Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE


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VOLUME LXXXVIII

NOVEMBER, 1911, to FEBRUARY, 1912

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

RICHARD CLAY & SONS, LTD.,
BRUNSWICK STREET, STAMFORD STREET, S.E.,
AND BUNGAY, SUFFOLK.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 2, 1911.

ARISTOTLE AS BIOLOGIST.

The Works of Aristotle, Translated into English. De Generatione Animalium. By Prof. A. Platt. Price 7*s.* 6*d.* net. De Partibus Animalium. By Dr. W. Ogle. Price 5*s.* net. Vol. iv., Historia Animalium. By Prof. D'Arcy W. Thompson. Price 10*s.* 6*d.* net. (Oxford: Clarendon Press, 1910–11.)

THE biological treatises of Aristotle are one of the chief marvels of antiquity. Remarkable in themselves for the evidence they give of the extraordinary powers of observation and reasoning possessed by their industrious author, they become truly astonishing when considered as only a comparatively small part of the life-work of a philosopher who entered profoundly into every department of human knowledge. The view has sometimes been entertained that after all Aristotle in his physical treatises was a mere copyist, that these works are rather of the nature of a literary compilation from sources now mainly lost than a record of original research and observation. A moderately careful study of, say, the "History of Animals" is sufficient to show that this is an error. Aristotle had undoubtedly made himself acquainted with what we should now call the "literature of the subject," and when it seems necessary he quotes from earlier writers. But it is not his way to borrow their statements uncritically. If Herodotus or Ctesias makes what he considers to be a mistake, he does not hesitate to say so. Moreover, the "History" teems with what are beyond all reasonable doubt good first-hand observations derived from actual dissection.

That errors should be numerous is only what might be expected considering the necessary limitations to research in the fourth century B.C. But it must be allowed that in his zoological and physiological speculations Aristotle displays reasoning powers of the highest order, and indeed it is often difficult to see that with the only data open to him he could have come to any sounder conclusions. It is curious that in the case of the strange phenomenon of hectocotylisation in the dibranchiate cephalopoda the Greek fishermen were right and Aristotle was wrong. But even here, as Prof. Platt remarks, he seems justified on the evidence before him. He could see no connection of the hectocotylised arm with the vasa deferentia, and "it is no wonder that he thought this decisive against the theory of the fishermen. He only deserves credit for doing so."

But in spite of this and many other errors perhaps equally excusable, it is undeniable that the three treatises before us contain an immense amount of accurate observation and skilful reasoning. Speaking of the "De Generatione Animalium," Prof. Platt says with truth, "should any man of science come fresh to the reading of this treatise, he will, I think, be amazed and delighted to see what grasp and insight Aristotle displays in handling questions which still absorb us after all the time" that has since elapsed.

The question of the dates of the composition of these books is of considerable interest in its bearing on Aristotle's more strictly philosophical work. Prof. D'Arcy Thompson lays stress on the frequency of reference in the "History of Animals" and other Aristotelian writings to the island of Lesbos and places near it. From this and other evidence he inclines to the view that Aristotle's natural history studies were carried on, or mainly carried on, between his two periods of residence in Athens, for during this interval he is known to have lived for two years in Mitylene, before his summons to the Court of Philip to undertake the tutorship of Alexander. Mr. Warde Fowler, on the other hand, thinks it probable that the "History" was at any rate begun in early life, the foundations being no doubt laid during his boyhood at Stageirus.

"This little town," as Mr. Fowler points out, "is placed in a most favourable position for a naturalist. It lies on a sea abounding in fish; above it rise the wooded heights of the eastern coast of the Chalcidic peninsula on which it stands; only a few miles distant is the river Strymon, which was so famous for water- and marsh-loving birds, as to give its name as a perpetual epithet to at least one species ['Strymoniæ grues']. Straight across the sea from Egypt and the Soudan came, and still come, every spring, multitudinous armies of migrating birds; they rest awhile about these rivers of the Thracian coast,

and then pursue their way northwards, crossing the Balkan Mountains into the plains of the Danube and Russia, to return again in the autumn. And, of course, for an inquiring naturalist a seaport town is always a desirable place, for here come sailors from foreign lands with tales of strange birds and beasts and plants, specimens of which they sometimes bring home with them. . . . We may be sure that young Aristotle was quick to profit by these chances."

