THURSDAY, NOVEMBER 24, 1898.

EARLY MATHEMATICS.

Facsimile of the Rhind Mathematical Papyrus in the British Museum. With an Introduction by E. A. Wallis Budge, M.A., Litt.D., D.Lit., F.S.A., Keeper of the Egyptian and Assyrian Antiquities. 21 Plates. (Printed by Order of the Trustees.)

THE Rhind Mathematical Papyrus, a facsimile of which the Trustees of the British Museum have just issued, together with an introduction by Dr. Wallis Budge, is the document from which we gather most of what we know of the conception and use of mathematics by the ancient Egyptians. The papyrus does not contain a systematic treatise on mathematics, nor does it attempt to deal with the subject from a scientific standpoint. It consists rather of tables and sets of worked out problems, such as would constantly require to be solved by an Egyptian master-builder, land-owner, farmer or estate-agent. In consequence of the inundation, the area of an Egyptian farmer's holding was constantly changing in extent, so that the need of some practical method of measuring area was pressing. The farmer after harvest would need some plan for estimating the storage space required for his grain; the cattle-owner and employer of labour would constantly have to face problems connected with the distribution of fodder and provisions; the builder would require some method for estimating the angle of a pyramid to be erected upon a given base. Such problems as these were of every-day occurrence, and they forced the ancient Egyptian to employ his ingenuity in solving them. How far he was successful, and to what extent he proved himself a mathematician, we can gather from the Rhind Papyrus.

The papyrus consists of a roll, now broken in two pieces, which measure 10 feet 6 inches and 6 feet 9½ inches respectively. The text is written throughout in hieratic, but its actual date is not quite certain. Dr. Budge assigns it to a period not earlier than the beginning of the eighteenth dynasty, about 1700 B.C., but adds that the actual text goes back to an older period. It was probably a copy of a papyrus written in the Hyksos period, about 2000 B.C., by a scribe Åāh-mes, who states hat he himself copied an original work of the time of Åmen-em-hāt III., a king of the twelfth dynasty, about 2300 B.C.

Before treating of the contents of the papyrus it will be well to indicate briefly the limits in their knowledge of mathematics displayed by the ancient Egyptians, whose system was not so perfectly developed as that of the old Sumerian inhabitants of Babylonia. They approached their subject from the practical and not from the theoretical side; but in spite of numerous disadvantages in their system of notation, it must be admitted that they showed great ingenuity in dealing with the mathematical problems they attacked. With regard to integers the Egyptians used a decimal system of notation, but their system was inferior to the decimal system of the Arabs; for while in the Arabic notation each power of 10 is indicated by simply adding or removing a cipher, the Egyptians had a different name and symbol for each power; thus 1, 10, 100, 1000, 10,000, and 100,000 were each expressed by a different figure. This fact, however, did not prevent them from dealing without difficulty with very high numbers. In dealing with fractions, however, the case was different; here they experienced great difficulties, for, oddly enough, the Egyptian could only express divisions of unity. Any number, in fact, could be turned into a corresponding fraction by placing before it the word *re*, *e.g.* ½, ⅓, ¼, &c. By this system they could not express a fraction with a numerator greater than 1, though there was no limit to the divisor; in fact, in one of the sections on Plate x*f.* of this papyrus, the fraction 1/5432 occurs. There is one interesting exception, however, for they were able to express ⅔, but still as a division of unity, for they represented the fraction by a sign which may be rendered 1/1½. The Egyptians must have possessed multiplication tables, and those for the lower numbers were probably committed to memory; among these must have been included a table of 1/1½ values, for they could take ⅔ of a number by a single operation, and if they wished to take ⅓ of a number they halved its 1/1½ part. Besides adding and subtracting they were able, by means of their tables, without difficulty to halve and double, and to multiply and divide by ten and five. Multiplication by other numbers, however, they performed by repeated doubling and then adding; thus to multiply seven by six an Egyptian would double 7 = 14; he would then double the 14 = 28; and he would then add 14 to 28 = 42.

This brief sketch of the system of elementary Egyptian arithmetic will serve to explain the interesting arithmetical table which occupies the first six and a half plates of the Rhind Papyrus. This table was evidently worked out to help an Egyptian in his calculations with regard to fractions; it probably would not be committed to memory, but merely used for consultation like a modern table of logarithms. These six and a half plates contain the working out of a table expressing in simple fractions, with 1 for the numerator, the ratios of 2 to the odd numbers from 3 to 99, *i.e.* the fractions 2/3, 2/5, 2/7, &c. Plate i., for instance, gives the working out of these fractions from 2/3 to 2/15, from which we get the following table of results:—

2 divided by 3 = 1/1½
2 ,, ,, 5 = 1/3 + 1/15
2 ,, ,, 7 = 1/4 + 1/28
2 ,, ,, 9 = 1/6 + 1/18
2 ,, ,, 11 = 1/6 + 1/66
2 ,, ,, 13 = 1/8 + 1/52 + 1/104
2 ,, ,, 15 = 1/10 + 1/30

That this table was not due to the fancy of one scribe, but was a recognised table of values in general use, is proved by a fragment of papyrus found at Kahun in April 1889, on which part of the same table is written, and which shows the same values as the result of the division of two by the odd numbers from 3 to 21. The use of such a table is not at first sight very obvious, for if it is necessary to express 2/5 in fractions with 1 as the numerator, 1/5 + 1/5 is a simpler solution than 1/3 + 1/15. It has been suggested, however, that the Egyptians may have used the table for reducing fractions with higher numerators to fractions of unity; thus 5/11 might of course be expressed by the Egyptian as 1/11 + 1/11 + 1/11 + 1/11 + 1/11, but by means of the table a shorter solution can be found, *i.e.* 5/11 = 1/11 + 2/11 + 2/11 = (by the table) 1/11 + 2/6 + 2/66 = (by their table of halves) 1/11 + 1/3 + 1/33.

On the right half of Plate xvi. is another somewhat similar but very much shorter table in a single column, giving some subdivisions of fractions which might prove useful in calculations, the results of course being expressed in divisions of unity, the table reading—

2/3 of 2/3 = 1/3 + 1/9
1/3 ,, 2/3 = 1/6 + 1/18
2/3 ,, 1/3 = 1/6 + 1/18
2/3 ,, 1/6 = 1/12 + 1/36
2/3 ,, 1/2 = 1/3

and so on. To the left of the table is a rule for finding 2/3 of a fraction, which reads as follows—

"To take 2/3 of a fraction. When it is said to thee, 'What is 2/3 of 1/5?' make thou its double and its six times. That is its 2/3. Thus is it to be done for every fraction that occurs."

The scribe evidently meant

$$2/3 \times 1/5 = 1/5 \times 2 + 1/5 \times 6 = 1/10 + 1/30$$

This general rule is exceedingly interesting, as it is the only one that occurs on the papyrus. In fact, the rest of the purely arithmetical part of the papyrus (Plates vii.–xii.) is thrown into the form of problems which are worked out with the object of being of practical use.

We have not space to do more than indicate the principal contents of the rest of the papyrus. Parts ii. and iii. (Plates xii.–xiv.) deal with the measurements of volume and area, in which given problems are worked out in estimating the amount of grain that can be stored in cylindrical and rectangular spaces of given proportions; in others the scribe has worked out the superficial area of fields of various shapes, the linear measurements of which are given; while diagrams are in some cases drawn of the shape of the fields. In this section of the work Dr. Budge remarks that the scribe has made a good many mistakes. Part iv. (Plate xv.) deals with the measurements of pyramids, of which six examples, with five figures, are given. The first on the page has the angle of the lower half of the southern stone pyramid at Dahshûr, four have the same angle as that of the second pyramid at Gîzeh, while the angle of the last is that of the pyramid at Mêdûm. Part v. (Plates xvi.–xx.) gives a worked out series of practical problems dealing with the reckoning of farm produce, the division of food among workmen, the cost of food for birds and animals, &c. They are all questions of practical interest, worked out, more or less, by rule of thumb. As Dr. Budge remarks in his Introduction to the Papyrus:—

"None of the examples or problems indicate that the Egyptians had any deep theoretical knowledge of arithmetic or geometry, but all of them show that they were very ready in making practical calculations."

Since the late Dr. Samuel Birch published an account of the contents of this document in the *Zeitschrift für Aegyptische Sprache* in 1868, the Rhind Papyrus has formed the subject of much discussion among both mathematicians and Egyptologists. A large body of students will, therefore, be grateful to the Trustees of the British Museum for placing in their hands the actual text of the papyrus in the form of a facsimile, which in beauty and accuracy of reproduction leaves nothing to be desired.

NEW ACCOUNT OF THE CHARACEÆ OF EUROPE.

Synopsis Characearum europearum. By Dr. Walter Migula. Pp. 176. Illustrated by woodcuts. (Leipzig 1898.)

THIS is an abridgment of the author's large and elaborate work on the subject, which forms vol. v. of the new edition of "Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz." The latter is by far the most extensive and minute account of the European Characeæ which has yet appeared; but the present work, containing as it does almost all the illustrations, and most of the letter-press information in a condensed form, will, we think, be found the more useful for all ordinary purposes.

The first eighteen pages are taken up with an account of the structure of the Characeæ, with illustrations, and a chapter on collecting, examining, and preserving specimens. These are followed by a key to the genera and species. At the end there is a list of books and memoirs dealing with the Characeæ, also one of published sets of specimens.

The remainder of the book consists of a tolerably complete description of the genera and species, with figures of nearly all the latter. The arrangement followed is almost entirely that of Braun's "Fragmente"; but the anomalous species *Lychnothamnus stelliger* of Braun is elevated to a separate genus, *Tolypellopsis*, Migula (*Chara*, sect. *Tolypellopsis*, Leonh.), and *Chara rudis*, *C. horrida*, *C. crassicaulis*, and *C. delicatula*, which Braun regarded as sub-species, are treated as species. The author has gone to extreme lengths in the differentiation of varieties. For instance, *C. aspera* is credited with thirty-nine named forms, *C. fragilis* with thirty-seven, *C. crinita*, *C. ceratophylla*, *C. intermedia* and *C. contraria* have each more than twenty; while *C. fœtida* (excluding *C. crassicaulis*) has actually sixty-nine! The majority of these forms are of the author's own describing. From the larger book we learn that many of them are based on plants from single localities, and, judging by the citations, it is fair to suppose in some instances from individual specimens. Considering the extreme variation to which the vegetative parts of these plants are subject, it seems to us a great pity to multiply names by distinguishing every trivial form.

In the nomenclature of the species Dr. Migula has implicitly followed Braun, in several instances quite disregarding the accepted rules. It would, we think, have been as well to have mentioned some of the more generally known synonyms.

The book is, unfortunately, entirely in German. As it deals with the Characeæ of the whole of Europe, it would have been more widely appreciated had the key and the diagnoses of the genera and species, at least, been in Latin.

As we have remarked, the illustrations are the same as those in the larger work. They are on the whole decidedly good, especially those of the magnified portions of the plants, and several of the species are more completely figured than in any earlier book. Some of the representations of the entire plants are somewhat crude and inartistic, and that of *Nitella translucens* is very poor;

some, on the other hand, give a good idea of the habit of the plants.

Taking it altogether, the "Synopsis" is a very useful addition to the literature of the order, and it will be found a convenient handbook for reference.

H. AND J. GROVES.

OUR BOOK SHELF.

The Unconscious Mind. By A. T. Schofield, M.D., M.R.C.S. Pp. vii + 436. (London: Hodder and Stoughton, 1898.)

DR. SCHOFIELD has set himself the task of familiarising the English public with the famous German theory of unconscious mental states. In his anxiety to let more accomplished psychologists speak for themselves he has, in many parts of his book, been content simply to reproduce the *ipsissima verba* of his authorities without criticism. Unfortunately he is himself scarcely psychologist enough to distinguish good authorities from bad, and trusts far too implicitly to the crudities and vagaries of such writers as Eduard von Hartmann. His work will hardly do much towards shaking the conviction of most English students of the science that "unconscious mind" is much such another phrase as "invisible colour" or "unextended body." Unconsciousness seems to mean very different things for him in the course of his argument. Instinct, he says, belongs to the "unconscious mind," because the animal executing the instinctive movement is unaware of its purpose. This seems quite unreasonable; the instinctive act is conscious enough in the sense of being attended both with sensation and with pleasure or pain; how then does the absence of knowledge of its biological value make it "unconscious"? Again we hear of "unconscious sensations," but they seem to mean no more than neural changes which would, under other conditions, be attended with consciousness. But surely it is obvious that it is one thing to say that if my attention had not been preoccupied a certain neural change would have resulted in a conscious sensation, and quite another to say that it has actually produced a sensation in my "unconscious mind." The unconscious execution of habitual mechanical processes is, of course, said to be presided over by "unconscious mind"; but where does the need of this undefined *tertium quid* come in? What is there, apart from the unscientific assumption as to the absolute heterogeneity of the psychical and physical, to prevent our saying quite simply that as a process becomes habitual and unconscious it ceases to be mental at all and becomes purely nervous? The believers in "unconscious mind" indeed profess to find it unthinkable that a combination of psychical elements should come to be replaced by a combination of physical elements, but they seem to have no better reason for their view than what Ebbinghaus well calls "this vulgar prejudice of the absolute distinction between mind and matter." It is probably not too much to say that Leibnitz's invention of the "petites perceptions" and Herbert's unlucky metaphor of the "threshold of consciousness" are responsible between them for an incalculable amount of psychological myth-making and confusion. Far the most valuable part of Dr. Schofield's book, the chapters in which he relates facts as to the therapeutic value of mental influences, is quite independent of his psychological theory.

A. E. TAYLOR.

Higher Arithmetic. By W. W. Beman and D. E. Smith. Pp. xvi + 193. (London: Ginn and Co., 1897.)

THE book before us is for the service of teachers. It is not intended as a first course, but for those who have already had some experience, and wish to review and extend their knowledge.

The authors have adopted quite a new line of treatment, and instead of making the subject into a set of puzzles, as is so often done, they have introduced many improvements by showing how the subject is applied to every-day use. Thus we have a chapter on "Longitude and Time," and the reader is made acquainted with the relationship between them, together with the excellent system of universal time in use in the United States and nearly all over the world. Again, it is pointed out how a knowledge of arithmetic is applied to solve problems in elementary electricity. From the beginning to the end of the book the authors have made it their chief aim to point out the utility of the subject in its various applications. The book contains, besides an excellent list of definitions and etymologies arranged alphabetically, a great number of well chosen and appropriate examples.

The Story of Marco Polo. With Illustrations. Pp. xiv + 248. (London: John Murray, 1898.)

THE preface is signed "Noah Brooks," and the little book is prepared specially for young readers. The plan is excellent, and well carried out. Selected extracts from Yule's "Book of Ser Marco Polo" are accompanied and woven together by a pleasantly written commentary, which seems to have been designed to interest the young people of the United States and the United Kingdom. Nothing could be better for the purpose. The extraordinary fidelity of many of Marco Polo's descriptions to fact is pointed out, and the incredulity with which they were received in a credulous age is duly dwelt on: a few of the more fanciful passages are also given, and the antiquity of these old stories noted. Probably many older people will see with surprise the minute exactness with which Marco Polo, six hundred years ago, described some of the most marvellous stock tricks of the modern Indian conjurers. The illustrations are not numerous, but very graceful and well selected. A map would have been a desirable addition.

H. R. M.

L'Art de Découvrir les sources et de les Capter. By E. S. Auscher. Pp. 278. (Paris: J. B. Baillière et Fils, 1899.)

BEGINNING with the physical properties of water, and dealing in order with the substances usually found dissolved in natural waters, the sources of these soluble materials, and the geological nature of the rocks through which subterranean waters percolate, the reader is introduced to the methods of water analysis in common use. The arrangement of strata and the characteristics of common rocks are explained with a view to making the circulation of underground waters easily understood. The third division of the volume, dealing with "La recherche des sources et des eaux souterraines," includes a chapter on "les signes extérieurs," which is only of doubtful scientific value, though many water-diviners doubtless receive great guidance from such considerations. Several of the illustrations are ingenious, and the book will be interesting to civil engineers who are concerned with questions of water supply.

Handbook of Insects Injurious to Orchard and Bush Fruits, with Means of Prevention and Remedy. By Eleanor A. Ormerod. Pp. x + 286; portrait and woodcuts. (London: Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 1898.)

MISS ORMEROD has now added to her long and useful series of works on agricultural entomology by publishing a volume specially devoted to the insects and mites injurious to fruit. It is hardly necessary to say that the book is worked out in her usual careful manner, and freely illustrated. The principal fruits are arranged in alphabetical order, commencing with apple; and under each, their insect enemies are enumerated. Fruit-growers who find their trees or bushes suffering from the attacks of insects, cannot do better than refer to this book to discover the cause and remedy. In a few touching lines, Miss Ormerod dedicates the book to the memory of her sister and co-worker, Miss Georgiana M. Ormerod, who was equally interested in entomological inquiries with herself. W. F. K.

Gas and Petroleum Engines. Translated and adapted from the French of Henry de Graffigny, and edited by A. G. Elliott, B.Sc. Pp. x + 140. (London: Whittaker and Co., 1898.)

A READABLE and instructive account of gas and petroleum engines is given in this little volume. The text can be easily followed by non-technical readers interested in gas and oil engines in use at the present time, and engineering students will find in the volume a good general survey of internal combustion motors. The subjects of the eight chapters are: the history of the gas engine, working principles of the gas engine, description of existing gas engines, carburetted air engine, petroleum engines, gas generating plant, engines for use with poor gases, and maintenance of gas and oil engines.

The Story of the Farm, and other Essays. By James Long. Pp. xv + 158. (London: *The Rural World* Publishing Company, 1898.)

THE essays in this volume refer more to the economics than the science of agriculture. The author, who has had a long experience of agricultural public life, and has contributed many valuable manuals to the literature of farming, acknowledges that agriculturists fail to recognise the two great elementary requirements of the hour—technical instruction, to which alone farmers can look for their advancement in knowledge and success, and co-operation. The Countess of Warwick contributes an introduction to the volume, on "Women and the Future of Agriculture."

Publications of the British Fire Prevention Committee. Edited by Edwin O. Sachs. Vol. i. (London: British Fire Prevention Committee, 1898.)

TEN papers on methods of fire prevention and kindred subjects appear in this volume, which represents the first fruits of the establishment of the British Fire Prevention Committee. The papers call attention to the need for increased protection from fire by preventive measures, wider knowledge of methods of fire-combating, investigations of materials and forms of construction, and research into the causes of fires. They should thus be the means of imparting very useful knowledge, and obtaining active support for the movement for better preventive measures against fire, which led to the formation of the Committee under whose auspices this volume has been published.

The Story of the Cotton Plant. By F. Wilkinson, F.G.S. Pp. 199. (London: George Newnes, Ltd., 1898.)

THIS latest addition to the Library of Useful Stories, written by the director of the Textile School at Bolton, gives a clearly expressed and popular account of the chief cultivated species of the cotton plant, the pests and other injurious agents which molest them, and the methods of cultivation in different countries. The processes of picking, ginning and baling are described, and the plans for manipulating the cotton in carding, drawing, &c., dealt with. The early attempts at spinning are passed under review, and pave the way for an account of the modern spinning mule and the other processes in the spinning of cotton. The little volume, though perhaps not likely to be widely read, should be very popular in Lancashire.

LETTERS TO THE EDITOR.

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Asymmetry and Vitalism.

PROF. JAPP has so entirely changed his position that it is useless to attempt to follow him. I would desire, however, to correct misunderstandings into which he has fallen in respect of my contentions with reference to his original position.

I did not intend to suggest that life originated in a crystalline form; but merely that, as living things can now assimilate crystalline bodies, the first living organism may have originated in connection with and by utilising a crystal, and that the asymmetry of this original living organism may have been controlled by the accidental asymmetry of the original crystal.

Once life began, I presume it descended, as it does now, by section and so forth, and, as I cannot follow Prof. Japp's difficulties as to a particular asymmetrical system breeding the like, I cannot see how the intervention of intelligence is required for its propagation, any more than for the growth of a particular asymmetrical crystal, once it is started.

