940 American iron production would have begun to decline, and low-grade ores not included in the estimate quoted would have to be used. Mr. Hayes, however, concludes that the factors are so indeterminable that any further prediction as to the date of exhaustion of American iron ores "is so uncertain as to be wholly unprofitable and unwarranted."

The United States have been one of the leading producers of phosphates since 1867, and nearly half the phosphate manufactured is exported for the benefit of the exhausted soils of Europe. At the present rate of increase, the supply will only last twenty-five years, and Mr. van Horn, the author of the report on phosphates, therefore recommends that future leases should only be granted on condition that the phosphate shall be used in the States.

That predictions of a coal famine in America are idle may be realised from the reports on the little-known coalfields of the western and central States in Bulletin 341. It is edited by Mr. Marius R. Campbell, and includes twenty-two separate memoirs and a bibliography. The coals are partly Eocene, belonging especially to the Fort Union Series, and partly Cretaceous, coming mainly from the Mesaverde Series. The Sentinel Butte Field in North Dakota and Montana yields an Eocene lignite, of which 33,000,000,000 tons are available within a thousand feet of the surface, and in seams 3 feet or more in thickness. The coal yields excellent producer gas, and can be made into briquettes without the addition of any binder. The coal contains 34 to 45 per cent. of water, and after it is air-dried its calorific efficiency is from 8200 to 8600 British thermal units. From Sentinel Butte a series of coal fields extends south-westward through Montana, Utah, Colorado, Nevada, and New Mexico. The Eocene coals become less important, and the Cretaceous coals more important to the

[1] United States Geological Survey. Bull. 341.—M. R. Campbell. Contributions to Economic Geology, 1907. Part ii., Coal and Lignite. Pp. 444, xxv pls., 7 figs. (Washington: Government Printing Office, 1909.)

Bull. 347.—F. E. Wright and C. W. Wright. The Ketchikan and Wrangell Mining Districts, Alaska. Pp. 210+v, xii pls., 23 figs. (Washington: Government Printing Office, 1908.)

Bull. 374.—F. H. Moffit and A. G. Maddren. Mineral Resources of the Kotsina-Chitina Region, Alaska. Pp. 103, x. pls., 9 figs. (Washington: Government Printing Office, 1909.)

Bull. 379.—A. H. Brooks and others. Mineral Resources of Alaska, Report on Progress of Investigations in 1908. Pp. 418, x pls, 21 figs. (Washington: Government Printing Office, 1909.)

Bull. 380.—C. W. Hayes and W. Lindgren. Contributions to Economic Geology, 1908. Part I, Metals and Non-metals, except Fuels. Pp. 406, ii pls., 32 figs. (Washington: Government Printing Office, 1909.)

Bull. 394.—Papers on the Conservation of Mineral Resources. Reprinted from Report of the National Conservation Commission, February, 1909. Pp. 214, xii pls., 2 figs. (Washington: Government Printing Office, 1909.)

south-west. Thus the Cretaceous coals at Crazy Mountain, Montana, are too thin to be mined, except for local use; but at Lewiston, Montana, the Lower Cretaceous coal from the Kootenai formation is of great value, though high in sulphur; the Grand Mesa field in Colorado has an estimated supply of 15,000,000,000 tons of Mesaverde coal, of a calorific value of from 8600 to 13,600 thermal units.

A second Bulletin (No. 380), "Contributions to Economic Geology, 1908," deals with minerals except fuels. Mr. C. W. Hayes has superintended the preparation of the reports on the non-metals and iron ores, and Mr. W. Lindgren those on the rest. The Bulletin consists of twenty-five papers and numerous bibliographies. Some of the reports are based upon only a few hours' or a day's visit, but others are preliminary reports based upon a longer study. J. S. Diller and G. F. Kay describe the Grants Pass goldfield in Oregon, which is one of those frequent and disappointing fields where the gold is very widely distributed through innumerable small veins and veinlets; the absence of well-defined lodes is unfavourable to profitable mining, until some clue be discovered to the distribution of the richer patches. The ores are found in association with greenstones and granodiorites intruded into altered sediments. The placer deposits are widely scattered, and are worked by many small mines, employing from three to five men each. Some of the placers are Cretaceous shore deposits.

Mr. F. L. Hess reports upon the tin, wolfram, and tantalum deposits of South Dakota. Tin is so scarce in the United States that much interest was excited by its discovery in pegmatite dykes traversing the Algonkian schists at Harney Peak. Assays showed the presence of up to 6 per cent. of tin, and the Harney Peak Tin Company was established to work the deposits on a big scale. Three million dollars of English money, in addition to some American, was spent in the venture, and Mr. Hess tells us that the 5000 tons of ore put through the mill yielded only 0·25 per cent. of tin. The tin cost more than its weight of gold. This failure is, perhaps, not surprising, as pegmatite dykes have never been found to pay as tin ores except on a small scale. The wolfram ores of the same locality are known from the descriptions of Mr. J. D. Irving, and though Mr. Hess does not altogether agree with his theoretical conclusions, he remarks that Mr. Irving's prediction as to the limited economic value of the deposits has been fully justified. This wolfram ore is of some interest, as it occurs as a replacement of dolomite and was introduced by solutions rising along vertical fractures.

Of the four papers in this Bulletin dealing with iron ores, one of the most interesting is by Mr. E. C. Harder, on the ores of the Appalachian region in Virginia. Some of the ores occur in the pre-Cambrian schists and crystalline rocks of the country at the eastern foot of the Alleghany Mountains; but the ores are not commercially important. They, however, include the interesting titaniferous magnetites of the Blue Ridge, which have been formed as segregations in a basic syenite (unakite); and the truly magmatic origin of these small bunches of ore is shown by the many included specks of minerals belonging to the enclosing rocks. The more important ores occur in the Palæozoic rocks of the Appalachian plateau, including "brown ores" of three distinct origins. They are "mountain ores" associated with Lower Cambrian quartzites, "valley ores" found in residual material formed from Cambrian limestone, and the Oriskany ores, which occur as replacements in the Silurian Lewistown limestone.

The manganese ores of the United States have been studied by Mr. Harder, who promises a special bulletin upon them. The ores are widely distributed, but are not much mined, since they usually occur in pockets of not exceeding 25,000 tons, and cannot compete with the imports.

Among reports on the non-metallic minerals is a short note on the mica deposits of southern Dakota, by Mr. D. B. Sterrett. The mica is found in pegmatites, which are sometimes intrusive dykes and sometimes veins due to pneumatolytic action. The two types pass imperceptibly into one another. The supply of sheet mica for lamps and furnace doors exceeds the demand, and most of the mica obtained is employed for the manufacture of electric machinery. There is a short report by E. G. Woodrow on the sulphur deposits near Thermopolis, Wyoming; the sulphur is deposited by hot springs, where the water comes in contact with limestone. The sulphur is deposited as crystals, and also as masses replacing the limestone.

Mr. Matson contributes some notes on the clays of Florida, and describes the ball clays, which are usually described as kaolin, as they are white burning, and can be used for either porcelain or white earthenware. As they are sedimentary, Mr. Matson seems unnecessarily doubtful as to whether they can be included in kaolin.

Bulletin No. 374 describes the mineral resources of the Kotsina-Chitina region of Alaska, by F. H. Moffit and A. G. Maddren. The name Chitina means "copper river," and copper is the most promising mineral of the district, though it has not yet been proved to occur in conditions under which it can be profitably mined. The district also contains some coal and alluvial gold, which has been worked since 1902. The copper is mostly found in the lower part of the Triassic Chitistone limestone, where it rests on the Nikolai greenstone, a series of basaltic lava flows, from which the copper is thought to have been derived.

The investigations on the general mineral resources of Alaska made in 1908 are reported in Bulletin 379, in a series of nineteen papers, edited by Mr. A. H. Brooks. The mining industry as a whole suffered a decline in output during that year owing to the diminished yield of copper. Gold is still the main source of wealth, though the yield fell slightly below that of 1906. Four-fifths of the supply is alluvial, and the cost of working the placers is so heavy that only the richest are worked. The lode mines, on the other hand, are low grade, the most important being those of the Alaska Treadwell group. Its ore yields only 2·3 dollars of gold per ton, but, owing to the large quantity and easy methods of mining, it can be worked at a cost of one dollar a ton. In spite of local predictions, dredges have already proved successful, and their use must add greatly to the available mineral wealth of the district. The most interesting placer deposits are those at Nome, on the Seward Peninsula, where the famous Third Beach, discovered in 1905, is still being worked. Alaskan shore placers are at present the most important that are being worked anywhere for gold. The report by Moffit and Knopf on the Nabesma-White River district shows that the copper there occurs in Carboniferous basaltic amygdaloids and in limestone along the contact with some intrusive diorites; but the fabulously rich copper deposits reported have not yet been found. J. W. G.

AIRSHIP FLIGHTS.

FOR some time public attention has been directed chiefly upon the records achieved by aëroplanes. Two airship flights undertaken during the past few days serve to illustrate what may be accomplished by dirigible balloons. On October 15, at about 8 a.m., Mr. Walter Wellman left Atlantic City in his gigantic airship *America* with the object of voyaging to Europe; and on the following day the frameless airship *Clément-Bayard No.* 2 travelled from Lamotte-Breuil by Compiègne to Wormwood Scrubbs—a distance of nearly 260 miles—in six hours.

The *Clément-Bayard No.* 2 is 251 feet long, and its greatest diameter 44 feet 4 inches. The *Times* gives the following particulars of the construction of this airship.