Whatever may have been the point in Aristotle's career at which the "History" was projected, there can be little doubt that he was always taking such opportunities as offered for making additions and corrections. It is also reasonable to suppose that the book as we have it may contain annotations by some of his pupils. The treatises "De Partibus" and "De Generatione" are shown by internal evidence to be later as a whole than the "History."

The present excellent translations will serve, it may be hoped, to induce many students of the history of biological knowledge to undertake an examination at first hand of the works of this great scientific pioneer. Aristotle suffers little by intelligent translation, for his excellence lies in the matter of his writings rather than in their form. "The author himself," as Prof. Platt justly observes, "would have been the last man in the world to complain of any sacrifice of graces of style." Though the translators have no doubt nearly always succeeded in "representing as exactly as possible what Aristotle said or meant to say," it must not be supposed that they have denied themselves the use of good and vigorous English. Dr. Ogle's translation of the "De Partibus" in especial (a revision of his former well-known version) is admirable as a piece of literary workmanship. The notes of all three translators are good and useful so far as they go; but to produce a completely annotated edition of Aristotle's biological works in the light of modern knowledge would be a task from which the boldest might shrink. The typography and general get-up of these volumes are all that could be desired, and are worthy of the reputation of the Clarendon Press. It should always be remembered with gratitude that their publication is due to the generous provisions of the will of the late Prof. Jowett. F. A. D.

SOUTH AFRICAN ORCHIDS.

Icones Orchidearum Austro-Africanarum Extra-Tropicarum; or, Figures, with Descriptions of Extra-Tropical South African Orchids. By Dr. Harry Bolus. Vol. ii., pp. vi+200+100 plates. (London: Wm. Wesley and Son, 1911.) Price 2*l.* 2*s.* net.

TO Dr. Bolus's many botanical friends this volume, his last contribution to South African orchidology, has a special interest. Its production was the ostensible motive of his frequent journeys home during the past few years, and the revision for the press of its last few pages was completed on the eve of his death, which occurred shortly after his arrival in England early in the summer of the present year. The copies of his book, distributed by his niece and co-worker, Miss H. M. L. Kensit, are a fitting memento of the author and of the important influence he exerted on the progress of botanical exploration in South Africa.

Bolus's botanical work was not confined to the study of the orchids. His wide and critical knowledge of the heaths is embodied in his contribution on that family in the "Flora Capensis"; and his extensive herbarium, which now passes to the South African College, bears witness to his general knowledge of the flora. But he will probably be best known for his careful study of the orchids, the results of which are embodied in various papers, but especially in the volume on the "Orchids of the Cape Peninsula" and the two volumes of the "Orchids of South Africa," the second of which is the subject of this notice.

The plan of the book is uniform with that of vol. i., which appeared in two parts (1893 and 1896 respectively). Excepting a few double plates and one on which are figured two species of Mystacidium discovered by, and dedicated to, Miss Alice Pegler, of Kentani, each of the hundred plates is devoted to one species; and the text consists of a corresponding number of quite separate technical descriptions. A characteristic feature is the duplication of each description in Latin and English. The distribution of each species is indicated by a citation of localities with collectors' names and numbers, and an indication is given of the source or sources from which the actual specimens figured were derived. The great majority of the plates were drawn from living specimens by Dr. Bolus himself, and the noting on the plate of the exact date at which the drawing was made shows that the material for the volume had been accumulating for more than twenty years. The extended period of preparation accounts for a slight want of uniformity of treatment. A few of the plates are in black and white; in the greater number, however, colour is used in proportions varying from the tinting of a simple leaf or flower to the full-blown coloured plate, such as that of *Disa uniflora* (plate 63). All are alike admirably clear, and include, in addition to the habit illustration, careful detailed drawings of the parts of the flower.