This preponderating influence of the parent entirely explains the other misunderstanding Prof. Japp has fallen into. I never suggested that the rotation of the sun, probably a very feeble cause, could make a seed, with its impressed asymmetry grow into a tree with a different asymmetry merely by bringing the seed from the northern to the southern hemisphere. All I suggested was, with reference to Prof. Japp's original position—namely, that at the *origin* of life the first living organism may have been given a particular asymmetry by its having been produced in one or other hemisphere. A cause which may have been quite sufficient to give this asymmetrical bias during the time of origination, may be quite inadequate to produce a change in the bias once it has been given.

GEO. FRAS. FITZGERALD.

Trinity College, Dublin, November 10.

Connection between Mânasarowar and Râkas-tâl.

MR. LANDOR, in his account of his journey in Tibet, "In the Forbidden Land," claims to have disproved the connection between the lakes Râkas-tâl and Mânasarowar. The notice in NATURE of November 3 speaks of the connection as being possibly open to doubt.

But it is not so. My brother, then Captain Henry Strachey, in the account of his visit to the lakes in 1846, published in the *Journal* of the Asiatic Society of Bengal, vol. xvii., gives full details on the subject. He crossed the stream that flows from Mânasarowar into Râkas-tâl at a point about a mile from the latter lake. He describes it as about a hundred feet wide and three feet deep, running rapidly from east to west in a well-defined channel. He did not visit the actual point at which this stream leaves Mânasarowar, but in 1849 I did so (see *R.G.S.J.*, vol. xxi.), and there is no more doubt about the fact than that the Thames runs past Richmond.

Mr. Landor, so far as his map and descriptions enable us to judge, and as the notice in NATURE suggests, did not go far enough north between the lakes to admit of his ascertaining the facts bearing on the subject. RICHARD STRACHEY.

Lancaster Gate, November 12.

Arctic and Sub-Arctic Bees.

OF the wild bees of Alaska nothing is known, except that several species of humble-bees (*Bombus*) are common. Consequently, when Mr. Trevor Kincaid wrote me last year that he was going to Alaska, and would collect bees, I was expecting to see, on his return, quite a new bee-fauna. He collected carefully, and brought back a nice series, but all *Bombus!* No other genus was seen, although brightly-coloured flowers are quite numerous in Alaska. On the Pribilof Islands he found a fine new species of *Bombus*, which I named *B. Kincaidii*, but there was no other bee. I have written to Dr. W. H. Dall, to ask whether he ever saw any bees other than *Bombus* in Alaska. He replies that he collected there in 1868 four or five *Bombus*, and some wasps of the genera *Vespa* and *Pompilus*, but he has no record of other bees.

In Greenland, also, the bees are *Bombus*. Peary saw one quite at the northern end of that country. The one exception in America to the rule that only *Bombus* occupies the far north, so far as I remember, is the occurrence of *Osmia bucephala* at Great Slave Lake. In Europe and Siberia the same rule seems to hold, but doubtless several genera go further north than in America. *Andrena lapponica*, for example, is a decidedly northern type. The object of this note is to draw attention to the interesting question of the northern distribution of bees Those who have occasion to visit northern regions should collect what bees they can, noting the flowers they frequent, and in this way much valuable information may be gained. Probably some of your readers are already in a position to throw light upon the subject. T. D. A. COCKERELL.

Mesilla Park, New Mexico, U.S.A., Nov. 6.

Why Birds are not Killed by Eating Poisonous Fruit.

THERE is a great difference of opinion on this subject. While some maintain that birds do not eat fruits of this kind, others hold that they eat only the surrounding pulp, as of the berries of Taxus, which is perfectly harmless, whereas the seed is very poisonous; others, again, have maintained that they do not eat sufficient to be poisonous. The real fact is, I believe, that none of these statements are true, but that actually the birds eat largely of these berries, both pulp and seed, and that they very shortly afterwards eject the seeds and skins by the mouth, thus avoiding any poisonous action.

The first experience I had of this habit was in finding in September last an immense number of thrushes and missel-thrushes feeding on the berries of *Pyrus aucuparia* in Sutton Coldfield Park. At least a square mile of ground had every patch of grass covered with the ejected seeds and skins of these berries, all the pulp having disappeared, while the colour of the skins was as bright and fresh as when they were swallowed; showing that they could not have passed through the alimentary canal. Each of the pellets was flat and round, and about the size of a sixpence. The birds were incessantly flying to and fro betwixt the trees in the adjoining woods and the park. The excessive drought of last summer, by decreasing the supply of their ordinary food, was evidently the cause of their attacking the berries at this early period.

The next evidence I had of this being the explanation of their immunity from the effect of poisonous food was in October last, when I found on Boxhill, in company with Prof. Conwentz, of Dantzic, a number of similar pellets, but consisting entirely of the seeds and skins of yew berries; the former being as bright green, and the latter as scarlet as they were on the tree. In each of these pellets I counted twenty or more seeds.

The real difficulty in accepting this explanation is that, so far as I know, no one has actually seen the birds eject the seeds. Two friends of mine saw, the other day, what was very nearly the accomplishment of the process. A thrush was seated under a well fruited yew, and going through violent spasmodic contortions, the wings drooping on the ground; they thought it was ill, but it flew away strongly as if there was nothing the matter.

The idea that these birds only suck off the pulp from the berries is, I think, fallacious. Prof. Conwentz and I found under a large tree on Boxhill a great number of small fruit-bearing shoots, which had clearly been bitten off by squirrels; the ground was quite covered with seeds divested of their aril, and unbitten, though a few berries with the pulp bitten had been dropped by the squirrels. Mr. Morton Middleton tells me that at Dicksgrove, Co. Kerry, the yew-berries are largely eaten by thrushes, missel-thrushes, blackbirds, greenfinches, linnets, &c., and afterwards rejected, but he has not seen the birds in the act of doing this. He says, however, that turkeys, not being able to eject the seeds, are killed by them, although Rhind ("Vegetable Kingdom") says that these, as well as peacocks and fowls, eat them with impunity. Mr. Bennett (NATURE, October 13, 1898) asks for information as to the effect of birds and animals eating poisonous plants, and says that blackbirds eat the berries of *Atropa belladonna*. It does not appear that this was more than a supposition, neither is there any observation, so far as I am aware, as to what part of the berry, seeds or pulp, is poisonous. He says that mice eat the seeds of *Datura stramonium*. Here again we do not know whether they eat more than the kernel, which they would readily extract from the seed, as I have found them do in the case of *Ranunculus repens*, a small hole being bitten at the edge of the seed, while every kernel was extracted from the double-handfuls of seeds, which were collected in heaps.

"J. C." (NATURE, vol. lviii. p. 597, October 20, 1898) saw thrushes feeding freely on the berries of *Daphne mezereon*, an undoubtedly poisonous plant. In this instance there can be little question that they eject the seeds. He says they were so stupefied that they might apparently have been taken with the hand.

Mr. E. Langley, in the same number of NATURE, says that he saw blackbirds also eat these berries, but they did not appear the worse for a number of them.

Gilbert White ("History of Selborne, 1789, 329) speaks of milch-sows being killed by yew-berries, while "barrow-hogs and young sows" did not suffer. He attributes this result to the former being weak and hungry, and therefore eating a much larger quantity.

Prof. Tuson found (*Field*, 1877) that pheasants were killed by the leaves of yew, and there are several similar instances recorded since that date.

A. von Kerner made a number of experiments to show that seeds eaten by blackbirds, germinated in the following June; whilst those not so eaten, remained on the ground three or four years. O. Kirchner says that a species of Motacilla eats the berries; but this I regard as a doubtful statement. I have frequently seen them capture flies attracted by the fruit, but have never seen them touch the fruit itself. Every one is, of course, familar with the manner in which owls disgorge the fur and bones of mice and skulls of small birds, a habit which Mr. Harting tells me is shared by all the raptorial birds, as well as by shrikes, flycatchers, and rooks; and there are other facts alluded to by Sir Herbert Maxwell in his "Memories of the Months," and others of insects feeding on deadly poisons without any injury. The habit of ejecting the indigestible parts of their food by birds, seems to require further observation and experiment. JOHN LOWE.

Sun-spots and Air Temperature.

THE following comparison is, I think, instructive:—

Make out a table (from Greenwich data), in which each month since the beginning of 1841 is simply characterised as + or −, according as its mean temperature has been above the average (warm), or below it (cold).

Then, in each five-year group having a sun-spot maximum year central, count the warm and the cold months; and the same with five-year groups having a minimum central. We get these tables:—

Max. groups.	*a* Warm months.	*b* Cold months.	*a* − *b*
1846–50	38	22	+ 16
1858–62	32	28	+ 4
1868–72	34	26	+ 8
1882–86	33	27	+ 6
1892–96	35	25	+ 10
	172	128	+ 44

Min. groups.	*a* Warm months.	*b* Cold months.	*a* − *b*
1841–45	26	34	− 8
1854–58	30	30	0
1865–69	35	25	+ 10
1877–81	26	34	− 8
1888–92	17	43	− 26
	134	166	− 32

Thus, in each of the maximum groups, there is an excess o. warm months; and taking the whole, an excess of 44 warm months. In most of the minimum groups, on the other hand, an excess of cold months; total excess, 32 months.

With regard to the exceptional case—1865–69—in the second table, it may be worth remarking that 1860–70 is one of Brückner's warm periods. It seems to me that a consideration of both those cycles—the sun-spot cycle of about 11 years, and Brückner's of about 35 years—furnishes the clue to a great deal of our weather. A. B. M.

On Keeping Marine Organisms Alive in Small Aquaria.

IN NATURE of November 10 (p. 44), a contrivance is mentioned by the use of which the sea-water in a small aquarium can be kept in motion. The same kind of apparatus has been employed during the winter 1897–98 in Kiel, for keeping Peridinea and Diatoms of the Plankton in a healthy condition. Prof. Geo. Karsten has described the apparatus used in the *Wissenschaft. Meeresuntersuch. der Kommiss. z. wissenschaft. Untersuch. d. deutsch. Meere in Kiel und der Biolog. Anstalt a. Helgoland*, vol. iii. part 2, March 1898, p. 8. In this case a clinostat-clockwork was used, and the plunger rose five times in three minutes. The bell-jar, serving as an aquarium, was very small, holding about 1·5 litre. Ceratium and Skeletonema got on very well, the same plants dying off rapidly on being kept in water at rest.

OTTO V. DARBISHIRE.

Owens College, Manchester.

THE NOVEMBER LEONIDS OF 1898.

VERY unfavourable weather was experienced all over the country at the middle of November, and the return of the Leonid meteors was very scantily observed. At many stations no observations whatever were possible between November 13 and 16, while at other places only one of these nights was partially clear. As a result of the bad atmospheric conditions, very few meteors have been recorded. But it seems certain, from a comparison of the fragmentary observations obtained at various places, that, apart from the unfavourable influence of the weather, the meteoric shower did not nearly answer expectation. In fact, the number of meteors visible appears to have scarcely exceeded the average number that may be counted on an ordinary mid-November night. It is true that the observations did not cover the whole of the three nights of November 14, 15 and 16, and were, moreover, effected in most cases under circumstances little calculated to ensure successful results. But making every allowance for the difficulties encountered, the feeble character of the shower is still significant, and proves that the earth in recently crossing the node of Tempel's comet of 1866, did not encounter the denser part of the meteoric stream, but a very attenuated region far in advance of the associated comet. Indeed, the recent display appears to have been scarcely richer than those of 1879 and 1888, when the comet was not a great distance from its aphelion. Of course, the real shower may have occurred in the daytime, but it would scarcely escape recognition in America or some other distant part, for observers all over the world are keenly alive to the attractions and the importance of the Leonid display, and have been on the alert to witness it.

Descriptions of the recent shower from the United States are not dissimilar to those from our own country. Of course, we cannot rely upon the exaggerated statements published in some of the American newspapers, or sent home by the New York correspondents of certain English journals. One of the latter, writing on November 15, says: "Astronomers throughout the United States watched the shower of Leonid meteors, which appeared between midnight and five o'clock this morning. Many of the meteors made brilliant flashes across the sky, and left fiery trains. One meteor in Orion lit up the entire city of New York at about one o'clock in the morning, and fell hissing, the sound indicating its close proximity." More trustworthy accounts from astronomical observers at the Lick Observatory, Mount Hamilton, the Princeton Observatory, and others at Richmond, Virginia, agree that the late display was a disappointing one, the meteors seen being neither numerous nor brilliant.

With regard to observations made in this country, the writer has received reports from London, Oxford, Bridport, Yeovil, Cardiff, Chester, Loughton (Essex), Cirencester, Stone (Staffs.), Leeds, Southport, Belfast, Dumfries, and several other places. A few quotations from these may perhaps be interesting:—

Belfast.—A watch was maintained on November 12 to 15h. 30m., but no Leonids observed. On the following night (13th), to the same time, six meteors were recorded, and of these three may have been Leonids. On November 14, the sky was overcast to 16h. 40m.; then it partly cleared; but there was a good deal of mist, and the stars shone very dimly. Between 16h. 40m. and 17h. 15m. the observer saw ten fine Leonids; but the sky became cloudy again, and observations were discontinued. The shower was regarded as a fairly strong one under the conditions, and the maximum appeared to be at about 17h.—W. H. Milligan.

Southport.—Observations were made at the Meteorological Observatory on November 14, 13h. 30m. to 17h. 30m., and the following were the hourly number of meteors (nearly all Leonids) noticed by one observer:—

h. m.		h. m.		
13 30	to	14 30	=	15 meteors.
14 30	to	15 30	=	10 ,,
15 30	to	16 30	=	3 ,,
16 30	to	17 30	=	2 ,,

The meteors were small, not one being brighter than a 1st mag. star. The scarcity of meteors, only five being seen between 15h. 30m. and 17h. 30m., is remarkable.—J. Baxendale.

Yeovil.—On November 14 the sky was clear, but only two or three meteors were remarked in the two hours between 13h. and 15h.—Rev. T. E. R. Phillips.

Cirencester.—Weather clear during the whole night of November 14, and only a little fog at low altitudes. Observations were made from a window facing E., between 11h. 45m. and 12h. 50m., but no meteors were seen. The sky seemed unaccountably light.—Miss E. Brown.

Gateshead.—On November 13, between 10h. and 15h., the atmosphere was favourable, and observations were made at short intervals, but no meteors were seen.—Dr. A. W. Blacklock (*English Mechanic*).

Northants.—On November 14, from midnight to 15h., a watch was kept with results almost *nil*. The sky was, however, partially veiled with clouds through which only a few stars could be seen. There was a very brilliant meteoric flash at 13h. 55m.—F. H. Wright (*English Mechanic*).

Bristol.—On November 12 the clouds passed off at 15h., and the sky was watched intermittently until 17h. Only seven meteors were seen. There was no sign of radiation from Leo. At 16h. 4m. the sky was illuminated, probably by the outburst of a large meteor in a region of the heavens hidden to the observer. The nights of November 13 to 19 were all overcast, and no observations could be obtained.—W. F. D.

Chester.—On November 16, between 10h. and 13h., six plates were exposed for 30m. each, but no meteor trails were secured. The meteors appeared to be scarcer than on any ordinary night. At 12h. 8m. a Leonid of the apparent brightness of Mars was seen, and with the exception of a small, swift Perseid nothing else was recorded.—F. W. Longbottom.

The remainder of the reports are stories of failure in consequence of the weather. At many places a series of dense fogs occurred just at the important time. In spite of these drawbacks, however, the fact remains that at certain stations on November 15 a clear sky invited observation, but presented very few meteors. It is true that Mr. Milligan saw some brilliant ones in the hazy sky of November 14, 16h. 30m. to 17h. 15m., and that the observed maximum of the "shower" seems to have occurred at nearly the same time as last year. But the phenomenon, so far as it was observed, was quite of minor character, and observers who saw nothing whatever, owing to the weather, may take comfort in the reflection that they lost very little. Of course, further observations may come to hand from distant places where the stars shone and meteors fell. If so, we may possibly have to modify our present ideas; but from the materials now before us, we can only draw the following conclusions:—

(1) The state of the atmosphere generally was very unfavourable for the observation of meteors.

(2) The number of meteors which appeared was small, and never at any time formed a display of special richness.

(3) The earth was too far in advance of the cometary nucleus to encounter the denser region of the meteoric stream.

But the observations obtained this year, if of a negative character, and very discouraging from an observational point of view, will yet be important as affording evidence of the tenuity of that section forming the vanguard of the stream.

The meteoric observer, disappointed as he has been in 1897 and 1898, may yet look forward with every confidence to the brilliant displays which will mark the years 1899, 1900 and 1901. W. F. DENNING.

NOTES.

IT has already been announced that in connection with the Royal Society the Colonial Office has instituted a Commission to investigate the subject of tropical malaria. We are now informed that the medical officers selected for the work in Africa are Dr. D. Daniels, of the Colonial Office Medical Service, Dr. Stevens, and Dr. Christopher. Dr. Daniels has sailed for India in order to make himself acquainted with the recent observations of Surgeon-Major Ronald Ross, of the Indian Medical Service, connecting the spread of malarial disease with certain species of mosquitoes. The two other gentlemen referred to will go direct to Nyasaland, in British Central Africa, to study malarial disease in that locality; and will eventually be joined by Dr. Daniels. With the knowledge acquired in a comparatively temperate climate, where, however, fever has of late years been peculiarly fatal, the three medical officers will, at a later date, visit West Africa, possibly on the Niger. The Royal Society proposes to contribute towards the expense of the investigation, the British Government, through the Foreign and Colonial Offices, finding the remainder. It is estimated that the investigations will occupy about two years, and reports will be submitted from time to time to a Committee nominated jointly by the Royal Society and the Secretary of State.

IT will be remembered that the late Mr. Alfred Nobel left almost the whole of his fortune to be converted into an international fund for the advancement of scientific research (see NATURE, vol. lv. p. 232). The bequest gave rise to a dispute, which we are glad to learn has been settled by a compromise between the contesting parties. The relatives of the deceased will receive 3,800,000 Swedish kronor, or about 211,000*l*., so that there still remains for the prizes the sum of 25,000,000 kronor, or nearly 1,400,000*l*. The income, computed at the rate of 3 per cent., will make the five prizes worth 150,000 kronor, or 8300*l*. each. It is expected that the compound interest during the time, which will necessarily be long, that will elapse before the prizes can be awarded, will increase the capital so as to cover the cost of managing the funds and the work entailed in properly distributing the prizes. It will be remembered that these prizes are to be awarded annually to persons making the most important discoveries in physics, chemistry, physiology or medicine. There is also to be a prize for the best literary contribution upon the subject of physiology or medicine, and also one for any person who has achieved the most or done the best things looking towards the promotion of the cause of peace throughout the world.

M. A. MICHEL LÉVY has been elected a corresponding member of the Berlin Academy of Sciences.

WE regret to see the announcement of the death of Dr. James I. Peck, assistant professor of biology in Williams College, and assistant director of the Marine Biological Laboratory at Woods Holl.

THE first competition offered by the Nansen Fund, which was established soon after the return of the *Fram* in 1896, has just been advertised. The subject is a thorough work in embryology based on original investigation, and the amount of the prize is 1500 kroner (about 80*l*.) The result will be announced at the annual meeting of the Christiania Academy of Science, May 3, 1900.

THE Christmas Course of Lectures, specially adapted to young people, at the Royal Institution, will be delivered this year by Sir Robert Stawell Ball, F.R.S. The subject will be "Astronomy," and the lectures (which will be illustrated by models and the optical lantern) will deal with the sun, the moon, the inner planets, the great planets, shooting-stars, and new methods. The first lecture will be delivered on Tuesday, December 27, at three o'clock, and the remaining lectures on December 29 and 31, and on January 3, 5 and 7, 1899.

THE death is announced at Paris, at the age of seventy-four, of M. J. N. Raffard, distinguished for his inventions and papers on science and technology. His inventions include governors for engines, several ingenious dynamometers, and many other appliances; he was the first to construct in Paris an electric tram-car worked by accumulators. He was a member of the Committee of Mechanical Arts of the Paris Société d'Encouragement, and also of the Editorial Committee of the *Revue de Mécanique*.