Inside the bag there are two compensating air balloons which can be filled separately. The car, 26 feet 3 inches beneath the envelope, is 147 feet 5 inches long. The stern is provided with a keel to preserve stability. The metallic framework is composed of triangular steel rafters, except in the portion occupied by the motors, crew, and passengers, where they are quadrangular. At the hind extremity this framework takes a turn upwards to support the equilibrator, a large triplane-like apparatus with eight square compartments resembling the main cell of a Voisin aëroplane, controlling ascent and descent. The equilibrator, comprising the rudder, composed of two mobile planes on vertical axes at either end of the triplane, is worked by an irreversible mechanism. There are two propellers driven by two 120 horse-power Clément-Bayard

motors mounted on a steel frame furnished with springs to deaden the vibration. Each propeller is driven by its own motor, but, in case of need, one single motor can drive the two propellers at the same time. The gear for the reduction of speed is placed in the prolongation of the driving shaft, beyond the propeller. The two propellers, of polished wood, have a diameter of 19 feet 8 inches, and are placed laterally in front, one on each side of the car, projecting beyond the sides of the steel framework. They occupy a position midway between the car and the balloon. The tractive power of each propeller is ascertainable at any moment. The dirigible is built to be able to ascend to an altitude of 6560 feet, and it is capable of travelling about 750 miles without replenishing its supplies of gas and fuel.

The *Clément-Bayard No.* 2 left Lamotte-Breuil with a crew of seven people, including M. Clément, the designer of the vessel, on October 16 at 7.5 a.m. (G.M.T.), passed over Amiens at 8.29 and Boulogne at 10.15. The Channel was crossed in some fifty-five minutes, and Ashford seen at 11.45 a.m. Tonbridge was passed at 12.29 p.m., the Tower Bridge at 1.4, and Wormwood Scrubbs was reached at 1.25. The whole distance, of nearly 260 miles, was thus covered in a little more than six hours at an average speed of about 43 miles an hour. The greatest altitude attained during the flight was between 800 feet and 900 feet, but most of the travelling was done between 600 feet and 700 feet. The average temperature was 60° F. The success of the enterprise must be attributed largely to the very favourable weather conditions which prevailed during the flight. There was only a slight wind, and it was in a direction which assisted the movement of the airship, so that the demand made upon the power of independent navigability was not great. We still await the construction of an airship which will satisfy the War Office tests, one of which is that the vessel has to traverse a triangular course of 300 miles within a fixed time-limit. When this has been done it will be possible to form a satisfactory estimate of the advantages of power-driven airships over the ordinary spherical balloon.

The *America*, in which Mr. Wellman with five companions made the daring attempt to cross the Atlantic, is a dirigible of the frameless type; it is 228 feet long, its greatest diameter 52 feet, and it has a volume of 345,000 cubic feet. According to the *Daily Telegraph* (under the auspices of which, with the *New York Times* and other American papers the flight was undertaken), the balloon is composed of three thicknesses of cotton and silk gummed together with rubber to make it gas-tight, and weighs 4850 lb. Underneath the balloon is suspended by steel cables the car, weighing 4400 lb. This car is built of the highest grade steel tubing, and in places withstands stresses of twelve tons. It is 156 feet in length, and the steel tank at its base is 75 feet long, with a capacity of 1250 gallons of gasoline. The engines, three in number (two of 80 horse-power and a service motor of ten horse-power), are placed in the steel car. Each of the large motors drives a pair of twin screws, and each propulsion system is independent of the other. The motors and other machinery weigh about 1500 lb. An electric light system, a wireless telegraph equipment, and a telephone connecting the different parts of the ship were installed.

Hanging from the airship by a steel cable is the equilibrator, a part of which floated upon the sea, the other being suspended vertically in the air. The purpose of this is to act as an automatic regulator of the upward and downward movements of the airship. When the ship rises it must lift some of the equilibrator from the sea in order to go up, and this added weight checks the rising movement. Conversely, when change of temperature or accumulation of moisture caused the airship to descend, a greater part of the equilibrator was let down upon the sea, thus reducing the weight carried by the balloon and checking the descent.

The total supply of gasoline carried was 10,000 lb., or about 1800 gallons, which was considered sufficient to drive the airship from Atlantic City to Europe. The distance is about 3000 miles. With one engine running the airship could make a speed of 20 miles per hour, and the quantity of gasoline carried would run one engine 200 hours. With both engines running the ship's speed in still air could be about 26 miles per hour.

After leaving Atlantic City at 8.5 a.m. on Saturday morning, October 15, the *America* travelled 20 miles in the first hour, but later the rate was reduced to 15 miles an hour. Nantucket Island, which is about 300 miles from the starting place, was reached in twenty-four hours. A wireless message was received from Mr. Wellman at 12.45 p.m. on Sunday, October 16, when the airship passed out of range of communication with Nantucket Island. The vessel was then directed to the north-east, and early on the morning of October 17 was believed to be travelling between Nantucket Island and Nova Scotia. At 4.30 on October 18 the airship was sighted in distress by the Royal Mail Steam Packet Company's steamer *Trent*, and after some difficulty Mr. Wellman and his crew were rescued and taken on board, the airship being abandoned. The position in which this occurred was latitude 35° 43′ N. and longitude 68° 18′ W., which is nearly 400 miles east of Cape Hatteras, on the North Carolina coast. The total distance covered by the airship appears to have been about 900 miles, and the duration of the voyage, during which she was in the air continuously, was sixty-nine hours.

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

THE address of the president of Section A, Prof. E. W. Hobson, was read on Thursday, September 1; this has appeared in full in these columns (NATURE, September 1, p. 284). It was succeeded by a paper—probably the most important paper read at the meeting—by Sir J. J. Thomson on positive rays. By the use of very large vacuum tubes Sir Joseph has been able to investigate the discharge at higher vacua than hitherto. Specially studying the rays which pass through a hole in the kathode, he detects:—(1) Rays undeviated by magnetic or electric forces. (2) Secondary positive rays, produced by these, which are deflectable by both forces, have a constant velocity of about 2×10^8 cm./sec. at all pressures and potential differences. The value of e/m for these is 10^4. They are accompanied by negatively charged ones similar in every respect to the positive ones, except in respect to charge. (3) Rays characteristic of the gases in the tube, conspicuous only when the pressure is low. Their velocity varies with the potential difference. When several gases are present, the maximum kinetic energy of the rays from each gas appears to be the same and equal to that due to a fall through the potential difference between the negative glow and the kathode. The value of e/m is inversely proportional to the atomic weight of the gas. They are probably atoms carrying unit positive charge; in the case of hydrogen there are rays corresponding to the molecule as well. Some of these have negatively charged rays associated with them. In a magnetic field the rays from a mixture of gases spread out into a sort of spectrum. With carbon monoxide two bands are formed, one due to carbon, the other to oxygen. As exceedingly small quantities of gas may be dealt with in this way, it appears probable that interesting results may follow from the application of this method to the analysis of gases in vacuum tubes. (4) Retrograde rays, travelling from the kathode in the same direction as the kathode rays. These are of types (1) and (2). They have negative constituents.

Dr. R. A. Houston followed with an exhibition of a spectrophotometer of the Hüfner type, which he has previously described in the *Phil. Mag.* for February, 1908, and with a description of a new and simple means of producing interference bands. An approximately right-angled prism is placed in front of a slit; the two emergent beams produce interference bands in front of the prism. This is being used as a student's exercise; it does not appear, however, that the bands can be put to any practical use. A new gyroscopic apparatus was next exhibited by Prof. A. E. H. Love. The machine consists essentially of a pair of bicycle wheels fixed to a round steel bar as an axle. The bar is prolonged beyond one wheel to carry a wooden wheel, by means of which it can be set

spinning, and the other wheel carries a square tin plate on which is fixed a card coloured in squares. The machine is so mounted that it can turn freely about its centre of gravity. To throw it out of truth without disturbing the centre of gravity two small bolts are inserted in the rims, one in each, at opposite points. The machine is set spinning about the axis of the wheels. When the instantaneous axis cuts the card at a point well within a square, a patch of the colour of that square is seen distinctly, and the rest of the card appears confused. As the axis moves, a series of distinct patches are seen at short intervals.

On Friday, September 2, the section divided. In the mathematical department Major P. A. MacMahon opened the proceedings by reading a paper on functions derived from complete and incomplete lattices in two dimensions, and the derivation therefrom of functions which enumerate the two-dimensional partition of numbers. The investigation was suggested by the solution of a ballot problem of finding the chance that at every stage of the voting the candidates are in their final order.

Dr. Baker in his paper on a certain permutation group said that he had been led to inquire into its properties by becoming interested in a game played by some children. The game consisted in writing down a series of letters and then rearranging them by writing the last first, the first second, the last but one third, the second fourth, and so on. When the rearrangement was completed it was performed again, and so on repeatedly. Finally, it was found that, after a certain number of rearrangements, the original order of the letters was obtained.

For instance, the set of seven letters

$$a\ b\ c\ d\ e\ f\ g$$

gives

$$g\ a\ f\ b\ e\ c\ d$$
$$d\ g\ c\ a\ e\ f\ b$$
$$b\ d\ f\ g\ e\ c\ a$$
$$a\ b\ c\ d\ e\ f\ g$$

Dr. Baker showed that when there are n letters the number of rearrangements required to reobtain the original order is the least number r, such that one of the two numbers 2^r-1, 2^r+1, is divisible by $2n+1$.