The species figured and described represent nineteen genera, but a large proportion are included in the typically South African genera, Disa, Satyrium, and Eulophia. Some are well-known species; a good proportion were discovered and have been previously described by Dr. Bolus, while a few, such as *Eulophia Pillansii* and *Mystacidium Aliciae,* are described here for the first time. Some are of special interest as representing rediscovered species. For instance, *Disa Telipogonis,* Reichenb. f., a remarkable little plant found by Berg on the summit of Table Mountain in 1816, was rediscovered in the same locality by Miss Kensit in 1904. The only other record of its occurrence was from the mountains in the Wellington district, where Dr. Schlechter found it in 1896, at a somewhat lower elevation.

A pleasing feature of Dr. Bolus's work is the readiness with which he gives credit wherever possible to those who have helped in his work either by sending specimens, or with their critical knowledge. Among these helpers may be mentioned, besides Miss Kensit, Dr. Schlechter, whose knowledge of the Cape orchids was perhaps second only to that possessed by Dr. Bolus, and Miss Alice Pegler, who has done good work

in the botanical exploration of the Kentani district, and to whom are dedicated the two new species of Mystacidium figured—her own discoveries. To these and others Dr. Bolus gives grateful recognition in his introductory note.

An index comprising a list of species and synonyms is placed at the end of the text matter, and a good portrait of the author as a frontispiece is a pleasing addition. A. B. R.

THE STUDY OF FIELD CROPS.

Southern Field Crops (exclusive of Forage Plants). By Prof. J. F. Duggar. Pp xxvii+579. Rural Text-book Series; edited by L. H. Bailey. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 7*s.* 6*d.* net.

AT a certain stage in his studies the agricultural student is called upon to consider crop-growing in its economic aspects, and he soon finds himself in a wide and rather indefinite field, where, in theory, his chemistry, botany, entomology, &c., ought to meet, and where the bearing of all the sciences on practical agriculture ought to be made manifest. In theory the student is to be directed in his studies of this branch of the subject by a man whose attainments in these several sciences is beyond reproach, and who has also a first-hand acquaintance with the economic problems involved. But in practice this ideal combination is never attained, and consequently the study of field crops goes in with agriculture, and is left entirely to the empiricist, no man of science having set up any claim to deal with them from the economic point of view.

Like other teachers of agriculture, Mr. Duggar is an empiricist; but he is an enlightened one, and makes liberal use of the data accumulated by his *confrères* on the science side. He deals, as one would expect, very fully with maize and cotton, to each of which some ten chapters are devoted, the rest of the book being occupied with the less common crops—wheat, oats, sorghum, rice, &c. The usual arrangement of the subject-matter is to begin with the structure of the plant; then to pass on to its races and varieties, the methods of breeding or improvement, the soils and fertilisers best adapted, the appropriate tillage and cultivation, and finally the insect and fungoid pests. Thus the whole field of science is covered, from chemistry and botany to entomology.

Considering how much such a task is beyond the powers of any one man, Mr. Duggar has done remarkably well. The purist in method, of course, might object to the empirical treatment of the subject, and feel dissatisfied with the numerous bald statements, such as "Insect pests [of oats] are the same as those of wheat, except that the oat is not attacked by the Hessian fly," just as the purist in language (and many others as well) might object to another statement—"*ensilage* is the verb, as 'to ensilage corn,' with the accent on the middle syllable." But these difficulties are inherent in the subject, and it would be unreasonable to judge the book from a point of view other than that from which it was written and will probably be used.