SIR GEORGE BADEN-POWELL, K.C.M.G., whose death, at the comparatively early age of fifty-one, we regretfully announce, took an active interest in scientific affairs, and in many ways assisted the advancement of natural knowledge. He was the son of the Rev. Prof. Baden-Powell, the Oxford geometrician and geologist. In 1896, he rendered a most valuable service to astronomy by conveying a small party of observers to Novaya Zemlya to make observations of the total eclipse of the sun. It will be remembered that on account of unfavourable weather the eclipse was not observed in Norway, where most of the British observers were situated; but, fortunately, better conditions prevailed at Novaya Zemlya, and excellent photographs were obtained of eclipse phenomena. The total failure of the British expeditions was thus saved by Sir George Baden-Powell's timely aid. His death will be mourned by many friends in the scientific world.

SIR JOHN FOWLER, K.C.M.G., Bart., the distinguished engineer, died on Sunday, at the age of eighty-one. His name is associated with some of the greatest engineering triumphs of this century. He was responsible for the design and construction of the Underground (Metropolitan) Railway, and carried out the scheme successfully in the face of gigantic difficulties and great opposition. He was engineer-in-chief of the Forth Bridge, which he designed in association with Sir Benjamin Baker, and he planned and commenced in 1875 the Sudan Railway to Khartum, now on the point of completion. It was in consideration of his work for the benefit of Egypt that in 1885 the Queen conferred upon him a Knight Commandership of St. Michael and St. George. For his services in connection with the Forth

Bridge, he was created a Baronet in 1890. He was president of the Institution of Civil Engineers in 1866, and delivered from the chair a very memorable address on the requirements of a complete engineering education. In 1890 he received the honorary degree of LL.D. from Edinburgh University.

PROF. CHARLES-MICHEL BRISSE, whose death occurred on October 13, was born in Paris on September 8, 1843, and lived a life of activity and usefulness. He was professor of mathematics at the lycée Condorcet for twenty-four years, and he also held the posts of tutor at the École Polytechnique, supplementary professor at the Conservatoire des Arts et Métiers, professor at the École Centrale, and professor at the École des Beaux-Arts. He was the author of papers on the displacement of figures and on the general theory of surfaces, and he translated into French several English and German works on the higher branches of mathematics. He also published numerous memoirs on actuarial subjects. In collaboration with M. Andre and M. Rivière, he published two editions of a "Course de Physique" for use in classes of mathematical physics. He was connected with the *Journal de Physique* for many years, and an appreciative note upon his services to the journal and to science appears in the November number.

THE temperature-entropy or "theta-phi" diagram of a substance, in thermodynamics, has been made well known to engineers through the writings of Mr. J. Macfarlane Gray. Those who wish to become familiar with an actual theta-phi diagram, or to study the properties of steam by its aid, will be glad to know that a diagram for one pound of steam at temperatures from 100° to 400°, designed by Captain Sankey, is now published by Messrs. Albert Frost and Sons, of Warwick House, Rugby. The basis of the chart is the water line and saturated steam line, and the space between these is closely divided by constant pressure and constant volume lines, which are extended into the superheated steam field; lines of constant dryness-fraction are also given. There are scales giving total heat, water-heat, and internal energy, from which these quantities can be read off without interpolation.

MR. PHILIP E. BERTRAND JOURDAIN sends us several notes reprinted from the *Journal* of the Royal Microscopical Society, 1898, pp. 395–400, dealing with improvements in microscopic lenses, with especial reference to photo-micrography. In the first of these notes he describes and figures an apochromatic objective and projection-ocular without fluorite, computed by Prof. Charles S. Hastings; but no information as to the precise nature of the glasses seems to be divulged by the makers. In a second note Mr. Jourdain describes a method of adjusting the sizes of the coloured images yielded by the Cooke lens; while a third note is devoted to a description of the planar lens recently computed by Dr. Rudolph, which, on account of its large aperture and wonderfully perfect astigmatic corrections, is admirably adapted for low-power micrography.

A SHORT article on the colours of lakes and seas, by Prof. Richard Abegg, of Göttingen, has been reprinted from the *Naturwissenschaftliche Rundschau*, xiii. 14. The author upholds the theory of Bunsen to account for the connection between the blueness of water and its purity: namely, that water itself absorbs red and yellow rays in preference to blue, and the purer the water the greater distance has the light to travel before being reflected by suspended particles, and therefore the greater the preponderance of blue. Bunsen's theory of selective absorption, combined with Soret's application of Tyndall's theory of the colours of the sky to water, are regarded by Prof. Abegg as affording a satisfactory qualitative solution of the question; but a number of interesting problems of a quantitative character still remain to be solved, and in this connection M. Spring's investigations are criticised at some length.

Some remarkable facts with regard to the electrical transmission of power in mining were brought forward by Mr. W. B. Esson in a paper read at the Institution of Civil Engineers on November 15. It was shown that the disadvantages attendant upon expensive transport of ore have been to a large extent neutralised by the electrical transmission of power. By using electrically-transmitted power the crushing-mills can be placed at the mine, and the serious expense of transporting the ore to the site of the water-power can thus be saved. Generally, electricity furnishes the only practicable means for transmitting power for mining operations, and the ease with which a copper wire can be carried over any kind of country, together with the plastic nature of the material, renders the electrical conductor the simplest and most trustworthy of all vehicles for power transmission. The plant erected at the Sheba Gold Mining Company's mine for the electrical transmission of power to the crushing-mills, five miles distant, was described by Mr. Esson, and the cost of milling was shown to be 1*s*. 8*d*. per ton of ore, as against 6*s*. 1*d*. per ton when aerial ropeway transport was used, and 1*l*. 12*s*. 6*d*. per ton during the time of ox-waggon transport. The water-power is obtained by a dam across the Queen's River, two miles above the generating station, to which the water is conveyed partly in open race and partly in tunnel. The maximum head derived is 32 feet. The turbines are of the Victor horizontal type, driving a countershaft of 300 revolutions per minute by ropes, and are together capable of developing 396 horse-power. The generating plant consists of three alternating-current dynamos supplying current at 3300 volts. The current is transmitted by cables to the mine, and at the receiving-house the pressure is reduced to 100 volts for driving motors and lighting the workings. The crushing-mill at Sheba works night and day; and in one year, of the possible 365 days of 24 hours each, the pressure cut off the conductors was only 4 days, 8 hours, 22 minutes, which were chiefly occupied in inspecting the water-race, overhauling the belts, ropes, &c., and in executing general repairs to the machinery. The efficiency of the plant from the turbine shafts at the generating station to the motor shafts at the mine may be taken as 70 per cent.

"IT is now some eighteen years since Mr. George Eastman, as an amateur photographer, began experimenting in a dark room in his own house with the intention of manufacturing photographic dry plates. . . . This was the modest beginning which blossomed in 1881 into the Eastman Dry Plate Company." So writes "Hermes" (*Commerce*, October 26, p. 785) in his interesting article under the heading "Every one his own photographer." Most of our readers have practised the art of photography at some time or other, and many have, without doubt, been users of the well-known Kodak and Eastman's films and papers. It is with these that the writer of the above-mentioned article deals; in fact, he gives an interesting digest of the history of this big firm since its commencement. So great and rapid has been the growth of this company, that in addition to their large manufactories in Rochester, New York, an equally large establishment has grown up in England, having its chief works at London and Harrow. The latter send their photographic materials over the whole world, with the exception of America, which is supplied from Rochester. Users of these materials will therefore read this article with interest, for not only will they be made acquainted with the numerous buildings and show-rooms by means of excellent reproductions, but the workshops and other manipulating sections are interestingly described by "Hermes," who has made a tour of all the company's premises.

THE *Engineering and Mining Journal* announces that Dr. Napier Ford has invented a substitute for rubber, namely perchoid, which is described as an oil that has undergone a high degree of oxidation. The oil is heated with litharge, stirred long and continuously, and then allowed to cool. Specially prepared tow is then dipped into it and placed in wire baskets, and exposed to air. The oil admitted to the filaments of the tow thus becomes wholly oxidised. This is drawn through rollers, and comes out a leathery material closely allied to, if not identical with, rubber. Its tenacity is increased by mixing sulphur with it. It is said that perchoid can be rolled as thin as a piece of tissue-paper, and that it makes leather impervious to moisture, though not to air.

SOME ten years ago a French missionary started the systematic rearing of two kinds of spiders for their web, and the *Board of Trade Journal* states that a spider web factory is now in successful operation at Chalais-Meudon, near Paris, where ropes are made of spider web intended for balloons for the French military aeronautic section. The spiders are arranged in groups of twelve above a reel, upon which the threads are wound. It is by no means easy work for the spiders, for they are not released until they have furnished from 30 to 40 yards of thread each. The web is washed, and thus freed of the outer reddish and sticky cover. Eight of the washed threads are then taken together, and of this, rather strong yarn cords are woven, which are stronger and much lighter than cords of silk of the same thickness. These spider web ropes are very much more expensive than silk ones, but it is hoped to reduce their cost somewhat in the future.

AT the meeting of the Academy of Science of St. Louis on November 7, Mr. James A. Seddon, of the Missouri River Commission, presented a paper on resistance to flow in hydraulics, in which the point was made that relatively a small part of this resistance, so far as open streams were concerned, was directly attributable to friction against the bottom and limiting banks, but that the resistance was found acting between accelerations and impacts, and showed in forced distortions of the free surface, from which forms the energy passed into internal motion.

WE learn from *Science* that the State Legislature of Vermont has passed an Act providing for the equipment and maintenance of a State laboratory, which shall include in its work "the chemical and bacteriological examination of water-supplies, milk and all food-products, and the examination of cases, and suspected cases, of diphtheria, typhoid fever, tuberculosis, malaria, and other infectious and contagious diseases." The sum of 1000*l*. has been granted for the establishment of the laboratory, and 1600*l*. per year voted for current expenses. Dr. J. H. Linsley is director of the laboratory. It appears that only three States have established similar laboratories—Michigan, Massachusetts and New York.

WE have received from Prof. B. Sresnevsky, director of the Iouriev (Dorpat) Observatory, the twelfth yearly report upon the rainfall of the Baltic provinces of Esthonia and Livonia. The observations refer to the year 1897, and contain monthly and yearly values, and the number of rainy days, for 125 stations, and the same values are also grouped into districts. Although not stated in the title, the work also contains temperature observations made at 8 a.m., and these are treated in the same way as the rainfall values. The ten-yearly mean of rainfall for the whole district is 21·9 inches, and the average number of rainy days is 162. The driest month is January, and the wettest, July. The general mean of the yearly temperature (for 8 a.m.) is 39°·4 (January 18°·5, July 62°·2). The results have been prepared by Dr. A. von Oettingen, formerly director of the Dorpat Observatory, and we are glad to see that, as soon as values for fifteen years have been obtained, it is proposed to issue a general summary, with diagrams.

THE Pilot Chart of the North Atlantic Ocean, published by the Hydrographer of the U.S. Navy for November, gives some interesting details of the track followed by the recent destructive hurricane in the West Indies. The centre of the storm passed to the southward of Barbados at 9h. 30m. p.m. on September 10; and reached Kingstown, St. Vincent, at noon on the 11th. From St. Vincent, the hurricane moved north-westward at the low rate of six miles per hour, and gales were experienced within a radius of 75 miles from its centre. On the 12th and 13th it was central to the west of the Lesser Antilles, turning to the northward on the latter date. On the 14th it continued its north-westerly course, recurving to the north-east on the 17th, near latitude 30° N. and longitude 71° W. The British steamship *Irrawaddy*, from port of Spain to New York, encountered the hurricane on the 11th, and kept within the storm area until the 18th; she had strong winds to gales of hurricane force throughout this period. On the 18th and 19th the storm pursued a north-easterly course, moving at the rate of twenty-five to thirty miles an hour, its area being increased considerably. The last report received by the U.S. Office was from the British steamship *Hesperia*. She reports, latitude 42° N., longitude 42° W., on September 20: "Winds S.S.W., force 10, shifting N.W., lowest barometer 29·62 inches; squalls blowing with terrific force; sea at times mountainous." The storm seems to have followed a somewhat more northerly and seaward course than the average track for September, as calculated by Padre Viñes in his investigation of the general movements of West Indian hurricanes, published by the Weather Bureau of Washington.

THE next volume of the *Transactions* of the Woolhope Field Club will contain a valuable paper (of which some copies have been printed) on the Hereford earthquake of December 17, 1896. The paper is the joint work of Mr. H. Cecil Moore, the Secretary of the Club, Mr. R. Clarke and Mr. A. Watkins, and gives the results of careful inquiries made in the central county of Herefordshire with regard to the damage caused by the earthquake. In the city of Hereford alone, it appears that 218 chimneys had to be rebuilt; but in the parish of Fownhope the damage was relatively greater, for twenty-two chimneys were repaired or rebuilt. The authors remark that a circle of six miles radius, with its centre at the centre of the ancient upheaval of the Woolhope Valley, includes by far the greatest damage in the county. The paper is illustrated by two plates, one showing the fractures in several pinnacles of Hereford Cathedral and other churches; the second being a map of the county, on which are marked the places where buildings were damaged.

THE Geological Survey of England and Wales has lately published short explanations of the new series maps relating to the country around Bognor and Bournemouth, by Mr. Clement Reid. We are now able to call attention to another explanation relating to Eastbourne, by the same author, and printed for H.M. Stationery Office, price 6*d*. It contains a general account of the geology of this favourite residential district, which includes not only Eastbourne, but also Newhaven and Seaford. The strata comprise the Cretaceous rocks from the Weald Clay to the Upper Chalk, the Lower Eocene strata, and superficial Drifts. Illustrations are given of the characteristic fossils. Mr. Reid calls attention to certain disturbances seen on the foreshore near Beachy Head, and a study of these leads him to conclude that the Chalk of the South Downs, unlike that of the North Downs, is not connected across the Channel with France.

Brief notes on water supply and economics are also given in this little pamphlet.

AMONG noteworthy acquisitions by purchase referred to in the Report of the Trustees of the Australian Museum, which has just come to hand, is the Mount Stirling meteorite, a mass of meteoritic iron weighing more than 200 lbs., found in Western Australia; a valuable collection of opalised reptilian remains, including the remains of the Mesozoic reptile *Cimolisaurus leucoscopelus*; a specimen of the very rare Golden-winged Parakeet (*Psephotus chrysopterygius*) from Port Darwin, only three examples of which are believed to be known; and some eggs of the Jabiru (*Xenorhynchus asiaticus*). The total number of acquisitions was 11,099, of which 7379 were presentations, 1455 were exchanges, 277 were purchases, and 1888 were collected by members of the staff. Sir William MacGregor contributed nearly one thousand ethnological specimens from his New Guinea Collection. The curator, Mr. R. Etheridge, jun., points out that the museum staff needs a trained collector. At present the funds at the disposal of the Trustees will not permit of such an appointment being made, which is regretted because museums and institutions in other countries send collectors to Australia and take away the best specimens.

FOREST resources are receiving increased attention in many places. A short time ago we recorded the establishment of the New York State College of Forestry for the professional education of the managers of the forests of the State. A report on the forestry conditions of Northern Wisconsin, containing the results of an investigation carried out by Mr. Fillibert Roth, has now been published by the Wisconsin Geological and Natural History Survey. As in many other cases, the forests of the State are shown to have been treated destructively. The wooded area is steadily being reduced, and at present nothing is done to protect or re-stock the "cut-over" lands, which are now unproductive waste land. Mr. Roth estimates that this policy causes a loss of 800 million cubic feet of wood per year to the State, besides driving from the State the industries which have been most conspicuous in its development, depriving a cold country of a valuable factor in its climatic conditions, and affecting detrimentally the character of the main drainage channels of the State. It is hoped that the report will aid in the formulation of rational forestry legislation, and so help to develop and restore the great forest resources of the State of Wisconsin.

MANY items of interest are contained in Mr. Edgar Thurston's report on the Madras Government Museum for the year 1897–98. How much appreciated the museum is may be judged by the fact that as many as 47,260 visitors have been admitted on a single day. The proportion of those able to sign their names to that of those unable to do so was about 1 : 6 on week days and 1 : 3 on Sundays. This is satisfactory as showing that Sunday opening continues to appeal to the educated classes, who are prevented by business from visiting the museum on week-days. Dr. A. G. Bourne made three tours during the year, viz. to the South Arcot district, the Palni, and the Shevaroy Hills. They were all undertaken with the view of filling gaps in the herbarium, and continuing the botanical survey. Particulars with reference to these expeditions, and the numerous specimens collected, are given in appendices to Mr. Thurston's report.

SOME remarks upon the practicability of destroying prickly-pear (*Opuntia Dillenii*) by means of the cochineal insect, are made by Dr. Bourne in an appendix to the report referred to in the foregoing note. Dr. Bourne points out that the historical evidence weighs entirely against the practicability of destroying prickly-pear by the cochineal insect. There seems to be no doubt but that the cochineal insects and the cacti are all introductions, and the net result has been that the yellow-flowered cactus has thoroughly naturalised itself, while the cochineal insect has just managed to struggle on here and there. There is evidence that cochineal insects were introduced five times between 1795 and 1883, with a view to the establishment of the cochineal industry in the country. In 1807 Government offered a reward of 2000*l.* for its successful introduction. It never became thoroughly established. It was, however, possible that, although a fine variety of the insect best for industrial purposes would not flourish, a wilder variety might become more or less naturalised. This has occurred to a small extent, and the idea of utilising this to destroy prickly-pear has been from time to time put forward. Dr. Bourne's investigations, however, show that it is impracticable to destroy prickly-pear by the so-called "wild" variety of the cochineal insect; and even if the scheme were practicable, he doubts the advisability of encouraging the development of an insect which might eventually become an infinitely greater pest than the prickly-pear.

A CATALOGUE and price list of the papers of the late Prof. E. D. Cope, arranged chronologically, with a price list of plaster casts, has been issued by Mrs. Cope, Haverford, Pennsylvania, U.S.A., who offers the papers and casts for sale.

TWENTY-FIVE papers on diseases of children will be found in the ninth volume of *Transactions* of the American Pediatric Society, edited by Dr. Floyd M. Crandall, and just published. The address of the president, Dr. Samuel S. Adams, deals with the evolution of pediatric literature in the United States.

A NEW edition of Babington's "Manual of British Botany" is in preparation by Messrs. H. and J. Groves. The first edition of this work was published in 1843; the eighth in 1881. It is hoped that the forthcoming edition—the ninth—for which the late author had accumulated many notes, may be ready early in next year.

DR. F. KRANTZ has issued a good catalogue (printed in German, French, and English) of minerals and geological specimens which he has in stock at the Rheinisches Mineralien-Contor, in Bonn. The catalogue contains particulars as to many collections of minerals arranged for purposes of instruction, and also for use with specified text-books of mineralogy. Lists of instruments and appliances used in the examination of minerals are also included.

THE additions to the Zoological Society's Gardens during the past week include two Red-sided Eclectus (*Eclectus pectoralis*, ♂ ♂) from New Guinea, presented by the Chevalier Angelo Luzzati; two Undulated Grass Parrakeets (*Melopsittacus undulatus*, ♂ ♀) from Australia, presented by Mr. A. J. Finch; a Booted Eagle (*Niseatus pennatus*) from Southern Spain, presented by Captain T. E. Marshall, R.A.; two Tawny Owls (*Syrnium aluco*), British, presented by Mrs. Borrer; a Red-fronted Amazon (*Chrysotis vittata*) from Porto Rico, presented by Mr. G. A. Phillips; a Cereopsis Goose (*Cereopsis novae-hollandiae*) from Australia, presented by Sir Cuthbert Peek, Bart.; two Gold Pheasants (*Thaumalea picta*, ♂ ♀) from China, presented by Mr. W. A. Upton; two Red-bellied Wallabys (*Macropus billardieri*, ♂ ♀) from Tasmania, presented by Major C. J. Urquhart; a Red and Yellow Macaw (*Ara chloroptera*), a Blue and Yellow Macaw (*Ara ararauna*) from South America, presented by Mr. W. Murray Guthrie; two Vulpine Squirrels (*Sciurus vulpinus*, ♂ ♀) from North America, a Slaty-headed Parrakeet (*Palaeornis schisticeps*) from Northern India, deposited; a Hyacinthine Macaw (*Anadorhynchus hyacinthinus*) from Northern Brazil, a Hobby (*Falco subbuteo*) from Holland, purchased.

OUR ASTRONOMICAL COLUMN.