Dr. Baker also read a paper on the trisection of elliptic functions, in which the problem was discussed in connection with the theory of the quartic equation.

Lieut.-Colonel Allan Cunningham read two notes of great interest on the theory of numbers, one on the factorisation of $(2^{77}+1)$, and the second on the question whether (2^p-2) is divisible by p^2 (p a prime). Upon these Dr. Baker made the following remarks:—

We are often told that the problems of the physicist are set to him by nature itself, but the problems of the mathematician are invented by himself, and therefore worthy of less attention. Those to whom this seems a sound criticism will probably admit that the puzzling problems of integral numbers are put to us from without. We should therefore regard the theory of numbers with especial concern, quite apart from its own extraordinary interest. In Germany at the present time great progress is being made in the subject; it touches our reputation as English-speaking mathematicians to encourage, so far as we can, a similar interest in the theory of numbers here.

Prof. A. W. Conway read a paper on the convergence of a certain series used in electron theory. The series was one obtained by means of Lagrange's expansion.

Dr. J. W. Nicholson read a paper on some problems of initial motion of electrified spheres, in which he referred to the work of G. W. Walker and Prof. Conway. Starting with an electron having a small Newtonian mass, it was shown that difficulties are met with when this mass is reduced to zero; it appears impossible to ascribe an initial acceleration to a conducting sphere without introducing imperfection in the conductivity, although the electrical distribution on the sphere tends to become uniform very rapidly. These results have a bearing on a possible conception of the electron. These difficulties are absent from the corresponding problem for an insulating sphere.

Dr. Duncan M. Y. Somerville pointed out the need of a non-Euclidean bibliography. It is now thirty years ago since Halsted published the first bibliography of non-Euclidean geometry, and one still finds it referred to as a standard work. In the discussion Prof. Love suggested that a report on the subject would be more valuable. (The general committee has since appointed a small committee to consider this question and draw up a report if considered advisable.)

Mr. H. Bateman read a paper on the present state of the theory of integral equations, in which he sketched the history of the subject and indicated some of the physical applications. Prof. Conway and Prof. Webster remarked that in the problems they had tried it was very difficult to get a simple solution by means of integral equations. In answer to this, Dr. Hobson pointed out that in the problems referred to the theory of integral equations fails to give a simple solution because a simple form of the solution does not exist; but by studying the theory we can hope to obtain some idea of the form and behaviour of the solution, although the analytical expression for it is not suitable for calculation. This important, exhaustive report of Mr. Bateman's has been ordered to be printed *in extenso*.

Mr. Bateman also read a paper on the foci of a circle in space and some geometrical theorems connected therewith. Special attention was paid to twisted polygons formed of isotropic lines.

Prof. J. C. Fields read a paper on the theory of ideals. Starting from Hensel's power-series, he defined adjointness relative to a prime p in a manner analogous to that in which he has defined the property in connection with the algebraic functions. If ϵ is the solution of an algebraic equation, it was shown that we can construct a rational function $R(\epsilon)$ possessing any assigned set of adjoint orders of coincidence corresponding to a prime p. It is deduced that we can construct a general function $R(\epsilon)$ which represents only integral algebraic numbers, and possesses a single coincidence with the branches of an assigned one of the cycles corresponding to any prime, while it is not conditioned with regard to any other specific prime or any other cycle corresponding to the prime in question. The aggregate of numbers so represented is a prime ideal.

The report of the committee on the further tabulation of Bessel functions was taken as read. This committee is proceeding to calculate the functions $I_n(x)$ and $K_n(x)$. Its scope has been extended so as to empower it to proceed to the calculation of any necessary functions.

Meanwhile, a joint meeting of the physics department and Section B (Chemistry) was being held. The proceedings of this meeting will be in part reported by the chemical section. Two papers only will be dealt with here. A paper was read by Mr. J. A. Crowther on the number of electrons in the atom. From the mean scattering of β particles in passing through a substance, it is deduced that the number in question is three times the atomic weight, provided that the positive electricity in the atom has a volume comparable with the atom itself. The substances considered are carbon, aluminium, copper, silver, and platinum. The numbers obtained, if the positive electricity be assumed to be divided into small particles comparable in size with the negative, are not proportional to the atomic weight—a result which would be in conflict with experiments on the scattering of Röntgen rays—and it is thence concluded that this alternative hypothesis is not correct.

The second paper was by Dr. R. D. Kleeman, on the attractive constant of a molecule of a compound and its chemical properties. Making use of previous deductions from surface tension and latent heat data, Dr. Kleeman shows that the various chemical compounds can be divided into groups, and it is found that this grouping corresponds with that obtained from purely chemical considerations; for example, the amines fall into three groups. The property specially studied is the ratio $T_c/\Sigma\sqrt{(A)}$, where T_c is the critical temperature and the denominator is the sum of the square roots of the atomic weights of the components of the compound.

The proceedings on Monday, September 5, began with a demonstration by Dr. H. J. S. Sand of vacuum-tight seals between iron and glass. An iron wire is sealed into a glass tube. While the glass is hot a small piece of heated steel tube surrounding the wire is pushed a few millimetres into the glass. After cooling, the tube is

soldered to the wire. The vacuum-tight seal is produced between the inner surface of the elastic steel tube, which on cooling is put under tension, and the glass, which comes under compression. Seals with wires of 1 mm. diameter have been produced in this way.

Dr. T. H. Havelock followed with deductions from the relations between densities and refractive indices. Dr. A. G. Webster (of Worcester, Massachusetts) gave a detailed account of a complete apparatus for the measurement of sound. The producer of the sound was a steel diaphragm rigidly driven by an electrically maintained tuning-fork, and made the back of a resonator of the form of a small hollow chamber or of a tube of variable length. The reaction of the sound upon the amplitude of the fork enables the constants of the resonator to be accurately determined, so that the rate of emission may be measured in watts. The phonometer (or measurer of the sound) is a glass diaphragm, made the base of a resonator, and bearing a light mirror, which constitutes one mirror of a Michelson interferometer. The displacement is measured stroboscopically by a telescope, and the amplitude of the pressure change is read off on a scale in dynes/cm.^{2}. The instrument is as sensitive as the ear for a pitch of 256 vibrations per second, and an accuracy within 10 per cent. is claimed.

In the short discussion aroused by this paper some doubt seemed to be felt of the agreement of results given with those obtained by Lord Rayleigh, but in the absence of trustworthy memories the point was left unsettled. Questioned as to the power exerted while he himself had been speaking, Prof. Webster left it to be inferred from the statement that ten million cornets (each of which could be heard half a mile away) emitted at the rate of a horse-power.

Prof. W. M. Hicks followed with a paper on the relation of spectra to the periodic series of the elements. In this he described some results recently obtained by him in a critical study of the spectral series of the second and third groups of the periodic table of elements, more especially their dependence upon the atomic volume of the element. Values for atomic volume or of density very close to observational values can be deduced in the case of the first three groups of the periodic series. Applying the method to the spectrum of europium as given by Exner and Hashek, a density of 13·1 was predicted for that element. Sir Norman Lockyer, discussing the paper, emphasised the importance of a study of series, especially in regard to the stars. In a paper on the series spectrum of the mercury arc, Dr. S. R. Milner gave the results of a photographic study of the mercury arc *in vacuo*, thus avoiding the faint continuous background which fogs the plate when the arc is observed in air; very much longer exposures can for this reason be given, and many new lines are then observed, among which the lines forming the continuation of the various series of mercury were strikingly developed. Measurements have been made up to the fifteenth line in the diffuse series and the thirteenth of the sharp series. Rydberg's difference law is exactly satisfied.

Mr. A. E. Oxley described an apparatus for a production of circularly polarised light obviating the lateral displacement of the beam produced by Fresnel's rhomb, but possessing the advantages of this rhomb in other respects. Two similar rhombs of glass are placed end to end in contact so as to form a *bent* double rhomb. By suitably choosing the dimensions the required object is attained. The angle of the rhomb chosen is 74° 38·2′ for glass of index 1·5035. The length (15 cm.) is, however, inconveniently long. A much shorter form, in which three reflections of the light occur, is obtained by putting in close contact two trapezium-sectioned prisms, the faces in contact being those containing the shorter of the two parallel edges of the trapezium. The relative retardation can be made $2\pi+\pi/2$, and the emergent light will then be circularly polarised. The apparatus can advantageously replace a quarter-wave plate in the quantitative study of elliptic vibrations. Mr. Oxley also described a new half-shade analyser, consisting of a double rhomb of glass of suitable angle to produce a retardation of 3π, which is equivalent to $-\pi$.

Section G (Engineering) then joined to participate in a discussion on the principles of mechanical flight, opened by Prof. G. H. Bryan. This discussion wandered away from the title, and developed into one on the relative positions of the mathematician and the practical engineer in the origination and development of new ideas on the subject of aviation. The engineers were present in strength, and the evidence brought forward from the parallel case of motion on water seemed to be greatly in their favour. Of the points more particularly bearing upon the advertised title of the discussion we may mention Mr. Dugald Clerk's advocacy of much lighter engines and of a considerable modification of the usual thermodynamic cycle. He recommended differences of pressure of two to one instead of five or more to one as at present. Mr. Scoble's account of his propeller tests was also of much value.