For in the meantime, while he is waiting for the true scientific treatment of crop husbandry to be developed, the student needs some one book in which he can find collected all the information he wants about ordinary crops. He is more concerned with the facts themselves than with their bearing on one another or on any central hypothesis. From this point of view Mr. Duggar's book is very good; there has obviously been a great deal of work expended in collecting the facts, and the references to the literature at the end of each chapter, if not entirely satisfying to the man of science, will at any rate put the student in touch with other work on the subject. In the present state of our knowledge the collection of the facts relating to the growth of crops is extremely necessary for further progress, and Mr. Duggar has contributed material that will be found distinctly useful.

As in the other members of this series, the book is well illustrated, and the pictures are well chosen, there being remarkably few of the ordinary useless field views. "An honest book," Dr. Bailey calls it in his introduction; ". . . these makers of observation text-books, that present the crops and the animals in their real and living details, will set going a great quiet movement to examine minutely the conditions of agricultural failure and success." E. J. RUSSELL.

PROPERTIES OF MATTER.

General Physics for Students: a Text-book on the Fundamental Properties of Matter. By E. Edser. Pp. ix+632. (London: Macmillan and Co., Ltd., 1911.) Price 7*s.* 6*d.*

IT is not often that a text-book, published under a familar title, presents so many novel and valuable features as Mr. Edser's latest production, "General Physics for Students." It is scarcely too much to say that with regard to contents and general mode of treatment the book forms a class for itself. By the collection of so much fresh material into one volume, Mr. Edser has made accessible to students many parts of physics, which, either from lack of time or initiative, they have hitherto been unable to appreciate. This has been done in no meagre fashion, the details, both experimental and theoretical, being consistently of a very comprehensive character.

The very care which has obviously been bestowed upon the work in order to suit it to the needs of students has, we think, been the cause of the one unfortunate feature of the book. This is the avoidance of the use of calculus notation—a procedure which the author seeks to justify in the preface. There is undoubtedly much to be said for such omission in the case of junior students whose teaching involves but rare recourse to calculus methods; but to continue the practice through a book of this kind is open to grave objections. The students who use the book may be divided into two classes—those sufficiently acquainted with calculus notation and methods, and those ignorant of them. The former class are liable to become annoyed at the repeated integration from first principles of the same function; the latter class may become accustomed to regard the laborious processes given as essential parts of the problems in

question. The author's reasons for following this method are not apparent, but we are tempted to believe that it is in order to conform with the regulations of the University of London, which still insist that the pass degree in physics should be obtainable without a knowledge of the calculus.

The earlier chapters of the book are devoted to the principles of mechanics, special attention being paid to oscillatory and gyrostatic motion. The simpler parts of the subject seem somewhat curtailed, but that is, perhaps, excusable in view of the very comprehensive nature of the book. Following chapters on gravitation and elasticity, we find surface tension very fully treated, and it is noticeable that the author very properly points out the inaccuracy of the statement often made, that the surface tension is equal to the surface energy per unit area. Chapters xi. to xiv. introduce subjects the inclusion of which renders this book unique. The author deals in a simple yet detailed and exact manner with the motion of fluids, including applications to the properties of vortex filaments and the waves on the surfaces of liquids. In the concluding chapter there is also to be found much that is new from the student's point of view. The consideration of the kinetic theory of gases is more complete in many respects than that which has usually been given, particularly with respect to the influence of the finite size of the molecules and the various methods of estimating their size and number.

As in Mr. Edser's other books in this series, the printing is excellent, and the heavy type used in the more important statements is very desirable. Good figures and diagrams form another pleasing feature. A wealth of examples (to which answers are given) should enable the student to become thoroughly acquainted with the principles described, and there is little doubt that the book, both from its general excellence and unique features, and notwithstanding the calculus methods referred to, will become almost indispensable to the students of physics.

MARINE ENGINES.

Marine Engine Design, including the Design of Turning and Reversing Engines. By Prof. Edward M. Bragg. Pp. 172. (London: Constable and Co., Ltd., 1911.) Price 8*s.* net.

IN this small book the author has endeavoured to describe methods by which the

"detailed design of the principal parts of marine engines can be determined, and has concentrated the results of several years of experience in teaching the subject of marine engine design to students of the University of Michigan."