THE ANDROMEDES.—As regards the return of the Andromedes, there is every reason to believe that by this time the shower will have passed by the earth's orbit. Brilliant displays were observed in 1872 and 1885, on November 27 in each year; and it would naturally be inferred that on the same day of the present year, which corresponds to an equal interval of time, a like occurrence should take place In 1892, however, the earth passed through this stream on November 23, and it has been computed that this recession of the node was caused by the perturbations of Jupiter, which were responsible for this difference of four days. If the observations made on the 23rd have indicated that this date is somewhat too early, observers should be careful to watch on the following nights, for, after all, the exact time of reappearance cannot be definitely foretold. The radiant point of this shower is in Andromeda ($25^\circ + 43^\circ$), and, therefore, at this time of the year at a great altitude. Unlike the Leonids they move slowly, as they have to overtake the earth in her movement round the sun.

A close watch on the night of the 22nd was kept at the Solar Physics Observatory, South Kensington; but the usual fog made its appearance at about 9 p.m., and became thicker towards midnight. Altogether *three* meteors were seen between 8.30 p.m. and 12.15 a.m., but none of these were Andromedes.

THE PLANET JUPITER.—The markings on Jupiter, which are involved in the dense atmosphere around him, have been subjected to minute observations for many years, and it is now that we are beginning to learn something of the circulation in operation on that planet. That the atmosphere does not rotate homogeneously has for many years been known, and the movement of the great red spot may be given as an instance of this irregularity. Mr. Stanley Williams, a faithful observer of Jupiter, showed clearly in 1888 that there existed a swift southern current which extended from latitude -37° to -55°. In a more recent communication (*Astr. Nach.*, No. 3528) he has published the results of observations of two southern spots within this zone which were visible, one in 1890 and the other two years later. The object of these observations was to investigate whether such a current is a permanent feature of the planet or not, and to trace from year to year the variations that may occur in the velocity of its motion.

Without entering into the details which are given in his article, we will limit ourselves simply to his results. The following table shows the periods of rotation obtained, the first being an observation by Prof. C. A. Young in 1886 of a small white spot in latitude 50° south.

Year.	Limit of lat.	Rot. period. h.	m.	s.
1886	-50°	9	55	11·1
1888	-37° to -55°			0·9
1890	-36° to -45°			6·7
1892	-32° to -39°			8·4

A glance at the figures in the last column shows that this southern current is not only a permanent feature of the planet, but that its velocity is not constant. As regards the limit of the zone in which this current exists, we are told that the current may extend further southwards, and perhaps even to the pole itself.

We hope that Mr. Stanley Williams will continue his observations in this region, and settle this question of limit, which is important in the light of the general atmospheric circulation of this planet.

THE PERSEIDS OF 1898.—In August last the weather was so favourable that at a great number of places observations of the Perseids were successfully made. A not unimportant feature of the display was the large number of meteors that did not radiate from Perseus at all, and this fact is very clearly brought out in the description and chart of the observations made by Messrs. Vacca and Senouque on the nights of the 10th to the 16th (*Bull. Soc. Astronomique de France* for November). It must be mentioned that at Paris, where these observations were made, the night of the 10th was not very clear; so the majority of the observations were made on the following nights.

An examination of the diagram shows several distinct radiant points, not only in Perseus, but in Cassiopeia, Cygnus, and the Great Bear.

Another set of interesting observations, made by M. Fournier, is published in the same journal, and contains also a reproduction of a chart, showing the trails recorded. This, however, is restricted to the night of the 10th, which was beautifully clear at the place of observation, and the chief radiant point deduced is well defined near η Persei. Out of sixty meteors observed, thirty-nine were Perseids, five or six sporadic, and some others apparently radiating from Cassiopeia.

ASTRONOMICAL SOCIETY OF WALES.—The last two monthly numbers of this Society's publication, the *Cambrian Natural Observer*, show that interest in astronomical phenomena is by no means at a low ebb, but rather verging on a spring tide. The October number contains some interesting notes about Gruithuisen, who was for some time editor of the *Jahrbuch*. His great speciality was a study of the lunar features; and although ridiculed, he was nevertheless "an assiduous and careful observer." Mr. Denning contributes some notes on meteoric fireballs, and describes how observations should be recorded. He gives, also, the right and the wrong way of recording them, or rather, we should say, the useful and the useless, from published examples, and we cannot help quoting them as guides to future recorders.

"On June 10, 1891, I saw a beautiful phenomenon. Suddenly at the zenith, east of the Great Bear, shone forth a yellow globe like Venus at her brightest. Dropping, somewhat slowly, it fell obliquely southwards. As it passed in its brilliant career, it lighted up its dusky path with a glorious lustre. When it had descended about half-way down towards the horizon, it burst into a sparkling host of glorious fragments, each dazzlingly shot over with all the hues of the rainbow."

The useful record was as follows:—

Date and time.—1892 December 12, 11h. 22m. G.M.T.

Object.—Fine meteor, nearly = Jupiter.

Path.—$55^\circ + 41^\circ$ to $45^\circ + 20^\circ$; length 22°.

Duration of flight.—1·2 seconds.

Colour.—Bluish-white.

Appearance.—Brightest in latter portion of its path, where it left a white streak for about one second.

Probable radiant.—ϵ Ursae Majoris.

The November number is especially a "meteor" number, and contains information on the observation of these bodies by Denning, Johnstone Stoney, Carslake Thompson, &c.

PHOTOGRAPHIC PLATES AND THE SPECTRUM.—In laboratories and observatories where a study is made of gaseous and metallic spectra by the aid of photography, it is important to make use of the differences between the sensitiveness of the numerous photographic plates which are obtainable. For that particular part of the spectrum which may be under investigation, it is always desirable to employ the greatest photographic action possible, and this can only be done by preparing plates which are most sensitive to this region. A very interesting comparison of the sensitiveness of various plates for the different regions in the spectrum is given by Mr. E. Sanger Shepherd (*Journal of the Camera Club*, vol. xii. No. 150), in an article on the photographic reproduction of paintings; and curves are added, showing clearly how each of the plates behave.

Comparing the Cadet spectrum plate and the Ilford chromatic plate, the former gives action beyond the D line, whereas the latter ceases at the D line; there is very little red sensitiveness, which is perhaps the worst feature of the plate, and there is a gap in the green. Lumière's panchromatic plate has extreme red sensitiveness; but except for a small gap, in the green it is sensitive all through the spectrum. In Lumière's "B" plate the sensitiveness in the red is very considerable and more extensive than in the plate preceding, but there is a very long gap in the green. Edward's snap-shot isochromatic plates have considerable sensitiveness in the green and yellow, and a little less in the red; the curve is here much smoother, and not subject to such great changes.

In the Cadet lightning spectrum plate we have extreme sensitiveness from the blue to the yellow, and yet sufficient red sensitiveness for many purposes. Considering the whole spectrum, it seems to be the best plate for uniformity throughout, and the small gap in the extreme red makes it possible to use a considerable amount of light for developing.

Although it is not absolutely necessary, it is always more convenient to develop in a room lighted sufficiently to see how the image appears. Many photographers do not pay sufficient attention to the purity and colour of light that is admitted. The gaps in the sensitive curves point out clearly those rays which have least action on the plate, and which should therefore be used as light filters. Thus for Lumière's "B" plates we must have a bright chromium green, a deep pot-green glass, together with aurantia; while for Lumière's "A," we should use a red light consisting, for instance, of aurantia, naphthol yellow and fuchsin films. For Thomas's plates a faint green or a fairly bright red glass with a strong tint of aurantia dye might be employed. Edward's snap-shot isochromatic and rapid spectrum plates require the quality of the filter light to be very pure.

THE CHEMICAL SOCIETY'S BANQUET TO PAST-PRESIDENTS.

REFERENCE has already been made to the banquet given on November 11 to Sir J. Henry Gilbert, Sir Edward Frankland, K.C.B., Prof. W. Odling, Sir Frederick Abel, Bart., K.C.B., Prof. A. W. Williamson, and Dr. J. H. Gladstone, Past-Presidents of the Chemical Society, who have been Fellows of the Society for fifty years or more. The idea of expressing in this way the high regard in which men of science hold the work of these distinguished chemists was an excellent one, and it was well carried out. The large number of congratulatory telegrams and communications received on the day of the banquet from every country where the science of chemistry is cultivated showed that the whole civilised world was in sympathy with the object of the banquet. Communications were received from France, Holland, Belgium, Germany, Sweden, Russia, Austria, the United States, and several other countries. Prof. Friedel wrote: "I should have been happy to associate myself with the Chemical Society in doing honour to these veterans of science. I have the honour to be the friend of most of them, and the beneficent action they have exerted on Chemical Science cannot be esteemed too highly. They form the finest phalanx of the Fathers of our science which exists in any country. With these sentiments you will understand the liveliness of my regret to be able to take part from afar and in spirit only in the honour paid them." At a meeting of the Russian Chemical Society the following was passed: "That the Society avail itself of the exceptional opportunity of being able to congratulate conjointly Sir Joseph Henry Gilbert, Sir Edward Frankland, Prof. Odling, Sir F. A. Abel, Dr. A. W. Williamson, and Dr. J. H. Gladstone, whose distinguished services during half a century stand out as a model for all investigators in chemical science, and also express the wish to see the further results of their labours in the annals of science for many years to come." A telegram from the German Chemical Society contained the message: "The sister Society sends both Jubilee congratulations and greetings to the Jubilee celebration of the Presidents of the Chemical Society, Gilbert, Frankland, Odling, Abel, Williamson, and Gladstone." These messages show that the distinguished men to whom the banquet was offered are held in the highest esteem in all places where chemical studies are carried on.

We regret that the limitations of space will not permit us to print the speech in which the President, Prof. Dewar, who occupied the chair at the banquet, alluded to the work of the six Past-Presidents, nor can we find room for any speeches other than those in which these distinguished men replied to the toast in their honour.

Sir J. Henry Gilbert said:—"After the extremely flattering and eloquent terms in which our President has referred to the work of the six Past-Presidents of the Society who are so highly honoured to-night, it is surely a difficult task to say anything in response. I feel that any words of mine would be entirely inadequate; and I must, I think, fall back on what I was intending to say, and give a little personal history of the early times of the Society. You are aware, most of you, that I am to-night in the position of the senior of the Past-Presidents, in consequence of the death of Lord Playfair. He was, as you know, one of the founders of the Society, and, before he died, the only survivor of those founders. I myself came in within three months of the foundation, and so had some knowledge of the Society's early doings. In fact, before I was really admitted to the Society, under the influence of the late Professor Graham, I undertook the translation of a paper by Redtenbacher and Liebig on 'The Atomic Weight of Carbon,' and that paper occupies eighteen pages in the first volume of the Society's 'Memoirs.' I should say that, less than a fortnight ago, I eceived a letter from Lady Playfair, just before she left to visit her friends in America, in which she said with what interest he had looked forward to being present at the banquet appointed for June—but that was not to be. I first made the acquaintance of Playfair in Liebig's Laboratory at Giessen, the year before the establishment of this Society, that is, in 1840. Playfair was at that time very busily occupied in translating the memorable work of Liebig, 'Organic Chemistry in its Applications to Agriculture and Physiology'; and before the session was over he left for this country with Liebig, who was to present the substance of that work as a report to the British Association at Glasgow in September. You may be interested to know who there were from this country in Liebig's laboratory at that time. Besides Playfair and myself, there were Dr. William Allen Miller, afterwards professor of chemistry at King's College; Dr. Stenhouse, who has contributed so much to the *Journal* of this Society; Dr. Angus Smith; and, lastly, Dr. Edward Schunck. He and I are, I believe, the only survivors of that time among those from England who were with Liebig then. Of the Germans who were there, some of the names you will probably remember. There were Heinrich Will, Varrentrapp, Redtenbacher, Hermann Kopp, Scherer, Bromeis, Boeckmann, and others, of various nationalities; but I believe that not one of these survives at present. Schunck joined the Society early in 1842, and he from that time to this has devoted himself to scientific investigation. He built a laboratory, and a museum devoted especially to specimens of organic bodies, in his own grounds on the other side of Manchester, where he still lives. He was, in fact, the oldest member of the Society, I believe, except Playfair and myself. He has worked indefatigably ever since; but I am very sorry to say he is not able to be here to-night, having had an attack of bronchitis, which renders it impossible, though it would have given him great pleasure to be present. Referring to that time at Giessen, I may say that Playfair, Stenhouse, and myself, each took our degree then; and Playfair, though joining with us, having gone with Liebig, the responsibility was left with Stenhouse and myself to give the usual supper to the other students of the laboratory, and a few distinguished guests, among whom was Bunsen, who was then at Marburg; and who, I am glad to learn from Sir Henry Roscoe, is still well. Stenhouse was much my senior. We had a large and lively party, but Stenhouse did not enjoy that sort of thing very much, and when the last bottle of champagne was opened, he said: 'Now, Gilbert, I shall leave you to it,' and away he went. That was, however, not near the end of the evening. They stayed a very long time, and we did not exchange the smoky atmosphere of the supper-room for the clearer air outside until early morning. We then went round the boulevards of the little town, the Germans singing students' songs, and coming in time to the hotel where Stenhouse lodged, we serenaded him from the outside. Then some one tried the door, and finding it unfastened, the whole party went up, lighted candles, and serenaded him in bed. Next morning there was a very capital caricature brought out, showing Stenhouse's rather long nose pointing in one direction, and his longer nightcap in the other. But this is enough of this kind of history, and I must now turn to rather more serious matters. It was in 1843 that I became associated with Mr. (now Sir John) Lawes in agricultural investigation—a collaboration which has now extended over more than fifty-five years. As you all know, however rude may be some of the methods of the art of agriculture, the investigation of the principles underlying its practices involves a wide range of scientific inquiry. It involves the chemistry of the atmosphere, of the soil, of vegetation, and of animal life and growth. That is to say, besides chemistry, it involves meteorology, botany, vegetable physiology, and animal physiology, to some extent. It is impossible to be a specialist in so many subjects, particularly in these days, and I can only say that in venturing to deal with these other branches of science we have taken great care to avoid mistakes. The wide range of the investigations must be accepted as some explanation of the fact that we have not contributed more of the results to the Chemical Society. Many of them being connected largely with other branches of science, have been recorded in other than purely chemical journals; whilst those having a more directly practical bearing have been published in the *Journal* of the Royal Agricultural Society, or in other agricultural publications—the Rothamsted papers now numbering considerably more than 100. But we feel that, however long or short may be the time that we shall still work together, we shall perhaps have done as much in opening up as in solving problems; and that we shall certainly leave plenty for our successors to do. In conclusion, considering that there still remain five of your honoured guests to speak, this is all I will say of my own career, and I will only now ask you, Mr. President, the Council, and the Fellows of the Chemical Society, to believe that I esteem very highly the great honour you have conferred upon me to-night."

Sir Edward Frankland—"Allow me to thank you, Mr. President, and the Council of the Chemical Society for this delightful entertainment which you have prepared for the Past-Presidents who have attained Jubilee rank. It was a generous, unique, and happy idea, which I feel sure we all heartily appreciate, not only as we sit at your hospitable board, but also when we reflect on the kind feelings which led to the conception of that idea. There used to be a phrenological organ entitled 'love of approbation,' and whether there is or is not a part of the brain told off to perform this function, I trust that chemists are not behind the rest of humanity in appreciating such an honour as you have conferred upon us on this auspicious occasion. Nothing could be more agreeable than thus meeting so many colleagues who are worthily keeping up the high reputation of the Chemical Society. There is but one drawback to our enjoyment, and it has been very feelingly alluded to by Sir Henry Gilbert, namely, that one who so recently stood at the head of our Past-Presidents should not still be present amongst us. In the lamented death of Lord Playfair, chemistry and science generally have sustained an immeasurable loss; for he was a binding link between science and the State, always ready to fight for the cause of truth against prejudice and ignorance, and never ceasing in his efforts to bring home to our rulers the vast importance of the applications of science to the progress, health and prosperity of the nation. As one of his first pupils, and after a life-long friendship, I may be permitted to testify that his energy in this cause was prompted by sincere convictions and not by political exigencies. Had Playfair lived a few months longer, we should never have had the misfortune to make the acquaintance of that new variety of *Homo sapiens* the 'conscientious objector,' who is just now giving so much trouble to our magistrates. This is not a time to sketch, even in merest outline, the epoch-making work of the Society, but I may at least state my conviction that it will be found, on comparing the volumes of our *Transactions* with those of the corresponding societies of other lands, that, considering the number of workers in each case, England is not behind any other nation in research work, and this in spite of the almost total absence of that lavish State aid which nearly every other civilised nation enjoys. In view of the vast number of discoveries pouring out from chemical laboratories, I hear it suggested that the day is not far distant when there will be nothing left to discover, when all the elements in the cosmos shall have been captured and fitted into the periodic system of Newlands and Mendeléeff, when there is not one more gas in the atmosphere left to be detected, and every element and group of elements shall have its ortho-, para-, and meta-position assigned to it. What will then remain to be done? Fortunately for investigators, we shall still be only as children gathering pebbles on the shore of the great ocean of knowledge. As yet we have only found the big boulders. To change the metaphor, chemistry now occupies the position of geography a century ago. The enormous number of chemical compounds are like so many islands, their latitude and longitude ascertained with precision, but on which the foot of man has not been put down, whilst their animals, plants, and minerals have never been exploited. When the ideal state of knowledge has been attained, chemists will perhaps find time to explore this vast archipelago, in which, there is no doubt, many interesting discoveries await those who shall undertake the task. Who can set a limit to the usefulness of these explorations? Even the most unpromising compounds may turn out valuable prizes! When aniline, chloroform, and carbolic acid were discovered, who could have predicted the revolutions in the arts and surgery which these bodies were destined to produce! They were but as desert islands until they attracted the attention of Hofmann, Perkin, James Simpson, and Lister. As chemists, I believe we have a noble future before us. Chemistry is distinguished from all other branches of knowledge as the helpmate of nearly every other science. The geologist, the botanist, and the physiologist find no thoroughfare unless they call in the help of the chemist. As soon as the physicist breaks into a molecule, he is trespassing on our domain. The bacteriologist has found that it is not the waggling of the tail of a pathogenic microbe that is the most important feature of its history, but that the chemical compounds which it secretes demand his closest attention. Even the astronomer has already to sit at the feet of the chemist! Thirty-three years ago, when our worthy President was but a youth, there was once a dinner party composed chiefly of chemists held at the 'Albion.' A few are still living—among them being Sir F. Abel, Prof. Odling, and myself. In an after-dinner speech on that occasion, my friend Abel is reported to have expressed himself in blank verse as follows (I hope he will forgive me, at this distance of time, for appropriating his words to my own use):

"'Looking to right and to left, I see many faces around me,
Faces so old and familiar I feel once again at the College,
Testing, as in former times, for chlorine with nitrate of silver,
Gazing with youthful delight at crystals just hatched in a beaker,
Yearning o'er aniline drops distilling from crystal alembic.
O! my dear friends, one and all, we have toiled up a difficult pathway!
Some are low down on the hill, and others are near to the summit.
Let us remember the past and forget not our absent companions;
Fortune may come to us all; but youth will return to us never!'"

Prof. Odling:—"I do not know that I can better commence the few observations I propose to make to you than by following in the wake of my predecessor, Sir Edward Frankland, and saying that it is no less a great pleasure than my bounden duty to express to you, Mr. President, and to the Council and Fellows of the Society, my heartfelt thanks for the great compliment that you have paid to my colleagues and myself on this long-to-be-remembered occasion. Speaking, however, for myself personally, it is not the first time that I have had evidenced to me the kindly feeling of the Chemical Society. On the occasion of my retirement from the Secretaryship in 1869, I had also the special honour done me of being entertained at a dinner by the Society; and I also received a further token of their goodwill in the form of a capacious loving cup of no inconsiderable value in itself, but of far greater value as a perpetual mark of the kind feeling towards me of those with whom I had been for so many years so intimately connected. Those of us whom you entertain this evening have for a long period of time, as Sir Henry Gilbert and Sir Edward Frankland have already remarked, been associated with one another in common pursuits and enjoyments; and if there is one thing more than another that enhances to me the gratification of this meeting, it is the pleasure of finding myself associated still with my old friends and colleagues, Gilbert and Frankland and Williamson and Gladstone, and my earliest friend of all, Sir Frederick Abel. We have been concerned with one another in a large number of undertakings, and for a long period of time have been accustomed to hear one another's voices as well upon festive as upon scientific occasions. But we have not been accustomed to hear them in exactly the order they have been arranged for this evening. I have always looked upon myself, not as a precursor, but as a follower of Williamson. It has been my pride to reckon myself one of his adopted pupils—a disciple of his ideas more perhaps than many of those who were his actual pupils. He was always very decided in his notions. Sometimes, indeed, I turned a little restive, but was always soon pulled up into form again—sometimes more abruptly, perhaps, than was quite agreeable at the moment. At one time I laboured under the sad suspicion of being a little unsound as to the Atomic Theory. Well, perhaps I was not altogether so stalwart in its defence as I ought to have been; but I can assure you that I was never really guilty of so reprehensible a heresy as that which was attributed to me.