The proceedings of Tuesday, September 6, were opened with a discussion on atmospheric electricity, initiated by Dr. Charles Chree. He explained that atmospheric electricity includes a great variety of phenomena. Omitting aurora as a subject so large as to require a separate discussion, there are the questions of the potential gradient in the atmosphere, the influence of potential gradient and electrical charges on the growth of vegetation, the phenomena of thunderstorms, the loss the charge experienced by insulated bodies, the number and nature of the positive and negative ions in the air, the vertical earth-air currents, and the phenomena of radio-activity. The potential gradient and its diurnal and annual variation have been the subject of study for a good many years, and we know that the phenomena vary largely with the season of the year at any given station, and that there are notable differences between different stations at ground-level. As yet but little is known of the diurnal and annual changes at different heights in the free atmosphere. Observations made near the top of the Eiffel Tower suggest that the phenomena alter rapidly as the height above the ground increases. Thus observations from balloons and kites, if these could be maintained at a fixed level, would be of great importance. The influence of electricity on the growth of plants, first seriously studied by Prof. Lemström, seems not unlikely to prove in the future to be of economic importance. The phenomena of thunderstorms have received considerable attention from meteorologists, but many lines of investigation present themselves. The loss of charge of insulated bodies and the ionic charges in the atmosphere have been studied most in Austria and Germany—Elster and Geitel, in particular, having done much pioneer work. In this country Mr. C. T. R. Wilson has investigated the electric charge brought down by rain, and has invented an instrument for measuring the earth-air current. While a great number of theories have been advanced to account for the several phenomena, there are few, if any, of them which command anything like universal acceptance.

Sir Oliver Lodge referred to the existence of a positive gradient of potential during fine weather and a negative gradient during wet weather, and spoke of the possibility of influencing the weather by varying the potential gradient, and thought that rain might be produced in this way, and that here was a field of experiment for the enterprising capitalist. Referring to the effect of electricity on plant life, he explained that the experiments with which he had been connected showed that in dull weather the plants were stimulated by the electricity, and the effect was good, but in bright, sunny weather they were overstimulated, with consequent bad results. He did not think that the action on plants was due to nitrification, but to some effect on the growing tips.

Dr. Shaw pointed out that in order to produce rain in considerable quantities it would be necessary to find a source for an enormous amount of energy, and he urged that any attempt to reverse the electric field should be first of all thoroughly worked out in the laboratory. He asked whether fine weather electricity had anything to do with thunderstorms. The two phenomena seemed to be distinct from one another.

Sir J. J. Thomson thought the real difficulty about producing rain by electrical methods would be political. If one's efforts resulted in deluging neighbouring countries with rain they did not want, or in depriving them of their normal supply, difficulties would begin. As he understood Sir Oliver Lodge, it was not a question of supplying

energy, but of transforming energy already existent in the atmosphere in order to produce rain. He referred also to the difficulty of explaining the return to earth of the outward flowing negative electricity, and mentioned, in conclusion, the relation between the radio-active contents of the air and its previous history; air which had travelled over the sea was much less radio-active than that which had been for some time over the land.

Dr. Chree in his reply emphasised the fact that during rainfalls there are fluctuations of potential, and in conclusion urged the necessity of observations over much wider areas before many of the problems of atmospheric electricity could be settled.

At this stage the section divided. In the department of cosmical physics Dr. W. Schmidt, of Vienna, communicated an interesting description of a new instrument, the variograph, designed by him for measuring short waves in atmospheric pressure. He showed records obtained by it at Innsbruck and Vienna. Conditions at Innsbruck, especially in the winter months, are very favourable for the production of waves, the cold air in the valley lying beneath a warmer upper layer. By recording with two instruments 2 km. apart, Dr. Schmidt deduced that both progressive and standing waves occurred, the period of the latter being considerably greater than that of the former; in a particular case the periods were 3·5 minutes and 9 minutes respectively, and the record showed the interference of the two sets of waves. Dr. Schmidt showed, too, that in Föhn weather, when regular waves were recorded, the regularity ceased when the Föhn wind actually broke through the cold layer and blew at Innsbruck, proving that the layer of discontinuity was essential to the formation of the waves. In some cases regular waves preceded by several hours the occurrence of line-squalls, corroborating Russell's observations of cirrus clouds.

Mr. Dines spoke on the records from the upper atmosphere obtained during the passage of the earth through the tail of Halley's comet. The traces obtained by Mr. Dines in ordinary cases are of two kinds, one in which the up and down curves coincide, the other in which loops are formed. The traces at the time of the comet showed an abnormally large proportion of the second kind, but it was not possible to say if the peculiarity was due to the comet or to the type of the prevailing weather.

Dr. Nicholson in a paper on radiation pressure in cosmical problems showed that more extended calculations do not confirm Schwarzschild's results in detail, but the general character of these results is preserved.

Miss Margaret White showed a series of slides giving the results of the hourly balloon ascents made from Manchester in March. The results corroborated in their main features those obtained in June, 1909, and communicated at the Winnipeg meeting.

Mr. Stupart gave some results of an inquiry into the vertical temperature gradients in Canada in the winter months. The principal conclusions were:—(1) that in cold winters in Manitoba the temperature increased upwards, the mountains being warmer than the plains; (2) that in warm winters the mountains were colder than the plains, and the vertical gradient approached the adiabatic value.

Mr. Gold communicated the results of an investigation into the effect of radiation on H_0, the height, and T_0 the temperature of the advective region. So far as radiation is concerned, the variation both in the temperature and in the absolute humidity of the atmosphere tend to increase the value of H_0 with approach towards the equator, but their effects on T_0 are in opposite directions. A necessary condition for the existing state of affairs is that the atmosphere should be very nearly transparent to low temperature radiation for considerable regions in the spectrum.

Prof. F. G. Baily described a sensitive bifilar seismograph for recording undulatory movements of the earth's surface of short period. By a system of multiplying levers, great sensibility is attained, and it may be expected that, when the present experimental instrument is replaced by a final form exposed in a suitable chamber, valuable results will be obtained.

In the department of general physics, which sat simultaneously with the above, Mr. Twyman described, on behalf of Prof. C. Féry, a successful attempt to simplify the long-range spectrograph to make it suitable for industrial investigations concerning metals, alloys, &c. The principle of auto-collimation is employed, a 30° quartz prism being traversed twice by the beam of light. By giving suitable curvatures to the two sides of the prism it acts also as the lens-system, producing a sharp spectrum on a cylindrical surface, exactly as with a curved reflecting grating, and with a much less inclination of the plate.

In a paper on the magnetic field produced by the motion of a charged condenser through space, Mr. W. F. G. Swann discussed the possibility of detecting the presumed field by means of a rotating coil, even though the impossibility of detecting it by a magnetic needle is admitted. His analysis seemed to indicate that if the specific inductive capacity may be looked upon as a quantity absolutely continuous throughout the dielectric, a magnetic flux through the coil should exist, but that if the dielectric action is to be explained by electric charges or doublets, no resultant magnetic flux is to be anticipated. Experiments made by the author gave a null effect, and this is taken to support the doublet theory of dielectric action.

Three papers were read by Prof. J. C. McLennan on behalf of the authors, who are his students at Toronto. In the first Mr. V. E. Pound details the results of experiments on the secondary radiation from carbon at low temperatures when bombarded by the α rays from polonium. Fifty per cent. more is produced at the temperature of liquid air than at atmospheric temperature. This is attributed to the much larger amount of air occluded in the carbon. The second paper, by Prof. McLennan and Mr. N. Macallum, was on a resolution of the spectral lines of mercury by a high-grade echelon spectroscope made by Messrs. A. Hilger. A number of slides were exhibited showing the components of the green and blue mercury lines and their resolution under the action of a magnetic field. The third paper was by Mr. W. T. Kennedy, on the active deposit obtained when the emanation from actinium is allowed to diffuse freely between two parallel plates placed about 2 millimetres apart over the actinium salt, the plates being maintained at a difference of potential of 250 volts. The deposit is found to reach a maximum for a particular gas-pressure. It was concluded that the proportionate amount of emanation which possesses a positive charge varies with the pressure.

Dr. H. S. Allen followed with an important summary of our present knowledge of photoelectric fatigue. This was accompanied with a bibliography, which has been ordered to be printed *in extenso*. This was succeeded by an interesting paper by Drs. W. Makower and S. Russ and Mr. E. J. Evans on the recoil of radium B from radium A. The magnitude of the effect observed was of the order to be expected if radium B carries the atomic charge of electricity and if its atomic weight is 214, as is to be expected on the transformation theory of radio-active processes.

The proceedings on Wednesday, September 7, began with a very interesting account by Sir Norman Lockyer of his work on stars and their temperatures. The spectra of the hottest stars indicate that in them we have to deal simply with hydrogen and with another form of hydrogen produced from it: but helium runs hydrogen very close as one of the constituents of a star's earliest atmosphere. Iron, even in a proto-form, enters into a star's atmosphere at a much later stage, and iron such as we know it in our laboratories at a later stage still. The general conclusion from Sir Norman's work is that we are able to establish a palæontology of chemical substances.

Prof. W. M. Hicks sketched some of the evolutions of a vortex, and was succeeded by Dr. C. Chree, who read a critical paper on the rate of propagation of magnetic disturbances. Dr. Bauer, of the Carnegie Institution, believes he has established as a fact that the so-called "sudden commencements" of magnetic storms are propagated at such a rate as to take, on an average, about 3¾ minutes to go round the earth, and he believes that the cause of these disturbances is a peculiar form of overhead electric current in the plane of the earth's equator due to charged ions, the height of which, on the average, is about fifty miles. Dr. Chree considers that the theory

which Dr. Bauer has advanced to account for the motion of these charged ions is unsatisfactory in several respects, and he further considers that the experimental evidence which has been brought forward by Mr. Faris to support Dr. Bauer's theory is inconclusive.