Within these modest limits the volume should prove useful as a class-book for students, although it cannot be admitted that Mr. Bragg is accurate in the opinion, expressed in his preface, that

"most of the text-books on the subject of marine engines deal only in a general way with the subject of design, and particularly . . . as referring to the numerous coordinating parts of the modern marine engine."

On the contrary, many excellent text-books exist—in English, French, and German—which contain full discussions of design of details for marine engines and numerous examples drawn from actual practice. The distinctive feature of the book under review is really found in its exclusive devotion to details of design, whereas preceding text-books have been more comprehensive in scope, and as a consequence are larger and more expensive.

Prof. Bragg confines attention to marine engines of reciprocating types; he leaves untouched problems connected with steam turbines as applied to ship-propulsion, although these are undoubtedly of primary importance in present circumstances. Rules and specimen calculations are given for determining the dimensions of cylinders, the "cut-off" in the admission of steam, the length of stroke, and other particulars for engines of specified powers and given rates of revolution. Steam speeds, valve diagrams, valves, and valve-gear are treated at considerable length. Attention is directed also to methods for calculating the strengths of many of the principal fixed and moving parts of reciprocating marine engines; in some cases the rules for details of marine engines issued by the principal societies established for the survey and classification of merchant shipping are reproduced.

The last two sections of the book contain a full discussion of the details of design for auxiliary engines fitted for the purpose of turning the crank-shafts over—when valves are being set or when the main engines are being overhauled—and of designs for small engines used for reversing the main engines in steamships. About one-sixth of the total space in the volume is devoted to these subjects, although they are unquestionably of less relative importance than must be assigned to other matters, to which less attention has been devoted by the author. His hope and expectation, as expressed in the preface, are that by keeping the book "free from the descriptive part of the subject it will fill a decided void" and be "much more readily available" than other text-books "for the particular use for which it is intended." The majority of students will, in all probability, favour the use of text-books which are less restricted in aim, and are richer in descriptions and illustrations of various types of engines. This opinion, however, in no sense reflects on the manner in which the author has done his work; and, of course, he is entitled to form and act upon his own estimate of the kind of text-book likely to prove of most service to students of marine engineering. W. H. W.

OUR BOOK SHELF.

Puppets: a Work-a-Day Philosophy. By George Forbes, F.R.S. Pp. ix+183. (London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

THIS is a philosophical sketch, or skeleton, clothed upon with the human interest of a story. A party of happy and well-to-do people are staying at a Scottish castle, and James Gordon expounds to them his philosophical views. These are of the idealistic kind, which may roughly be called Berkeleyan, and Gordon develops them very ingeniously, making some use of the modern psychological doctrine of the subconscious. All our knowledge of the world is a mental knowledge; all "things" are *thoughts* or, at least, cannot

be proved to be anything further. But this does not destroy anything of importance, or reduce cosmos to chaos, as "common-sense" might suppose. The world of each one's experience is real enough in each one's own mind, and there is no gain in attributing to it any material kind of reality. The concordance, in a general way, of my experience with your experience, is explained by supposing a universal-thinking or dominant Self who is thinking the world. Or, as Berkeley would say, the universe exists as the thought of God.

Our human selves are greater than their present manifestations. For educative purposes, each of us has been given a puppet to work and manage (our bodies, namely), and we can only express ourselves very inadequately through this dull mechanism. Indeed, some of the faculties we are proud of are the results of our limitations—for instance, reasoning. "There is simply no limit to what the mind can think of were it not spoilt by reasoning." Witness the marvellously accurate movements of the fingers in piano-playing, movements which must be supposed to be controlled by intelligence, but which certainly could not be performed at that speed if the slow consciousness had to superintend every muscle-twitch. Similarly with calculating prodigies, who multiply six figures by six figures, not in the way we multiply, but by a sort of instinct.