"You are doing us honour here this evening not so much, or not only, as students of the science of chemistry, but also as Past-Presidents of the Chemical Society. As ancients of that Society, we may all of us perhaps be permitted to talk a little about ourselves without incurring the imputation of egoism, and also to talk a little about old times without incurring the reproach, after our fifty years' fellowship, of senile garrulity. At the period during which I acted as one of the Secretaries of the Society, and my colleague, Prof. Redwood, concerned himself mostly with the business department of our affairs, the Chemical Society had not developed very far its function as a publishing agency, and as a consequence, even for that little prolific time, we did not get our fair share of important papers communicated at first hand to our meetings. But if we did not receive elaborate communications, we enjoyed the benefit of elaborate discussions; and there was no new class of compounds, no newly propounded doctrine, no new reaction which was not submitted to our keen examination and controversy. The subjects of several of those controversies, and even the fashion of them, still linger in one's memory. I need scarcely say that chemical theory came in for a large share of our attention. The molecular weights of water and carbonic acid, the atomic weights of oxygen and carbon, and, above all, the then newly introduced idea of polyatomic radicles, were keenly discussed. We were a little too late for the interesting question as to whether compound radicles could possibly be oxygenous; but still, radicles were predominant at that time in chemical science, and reigned with undisputed sway over the whole domain of organic chemistry. One cannot but reflect how fleeting has been their reign. The doctrine of radicles has now sunk to an entirely subordinate position in chemistry, not unlike, may I venture to say, the subordinate position into which radical doctrines have fallen in a different sphere. There was one particular controversy I remember very well, and am sure Frankland will remember also. It was of this kind: whether the bodies called ethyl and methyl were really ethyl and methyl at all, or something else. Well, a question of that kind in those unsophisticated days had to be answered definitely by a plain aye or no. There was no loophole for escape or trimming, no possibility of saying that the one answer was just as true as the other, according to the point of view taken; nor was there existent in that period of innocence, for the solution of yet more puzzling problems, what we know now by the name of tautomerism, by which we learn that a body is, and at the same time is not, what it is alleged to be; that it is sometimes one thing and sometimes another, and sometimes both together, and yet preserves its individual chemical entity. In those days the principal provider of chemical material for our meetings was far and away Hofmann. He was in the habit of sending his multitudinous papers to the Royal Society for publication; but he gave us the advantage of his presence and his personal disquisitions; and I would appeal to all in this room who had the advantage of seeing him to say if they can possibly forget his appearances at the blackboard of the Chemical Society, and the enthusiasm and lucidity of his expositions of different points of chemical constitution, enlivened as they were by that extraordinary display of vivacity so inconsistent with the quiet phlegm we are in the habit of attributing to those of his nationality. But, despite the productiveness of Hofmann, still there were evenings on which something else was required; and then it behoved the Secretary to search far and wide for material to bring before the meeting of chemists who, with Greek-like avidity, were always clamorous for 'some new thing.' At that period the activity of the Giessen school was somewhat on the decline, and we looked for novelties in chemistry, as for novelties in mantles and millinery, to Paris. We had for our consideration the acidic ammonias of Gerhardt and the diatomic glycols of Wurtz, and the production of alcohol without the aid of either sugar or yeast, by Berthelot; and many other remarkable contributions to the knowledge of the day. But our friends across the water, with so much—so very much—justly due to them, nevertheless did manifest now and then a tendency to appropriate to themselves what did not altogether belong to them; and in this the country of Black and Priestley and Cavendish and Dalton and Davy, we were astonished one fine morning at being informed that 'la Chimie est une science française.' But even with the productiveness of Hofmann and the searchings of the Secretary, it did sometimes happen that our bill of fare was a little meagre. But what of that? Those were supper-eating days, and a meeting rendered brief by want of pabulum could always be supplemented by a prolonged and substantial, and, I may add, a musical, meal at a then well-known resort not far from Covent Garden; and when it happened, as it did sometimes, that our proceedings were not so exhilarating as they should have been, when divine philosophy had proved less charming than its wont, Hofmann, despite the abundant supply of tea and coffee of excellent quality, would, with a burst of inspiration, thrust forth his right hand and say: 'I will tell you, we will have a punch!

"But the Chemical Society has a future to look forward to, as well as a past to look back upon. At the Jubilee of the Society some seven or eight years ago, it devolved upon me to give an account within the short period of a quarter of an hour—I believe I occupied twenty minutes—of the progress of chemical science during the preceding fifty years. But to-day is also a Jubilee or almost so, the Jubilee of our incorporation by Royal Charter, which, in the then days of our insignificance, Playfair did so much to obtain for us. Now, on this diamond Jubilee, I ask you how many minutes will you give me to lay before you a forecast of the chemical progress that may be expected to take place within the next fifty years? I will only venture to say that, judging by the number and activity and intellectual gifts of the workers of the present day, we may feel assured that the achievements of English chemistry and the progress of the Chemical Society in the past will be as a mere nothing to the brilliancy which they will attain to in the future."

Sir Frederick Abel—"Sir Edward Frankland has out of his vast stores of knowledge recalled a fact of which I confess I was ignorant, that in years past I indulged a poetic fancy. I only wish I might now be inspired in order to find words to express on behalf of myself and my old friends our appreciation of this glorious reception which you have given us. The Chemical Society is endeared to me in many ways. Among the epochs of a somewhat long career of ceaseless activity, that which connected me intimately with the work of the Society is one of those which I recall with the greatest pleasure and satisfaction. And it so happens that the years of my connection with the Society in various functions were years in which some of the most memorable events in its annals occurred. As Treasurer, it was my privilege to arrange with the illustrious chemist and brilliant orator, Jean Baptiste Dumas, for the delivery of the first of those memorable lectures which were given through the agency of the Chemical Society in honour of the memory of Michael Faraday. While I was Treasurer, the volume of the *Journal* of the Society, which was then of modest and slender dimensions, nurtured by well digested extracts from foreign journals, speedily gained proportions unwieldy in character, so unwieldy, in fact, that the one volume split up into two before long. In the first year of my Presidency, the Research Fund, which was initiated in a modest manner by Mr. Thomas Hyde Hills, was placed upon a firm and substantial basis through the generosity of one of the most respected of the Society's original members, Dr. Longstaff; and in the second year in which I held that office, the somewhat revolutionary agitation which was persisted in by a not unimportant section of the younger Fellows of the Society, an agitation which, by the way, has been imitated since—led to earnest deliberation and consultation between the Council and some of its chosen members outside the Council, which resulted in the birth of an institution now flourishing exceedingly, which has become the guardian of the best interests not only of the chemical profession but also of the public. I of course allude to the Institute of Chemistry of Great Britain and Ireland. When I look back to the early days when I first owned the proud title of F.C.S., and remember my attendance, in a small room at the Society of Arts, at the meetings of the Chemical Society, presided over in succession by William Brande and Phillips, the business being managed by George Fownes and Robert Warington, the founder of the Chemical Society, and the funds not very cleverly handled by dear old Robert Porrett, one of the most prominent forms that appears in my mind's eye is that of the favourite pupil of Liebig, my venerated master, Hofmann. In the very first years of the Society, Hofmann became the very life and soul of it. He was beloved by his English brethren directly he came among them, and for years he was by far the most prolific contributor, either himself or through his pupils, to the volumes of the Society. Pardon me if I have been tempted into reminiscences; it is difficult to avoid it at such a gathering as this. The welcome you have given to the veteran Past-Presidents will remain in their minds to their last day as one of the great joys of their lives. To the many old friends and colleagues whom I see around me—Past-Presidents who, as men of science, hold positions second to none, whose names are familiar as household words—to them I can wish no higher gratification than that they may live to experience the satisfaction of such an entertainment, and of such a graceful appreciation of their work, as has been the lot of your old Past-Presidents to-night."

Prof. A. W. Williamson—"I thank you, Mr. President, most heartily for the kindly words you have uttered in relation to me, and to my efforts for the advancement of chemistry. It is an immense satisfaction to me to see a man of your talents and vast acquirements placed in so influential a position as that which you so worthily occupy. But whilst thanking you I am bound to confess that I have been for some time past a most unworthy member of the Chemical Society. It happened that after a good many years of work in our Society, I had other matters of such importance claiming my time and attention, that I was unable to continue to work amongst my colleagues and friends in the Chemical Society.

"Before I came over in 1849 to work at University College, I had become acquainted in the Giessen Laboratory with that most remarkable man, August Wilhelm Hofmann, and I may mention a characteristic incident illustrating his earnest and steadfast devotion to his science. He had for a considerable time been working at derivatives of aniline, and in order to carry on these researches as effectively as possible, he prepared by the action of caustic potash on indigo about some two gallons of aniline. The product was placed in a big bottle on the mantelpiece in his bedroom, and the story goes that he used to stand and gaze at it for some time every morning and evening, and gloating over it with delight would think, 'what a number of splendid products I shall make out of this aniline!' The energy and devotion with which he followed up his work on the derivatives of aniline at the expense of many other researches which he might with advantage have followed up was such that he came to be talked of as the great worker on aniline, and Sir Benjamin Brodie somewhat prematurely wrote his epitaph in the following words, 'Hic jacet Aniline.' His researches extended, however, at an increasing rate into other and wider departments of chemistry, and his energy and enthusiasm were such as to make him the leading explorer in the domain of organic chemistry. Berzelius had been for a lengthened period the one great man in the domain of inorganic chemistry, which was the only part of the science which had been explored to any appreciable extent. When I saw the vast piles of knowledge which Hofmann was so rapidly accumulating in the new domain of chemistry, I felt, and ventured to say, that his masterly labours entitled him to be called the Berzelius of Organic Chemistry. I happened to be present at a meeting of the Chemical Society at which a young chemist read a paper in the presence of Hofmann on some theoretical matters of importance which had already engaged the attention of distinguished chemists. Hofmann did not enter into any particulars of the paper, but he gave vent to an outburst of heartfelt delight at the simple narrative which had been read. There are various incentives to work, but the most potent incentive to earnest and efficient work is probably the example of a man like Hofmann, whose whole delight lay in mastering the truths of science, and in learning more and more particulars of the order of nature, and Hofmann possessed that power in a most eminent degree.

"We see in this grand hall an assemblage of chemists known by their earnest labours and valuable discoveries, and we are honoured by the presence of men of the highest distinction in other branches of science, as well as of leaders in the learned professions. It might not be unreasonable to believe that enthusiastic delight in the triumphs of chemical research is duly represented by some of the guests in this hall, and that the lively conversation which has been going on may not relate merely to high questions in jurisprudence, medicine, or legislation, but that some samples of chemical enthusiasm may reach the ears of the learned representatives of other professions.

"I feel sure that at a future time we shall all look back with the highest pleasure upon this delightful evening, which we owe to the kindly exertions of our President and other leading members of the Society."

Dr. John Hall Gladstone—"It is a pleasant thing to look on the faces of so many friends with whom one has worked in olden times, with whose works one is well acquainted. Though, of course, there are many at the present time who come into the Society, and whom I can look to as budding philosophers: unfortunately, I do not know their names so well as their faces. The pleasure is not merely because we call ourselves chemists, but because there is a bond of union between us arising from the desire of discovering the wonderful secrets of the great cosmos of which we ourselves form part. There is a great difficulty in speaking to you this evening, because so much that I should have liked to say has already been said by previous speakers. Still there are one or two things which, if you will permit me, I should like to bring before you. First of all, in your too flattering description of myself and of my work—which makes me rather ashamed to stand up and speak—there was a point which I think calls for remark, and so I must venture upon that which characterises the speeches of all of us, a certain amount of early autobiography. I was exceedingly fond of science from a little child. My favourite science was geology, and also what could be seen in the microscope—infusoria, and other little objects we have heard of in later times. But, in choosing a profession, my father said geology was not a promising career, and recommended chemistry. I knew very little about it, but went to University College and studied under that admirable teacher, Professor Graham, and afterwards under Liebig. I suppose it was from Graham that I acquired the taste for the physical side of chemistry and its connection with heat, light, electricity, and other forces of nature. I looked out for a scientific position, and lectured at St. Thomas's Hospital for some time, made analyses, and considered myself a professional chemist. It may be that circumstances have caused me to sink into the position of an amateur chemist, but my first intention was that of following chemistry as my profession in life. It has not been necessary to continue that; and I have had this advantage, that I could always keep in my laboratory a good, trained assistant, and thus, whilst I was engaged in other works and ways, and in endeavouring to extend the knowledge of chemistry and elementary science in our primary schools, the work still went on more or less under my immediate direction. I should like to have said something about the progress of chemistry during these past fifty years; but the subject is so enormous, and you yourself have touched upon it to such an extent and so well, that I need only allude to the fact that this great change of volume of chemistry has caused it to be necessary that we should specialise. Specialisation has its advantages, but also its disadvantages. One danger is that we may become narrowed in our views. So it would appear to be best to have a home somewhere or other, but to make occasional excursions in the neighbourhood, and take summer holidays so as to get our nerves braced up to work again at our own pet subjects. I must not touch upon other points, such as the relations of the physical forces to chemistry, or its useful applications, and the great value of chemical research for the welfare of mankind. These are subjects too large and important to enter upon at this late hour. It seems to me that while we are always increasing the mass of knowledge we possess, the space which we see to be bright becomes larger and larger, but there is beyond a dim nebulosity. It is our work to bring from that nebulosity something into the bright space, so that it becomes the property of the human race. But there is beyond this a region which we do not understand—infinite as far as we know—and our object is to increase that which is knowable, in the firm belief that it will be for the advantage of our fellow creatures. While I feel thankful for the joy that I have had in taking some part in these discoveries, I cannot look to have much more time given me for carrying on this work of investigation; but still, there may be a few threads of old research I may gather up, and in doing so I shall be greatly encouraged by the kind remarks of this evening, and the way in which our work has been received by the friends gathered around us."

RECENT AND FOSSIL RHINOCEROSES.[1]

PROF. OSBORN'S palæontological work is so painstaking, and his material is so rich, that all interested in the study of the evolutionary and distributional history of those remarkable Peristodactyles which may be included under the general title of Rhinoceroses, cannot fail to welcome the appearance of the elaborate and well-illustrated memoir before us. As at present planned, the complete memoir is to consist of no less than seven parts, two of which are contained in the present issue; so that until the whole appears, a suspension of judgment in regard to many points is due to the author.

Prof. Osborn is of opinion that the Rhinoceros-like Ungulates may be divided into the three families of *Hyracodontidæ*, *Amynodontidæ*, and *Rhinocerotidæ*. And as this arrangement tallies fairly well with the date of appearance and disappearance, and also with the relative specialisation of its various members, the general principle may be adopted. It must not, however, be supposed that either of the first two families are exclusively ancestral types of the third, as many of their representatives tended to specialise at a comparatively early period, and took an evolutionary line of their own. Some, for instance,

[1] "The Extinct Rhinoceroses." By H. F. Osborn. *Mem. Amer. Mus Nat. Hist.*, vol. i. part iii., pp. 75–164, Plates XIIA–XX. (1898.)

developed into upland running types, which competed with the Horses and Ruminants of the plains; while others were more likely frequenters of marshes and river-banks, like many of the Rhinoceroses of the present day. Neither the Hyracodonts or the Amynodonts ever developed horns, and all the early species of true Rhinoceroses had weak, hornless nasal bones, so that in external appearance they were probably more like large-sized Tapirs than the well-armed animals with which we are now familiar.

"They did not interfere with each other," writes the author, "because each enjoyed a different local habitat while occupying the same general geographical regions. The Hyracodonts dwelt in the drier grassy plains. The Amynodonts frequented the river and lake borders. Up to the time of the extinction of these two related families, the true Rhinoceroses maintained a somewhat uniform structure, both in Europe and America, differing so far as we know in size rather than in proportions. Their dentition and their feeding habits were probably similar to those of the *R. bicornis* of Africa, and the *R. sumatrensis* and *R. sondaicus* of Asia, namely upon shrubs, leaves, and softer herbage. After the extinction of the rival families, however, there was naturally a tendency on the part of the true Rhinoceroses to enter the peculiar local habitats previously occupied by the Hyracodonts and Amynodonts, and they accordingly diverged into upland and lowland, short and long-limbed, brachydont and hypsodont types."

From this it will be evident that Prof. Osborn by no means confines himself to the dry details considered sufficient by so many palæontologists, but endeavours to give his readers a mental picture of the habits of the animals he so well describes. He next proceeds to show that the *Rhinocerotidæ*, or true Rhinoceroses, diverged into four sub-families. These are, first, the *Aceratheriinæ*, or Hornless Rhinoceroses; second, the *Diceratheriinæ*, or Transversely-horned Rhinoceroses; third, the *Rhinocerotinæ*, or typical Rhinoceroses; and, fourth, the *Elasmotheriinæ*, represented only by the huge *Elasmotherium* of Siberia. And he further shows that while the first and second of these, like the Hyracodonts and Amynodonts, are common to the Old and New Worlds, the third and fourth are exclusively Old World types.

In the New World the Rhinoceroses became entirely extinct at the close of the Miocene period; and this, although it is not mentioned by the author, is doubtless the reason they never penetrated into South America, which up to that date was cut off from North America. No reason can at present be assigned for the sudden extinction of the group in North America, seeing that a profusion of animals, adapted apparently for a warm climate, flourished there during the Pliocene; while the case of the Woolly Rhinoceros and the Elasmothere indicates that the Rhinoceroses themselves were capable of fitting themselves to withstand sub-arctic conditions.

Whether the group first originated in the Eastern or the Western Hemisphere, the author, perhaps wisely, refrains from discussing. In both regions they appear to have come into existence at approximately the same period; and in both, up to a certain stage, they seem to have undergone a parallel development. This, as in the case of the Horses, would seem to suggest that during the middle portion of the Tertiary epoch the connection between the Old and the New Worlds was much more extensive than a mere narrow bridge across Bering Strait. But, on the other hand, the existence of large groups like the Civets and Hyænas which never succeeded in travelling from the Eastern to the Western Hemisphere, is, so far as it goes, in favour of only a narrow connection in high latitudes.

As already mentioned, the author includes all the typical Rhinoceroses in a single sub-family or group. On p. 84 this group is correctly termed *Rhinocerotinæ*, but in the table on p. 121 it is renamed *Ceratorhinæ*, which is obviously wrong. As with the *Aceratheriinæ*, the author considers that the group may be divided into a Dolichocephalic and a Brachycephalic section. The former section is taken to include all the Pliocene and Plistocene Old World species, with the exception of the Pikermi *R. pachygnathus*; while the latter embraces the Miocene and recent Old World types, except the living *R. sumatrensis*. To this classification we must take one exception. In our opinion the African "White Rhinoceros" (*R. simus*) is as dolichocephalic as the Plistocene *R. antiquitatis*. The figure of the skull of the former, which the author has copied from some previous writer, is misleading; and if he had the opportunity of seeing the fine series of specimens in the British Museum, he would in all probability amend the statement.

Space prevents detailed notice of the interesting observations which the author gives on the evolution of the cheek-teeth in the group. It may, however, be observed that he is in accord with previous writers in regarding the white and woolly Rhinoceroses as presenting the culminating point of molar evolution among the typical Rhinoceroses; *Elasmotherium* representing a still more specialised offshoot by itself. At present we are left in some degree of doubt as to the author's views with regard to the generic or subgeneric divisions of the Plistocene and recent Rhinoceroses; but light will probably be thrown upon this point as the work proceeds. So far as they have been carried at present Prof. Osborn's labours afford, in the main, a distinct advance in our knowledge of a very interesting group, and the completion of his memoir will be anxiously awaited by all who have made the subject a special study. R. L.