Then followed several reports of committees, which were either outlined or taken as read. These included the report of the seismological committee, in which reference is made to the interesting results on the semi-diurnal change in level (caused by the tide) obtained by Plummer at Bidston Observatory. The meeting of the section then came to an end.

CHEMISTRY AT THE BRITISH ASSOCIATION.

IN arranging the programme for the Sheffield meeting the organising sectional committee had made it the main object to discuss broader questions of interest to other sections rather than to encourage the reading of papers appealing mainly to specialists; further, in view of the special character of the industries of Sheffield, much of the programme was devoted to metallurgical subjects. The results of the meeting fully justified this departure, and the three joint discussions not only proved of the greatest interest, but were most stimulating in character; indeed, it is probable that in two cases, at least, they will serve as points of departure for much new research. The metallurgical papers were equally stimulating and in harmony with the tone set by the president's address—the meeting as a whole should do much to inspire the filling of some of the gaps in our knowledge to which Mr. Stead made reference.

The joint discussion with Section A attracted a very large audience. The subject chosen—combustion—should have had the cooperation of the engineers, who were discussing the report of their committee on gaseous explosions on the same morning, but could not see their way to attend the joint meeting. Prof. Bone presented a report giving a very complete summary of the principal researches upon the chemical aspects of gaseous combustion during the past thirty years. He dealt in turn with ignition temperatures, the explosion wave, the pressures produced in gaseous explosions, the influence of moisture upon combustion, the combustion of hydrocarbons, and the influence of hot surfaces upon combustion. This last question is of considerable technical importance, hot surfaces accelerating dissociation, and probably also combustion, and hence playing a potent part in the development and concentration of the heat in gas-fired furnaces. The line of attack followed has been to determine the rates of combination of different gases with oxygen when the reacting mixtures are brought into contact with various solid surfaces at selected constant temperatures.

Sir J. J. Thomson directed attention to the fact that combustion was concerned, not only with atoms and molecules, but also with electrons, *i.e.* bodies of much smaller dimensions and moving with very high velocities. These may precede the explosion wave and prepare the way for it by ionising the gas. The motion of the ions can be stopped at once by means of a transverse magnetic field, and it would be of great interest to repeat Prof. Dixon's experiments on the photography of the explosive wave under such conditions.

It had been shown by the work of Townsend and others that in carefully dried gases the velocity of the negative electrons might be 100 times as great as the velocity of the positive electrons. The amount of moisture required to reduce this velocity to its ordinary lower value was exceedingly small, and comparable with that required to initiate chemical change. It was not unlikely that the two phenomena were very closely related.

In reference to the influence of hot surfaces in promoting combustion, it was not improbable that the emission of charged particles from the surface was a factor of primary importance. Hot lime gave out an enormous stream of negative electrons; hot metals emitted an excess of positive electrons. These electrons might produce very important effects by uniting (perhaps selectively) with moisture, with the oxygen or with the inflammable constituent of the gaseous mixture. The action of surfaces might ultimately be found to depend on the fact that they formed a support for layers of electrified gas in which chemical changes proceeded with high velocity.

Sir Oliver Lodge referred to the fact that the velocity of sound was not a constant quantity. If a bullet were to travel with a velocity greater than that of sound the air would be shattered as if by an explosion. This result was in practice prevented by the compression, and consequent heating, of the air in front of the bullet, whereby the velocity of sound was momentarily raised to perhaps three times its ordinary value. Whilst hot surfaces promoted combustion, cool surfaces had an opposite effect; this was responsible for the production of vast quantities of soot and smoke, especially in firing steam boilers. The discovery of a surface which would promote combustion even at lower temperatures would be of very great value.

Prof. H. B. Dixon stated that the explosion of hydrogen and chlorine by light was of special interest, as it did not occur in the well-dried gas. Both Mellor and Chapman and Burgess had failed to find any evidence of ignition by light of a mixture of two substances—three kinds of molecules seemed to be necessary. But when once the explosion wave was started it proceeded independently of moisture, and, indeed, was actually most rapid in the dry gas; the explosion was then propagated by molecular collisions between pairs of molecules. It was not unlikely that invisible compression waves might travel a little in front of the visible flame, the particles being thereby raised to a higher temperature, but remaining uncombined until they collided with one another.

Prof. Armstrong denied the possibility of any interaction taking place between two substances if neither was an electrolyte. Highly purified materials must be used for work of this kind. Perhaps the most suggestive experiment was that of Sir James Dewar, who had purified helium so perfectly by the use of charcoal cooled in liquid air that it would not permit an electric discharge to pass through it, although the presence of the gas was clearly shown by the radiometer.

A paper on the molecular weight of radium emanation, by Sir Wm. Ramsay and Dr. R. W. Gray, was delivered by Dr. Gray, who first described in detail the construction of the micro-balance used, and showed how the exact volume of emanation weighed was determined. The mean value of 221 was obtained for the molecular weight of the emanation, and the fact emphasised that the radium emanation was in every sense a true chemical element. Chemically it is absolutely inert, and the atomic weight shows that it falls into the argon series in the periodic table, filling the second vacant space below xenon. The name "niton" (shining) and the chemical symbol Nt was proposed for the emanation. Sir J. J. Thomson suggested that the name should be left to the Congress of Radiology at Brussels (see NATURE, October 13).

The more purely physical papers read at the joint meeting are dealt with in the account of the proceedings of the physical section.

The report on solubility submitted by Dr. J. V. Eyre is the outcome of a systematic study of the literature; the material is classified chronologically and according to subject, and contains a brief statement of the main conclusions arrived at by the various authors.

The conjoint discussion on the biochemistry of respiration was of the greatest value in enabling workers on the subject, representing the three sciences concerned, to correlate their views. Mr. F. F. Blackman, who opened the proceedings, gave a very complete summary of the present position of the subject, dividing it into three sections:—(1) the nature of the chemical reaction (or complex of reactions) that constitutes respiration; (2) the extent to which this reaction in the cell conforms to the laws of general chemistry; (3) the influence on the progress of the reaction of the peculiar medium (protoplasm) in which it takes place. A summary statement of respiration takes the form of the equation for the complete oxidation of glucose, but actually the process is most complicated. The existing theories as to the stages in

which glucose undergoes oxidation and the part played by oxidases were all fully described.

Mr. Blackman advocated the hypothesis that normal respiration consists of two processes, a small "protoplasmic respiration" which cannot be suppressed without death, and a larger "floating respiration" which depends on the available sugar supply, and can be reduced or abolished by starvation.

A brief summary of the oxidative breakdown in animal tissues was given by Mr. H. M. Vernon, who described some of his own work on the subject.

Dr. E. F. Armstrong summarised the existing knowledge with regard to the oxydases, and debated whether they are to be regarded as organic enzymes or as inorganic catalysts in a colloidal substrate. The facts that oxydase solutions retain their activity after somewhat drastric purification, that they invariably contain, even after the most thorough purification, traces of manganese, iron, or calcium salts, and that their action may be imitated by colloidal suspensions of the salts of these metals, are all in favour of the later view. On the other hand, there is distinct evidence of the specific nature of oxydases and of the existence of different oxydases. He further described the remarkable blackening of the leaf of *Aucuba japonica* produced when this is exposed to toluene or chloroform vapour, the change being attributed to an oxidative effect produced by an oxydase. A systematic investigation of what substances were able to cause this blackening showed it to be produced by most organic vapours, *e.g.* ethyl acetate, ether, benzene, &c., by carbon dioxide, and by such salts in aqueous solution as cadmium iodide, mercuric chloride, and sodium and potassium fluorides. All these substances possess but little affinity for water, and it is supposed that they are therefore able to pass through the differential septa, enter the cell, and set up osmotic disturbances whereby the cell contents become diluted and hydrolysis sets in to restore equilibrium. This brings the various cell enzymes into play, and a general degradation takes place. Measurements of the amount of sugar or starch or glucoside in the leaf before and after stimulation confirm this view—a great increase in the amount of reducing sugar is produced.

The stimulative effect of chloroform on respiration formed the subject of a paper by Mr. D. Thoday, whose results appeared to harmonise very closely with those of Dr. Armstrong; this paper will be more appropriately discussed under Section K. Prof. Armstrong, who followed, made a critical examination of the mechanism of the oxidative changes, and laid stress on the extremely complicated nature of the respiratory phenomenon.

The joint meeting with the Educational Section to discuss the neglect of science by industry and commerce attracted a large audience. Mr. Blair, who opened, spoke at considerable length in detailing evidence which he had collected from 150 past students of universities or institutions of university rank—all belonging to a class for whom the earning of a living was imperative. His paper appeared in full in NATURE of September 15. Following a supplemental paper by Sir Wm. Tilden, the subject was debated in turn by Dr. H. T. Bovey, Principal Griffiths, Dr. Beilby, Sir Wm. White, Mr. J. E. Stead, and Prof. Armstrong. The general tone expressed, both in Mr. Blair's address and by subsequent speakers, was one of hope, and it was agreed that England is not so far behind other countries in the application of science to commerce and industry as is often asserted. The main fact emphasised was that it was, above all, necessary to educate the public and bring home to them the advantages of pure science, and, further, it was all-important to establish some easy means to bring about a better understanding and more frequent communication between those who studied science and those concerned in its application.