This philosophy, of course, includes some kind of immortality, for, though the body-puppet dies, the self which worked it is not thereby rendered any less alive; and it goes on experiencing, in other forms, probably not spatial and temporal.

The psychology of the book is quite admirable, and even its farthest-reaching speculations (which are put forward as such, and not as dogmas) are logical and justifiable, from the idealist's point of view. And the philosophic pill is nicely sugared with two love stories which end as happily as the most benevolent reader could desire. J. A. H.

The Relative Volumes of the Atoms of Carbon, Hydrogen, and Oxygen, when in Combination. By Hawksworth Collins. Pp. 107. (London: Morton and Burt, Ltd., 1911.) Price 7*s.* 6*d.*

THE author's views on the volume relations of the atoms in chemical combination differ fundamentally from those of previous observers. The present book deals exclusively with liquids containing carbon, hydrogen, and oxygen. At 15° and atmospheric pressure an atom of hydrogen, when in combination with an atom of carbon, occupies one of four relative volumes, viz., 15·25, 12·22, 9·95, and 5·76. The volume of any one atom of hydrogen is determined by the portion of the carbon atom to which it is attached. There are four portions of the carbon atom, corresponding with the valencies, and the theory implies that the valencies are unequal. The relative volume of the carbon atom is generally 0·71, but in certain circumstances expands to 8·0. From this it follows that the volume of a hydrogen atom may be twenty times that of a carbon atom. Oxygen has three volumes, 2·51, 4·45, and 7·53, depending on the nature of the compound and the position of attachment to the carbon atom.

This remarkable theory of atomic volumes is explained within the limits of four pages, and the remainder of the book is occupied with the graphic formulæ of 100 organic compounds (alcohols, ethers, &c.). In these formulæ the carbon atoms are represented as oblongs divided into four portions, and the positions of attachment and the relative volumes of all the atoms are shown.

The author states that "the theoretical and experimental specific gravities never differ by more than 0·001, although different experimentalists seldom agree to more than two places of decimals." It is difficult to see how these statements can be reconciled. Moreover, the author has the choice of nine volumes for the three elements, whereas Kopp obtained a fair agreement between observed and calculated values for molecular volumes at the boiling point with one volume each for carbon and hydrogen and two volumes for oxygen; it is evident, therefore, that an agreement between observed and calculated values on the former basis can scarcely be regarded as conclusive evidence in favour of the author's theory. The theoretical discussion of the subject is quite inadequate, and it is to be hoped that some of the more obvious omissions will be repaired in the later volumes on the subject which are promised.

Forest Flora of the Siwalik and Jaunsar Forest Divisions of the United Provinces of Agra and Oudh, being a revised and enlarged edition of the Forest Flora of the School Circle, N.W.P., with Analyses, compiled for the use of the Students of the Imperial Forest College, Dehra Dun. By U. Kanjilal. Pp. xxix+457. (Calcutta: Government Printing Office, 1911.) Price 1.14 rupees for public; 1.4 rupees for students.

TEN years have elapsed since the first edition of the "Forest Flora of the School Circle, N.W.P.," was published; meantime the division of the School Circle has received other names for both forest and administrative purposes, which are given in the revised title, and the author has noted certain alterations and emendations that are desirable. The glossary has been revised, family names have been changed in accordance with the Vienna rules, an important addition has been made in the shape of an analytical synopsis of the orders and families which provides ampler details for their determination, and a general revision of the flora has been effected. The teaching experience of the author has suggested but few changes in the list of species described. Only two of the additional species incorporated are trees, *i.e. Diospyros Kanjilali* and *Linociera intermedia*; the former was described in 1905 by Duthie from material supplied by the author. These alterations will serve to increase the usefulness of this pocket flora.

Wilson's Folding Globe. Circumference 40 inches. (London: George Philip and Son, Ltd.) Price 7*s.* 6*d.* net, in cardboard box.