THE BRITISH ASSOCIATION.

BRISTOL MEETING.

SECTION K (BOTANY).

OPENING ADDRESS BY PROF. F. O. BOWER, SC.D., F.R.S., PRESIDENT OF THE SECTION.[1]

II.

I. *Algae and Fungi.*

AT first sight those Algae and Phycomycetous Fungi which show a subdivision of the zygote appear to offer the key to the enigma of the first start of antithetic alternation, and such rudimentary fruit-bodies as those of *Oedogonium* and *Coleochaete* are frequently quoted as prototypes of sporogonia. My own position has been that they may be "accepted as suggestive of similar progress in the course of evolution of Vascular Plants." On the assumption that the zygote is equivalent in all cases—and this is itself a pure assumption—the fruit-body of such Algae or Fungi would be comparable to the sporophyte in higher forms; but it must be clearly remembered that it is not even then proved to be *homogenetic*. Dr. Scott has based a strong line of criticism of antithetic views upon these cases. He remarks: "The sudden appearance of something completely new in the life-history, as required by the antithetic theory, has, to my mind, a certain improbability. *Ex nihilo nihil fit.* We are not accustomed in natural history to see brand new structures appearing, like morphological Melchisedeks, without father or mother. Nature is conservative, and when a new organ is to be formed it is, as every one knows, almost always fashioned out of some pre-existing organ. Hence I feel a certain difficulty in accepting the doctrine of the appearance of an intercalated sporophyte by a kind of special creation."

In answer to this, I state that to me the zygote, from which our hypothesis starts, is not "nothing"; it is a cell with all the powers and possibilities of a complete cell. Vöchting, in his "Organbildung," has fairly concluded that "a living vegetative cell which is capable of growth has not a specific and unalterable function." I have myself demonstrated that cells typically sporogenous may develop as vegetative tissue, and conversely that tissues normally vegetative may on occasions become sporogenous. We may, therefore, say generally as regards the sporophyte, that "a living cell which is capable of growth has not a specific and unalterable function." This I conceive to have been the condition of the zygote, and of its early products.

I think that the words "intercalation" or "interpolation," as used by writers on antithetic alternation, have been quite misunderstood. I have contemplated no sudden development—indeed, on the first page of my "Studies" I have spoken of the sporophyte as "gradually" interpolated. Nor is the suggested development something "completely new," for I specially speak of elaboration of the zygote. This is the parent of these "morphological Melchisedeks"; and unless segmentation be held to be synonymous with "special creation," I confess I do not see where the initial difficulty arises. I agree that nature is conservative; what we contemplate is the fashioning of the sporophyte by a process of which the first step is segmentation, out of a pre-existing organ—the zygote. Such simple segmentation is seen in the case of certain Algae and Fungi, and these may be taken as suggesting how the sporophyte of the Archegoniatae may have come to be initiated. But I am not aware of having ever suggested that these segmented zygotes of Algae are the homogenetic prototypes of the more elaborate sporophytes.

[1] Continued from p. 69.

Dr. Scott further states that "the reproductive cells produced by the ordinary plant of an *Oedogonium* are identical in development, structure, behaviour, and germination with those produced by the oospore." Prof. Marshall Ward, also speaking of *Œdogonium*, remarks "the attempt to get over this by terming asexual spores borne by the gametophyte *gonidia*, and reserving the term *spore* for bodies indistinguishable from these gonidia by any morphological or physiological character whatsoever, beyond their origin from a so-called sporophyte, carries its own refutation." Now, as a matter of fact, Pringsheim's description and figures of *Oedogonium* give scanty details; in most of the germinating zygotes the nuclei themselves are not clearly shown; much less the details of behaviour of those nuclei on germination. Klebahn has described the fusion of the sexual nuclei in *Oedogonium*, but I am not aware that he, or any one else, has yet made detailed observations on the nuclear condition of the zoospores, or the changes which take place in the germinating egg. Till this is done I submit that it is premature and undesirable to make such assertions as those of Dr. Scott and Prof. Ward. We now know that important nuclear changes do take place on the germination of the zygotes of certain Algae and Fungi. These changes are connected with a division of the nuclei into four, which is the number of the zoospores usually produced on germination in *Oedogonium;* the details may differ, but in the zygotes of *Closterium* and *Cosmarium*, and in the formation of the auxospores of *Rhopalodia*, Klebahn has demonstrated this division into four; also Chmielewsky has described a similar production of four nuclei in the germinating zygotes of *Spirogyra*. When it is further stated that in some of these cases there is good reason to think that a reduction of chromosomes is connected with the division into four, just as a reduction is now known to accompany the tetrad division in Archegoniate and Phanerogamic plants, it is plain that such cases as that of *Oedogonium* ought not to be assumed to support an homologous view without any fresh observation of the facts.

With the whole question of alternation, the nuclear details and differences in number of the chromosomes on division are now intimately bound up. Though the observations are still few, so far as they go they are consistent with the generalisation first stated by Overton, and elaborated by Strasburger as regards the Archegoniate and Phanerogamic plants. It has now been seen in cases drawn from various groups, that the cells of the gametophyte show a certain number (n) of chromosomes, while those of the sporophyte show on nuclear division double that number ($2n$) of chromosomes. Since Section K has had the advantage of a statement on this subject from Prof. Strasburger himself at Oxford, and as Dr. Scott also discussed the matter at Liverpool, I need not enlarge. I shall only remind you that Strasburger took up the position that the number of chromosomes which appears in each sexual nucleus is that original number which the ancestors possessed in a pre-sexual period; while the reduction of the double number which results from sexual fusion is, in his opinion, to be regarded as an atavistic process. As far as investigation has yet gone, I see nothing to prevent the acceptance of this as a provisional theory.

It is now well known, however, from the observations of Farmer and of Strasburger, that the nuclear conditions of *Fucus* are peculiar; that the reduction only takes place on the formation of the sexual organs themselves, and that the *Fucus* plant, like a sporophyte in the Archegoniate series, has the double number of chromosomes. At first sight this might appear to be a fatal difficulty, and Dr. Scott, attributing to the adherents of the antithetic theory views from which I personally dissent, has landed them in a seeming *reductio ad absurdum*. He himself does "not think we are as yet in a position to draw any morphological conclusions from these minute differences, interesting as they are." But we need not accept either of these extreme positions, if only a certain elasticity of theory be maintained, which should come naturally to adherents of polyphyletic development. I think the difficulty will chiefly be felt by those who, like some of the earlier writers on alternation, attempt to reduce all plants which show sexuality to one stiff scheme; this has been found to fail in the case of alternation, and a healthy recognition of various types of alternation has been the consequence. So in the matter of chromosomes, and of the position which the event of reduction holds in the life-cycle; difficulties such as this in *Fucus* may be anticipated, if we assume that all plants will conform to one plan. But Strasburger has not considered it necessary to cast aside the nuclear details as a basis for morphological conclusions, because all plants investigated do not fall in with a preconceived scheme. On grounds of comparison of behaviour of the nuclei before and after conjugation in *Closterium*, *Cosmarium*, *Spirogyra*, in certain Diatoms, and finally in *Actinophrys*, he has arrived at the conclusion "that a shifting (Verschiebung) of the time of division into four, together with reduction, is possible in the history of development of organisms." It will doubtless be necessary later to put a precise meaning upon the word "Verschiebung," and to define how far in given cases it is to be understood as an actual shifting of the event within one line of descent, how far it merely expresses an initial difference maintained, or it may be, extended, in different lines. Meanwhile, those who accept Prof. Strasburger's position will see that while in various evolutionary sequences the reduction may take place at different points in the cycle, still it may have settled down to a fixed and constant position in any one sequence; that I conceive to have been the case for the Archegoniate series. The validity of this conclusion does not seem to me to be affected by the diverse state of things seen in so far removed a sequence as that of the brown Algae.

Here a brief reference must be made to the very beautiful results of Wager on the changes in the zygote of *Cystopus candidus*, which have been verified and extended by Berlese. Wager states that in this fungus the process of fertilisation does not differ in any essential particular from the process as it takes place in Angiosperms. On the division of the fusion-nucleus of the zygote the number of the chromosomes present before division appears to be considerably in excess of the number observed in the nuclei of the oogonium. "By counting as carefully as possible 20 to 24 or even more appear to be present, and the impression is produced that the number is certainly much larger than that observed in the oogonium." Divisions of the nucleus then follow to form 4, 8, 16, and finally 32, in which condition a period of rest ensues; and finally, it appears that a division of each into four follows, to form the nuclei of four spores. Wager believes the reduction to take place at this last division, and Berlese has established a strong probability that such a reduction actually does take place. Plainly these observations are not final or conclusive, and even if they were, the strict homogeny of this fruit-body with a rudimentary sporophyte of a green plant would not be proved. It must, however, rank at least as an important parallel case, illustrating how the reduction may be effected in a distinct line of descent.

We see then that in green Algae such as *Oedogonium*, *Sphaeroplea*, and *Coleochaete*, certain divisions follow fertilisation, but we are not yet in possession of the nuclear details. I prefer, therefore, to suspend judgment as to the nature of those divisions; but in view of the peculiar behaviour already seen in other zygotes, it may be distinctly anticipated that some form of reduction will be demonstrated at that stage. If that be shown then we shall be right in recognising in these small cell-bodies the rudimentary correlative of a sporophyte—the sort of beginning from which a neutral generation may have sprung in land-living plants. We cannot go further than this as regards the green Algae until we are in possession of the facts. There is no greater desideratum in morphology at the present moment than a detailed knowledge of the germination of zygotes such as that of *Oedogonium*.

Here I may remark that the admirable observations of Prof. Klebs, whom the Section will welcome as a distinguished guest, do not appear to me to touch this question. His very varied and convincing experiments show in a number of Algae and Fungi that, as regards the succession of vegetative and sexual modes of propagation, the experimenter has a very complete control. I do not find, however, any observations of his which touch the behaviour of germinating zygotes of green Algae as regards details of segmentation. I do not mention this as in the least impairing the brilliancy of Prof. Klebs's work, but because Prof. Ward has brought Klebs's results to bear upon the discussion on antithetic alternation in a manner which I do not think that the facts will support.

II. *Bryophyta*.

Turning now to the Bryophytes, these plants stand at the moment in a somewhat discredited position. We have been warned by Dr. Scott that "there is no reason to believe that the Bryophyta, as we know them, were the percursors of the Vascular Cryptogams at all," and that "there is no appreciable resemblance between the fruit of any of the Bryophyta and the plant of any Vascular Cryptogam," and the suggestion has been thrown out afresh that they may really be "degenerate descendants of higher forms."

In view of statements such as these it may be well to examine the Bryophyta quite separately, without reference to Vascular Plants at all, and see what are their main bearings on theories of alternation. And if the Bryophytes were the only Archegoniate Plants in the world, I think the case for their origin by a progressive antithetic alternation would be an uncommonly strong one; the points which are especially noteworthy are: (1) The readiness with which they may be arranged in natural sequences which illustrate increasing vegetative complexity of the sporophyte as a consequence of progressive sterilisation; (2) The nuclear details, which are as yet known, however, in only few cases; (3) The constancy of the two alternating phases, the relations of which are very seldom disturbed by apospory, and never, to my knowledge, by apogamy.

The first of these matters has been dealt with at length in my "Studies." It is, of course, possible for any one to read such sequences as are there mentioned in reverse order, and to uphold a theory of simplification; but this must be shown to be in accordance with probability. Now it appears to me that the general probability in the case of the Bryophytes is against simplification, for the larger the number of spores which can be matured the greater the probability of survival; even in cases where, as in *Buxbaumia* and *Diphyscium*, there is an exiguous, and probably reduced Moss-plant, the sporogonium is not of a reduced type, but, on the contrary, unusually large. It seems to my mind much more probable that the Bryophytes as a whole illustrate a course of progressive complexity. A comparison of anatomical details frequently suggests a progressive sterilisation, a process which we see demonstrated both in Pteridophytes and Phanerogams, where actual conversion of potentially sporogenous tissue into temporary or permanent vegetative tissue does occur. When it is added that the nuclear evidence, scanty though it still is, shows the sporophyte with a double number of chromosomes, and the reduction taking place on the tetrad division of the spores, the comparison with the segmented zygotes of Algae and Fungi above mentioned seems inevitable. The position of those who hold views of antithetic alternation will, therefore, be that the simple sporogonium was produced as a post-sexual growth. The starting-point was probably some such multicellular body as we see nowadays in certain Algae and Fungi resulting from division of the zygote, but not necessarily homogenetic with any such body that we know now living. The land-habit imposed a restriction on fertilisation, and an alternative method of increase in numbers was an advantage. The multicellular body resulting from division of the zygote provided the means for this; the cells developed separately as dry, dusty spores. As the number of divisions increased, the powers of the plant to nourish, protect and disseminate the spores became the measure of the number produced. Hence followed the elaboration of the nourishing and disseminating mechanism, which has involved a diverting of some cells from their first office of spore-production, the start being, perhaps, made in a manner similar to the formation of the peridium in the Uredineæ. To my mind—taking the Bryophyta alone—there is an inherent probability in all this, which far counterbalances any of the obstacles which have been raised against it.

The greatest obstacle is the fact of apospory in Mosses. This departure from the usual alternation will be more generally discussed in relation to the Ferns, where it is more frequent. Besides its being artificially induced in Mosses by special treatment, it appears also to have been noted by Ugo Brizi in nature, in the case of atrophied capsules of *Funaria*, which had buried themselves in the soil. The essential point is the production of the sexual generation by direct vegetative growth from the neutral. This would appear to involve a reduction of chromosomes, but Pringsheim's drawings show nothing analogous to the usual process of tetrad division to form the spores; the reduction, if it occurs, must be effected in some other way.

A theoretical suggestion on this point will be made later. Meanwhile let us estimate its probable importance as regards the Bryophyta. It cannot fail to strike the observer how uniform is the alternation in these plants; there are, I believe, no recorded cases of deviation from the normal alternation in Liverworts. I know of only a single case of apospory among Mosses taken in the open, and then in atrophied capsules; apospory, when induced, follows such extreme treatment as chopping the sporogonium into pieces. And it is not as if the Mosses and Liverworts had escaped detailed observation; hardly any group of plants had been more carefully examined by competent observers. Deviations from strict alternation then are rare, and appear under physiological stress. This great group, which includes the simplest sporophytes among Archegoniate plants, is also singularly constant in its alternation. I think this is to be connected with the permanently dependent condition of the sporophyte; its equable physiological condition, nursed and protected by the Moss plant, finds its morphological expression in its comparative uniformity. Conversely the independent position of the sporophyte in Ferns, and its exposure to varied conditions may have elicited more freely in them unusual developments.

III. *Abnormalities.*

And now I may pass to my third point, and discuss more generally the argument from abnormalities. I have no wish to prejudge the question by the use of this term as applied to apogamy and apospory, or in any way to detract from their morphological importance—I merely intend to express that they are departures from that order of events which is the most frequent in Archegoniate plants at large, and I particularly wish to point out that while such irregular developments are now shown to be frequent in Ferns, they are exceedingly rare in Bryophytes, and are not, I believe, hitherto recorded for Lycopodineae or Equisetineae.

While direct vegetative transitions from one generation to the other may appear as a *primâ facie* support of an homologous origin of the two generations, I must protest against their being used, as they have been, as evidence against an antithetic view. It has been said that the facility with which these transitions from one generation to another in Ferns take place "shows that there is no such hard and fast distinction between the generations as the antithetic theory would appear to demand." Why should it demand a hard and fast distinction? For my own part, I had already described apogamy and apospory as occurring in the same individual before I wrote on alternation. The presumption seems to be that a distinct course of evolution must have imposed "hard and fast" limits upon the potentialities of the parts evolved. But we ought to remember how the root, whether in Phanerogams or Ferns, has doubtless had a long course of evolution as a member distinct from the shoot; and yet we see it bearing adventitious buds upon it, as in the Rosaceae, Poplar or Elm; or even transformed at its apex into a shoot, as in *Platycerium* or *Anthurium*. Such cases as these, though not exact parallels, should suffice to show that hard and fast lines are not to be anticipated as a consequence of a distinct course of evolution.

There is another kindred, though almost converse, proposition which has been advanced by Pringsheim. He made his experiments on Moss fruits, "in the hope that he would succeed in producing protonema from the subdivided seta of the Mosses, and thus prove the morphological agreement of seta and Moss-stem." The point here appears to be that parts which are capable of producing similar growths are in "morphological agreement." I cannot assent to this proposition. In the case of the roots above quoted, the production of buds upon them, or the conversion of their apices into shoots, does not prove their "morphological agreement" with shoots upon which such developments are common.

By those who use such arguments it is to be borne in mind that the two generations, however distinct in their evolution, are still merely stages in the life-history of one and the same organism. The hereditary qualities of the race as a whole must be transmitted through the successive generations. It may be a question how far, and under what conditions, its various potentialities come into evidence, as, for instance, in the formation of an apogamous sporophyte, or of an aposporous protonema: but that some such potentialities are there is in no way inconsistent with the antithetic theory.

I have above pointed out how morphology has recently passed to an experimental stage, and I am glad to say that by means of the cultures of Dr. Lang and others we are beginning to gain an insight into the circumstances which lead to these phenomena. In certain Ferns direct apogamy occurs; that is, "the immediate production of vegetative buds by prothalli which are usually incapable of being fertilised"; the origin of this is still obscure. But apogamy may also be induced in various other species. Dr. Lang states that "the causes which appeared to induce apogamy in these prothalli were, the prevention of contact with fluid water, which rendered fertilisation impossible, and the exposure to direct sunlight. Possibly the temperature had some effect." It is further to be noted that in every case of induced apogamy "normal embryos were produced when conditions permitted fertilisation." Now the conditions of prevention of fertilisation, exposure to light, and possibly also a high temperature, all lead to a plethoric state, which we may thus recognise as a precursor of induced apogamy, possibly also of apogamy at large.

On the other hand, the circumstances which precede or accompany apospory are commonly those of deficient nutrition. In the case of Ugo Brizi's *Funaria*, it is mentioned that the capsules were atrophied and buried in the soil, where they could not obtain nourishment by their own assimilation. In the induced apospory of Stahl and Pringsheim the growths appear upon parts of the chopped up seta, isolated from their usual sources of supply. Among Ferns, the conditions of nutrition which precede apospory have not been noted in all cases; but the following facts are interesting. *Athyrium Filix-foemina* var. *clarissima* is a pale chlorotic Fern with exiguous leafage, while the more or less complete arrest of the sporangia is a concomitant of apospory. In *Polystichum angulare* var. *pulcherrimum* there is no obvious disturbance of the vegetative organs, but I have specially noted the sporal arrest, which, in the specimens examined by me, appeared to be complete. This is, then, a concomitant of apospory, though it may be uncertain how far there is a casual connection. In the case of apospory in *Pteris aquilina*, reported by Farlow, there is an irregular diminution of leaf-area in the pinnules which show apospory; this is accompanied by various stages of abortion of the sporangia, though some fully-matured spores were found. Here, as also in *Polystichum angulare*, the tips are specially affected. Farlow remarks, "the sporangia became more and more irregular the nearer they were to the tip." In the case of *Scolopendrium vulgare*, the plants which showed apospory at so peculiarly early a stage had been raised by Mr. Lowe from prothalli which had been repeatedly divided, a process calculated to affect the physiological condition. The aposporous plants of *Trichomanes alatum*, *pyxidiferum*, and *Kaulfussii*, were all cultivated under artificial conditions, and are characteristically shade-loving plants, a habit which must affect their nutrition. Perhaps the most interesting case, however, is that described by Atkinson in *Onoclea*. In plants from which, by removal of the foliage leaves, the sporophylls had been induced to change their character and develop as foliage leaves, the sori were arrested. "When the leaf has lost so much of its reproductive function that the sporangia are becoming rare or rudimentary in the sorus, apospory frequently occurs, and the placenta develops among the rudimentary sporangia prothalloid growths." Here is, again, a case of deficient nutrition; the assimilating leaves, after formation, but before they could have carried their functions far, were removed. The plant makes an effort to supply their place at the expense of spore-production; arrest of sori and sporangia is the result, accompanied by cases of the direct vegetative transition to the prothallus. From these examples we see that deficient, or, at least, disturbed nutrition is frequently, perhaps always, a concomitant of apospory. Thus there is some countenance for the view that apospory and apogamy follow on converse conditions of nutrition.