On Tuesday, September 6, it was necessary to divide the section, the metallurgical and the organic chemistry papers being taken separately. The first paper, by Prof. J. O. Arnold, dealt with a fourth recalescence in steel. Steel in cooling contracts to a certain point, and then suddenly expands. It is agreed that this takes place three times; but Prof. Arnold, as the result of several years' experience, considers there is a fourth recalescence due to constitutional segregation, namely, the falling out between Ar_3 and Ar_1 of the ferrite and hardenite from their state of solid solution into microscopically visible masses. Numerous photomicrographs and cooling curves were shown to support this view. In the ensuing discussion Dr. C. H. Carpenter contended there was no need to term the process a fourth recalescence, and interpreted it as a prolongation of the Ar_3 and Ar_2 inversions. He criticised adversely the apparatus employed by Prof. Arnold, advocating in its place the differential method of registering recalescence. Prof. Arnold, in replying, stated this method to be quite untrustworthy. Mr. Stead said it is well known that in steels containing under the eutectoid proportion of carbon, when cooling from Ar_3 to Ar_{1-2-3}, the carbides and ferrite segregate. Prof. Arnold by his very careful research was the first to show that this segregation is coincident with an evolution of heat.

Prof. H. M. Howe, in a brief paper on allotropy or transmutation, took the view that changes such as that from the diamond to lampblack in reality involve transmutation, and the fact that but a single series of derivatives is given by such compounds was explained as meaning that the derivativeless element inevitably transmutes whenever it enters into combination.

A second paper dealt with the closing and welding of blow-holes in steel ingots, in which the author supported the practice of allowing blow-holes to form rather abundantly, so as to prevent the formation of a pipe, and then, relying on the ease with which such steel welds, trying to get flawless metal by welding these blow-holes up in the process of rolling the ingot out into its final form. This procedure is of great economic importance in that it enables the steel maker to avoid the serious discarding which would be necessary in case his ingots were free from blow-holes, and hence deeply piped. Many metallurgists have condemned the practice on the ground that the closing of blow-holes is impossible, because the gas which they contained must remain ever present during the rolling, even though somewhat compressed. Prof. Howe described in detail experiments showing that the blow-hole gases had been reabsorbed by the metal to a very great degree, and suggested prolonging the exposure to a temperature above the welding point, so as to complete the reabsorption of the gas while the metal was still weldable. The welding of the blow-holes should be promoted rather by the practice of "reheating" than by that of "direct rolling." Following some remarks by Prof. Arnold and Mr. Hadfield, Mr. Stead described an investigation carried out with Mr. F. M. Parkin on the same subject, which proved conclusively that when two metallic surfaces, quite free from oxide or any foreign matter, are brought together and hammered at temperatures from 1100°–1150° C., they weld up completely. The question as to what becomes of the imprisoned gas requires careful research; when the cavities are large the gases are enormously compressed, and must interfere with efficient welding. As a result, blisters occasionally appear on finished sheets if afterwards reheated. The gases extracted from a large blister in a soft steel slab gave on analysis:—CO_2, 23 per cent.; CO, 50·5 per cent.; hydrogen, 17 per cent.; marsh gas, 3·5 per cent.

The next paper, on the provident use of coal, by Prof. H. E. Armstrong, gave rise to a very considerable discussion. During the early stages of combustion a variety of volatile inflammable substances are given off which burn with a smoky flame. By first coking the coal at a low temperature these may be removed and recovered, and a fuel obtained which burns as readily as coal and gives a hotter fire. The gas given off by the coking process is very rich, and it was advocated that this be substituted for the product now produced by carbonising coal at very high temperatures, so as to obtain the maximum possible yield. It is essential that the quality of gas be improved; since the sulphur clauses of the Gas Acts were repealed there has been a steady deterioration. There is no reason why the coal now used in the raw state by the community should not be first coked at a low temperature. The gas would be available as an illuminant and for heating; the residual coke could be burnt without

producing smoke, and a variety of bye-products would have considerable commercial value.

Prof. A. Smithells stated that the point to be proved was whether fuel of the type advocated could be produced under conditions which would enable it to compete economically with the coal and products as put on the market under existing conditions. He considered the whole question to be in the experimental stage.

Dr. Beilby pointed out that in order to supply the public with soft coke instead of the 40 million tons of coal now required for domestic purposes the gas industry would have to be completely revolutionised, and some other very large uses found for the gas and other bye-products. It would not be possible to get chemical uses for such a large quantity, and it would have to be largely burnt as fuel. Mr. Archbutt emphasised the evil caused by sulphur in the gas; the public is not aware of this being the cause of the corrosion of brass, tarnishing of silver, and the destruction of books and furniture. Mr. A. W. Oke defended the gas companies, and other speakers supported Prof. Armstrong, who, in replying, stated that the use of a very large radiant and the supply of a greater quantity of gas was progress in the wrong direction. He agreed with Dr. Beilby that it would be necessary to regard the products of coking from the point of view of their fuel value, but that was a largely enhanced fuel value.

Prof. McWilliam described the properties of a series of steels with varying carbon contents, but containing, in addition, about 1 per cent. manganese, and a similar series containing 2 per cent. chromium, from results recently obtained by him in conjunction with Mr. E. J. Barnes. In pure iron-carbon steels the strength rises steadily with the amount of carbon up to 1·25 per cent. carbon, a further increase resulting in a reduced strength. The carbon is present as iron carbide, and other elements mainly influence the nature, composition, or distribution of the carbide in the steel. The effects of heat treatments such as long annealing and quenching, followed by tempering at different temperatures, are comparatively small when the carbon is low, but greater as the carbon is increased. Comparative tables were shown of steels with carbon contents and heat treatments as nearly alike as could be selected, and varying only in the special element added, to illustrate the very considerable and abiding influence of the fundamental chemical composition.

In the absence of the author, a communication by Dr. Rosenhain, on the crystalline structure of iron at high temperatures, was taken as read. The conclusions drawn from the research are that iron at temperatures up to 1100° C. behaves as a crystalline aggregate; it exists in three different modifications possessing widely different mechanical properties, the temperature range at which these modifications exist being consistent with their identification with the α, β, and γ forms of iron. β Iron, though existing at a higher temperature, is markedly stronger and harder than α iron. Iron as found in approximately pure metal at high temperatures possesses the structure and some of the properties of γ iron as found in certain alloy steels. The failure to harden pure iron by quenching is due to the difficulty of inhibiting the $\beta \rightarrow \alpha$ transformation by rapid cooling except in the presence of carbon. If β iron could be preserved in existence at the ordinary temperature it would possess a very high degree of hardness and strength probably quite comparable with that of hardened steel.

Dr. S. M. Copeman brought forward the subject of ferro-silicon, with special reference to possible dangers arising from its transport and storage. A number of accidents have occurred from the handling or transport of ferro-silicon, particularly cases of sudden illness and death caused by the gases evolved from certain cargoes. The subject has had full inquiry at the hands of the Board of Trade, who entrusted the investigation to Dr. Copeman, with the collaboration of Mr. S. R. Bennett and Dr. Wilson Hake. Most of the high-grade ferro-silicon, containing 50 per cent. of silicon, is produced electrically in France. About 4000 tons are imported annually into England. This alloy is exceedingly brittle, and readily decomposes in a moist atmosphere, when poisonous fumes of phosphoretted hydrogen are evolved. The official recommendations adopted by the Board of Trade comprise the need for ascertaining that the ferro-silicon has been broken into small pieces some time before being taken on board ship; the proper marking of each barrel; the prohibition of conveyance on passenger vessels; and the adoption of certain other precautions during transport. Subsequently Dr. Wilson Hake described the apparatus he had employed for analysing the poisonous gases produced, and Mr. S. R. Bennett showed photo-micrographs of certain ferro-silicon alloys. The suggestion was made that the alloy might be protected from moisture by immersion in varnish, but it was stated that it crumbles so readily as to be always presenting new surfaces.

Two rival theories have been suggested to explain the corrosion of iron and steel. The electrolytic theory assumes that pure oxygen (or air) and pure liquid water *alone* are necessary to effect the rusting of pure iron. According to the acid theory, the presence of at least traces of an acid either free or combined with a base is essential to corrosion. Dr. J. N. Friend described a simple form of apparatus by means of which the correctness of the acid theory is established.

A paper embodying researches carried out in the chemical department of Sheffield University, by Messrs. C. Chappell and F. Hodson, dealt with the influence of heat treatment on the corrosion, solubility, and solution pressures of steel. The tests made were simple corrosion, *i.e.* loss of weight after immersion in sea water; galvanic corrosion, *i.e.* loss in sea water in contact with Swedish bar iron; solubility in 1 and 2 per cent. sulphuric acid after seventy-two hours; solution pressure in sea water, 1 per cent. sulphuric acid and N/10 ferrous sulphate. The results show that the solubility tests are untrustworthy as a guide to the relative rates at which the steels corrode. The general effect of heat treatment on the various properties examined is found to be the same in the case of all the tests except simple corrosion, where heat treatment exerts practically the opposite effect. Although heat treatment exerts considerable influence on corrosion, it cannot be expected to make up for the defects due to segregation or inferior material. A research committee, with a grant of 15*l*., was appointed for the further study of this question, with Mr. W. E. S. Turner as secretary.