We may next inquire how these converse conditions may lead to the changes in question; and especially the state of the nuclei ought to be considered. Owing to practical difficulties of observation the behaviour of the nuclei in apogamy and apospory has not been directly followed. But if the nuclear difference between the two generations be as it is believed, nuclear changes will be closely connected with these vegetative transitions. What could appear more natural than that apogamy, which presumably involves a doubling of the chromosomes, should follow a condition of plethora, and that apospory, which presumably involves a halving of the chromosomes, should follow deficient nutrition?

One further fact in either case appears to me to be specially noteworthy, that the changes are not confined to a single cell. The directly apogamous bud of *Nephrodium Filix mas* may perhaps be referable to a single cell, but Dr. Lang shows by numerous examples that the transition from characteristic tissue of the gametophyte to that of the sporophyte may arise at various points, and involve considerable tracts of tissue. Similarly I have shown in the case of apospory that the change may affect not one cell only, but cell-groups at various and distinct points on the same individual. It would seem that there is a widespread disposition of the tissues to undergo the change.

For my own part, I think the usual attitude on the chromosome question has been too absolute and arithmetical. Evidence is accumulating from various sources that the usual numbers are not strictly maintained; it is known that in vegetative cells there are often considerable differences of the number of chromosomes from those in the sexual cells of the same plant, while observers have noted the irregularities in the divisions of the pollen-mother-cells in such plants as *Hemerocallis* and *Tradescantia*. If there be any causal connection between the number of chromosomes and the morphological character of the sporophyte and gametophyte, irregularities such as these at least countenance the idea of nuclear instability being possible; it will be a question for special treatment and investigation how far nuclear instability is connected with disturbed nutrition. But into the mechanism of the presumable nuclear change, and the question whether it be sudden or gradual, we cannot enter with any more than a speculative interest, in the absence of direct observations. Whatever the nuclear details may be, I regard it as a matter of very great importance to recognise that special conditions of nutrition commonly accompany, if indeed they do not actually determine, those changes which we term apospory and apogamy. But the story of the past is not simply a matter of conditions of nutrition, as we see them now influencing Archegoniate plants in their present highly specialised state. The real question is a purely historical one, How *did* the present state of things come about?

(*To be continued.*)

THE TEACHING OF SCIENCE IN ELEMENTARY SCHOOLS.[1]

YOUR Committee are able to report that the quantity, if not the quality, of the teaching of science subjects in elementary schools has made progress during the past year. The following table, made up from the return issued by the Education Department, gives the figures for the scientific class subjects as compared with English. In the report for last year it was mentioned that the number of school departments taking object lessons would greatly increase, as the Government code of regulations announced that they would become obligatory in the three lower standards on and after September 1, 1896. We now see the result, so far as the schools are concerned whose school year ended between August 31, 1896, and August 31, 1897, but the full effect cannot appear until the next year's return, the whole of which will be in the obligatory period.

Class Subjects—Departments	1890-91	1891-92	1892-93	1893-94	1894-95	1895-96	1896-97
English	19,825	18,175	17,394	17,032	16,280	15,327	14,286
Geography	12,806	13,485	14,256	15,250	15,702	16,171	16,646
Elementary Science	173	788	1,073	1,215	1,712	2,237	2,617
Object Lessons ...	—	—	—	—	—	1,079	8,321

The number of departments in "schools for older scholars" for the year 1896-97 was 23,080, all but 10 of which took one or more class subjects. But history was taken in 5133 departments, and needlework (as a class subject for girls) in 7397 departments, and sundry minor subjects in 1056, making, with the other four subjects of the table, a total of 55,456. This shows an average of more than $2\frac{1}{3}$ class subjects to each department; but it must be borne in mind that the same subject is not always taken in all the standards, in which case three class subjects will appear in the return.

It was remarked in the last report that "the increased teaching of scientific specific subjects in the higher standards is the natural consequence of the greater attention paid to natural science in the lower part of the schools." The following table shows the correctness of this inference:—

[1] Report of the Committee, consisting of Dr. J. H. Gladstone (Chairman), Prof. H. E. Armstrong (Secretary), Prof. W. R. Dunstan, Mr. George Gladstone, Sir John Lubbock, Sir Philip Magnus, Sir H. E. Roscoe, and Prof. S. P. Thompson. (Read before Section B of the British Association at the Bristol Meeting.

Specific Subjects—Children	1891–92	1892–93	1893–94	1894–95	1895–96	1896–97
Algebra	28,542	31,487	33,612	38,237	41,846	47,225
Euclid	927	1,279	1,399	1,468	1,584	2,059
Mensuration...	2,802	3,762	4,018	5,614	6,859	8,619
Mechanics	18,000	20,023	21,532	23,806	24,956	26,110
Animal Physiology	13,622	14,060	15,271	17,003	18,284	19,989
Botany	1,845	1,968	2,052	2,483	2,996	3,377
Principles of Agriculture ...	1,085	909	1,231	1,196	1,059	825
Chemistry	1,935	2,387	3,043	3,850	4,822	5,545
Sound, Light, and Heat ...	1,163	1,168	1,175	914	937	1,040
Magnetism and Electricity	2,338	2,181	3,040	3,198	3,168	3,431
Domestic Economy	26,447	29,210	32,922	36,239	39,794	45,869
Total	98,706	108,434	119,295	134,008	146,305	164,089

It appears that the mathematical subjects still command the most favour on the part of the teachers, algebra having taken a very remarkable lead. All the physical sciences have increased even more than might have been expected from the increase of scholars. The principles of agriculture is the only subject that shows an actual decrease.

Estimating the number of scholars in Standards V., VI., and VII. at 615,000, the percentage of the number examined in these specific subjects, as compared with the number of children qualified to take them, is 26·6; but it should be remembered that many of the chiidren take more than one subject for examination. The following table gives the percentage for each year since 1882, and shows that science is gradually recovering from the great depression of about eight years ago:—

	Per cent.		Per cent.
1882–83	29·0	1890–91	20·2
1883–84	26·0	1891–92	19·7
1884–85	22·6	1892–93	20·2
1885–86	19·9	1893–94	20·9
1886–87	18·1	1894–95	22·7
1887–88	16·9	1895–96	24·2
1888–89	17·0	1896–97	26·6
1889–90	18·4		

The Returns of the Education Department here given refer to the whole of England and Wales, and are for the school years ending with August 31. The statistics of the London School Board are brought up to the year ending with Lady Day, 1898. They also illustrate the great advance that has been made in the teaching of elementary science as a class subject, and they give the number of children as well as the number of departments.

Years	Departments	Children
1890–91	11	2,293
1891–92	113	26,674
1892–93	156	40,208
1893–94	183	49,367
1894–95	208	52,982
1895–96	246	62,494
1896–97	364	86,638
1897–98	322	70,626

The last year shows an apparent falling-off in the teaching of this subject, but, as has been mentioned above, the Government having made the giving of object lessons obligatory in the lower standards, 442 departments, with 75,993 children, have already adopted them. This has caused a reduction in the teaching of "Elementary Science" under that name; but, taking the two subjects together, this must be regarded as a very considerable gain.

The Education Department continues to meet the objection against the limitation under the Code by which only two class subjects are allowed to be taught, by adding combined courses of study. This year a new course of this character has been introduced into Schedule II., described as "Elementary Science and Geography Combined." And as, under the present regulations, one of the class subjects must be such as can be taught by means of object lessons in the lower standards, some such subject as the combined one above mentioned must be taken. A copy of the scheme is given in the Appendix, by which it will be seen in the lower standards the phenomena of the land and water are to be illustrated experimentally as an introduction to geographical science.

A similar principle has been adopted in respect of the specific subjects. Hitherto chemistry has formed a course of itself, and physics has been divided into two separate courses, the one dealing with sound, light, and heat, and the other with magnetism and electricity; but they formed only three out of the nineteen subjects from which choice could be made. A separate course of elementary physics and chemistry combined has now been introduced, which is set out in the Appendix, and which is admirably adapted for experimental investigation at the hands of the students themselves.

The work under the Evening Continuation Schools Code continues to progress, as will be seen from the following table:—

Science Subjects	Units for Payment							
	England and Wales				London School Board			
	1893–4	1894–5	1895–6	1896–7	1893–4	1894–5	1895–6	1896–7
Euclid	595	1,086	1,648	2,270	10	29	7	—
Algebra	3,940	6,657	10,374	14,260	316	302	535	714
Mensuration ...	14,521	32,931	41,772	50,748	279	374	452	369
Elementary Physiography	2,554	4,045	6,590	6,325	37	9	5	—
Elementary Physics and Chemistry ...	6,500	7,850	6,749	5,183	79	200	152	129
Science of Common Things	6,223	10,350	12,906	18,293	231	262	468	556
Chemistry ...	3,484	7,814	8,222	9 641	212	455	404	488
Mechanics ..	841	1,148	1,458	2,196	230	197	209	127
Sound, Light, and Heat ...	500	1,046	861	1,156	—	15	11	7
Magnetism and Electricity ...	2,359	4,451	5,073	6,990	662	776	783	939
Human Physiology...	5,695	8,395	7,825	10 047	91	68	56	49
Botany	336	547	905	1,080	5	91	97	32
Agriculture ...	3,579	4,991	4,694	4,061	—	—	—	—
Horticulture ..	438	1,140	1,812	1,911	—	—	—	—
Navigation ...	42	69	142	99	—	—	--	—
Totals ...	51,607	92,520	111,031	134,260	2,152	2,778	3,179	3,410

It is again evident that the mathematical subjects are rapidly increasing in favour, and that agriculture is decreasing. It will be noticed with satisfaction that the science of common things is receiving greatly increased attention, but it is a matter of regret that there is a decrease in the time given to elementary physiography, and still more so in the case of elementary physics and chemistry. Agriculture would become a more valuable and probably a more popular subject of study if a really good practical course were devised.

An important change has been taking place in Scotland. The Code of the Scotch Education Department now admits of the possibility of gaining the full class grant, although only two subjects are taken. As one of these must be English, and in the higher standards provision must be made for history or geography or both, the teaching of science as a class subject has been greatly reduced during the last two years. But a new article in the Code for 1895 offers a special grant of a shilling on the average attendance of boys who are satisfactorily taught "elementary science"; and this has far more than made up the deficiency. In fact the aggregate total of children learning elementary science in the Scotch schools has risen from 34,151 in 1894–95 to 85,671 and 133,855 respectively in the two succeeding years.

Your Committee have frequently referred to the anomaly that pupil teachers are not obliged to receive any instruction in natural science, although they may have to give instruction in such subjects, either specifically or in the form of object lessons; indeed, if they should be in charge of a class of the three lower standards it would be obligatory upon them to give such object lessons. A Departmental Committee, consisting of the Rev. T. W. Sharpe, Her Majesty's Chief Inspector of Schools, as Chairman, and several Inspectors and Principals of Training Colleges and Pupil-teacher Centres, have reported upon the pupil-teacher system. They recommend that the age for entering as pupil teachers should be raised, and that the interval between the elementary school and their apprenticeship should be passed at a secondary school. This would by no means ensure that the young people would receive any instruction in science during that period of their career. No alteration is proposed n the optional science course prescribed by the Code of the Education Department, except that the Queen's Scholarship examination is to be limited to the elementary stage of physiography prescribed in the syllabus of the Science and Art Department. With regard to the college course the recommendation is singularly weak, science being placed as an optional subject, without any definite course of study prescribed. For the first two years it is laid down that of the optional subjects not more than two must be taken out of a list of four or six respectively, some of which from their very nature are almost sure to be taken in preference.

An important letter has been addressed to the Right Hon. Sir John Gorst by Sir Philip Magnus, the Chairman of the Joint Scholarship Board, in conjunction with the Chairmen of its four educational committees. They point out the necessity of securing the proper training of those who will be teachers of scientific subjects, and that the instruction of pupil teachers in science is now often carried on, under great pressure, by a system of cram, and even by persons who have not themselves any satisfactory knowledge of modern scientific methods. They suggest as a remedy that the first part only of the elementary stage, physiography, be compulsory; that the teaching of this subject be recognised only where it is given with proper accessories, all pupils performing the experiments in a series of at least twenty-four lessons of two hours' duration; and that inspectors should be required particularly to report whether proper apparatus and accessories are provided.

In last year's report your Committee referred to what Mr. Heller was doing in respect of the teaching of science in the schools of the London School Board. He has since obtained a better appointment at Birmingham, but the syllabus of lessons which he prepared is still employed in the schools. This of course requires that the masters and mistresses should be qualified for carrying it out, and for this purpose classes of twenty-four hours are conducted for their benefit by the science demonstrators. These gentlemen have lately agreed upon two separate syllabuses for masters and mistresses, which follow in general the scheme they are expected to teach to their scholars. The classes of a similar kind that have been carried on hitherto have been appreciated by the teachers, and the Board are increasing their laboratory and other accommodation for the purpose. It is recognised that it will be necessary to continue these teachers' courses for some years, in order to overcome the difficulty which now exists in consequence of the general want of practical experiment in such instruction in science as has been given in the course of training of most class teachers.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The 194th meeting of the Junior Scientific Club was held in the Physiological Lecture Room of the Museum at 8 p.m. on Wednesday, November 16. After the election of new members, Mr. A. F. Walden (New College) brought forward his motion respecting the appointment of a Committee to act with the Treasurer of the Robert Boyle Lecture Fund. The motion was carried, and the Club elected Mr. A. E. Boycott (Oriel) and Mr. A. S. Elford (St. John's) to serve on the Committee. Mr. A. D. Darbishire (Balliol) read a paper on natural selection among Lepidoptera. His remarks were illustrated by several cases of butterflies. Mr. J. E. Marsh (Balliol) followed with a paper on the constitution of camphor, in which he attempted to survey all the recent work on the subject.

MR. ERNEST WILSON has been appointed professor of electrical engineering at King's College, London, in succession to the late Dr. John Hopkinson.

DR. GIUSEPPE SANARELLI, of the Uruguayan Medical School and Director of the Hygienic Institute at Montevideo, whose discovery of the microbe of yellow fever has brought him much distinction, has, the *Lancet* states, been offered by Dr. Baccelli (Minister of Public Instruction) the chair of Hygiene in the University of Bologna, left vacant by Prof. Roncati.

THE two first formal steps towards the establishment of a Midland University, to be called the University of Birmingham, were taken on Friday last, at a meeting of the Court of Governors of Mason University College. In reference to the scheme, the Management Committee reported that, in their opinion, the University to be established in Birmingham should be a teaching University, as distinguished from a University which only examines students for degrees. The University should therefore have the control and direction of all the teaching as well as the examining of students. With this end in view the Committee recommend that, if an agreement can be made with the governors of Mason University College, the University should be allowed to absorb the college. In this case the college would cease to exist as a separate institution, and its endowments, buildings, equipment, and staff would be transferred to the University. The Committee have had under consideration the financial position of the University. They are of opinion that, in order to completely carry out the above scheme, an endowment of not less than 200,000*l.* is required beyond that already held by Mason University College. Such an endowment would just double the present endowment of the college. The Committee expressed their opinion that every effort should be used to at once increase the endowment fund in order that an endowment of not less than 200,000*l.* may be obtained to enable the University to start under favourable conditions.

Mr. Chamberlain moved the two resolutions, one recommending that steps be taken to absorb and include Mason College in the new University; and the second, authorising the Council of Mason College to take the necessary measures to obtain a Royal Charter for the establishment of the University. In presenting these resolutions Mr. Chamberlain remarked: "I think our ideal may be stated in a few words to be the creation in Birmingham of a great centre of universal learning, of an institution which should provide for the intellectual cultivation of mind in the broadest possible sense, and which shall maintain for ever in the city the highest standard of intellectual eminence. We desire that in this school all acquired knowledge should be taught and explained, and we further desire that knowledge should be advanced by original research, and by the willing co-operation of those who are engaged as professors and teachers. The enormous development of science requires undoubtedly an extended application of the means of instruction. Of course, there is special reason why science should take a very prominent place in connection with a University which is situated in the centre of a manufacturing and commercial district, and it would, in my opinion, be pedantry were we to pretend that we did not attach the highest importance to this branch of our work, and did not intend that it should be distinctly carried out and should give to the University a special position of its own."

REFERRING to the address delivered by Mr. Chamberlain on the subject of a University of Birmingham, and referred to above, the *Times* remarked on Monday: "Those who carefully study German commercial methods are well aware that the chief cause of German success at the present time is the German manufacturers' respect for science. There is at the present moment at Düsseldorf a chemical company which employs thirty-three trained chemists, picked University men, who are paid good salaries with a share of the profits due to any invention which they may make; this company pays very high dividends, and its business has increased by leaps and bounds. It would be interesting, but not encouraging, to learn what has been the parallel history of the chemical works on the Tyne. This points to one way in which a Birmingham University, properly equipped, worked and encouraged, may affect the commercial prosperity of the city."

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No 10.—Gravitational constant and mean density of the earth, by F. Richarz and O. Krigar-Menzel. The gravitational constant, *i.e.* the constant which has to be inserted in the equation for determining the attraction from the product of the masses and the inverse square of their distance apart, when C.G.S. units are chosen, was found by the method of weighing a mass at two different altitudes above the earth's surface. The result arrived at was $6 \cdot 685 \times 10^{-8}$. The value for the mean density of the earth was $5 \cdot 505 \pm 0 \cdot 009$.—Surface tension in narrow capillary tubes, by P. Volkmann. When measurements are made on freshly-drawn capillary tubes, the results are well in accordance with the known laws, whatever the substance and diameter of the tubes. In old and wide tubes the surface tension is higher by 0·02 mgr./mm., probably owing to the absence of solubility of the substance of the older specimens of glass.—A method for determining the thermal conductivity of solids, by F. A. Schulze. A rod of the material examined is at the temperature of the room. At a short distance from one end a thermo-couple is inserted. From a given instant, the end surface is exposed to a stream of water at a different temperature. Knowing the specific heat of the body, the author works out in detail an equation for finding the thermal conductivity, and illustrates it by examples which show a maximum error of 4 per cent.—Specific heats of metals at low temperatures, by U. Behn. If the decrease of the specific heat with the temperature is represented graphically, it appears probable that all the curves intersect at the temperature of absolute zero. At that temperature it is also possible that the specific heats themselves are zero. In any case, Dulong and Petit's law does not hold for low temperatures.—Coherers, by E. Aschkinass. The theory of the coherer according to which the decrease of resistance is accounted for by sparks which weld the particles temporarily together, does not suffice for the case of peroxide of lead, where the resistance increases under the influence of electric waves. The coherer action pure and simple is only observed under feeble electric radiation. When the latter is strong, disturbing influences supervene.—Electrical and thermal measurements made on discharge tubes, by E. Wiedemann and G. C. Schmidt. When the appearance of discharge tubes is similar, whether they are fed by an influence machine or a continuous current, it is safe to assume that the potential gradients are the same. The values of the potential gradient as derived from probes and from calorimetric measurements respectively are the same, but the latter method is more suitable when the discharge is discontinuous.