The sub-section, under the chairmanship of Prof. Orme-Masson, was occupied mainly with papers from the chemical laboratories of Sheffield University, which testify to the valuable amount of original inquiry which is being carried out there under Prof. Wynne's guidance. Prof. W. P. Wynne and Dr. J. Kenner presented a paper dealing with the nitrochloro- and dichloro-toluene sulphonic acids, whilst Dr. J. Kenner and Mr. E. Witham described the formation of tolane derivatives from benzotrichlorides. A paper on an instance illustrating the relative instability of the trimethylene ring as compared with the tetramethylene ring was read by Dr. J. F. Thorpe (Sorby research fellow). Open-chain nitriles formed from three carbon rings readily pass into imino derivatives of cyclopentene under similar conditions; four carbon rings remain entirely unaffected. A second paper, by Mr. A. D. Mitchell and Dr. J. F. Thorpe, dealt with the elimination of a carbethoxyl group during the closing of the five-membered ring. The closing of an open chain of five carbon atoms to form a five-membered ring imparts to the molecule a condition of tension which limits the capacity of the constituent carbon atoms to combine with groups of more than a certain volume.

Three important physical chemical communications were made by Mr. W. E. S. Turner. The first paper, written jointly with Mr. C. J. Peddle, dealt with molecular association in water, illustrated by substances containing the hydroxyl group. The fact that molecular association may take place in water is not generally recognised, but the authors find it to be quite extensive among aromatic substances. Benzoic acid, for example, is associated in water to a greater extent than in benzene, and the aromatic acids examined nearly all exhibit marked association. A second paper was entitled "The Problem of Molecular Association. 1. The Affinities of the Halogen

Elements." As the result of the determination of the molecular weights of fifty to sixty halogen containing substances of different types, it was shown that molecular association occurs only when the halogen compound is an electrolyte, that there is no special virtue in the halogen elements—such as the existence of a large number of contra or residual valencies—neither is there any virtue in the halogen ion differentiating it from other ions. Molecular association in neutral solvents is the reverse of the supposed electrolytic dissociation in the dissociating solvents.

The third paper, by W. E. S. Turner and E. W. Merry, dealt with the molecular complexity of nitrosoamines. Measurements of the surface energy of three nitrosoamines show that aliphatic nitrosoamines are associated liquids, whilst aromatic nitriles and nitro-compounds are non-associated.

Dr. F. M. Perkin communicated a short note on the action of metals upon alcohols. When ozone is bubbled through lead suspended in a state of fine division in alcohol lead ethoxide is formed, and this substance is readily obtained on boiling up finely divided lead with absolute alcohol. A few drops of alcoholic mercuric chloride solution are added to facilitate the reaction, or dry air is bubbled through the heated mixture for the same reason.

The method has been extended to the preparation of lead methoxide, cadmium ethoxide, mercurous ethoxide, and silver ethoxide.

The reports of the research committees contained much valuable matter. That on dynamic isomerism dealt with the absorption-spectra of camphor and a number of its derivatives. The report of the study of hydroaromatic substances deals with the constitution of the 3 : 5-dichloro-*o*-phthalic acid obtained from dimethyldihydroresorcin and the preparation of 1 : 1 : 2-trimethylcyclohexanone.

The transformation of nitroamines committee report on the chlorination of anilides and the transformation of acylchloroaminobenzenes, and also on the bromination of anilides. The committee on isomorphous sulphonic derivatives of benzene state that during the past year the results obtained by the examination of twenty-nine derivatives of the 1 : 4 series have been discussed from the point of view of the Barlow-Pope theory, correlating crystalline structure with molecular form, and found to be in complete accordance with it.

GEOLOGY AT THE BRITISH ASSOCIATION.

AS was perhaps natural in a year when a geologist, Dr. Bonney, was president of the association, there was an excellent gathering at Section C, which was fortunate in being able to welcome, in addition to the president, Prof. A. P. Coleman, three other geologists from Canada, Dr. R. Bell, Mr. J. B. Tyrrell, and Prof. Spencer. The meetings of the section were well attended, the number of papers presented was sufficient to afford a full programme for the last day (Wednesday), and several well-sustained discussions took place. Any account of the sectional proceedings would be incomplete without a reference to the interesting series of excursions arranged by Mr. B. Hobson and Mr. Cosmo Johns. On Saturday there was a whole day excursion to the Castleton district under the leadership of Dr. Arnold Bemrose, while four half-day excursions were carried out. The sectional dinner was attended by more than sixty members. Successful joint meetings were held with the geographical section and agricultural sub-section; the papers read on the latter occasion are referred to in the report of the sub-section.

The great majority of the papers and reports read before the section were stratigraphical in character. In pre-Cambrian geology there was, in the first place, the president's address on "The Canadian Shield," already printed *in extenso* in NATURE (vol. lxxxiv., p. 333).

Two reports were also presented dealing with pre-Cambrian rocks, one on the composition and origin of the crystalline rocks of Anglesea, and one on Charnwood rocks.

Lower Palæozoic stratigraphy was represented by a paper by Dr. J. E. Marr and Mr. W. G. Fearnsides on the Lower Palæozoic rocks of the Cautly district, Sedburgh, and a further paper by Miss G. R. Whatney and Miss E. G. Welch described the graptolitic zones from the Salopian beds of the same area; the only other region in which the majority of these zones have hitherto been traced is the Welsh border country. Two reports relative to the Lower Palæozoic rocks were also presented; the committee appointed for the excavation of critical sections in the Palæozoic rocks of Wales and the west of England presented an important report drawn up by Mr. E. S. Cobbold on excavations among the Cambrian rocks of Comley, Shropshire, this including a general revision of the results yielded by the excavations of the past three years and a vertical section. An interim report on the rocks of the Glensaul and Lough Nafooey areas, cos. Mayo and Galway, was also read.

A number of papers had reference to Carboniferous strata. Mr. Cosmo Johns' lecture on local geology was chiefly concerned with the Carboniferous rocks, and he further presented a paper on the Yoredale series and its equivalents elsewhere. The report of the committee on the faunal succession of the Lower Carboniferous (Avonian) of the British Isles consisted of an important report drawn up by Dr. A. Vaughan correlating the Belgian succession of the Carboniferous limestone rocks with that of the south-west of England. Mr. E. E. L. Dixon presented a paper on the geology of the Titterstone Clee hills, and three important papers bearing on the Coal-measures of the south Pennine area were read, viz. that by Mr. H. Culpin on marine bands in the Coal-measures of south Yorkshire, that by Mr. W. H. Dyson on the Maltby deep boring, and that of Dr. L. Moysey on some rare fossils from the Derbyshire and Notts coalfield. Members of the section had an opportunity on one of the excursions of inspecting the fine collection of fossils at the Maltby mine, and of obtaining many for themselves, while Dr. Moysey kindly brought his collection to Sheffield, and it was on view during the meeting. A report was also presented by the committee for the investigation of the fossil fauna and flora of the Midland coalfield.

An important discussion took place relative to the concealed coalfield of Notts, Derby, and Yorkshire, which recent discoveries have proved to be far more extensive than was formerly supposed. Prof. P. F. Kendall, in opening the discussion, described the evidence for a great eastward and southward extension of the concealed coalfield, the south-western margin being probably formed by a prolongation of the ancient rocks of the Charnwood area. He further announced that coal had been met with in a boring at Scunthorpe, a point eleven miles to the east of its previously known extent. Triassic geology was represented by a suggestive paper from the Rev. E. C. Spicer on present-day Triassic condition in Australia, and by one by Mr. A. R. Horwood on the origin of the British Trias.

A number of papers and reports had reference to African geology. Dr. J. W. Gregory read a paper on the geology of Cyrenaica, Dr. J. D. Falconer one on the geology of northern Nigeria, and Dr. F. H. Hatch one on the geology of Natal.

A somewhat lengthy report on the correlation and age of South African strata was presented, and a second report on topographical and geological terms used locally in South Africa.

One of the most interesting discussions during the meeting was that following a paper by Mr. G. W. Lamplugh on the shelly moraine of the Sefström Glacier, Spitsbergen, and its teachings. Observations on this glacier, which is subject to somewhat rapid advances and retreats, showed that (1) in a very few years a thickness of some 70 to 80 feet of shelly Boulder-clay could be accumulated, the glacier scooping up the material from the sea bottom and pushing it before itself; (2) that in this clay uninjured shells occurred plentifully; (3) that within a few yards of the spot where the Boulder-clay was accumulating many forms of animal and plant life could flourish—all points of importance in helping to an understanding of British glacial deposits. Other papers referring to glacial geology

were a report on erratic blocks, and a paper by Prof. E. Hull on the glacial rocks of Ambleside.

Very few papers dealt with palæontological subjects. Mr. M. Odling described a problematical fossil from the Chipping Norton limestone, and Dr. M. C. Stopes read a paper on structural petrifications from the Mesozoic and their bearing on fossil plant impressions.

Sir T. H. Holland read a suggestive paper on the cause of gravity variations in northern India; Mr. T. Sheppard gave a well-illustrated account of the Humber during the Human period; Dr. Tempest Anderson showed a magnificent series of photographs in illustration of his paper on Matavannu, a new volcano in Savaii (German Samoa); and Dr. A. Irving read papers on the pre-oceanic stage of planetary development and on a buried Tertiary valley through the Mercian chalk range, and its later rubble drift. Prof. A. McWilliam described the metallurgical industries in relation to the rocks of the (Sheffield) district. Finally, reports were presented by Prof. J. Milne on seismology, and by Prof. W. W. Watts on geological photographs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Gedge prize has been awarded to G. R. Mines, of Sidney Sussex College, for his essay entitled "Researches on the Physiological Action of Inorganic Salts chiefly in Relation to the Cardiac and Skeletal Muscles of the Frog."