Bollettino della Società Seismologica Italiana, vol. iv., 1898, Nos. 2, 3.—Echo in Europe of the Indian earthquake of June 12, 1897, by G. Agamennone.—Seismoscope with multiple effect, by A. Cancani.—The earthquake of Grandson [February 22, 1898], by F. A. Forel, a paper (in French) describing a series of short waves, about half a metre in height, which were observed on the lake of Neuchâtel at the time of this earthquake.—On the various systems of registration in seismology, by A. Cancani.—On the Rieti earthquake of June 28, 1898, by G. Brucchietti. An account of the damage caused by this earthquake at Rieti and elsewhere.—Notices of earthquakes recorded in Italy (July 27–September 17, 1897), by G. Agamennone, the most important being the earthquakes of Japan on August 4–5, Turkestan on August 15 and September 17, and Tuscany on September 6, and earthquakes of unknown, but distant, origin on August 6, 13, 16, 20 and 26.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, November 2.—Mr. G. H. Verrall, Vice-President, in the chair.—Mr. Merrifield exhibited some *M. aurinia* from Touraine forced and cooled as pupae, the latter being much the darker and more strongly marked, some *E. cardamines* from Sussex, those cooled having the apices of the wings darker and the discal spots smaller than those which have been forced, and some *C. edusa* from eggs laid by two normal females taken in Savoy, two out of the five reared being of the var. *helice*; the marginal border of one male, which had been forced, was very pale and much suffused with long yellow scales. He also showed four *P. machaon*; two of them, forced as pupae, had their dark parts very pale and their tails long and slender, the two which had been cooled having the dark parts much extended in area and darkened in hue, their tails being short and broad. These results, which were to be obtained with winter as well as summer pupae, corresponded with those previously obtained by Dr. Standfuss.—Mr. J. J. Walker exhibited two winter nests of *Porthesia chrysorrhoea* from the Isle of Sheppey, where the species had lately become very common.—Dr. Mason exhibited a Buprestid larva found among Baltic timber at Burton-on-Trent. This had been among wood in a box since the beginning of July last, and there was scarcely a trace of frass. Marsham had recorded the escape of a larva of *Buprestis splendens* from the wood of a desk in the Guildhall, which had stood there for more than twenty years. It is probable that the growth is extraordinarily slow, and consequently that the larva can maintain life for very long periods in most unfavourable conditions.—Mr. Blandford called attention to similar cases which he had brought before the Society. It appeared likely to him, from what was known about such insects as *Callidium variabile*, which was occasionally bred from dry wood at long intervals, that these species were not abnormally slow-growing under normal conditions, but became so in dry timber, in which they probably sustained life with difficulty, especially when the outside of the wood was varnished.—Mr. Waterhouse exhibited for Mr. G. W. Kirkaldy living examples in various stages of a *Caryoborus* in nuts of *Attalea funifera* from Brazil. Elditt had described the attacks of an allied species upon the seeds of *Cassia fistula*.—Mr. Tutt exhibited for Dr. Chapman a series of Swiss examples of *Zygaena exulans*, and discussed the differences between them and the Scotch form.—Papers were communicated by Mr. W. F. H. Blandford on some Oriental Scolytidæ of economic importance with descriptions of five new species, and by Mr. van der Wulp (through Colonel Yerbury) on Asilidae from Aden and its neighbourhood.

Linnean Society, November 3, Dr. A. Günther, F.R.S., President, in the chair.—The President exhibited an abnormal twin tusk of an adult Indian elephant, and made the following remarks. The tusk occupied the right jaw of the animal. The two teeth were developed from separate papillae and remained perfectly separate, without any connecting ossification, although they grew side by side from the same socket, the uneven surface of one closely fitting into that of the other. He was inclined to look upon the smaller tooth as a persistent milk-tooth, which, not being shed, continued to grow from its original papilla; but Mr. Charles Tomes, F.R.S., considered it a case of duplication, such as is sometimes found in man and other mammals, in which the development of two separate papillae gives rise to a twin tooth of the permanent dentition. No such case seems to have been previously observed in the elephant.—Prof. G. B. Howes, F.R.S., exhibited some young and six living eggs of the New Zealand lizard *Sphenodon* (*Hatteria*), received from Prof. A. Dendy, of Christchurch, N.Z., part of a full series which had furnished that gentleman with material for a monograph on the general development of the animal, now in course of publication. Briefly referring to the previous attempt of Parker and Thomas to secure material for the study of this subject, he said that the palaeontological discoveries of Credner justified us in regarding the Rhyncocephalia as the most central among terrestrial vertebrata. He remarked that the specimens had been sent him for the express purpose of working out the development of the skeleton. Recapitulating the more salient discoveries recently announced by Prof. Dendy in his preliminary paper in the *Proc. Royal Soc.* and elsewhere he said, in comment upon them, that the plugging of the nostrils by cellular tissue during development is a phenomenon already described by the late T. J. Parker in *Apteryx*, and that it appeared to him akin to that of the occlusion of the oesophagus of the vertebrate embryo first described by Balfour, which De Meuron had sought to associate with the metamorphosis of the branchial diverticula. He pointed out that Dendy's discovery of a third pair of incisors was confirmatory for the upper jaw of the conclusions of the late Dr. G. Baur, and remarked that he had received a letter from Prof. Dendy, dated September 12, stating that he and his colleagues at the Antipodes had secured a Government order protecting the eggs as well as the young of *Hatteria*.—Mr. A. F. Crossman exhibited some photographs illustrating the case of a chicken hatched and reared by a common buzzard. The buzzard had laid an egg in captivity, and manifesting a desire to incubate, a hen's egg was substituted, which in due course was hatched and the chicken reared, the foster-parent feeding it upon morsels of flesh. It thus appeared that in a conflict of instinct, under altered conditions of life, the maternal instinct had proved stronger than the natural impulse to kill and devour weaker prey. Mr. J. E. Harting remarked that the case was not an isolated one, instances of buzzards rearing chickens having been previously recorded (*Zool.*, 1881, p. 103), as well as several cases of eagles hatching goose-eggs and rearing the goslings (NATURE, April 1879, and *Field*, February 1896).—Messrs. H. and J. Groves exhibited specimens of *Nitella hyalina*, Agardh, a new British plant, and made some remarks on its affinities and distribution. Mr. W. Carruthers, F.R.S., and the President made some observations by way of comment.—Prof. H. Marshall Ward, F.R.S., read a joint paper by Miss Dale (Pfeiffer student of Girton College) and himself on *Craterostigma pumilum* (Hochst.), a rare plant which had been brought from Somaliland by Mrs. Lort Phillips. As it had flowered in the Cambridge Botanic Garden during the past summer, and ripe capsules and seeds were obtained, a complete description was possible.—The Rev. T. R. Stebbing, F.R.S., read a paper on "Amphipoda from the Copenhagen Museum and other Sources," in continuation of a former memoir on this subject (*Trans.* Linn. Soc., *Zool.*, vol. vii. part 2). Several new species and a few new genera were described.

Royal Microscopical Society, October 19.—Mr. E. M. Nelson, President, in the chair.—The President referred to a microscope made by Reichert, and exhibited by Messrs. Baker. It was designed for examining opaque objects; a reflector was fitted in the tube of the microscope, which threw the light down upon the object through the objective. This was an old idea revived, but in its present form it was said to be very useful in steel works for examination of fractures of the metal.—Mr. C. Beck exhibited four new students' microscopes, mounted upon true tripod stands.—Messrs. Watson and Sons exhibited another microscope, named the "Fram," specially designed for students' use.—The President exhibited an old microscope by John Cuff, of Fleet Street, date about 1760; and also an old French microscope, date about 1765. He then described some micro-rulings presented to the Society, and made by Mr. H. J. Grayson, of Melbourne; these were mounted in realgar, a medium possessing a refractive index of 2·5, which caused the lines to stand out with great distinctness. Two were micrometers and two were test plates. The micrometer rulings had been critically measured, and were found to be accurately and evenly spaced; and the test plates were beautifully ruled. There was also a specimen of ruling suitable for a diffraction grating. Mr. Grayson had likewise sent a number of slides of test diatoms mounted in realgar, and some mounted in styrax, for comparison. The slides showed no signs of crystallisation; they had stood the heat and rough handling in the post from Melbourne, and the great heat of the past summer; and Mr. Grayson said that, from the method adopted by him, there was no fear of crystallisation taking place.—A paper by Mr. J. Newton Coombe, "The Reproduction of Diatoms," was read by the Secretary, and was illustrated by a series of lantern slides. Mr. Bennett said the paper appeared to throw a new light on the various modes of reproduction, and seemed to point to the removal of the diatoms from the Protophyta to a position among the Conjugatae.—Part iii. of Mr. Millett's "Report on the recent Foraminifera of the Malay Archipelago" was taken as read.

MANCHESTER.

Literary and Philosophical Society, October 18.—J. Cosmo Melvill, President, in the chair.—Mr. J. J. Ashworth exhibited a plant and cobs (both ripened and immature) of Indian corn (*Zea maïs*) grown at Wilmslow, Cheshire. Mr. Charles Bailey made some observations on the exhibits, remarking especially on the inflorescence and fructification of the plant, and on its geographical distribution.—The President communicated a paper by Mr. Peter Cameron, entitled "Hymenoptera Orientalia, or contributions to a knowledge of the Hymenoptera of the Oriental zoological region," Part viii. The author described a large number of new genera and species of hymenopterous insects from the Khasia Hills in the Eastern Himalayas, a district which has not hitherto been worked for its Hymenoptera. The specimens were collected by the natives, some of whom make excellent collectors, but who mostly confine their attention to large or medium-sized species. That the species inhabiting this region must number many thousands, is evident from the fact that in the comparatively small district of Sikkim there are found about 600 species of butterflies and (probably) thousands of moths.

EDINBURGH.

Mathematical Society, November 11.—Mr. J. B. Clark, President, in the chair.—Mr. George Duthie communicated a paper on "Systems of circles analogous to Tucker's circles," by Mr. J. A. Third, and Mr. W. L. Thomson read a paper on the "Geometrical theory of the hyperbolic functions."—On the motion of Prof. G. A. Gibson, a committee was appointed to consider the treatment of proportion in elementary mathematics.—The following were elected office-bearers for the current session:—President: Dr. Alex. Morgan. Vice-President: Mr. R. F. Muirhead. Hon. Secretary: Mr. J. W. Butters. Hon. Treasurer: Mr. F. Spence. Editors: Mr. John Dougall, Mr. Charles Tweedie, Dr. C. G. Knott. Committee: Messrs. J. D. H. Dickson, Geo. Duthie, and A. Lindsay.

PARIS.

Academy of Sciences, November 14.—M. Wolf in the chair.—Observations of the meteor swarm, by M. Loewy. Owing to the unfavourable weather, on the nights of November 10 and 11 only two meteors belonging to the group of Leonids were observed.—Observations on the sun, made at the Observatory of Lyons with the Brunner equatorial during the second quarter of 1898, by M. J. Guillaume. The results are given in three tables, showing mean area of spots, and their distribution in latitude and longitude respectively.—On the development of uniform functions in Taylor's series, by M. Émile Borel.—On an indeterminate equation, by M. Carl Störmer.—On the production of crystallised tungsten by electrolysis, by M. L. A. Hallopeau. The electrolysis of lithium paratungstate gives metallic tungsten in a well crystallised state. The corresponding sodium and potassium salts yield only tungsto-tungstates on similar treatment.—Volumetric estimation of boric acid, by M. Copaux. The method used is developed from those proposed by Gasselin, R. Thomson, and Barthe, the titration being carried out in presence of alcohol and glycerol, helianthin and phenolphthaleïn being used as indicators. The analyses of borax and ethyl borate quoted are very satisfactory.—New halogen derivatives of guiacol and veratrol, by M. H. Cousin. Trichloro-guiacol, dibromoguiacol, tetrabromoguiacol, trichloroveratrol and tribromoveratrol have been prepared and described.—On a new sugar accompanying sorbite, by MM. Camille Vincent and J. Meunier. When sorbite is crystallised from aqueous solutions, the new sugar remains in the mother liquors. These are then fermented by the sorbose bacterium, which oxidises the residual sorbite, and the sugar is then extracted from the syrup by benzaldehyde in presence of sulphuric acid. The sugar obtained from this is an octite, $C_8H_{18}O_8$, and has not been crystallised. A comparison of its properties with those of sorbite shows that the substances are quite distinct.—Derivatives of natural methylheptenone, by M. Georges Leser. The reaction between sodium, acetic ether, and natural methylheptenone has been studied, and a condensation product $C_{16}H_{26}O$ isolated and analysed.—Volumetric analysis of acetaldehyde, by M. X. Rocques. The results obtained by the method previously given by the author have since been found to vary with the temperature. To obtain exact results it is necessary to carry out the reaction in closed vessels at 50° C.—Estimation of diabetic sugars by the polarimeter, by the reduction coefficient, and by fermentation, by M. Frederic Landolph. The author distinguishes three classes of diabetic sugars, which are clearly indicated by the relations existing between the amount of Fehling's solution reduced, the rotatory power, and the amount of carbon dioxide produced on fermentation.—Some general preliminary conclusions on humic coals, by M. C. Eg. Bertrand.—On the mode of formation of indigo in the methods of commercial extraction, by M. L. Bréaudat. The suggestion that micro-organisms play a part in the indigo fermentation, would appear to have no foundation. The plant especially studied, *Isatis alpina*, contains a hydrolysing diastase and an oxydase. In presence of water, the former splits up indican into indigo-white and indiglucin, and the latter oxidises the indigo-white in presence of an alkali to indigo.—On the absorption of the halogen salts of potassium by plants, by M. E. Demoussy. Plants growing in solutions containing potassium chloride, at first rapidly absorb the salt, but this absorption slows down and finally ceases. Sodium bromide is also absorbed, but not the iodide.—Researches on lesions of the nervous centres produced by experimental hyperthermy, by M. G. Marinesco.—On early lesions of the nervous centres in hydrophobia, by M. V. Babes. Hydrophobia produces cellular and vascular lesions of the grey matter, which can be made out one or two days before the appearance of the first rabic symptoms.—Observations on the general course of histogenesis and organogenesis, by M. J. Kunstler.—On burrowing in the Homaridae and Thalassinidae, by M. Georges Bohn.—On the development of some species of *Trochus*, by M. A. Robert.—Absorption of carbohydrates by roots, by M. Jules Laurent. A maize plant will grow and gain weight in an atmosphere free from carbon dioxide, if supplied with glucose. Sunlight, however, is necessary for this assimilation.—On the vertebrate layer of the asphalte mines of Pyrimont (Savoy), by M. Ch. Depéret.—On the green ray, by M. L. Libert. Notice of the appearance of this phenomena at Sainte-Adresse.

NEW SOUTH WALES.

Linnean Society, September 28.—Prof. J. T. Wilson, President, in the chair.—On the mountain ash of Southern New South Wales, by Henry Deane and J. H. Maiden.—On two new species of *Eucalyptus* from New South Wales, by R. T. Baker. Two well-defined species, remarkable for the chemical constituents of their oils, belonging to the group Renantherae, and known vernacularly as "Silver Top Stringybark" and "Messmate" respectively, are recorded in this paper. For the first of the two the name *E. laevopinea* is suggested because the oil obtained from the leaves consists largely of pinene which is *laevo-rotatory*, and the name *E. dextropinea* is proposed for the second species owing to the oil consisting largely of pinene, which in this case is *dextro-rotatory*. In both the specific rotation is greater than in the well-known pinenes obtained from the Coniferae, although chemically identical.—A description of certain objects of unknown significance, formerly used by some New South Wales tribes, by Walter R. Harper.—Mr. W. W. Froggatt exhibited a twig from a fruit-tree obtained near Sydney, which had 150 eggs of an undetermined grasshopper attached to it in a double row; also a number of the newly-hatched young insects. These were of interest because of their remarkable resemblance to a common ant (*Iridomyrmex purpureus*, Sm.), which is plentiful in the orchards and bush about Sydney, hunting over the trees for food. It seems probable that this may be a case of protective mimicry, the grasshoppers perhaps being protected against the attacks of insectivorous birds, and the ants also deceived.—Mr. J. Mitchell, of Newcastle, forwarded a brief note announcing his discovery of the print of an insect's wing in the shale overlying the Yard Seam of coal at the base of Flagstaff Hill, Newcastle. There was, he believed, no previous record of the presence of insect remains in rocks of the Permo-Carboniferous Age in New South Wales. He hoped to be able to exhibit the specimen at a future meeting.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.30.—Preliminary Note on the Spectrum of the Corona: Sir J. Norman Lockyer, K.C.B., F.R.S.—On the Condensation Nuclei produced in Gases by the Action of Röntgen Rays, Uranian Rays, Ultra-Violet Light, and other Agents: C. T. R. Wilson.—The Origin of the Gases evolved on Heating Mineral Substances, Meteorites, &c.: Dr. M. W. Travers.—Memoir on the Theory of the Partitions of Numbers: Part 2: Major MacMahon, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Rotatory Converters: Prof. S. P. Thompson, F.R.S.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY, at 5.—On the Properties of Liquid Mixtures: R. A. Lehfeldt.—On certain Diffraction Fringes as applied to Micrometric Observations: L. N. G. Filon.

MONDAY, NOVEMBER 28.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Year on Christmas Island: Chas. W. Andrews.

IMPERIAL INSTITUTE, at 8.30.—Gold-Mining in Victoria: Ernest Lidgey.

SOCIETY OF ARTS, at 8.—Acetylene: Prof. Vivian B. Lewes.

INSTITUTE OF ACTUARIES, at 5.30.—Inaugural Address by the President, H. W. Manly.

TUESDAY, NOVEMBER 29.

ZOOLOGICAL SOCIETY, at 8.30.—Further Notes on the Amazonian Lepidosiren: Dr. E. A. Goeldi.—On the Anatomy of Adult and Foetal Specimens of *Pedetes caffer* as compared with that of the *Dipodidae*: F. G. Parsons.—On a New Species of Spiders from Trinidad, West Indies: F. O. Pickard-Cambridge.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Effect of Subsidence due to Coal-Workings upon Bridges and other Structures: Stanley Robert Kay.

WEDNESDAY, NOVEMBER 30.

SOCIETY OF ARTS, at 8.—Photographic Developers and Development; C. H. Bothamley, F.R.S.

THURSDAY, DECEMBER 1.

LINNEAN SOCIETY, at 8.—On the Biology of *Agaricus velutipes*, Curt.: R. H. Biffen.—On the Gastric Glands of the Marsupialia: Jas. Johnstone.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—The Oxidation of Polyhydric Alcohols in presence of Iron: H. J. H. Fenton and H. Jackson.

FRIDAY, DECEMBER 2.

GEOLOGISTS' ASSOCIATION, at 8.—Contributions to the Geology of the Thame Valley: A. M. Davies.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Sunlight Gold-bearing Reef, Lydenberg, Transvaal: Charles Benjamin Saner.

QUEKETT MICROSCOPICAL CLUB, at 8.

BOOKS, PAMPHLET, SERIALS, &c., RECEIVED.

BOOKS.—Deutscher Botaniker-Kalendar für 1899 (Berlin, Borntraeger).—Symbolae Antillanae seu Fundamenta Florae Indiae Occidentalis: edidit I. Urban, Vol. 1, Fasc. i. (Berlin, Borntraeger).—Society for the Promotion of Engineering Education: Proceedings of the Fifth Annual Meeting (Lancaster, Pa.).—Transactions of the American Pediatric Society, Ninth Session (New York).—Psychologische Untersuchungen über das Lesen: B. Erdmann and R. Dodge (Halle, Niemeyer).—Animals of To-day, their Life Conversation: C. J. Cornish (Seeley).—Colour in Nature: Dr. M. I. Newbigin (Murray).—Among the Celestials: Captain F. Younghusband (Murray).—The Five Windows of the Soul: E. H. Aitken (Murray).—Australian Legendary Tales: collected by K. L. Parker (Nutt).—More Australian Legendary Tales: collected by K. L. Parker (Nutt).—From Sphinx to Oracle: A. S. White (Hurst).—Essai d'une Philosophie Nouvelle: L. Ribert (Paris, Alcan).—Pflanzen-Geographie auf Physiologischer Grundlage: Prof. A. F. W. Schimper (Jena, Fischer).—Quick and Easy Methods of Calculating: R. G. Blaine (Spon).—The Story of Geographical Discovery: J. Jacobs (Newnes).—Text-book of Algebra: Drs. Fisher and Schwatt, Part 1 (Philadelphia, Fisher).—Monographieen Afrikanischer Pflanzen Familien und Gattungen: i. A. Engler; ii. E. Gilg (Leipzig, Engelmann).

PAMPHLET.—Experiments on the Pressures and Explosive Efficiency of Mixtures of Acetylene and Air (Leeds, Jowett).

SERIALS.—Atlantic Monthly, November (Gay).—Proceedings of the Royal Society of Victoria, Vol. xi. Part 1 (Melbourne).—Proceedings of the Indiana Academy of Science, 1897 (Indianapolis).—Journal of the Franklin Institute, November (Philadelphia).

Public School Protractor Scale (Macmillan).

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