R. H. Compton, Gonville and Caius College, has been elected to the Frank Smart (university) studentship.

The State Medicine Syndicate has appointed J. E. Purvis, of St. John's and Corpus Christi Colleges, to be secretary to the syndicate in the place of Dr. Anningson, who has resigned the office after twenty-five years' service.

The council of the Institution of Civil Engineers is prepared to consider applications for a nomination to the Palmer scholarship. The nominee must be the son of a civil engineer, must be desirous of studying and graduating at the University of Cambridge, and must be in such circumstances as to need the scholarship, which is of the annual value of 40*l*. Copies of the regulations may be had from the secretary of the institution, Great George Street, Westminster, S.W.

THE first course, dealing with neurology, of the Page May memorial lectures in physiology, will be delivered by Prof. C. S. Sherrington, F.R.S., at University College (University of London) on the following Mondays and Tuesdays, at 4.30 p.m.:—October 24 and 25, November 7 and 8, November 28 and 29. The lectures are open to the public without fee.

IT is announced in *Science* that at Yale University the salaries of professors and assistant professors have been increased by 9800*l*. from the alumni fund. The salaries of full professors are to be 800*l*. to 900*l*. and 1000*l*., based mainly on length of service, but modified somewhat by university responsibility and personal distinction. In the case of assistant professors the maximum salary is increased to 600*l*.

THE Aëronautical Society offers the following course of lectures at the Northampton Polytechnic Institute, Clerkenwell:—November 2: the study of dynamic flight, J. H. Ledeboer; November 16: the mechanics of the aëroplane, Algernon E. Berriman; November 30: theory and design of propellers, T. W. K. Clarke; January 11, 1911: aëroplane surfaces and controls, with some remarks on chassis, Herbert F. Lloyd; January 18: the motive power in aëroplanes, Captain A. D. Carden, R.E.; January 25: lines of aëronautical research, Bertram G. Cooper. The lectures will be given on Wednesdays at 8 p.m., and applications for tickets are to be addressed to the secretary of the Aëronautical Society, 53 Victoria Street, Westminster, S.W.

A CIRCULAR letter has been issued from the Education Offices of the London County Council inviting from the optical trade an expression of opinion on the advisability of endowing a central opto-technical institute at a cost of probably 30,000*l*. for the building alone. As a successful issue to this project is dependent mainly on the expression of a large volume of trade opinion in its favour, Mr. J. Aitchison arranged for a meeting of opticians to be held on Monday last, October 17, at Anderton's Hotel, Fleet Street, E.C., at which it was resolved to support the suggested establishment of an opto-technical institute in Clerkenwell "to further the work which has been hitherto carried on at the Northampton Institute, and has proved of great value to the optical industry." In his letter convening the meeting Mr. Aitchison remarked:—"Whatever difference may still exist between different parties in the trade, all are agreed to cooperate in whatever seems to be possible for the advancement of our industrial status, by forwarding the course of technical education and concentrating public attention on the importance of the movement."

THE first part of "Statistics of Public Education in England and Wales" for 1908–9 is now available (Cd. 5355). It deals entirely with educational statistics. New tables have been added this year giving particulars as to the occupations of the fathers of pupils and as to the previous education of pupils in secondary schools. The tables dealing with technical education remain much the same as in previous years. Before giving particulars as to the number of technical institutions in England, it must be pointed out that the Board of Education defines a technical institution as one giving an organised course of instruction in day classes, including advanced instruction in science, or in science and art, and provided with a staff and equipment adequate for the purpose. Provision must be made in such institutions for at least a two years' systematic course in science, or in science and art, either alone or in conjunction with subjects of general, commercial, manual, or technological instruction. Except in special cases no student may be admitted to the course unless he has passed through at least a three years' course of instruction in a "recognised" secondary school, or is more than sixteen years of age and qualified by his general education to profit by a course of advanced instruction. In 1908–9 forty such institutions were recognised by the Board of Education, and they provided 121 courses. The number of teachers in the institutions was 787, and the number of students who attended at any time during the year was 3314. Of the teachers 766 were men, and of the students 3091 were boys and men. As regards the age of the students, it may be said that 1046 were under eighteen years of age. The number of efficient secondary schools on the Board's grant list was 804 in 1908–9. These schools provide a progressive course of instruction in the subjects necessary to a good general education upon lines suitable for pupils of an age-range at least as wide as from twelve to sixteen or seventeen. Among other things, an adequate proportion of the pupils must remain at least four years in the school. In these 804 efficient schools there were 4338 men- and 4098 women-teachers teaching 73,270 boys and 62,401 girls.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 4.—Mr. Francis Jones, president, in the chair.—T. **Thorp**: A method for preventing the tarnishing of silver-on-glass parabolic mirrors. The mirror was carefully levelled on a turntable, and its axis of rotation made coincident with that of the turntable. The whole was then rotated uniformly at the calculated speed required to cause a liquid to assume the same parabolic form as that of the mirror. A 1 per cent. solution of "Schering's" celloidine in amyl acetate (after a lengthy period of settling) was flooded on to the surface of the mirror to a depth of about one-third of a millimetre. This was allowed to dry very slowly, when the resultant film was found to have a perfectly even surface of a thickness of about 1/300th of a millimetre. On testing the mirror no perceptible loss

of definition was observed, and in actual use the performance was satisfactory. It is absolutely essential for the success of the method that the mirror be quite enclosed, and exposed only to an atmosphere of amyl acetate so as not to be allowed to dry, for about one hour after the solution has been flooded on, as, without this precaution, a perfectly uniform film cannot be obtained.—Dr. Henry **Wilde**: The origin of cometary bodies and Saturn's rings. The first part of this paper is a further exposition of the author's theory of the origin of comets and cometary bodies from the interior of the planets of the solar system, with new illustrations drawn from experimental mechanics. Dr. Wilde considers that the recently discovered satellites of Jupiter and Saturn, which have retrograde motions, are planetary ejectamenta, and from their comparative minuteness are hardly entitled to rank as satellites. The theory advanced by Olbers, the illustrious discoverer of Pallas and Vesta, that the planetoids are fragments of an exploded planet, finds confirmation in the great irregularities of their orbits and the direct and retrograde motions of cometary bodies. The author next discussed the origin of Saturn's rings, which has for a long time engaged the attention of natural philosophers. Kant assumed that Saturn at an early period of its history had the characteristics of a comet, and that its tails contracted upon the planet and formed a ring. Laplace supposed the rings to be the original nebular substance uncondensed into the form of a satellite. The author ventures to affirm that the rings are the ejectamenta of Saturn when its diminishing energies were insufficient to eject a comet with its train of meteorites, or a cometary satellite. Dr. Wilde adduced evidence to show that the interior rings were formed some time subsequently to the outermost one, which is separated from the others by an annular space of 2585 miles. The author has drawn up a table of distances of the rings from Saturn and the times of their revolutions, calculated from his measurements of the photographs recently taken at the Lick Observatory.

NEW SOUTH WALES.

Linnean Society, August 31.—Mr. C. Hedley, president, in the chair.—Dr. H. G. **Chapman**: A contribution to the study of the precipitins. The paper records the results of an examination, by gravimetric methods, of the relations of the interacting substances in precipitin interactions. It was found that the amount of precipitate yielded by each antiserum was a fixed quantity for each cubic centimetre of antiserum, provided that sufficient homologous protein was present to precipitate completely the precipitin in the antiserum. In total interactions the weight of precipitate was proportional to the amount of antiserum. In partial interactions the weight of precipitate increased with ascending weights of homologous protein. Since the precipitates are derived mainly from the antiserum, it has been possible to determine the weight of the anti-substance in the antiserum. Consequent on the results of the gravimetric study of the interaction, a method has been devised to separate the proteins of closely allied species. Suggestions are made as to the composition of a precipitin-antiserum, as regards the components, giving rise to general avian and specific interactions. The preliminary results of the application of the test to the differentiation of vegetable proteins are recorded. They show that a group-specificity holds for proteins of vegetable origin. The derivation of precipitate from antiserum has not been sufficiently considered in relation to deviation of complement.—Dr. A. J. **Turner**: Revision of Australian Lepidoptera, part v. Part v. deals with the subfamily Geometrinæ of the family Geometridæ, comprising 40 genera and 124 species. The number of known species has been greatly added to, especially from the northern part of Australia, since the publication of Mr. Meyrick's "Revision of Australian Lepidoptera, No. ii., Geometridæ," in the society's Proceedings for 1887 (p. 835).—A. F. Basset **Hull**: Description of a fossil Chiton (Mollusca) from north-west Tasmania. The description is based on an example of a median valve, which shows the species to have been allied to, but distinguishable from, *Lorica affinis*, Ashby and Torr, and the living *L. volvox*, Reeve. The specimen was collected by Mr. W. S. Dun from the base of the Turritella sandstone at the foot of a bluff between Wynyard and Table Cape. The beds are referred to the Jan Jukian by Hall and Pritchard; that is to say, they are near the base of the Tertiary, as developed in southern Australia. Victorian geologists correlate them with the marine series at Spring Creek. The Eocene age attributed to these beds must be regarded as purely relative.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Standardisation of Locomotives in India, 1910: Cyril Hitchcock.

WEDNESDAY, OCTOBER 26.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Annual Meeting.

FRIDAY, OCTOBER 28.

PHYSICAL SOCIETY, at 5.—Demonstration of a New Method for producing High-tension Discharges: Prof. Ernest Wilson and W. H. Wilson.—The Behaviour of Steel under combined Static Stress and Shock: F. Rogers.

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