THIS ingenious device will prove of excellent service to teachers of geography in assisting them to correct the misleading ideas which are apt to arise in the minds of young pupils by the exclusive study of flat map projections. The mere fitting up of the globe, with the aid of the simple accessories provided, will impress upon the beginner the distortion entailed by the representation of a spherical surface on a plane. When placed flat, the "gores," which when arranged form the globe, make up an equal scale map of the world. There is sold with the folding globe a map of the world on Mercator's projection, so that a proper understanding of its advantages and disadvantages may be secured by comparing it with the equal scale map.

A Text-book of Geography. By G. Cecil Fry. Second edition. Pp. xxi+468. (London: W. B. Clive, University Tutorial Press, Ltd., 1911.) Price 4*s.* 6*d.*

THE first edition of this book was reviewed in NATURE for March 11, 1909 (vol. lxxx., p. 31). In the present edition more than thirty new maps and diagrams have been added, as well as a number of climatic data for the principal divisions of the world. A new appendix of some 350 examination questions has been introduced.

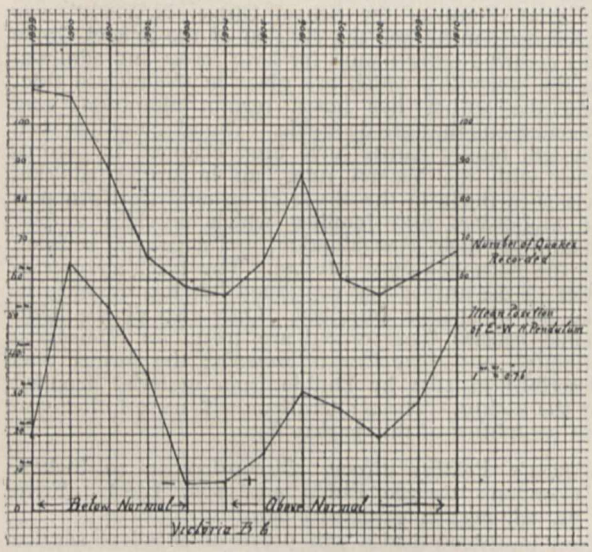
LETTERS TO THE EDITOR.

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

Irregular Long-period Changes in Level.

AT the Portsmouth meeting of the British Association Mr. F. Napier Denison contributed a paper on changes in level observed with a horizontal pendulum at Victoria, B.C. Observations commenced in January, 1899, and extended over the next eleven years. For the most part these refer to changes in level in an east-west direction. Like observers in other parts of the world, he found diurnal, annual, and other changes, all of which can be referred to epigenic influences.

Over and above these Mr. Denison pointed out that the pendulum did not annually return to its normal position; for irregular periods varying between twelve and thirty months the zero might travel eastwards, after which it would make a greater or less excursion towards the west. But here comes the interesting point. A curve of these wanderings very closely agrees with one representing the annual frequency of world-shaking earthquakes, which



have been most numerous when the pendulum was farthest removed from its normal position, whether this was to the east or west. The accompanying curves by Mr. Denison are self-explanatory.

With the object of throwing further light on these observations it would be of interest to learn whether these long-period changes in level, and, I may add, in azimuth, have been recorded at observatories which have piers on rock foundations, particularly in districts where there is reason to suppose rock folding may still be in progress. Such observatories may perhaps be found in Switzerland, Italy, the Balkans, North India, and the American and Asiatic shores of the Pacific. I have not, however, been able to find a catalogue which gives information about the foundations of astronomical observatories.

An excellent *résumé* relating to changes in the vertical is given by Sir G. H. Darwin in a report to the British Association (1882). What is now required is a *résumé* since 1899, from which date we possess a fairly complete catalogue of world-shaking earthquakes, each of which, there is reason to suppose, may be regarded as the announcement of a general relief in seismic strain, and as one earthquake may beget another, they frequently take place in widely removed districts at about the same time. If a megaseism means a relief of strain in the crust of our world, can astronomers throw any light upon its growth?

All who are interested in earth physics would like to know whether evidences of long-period changes in the vertical exist, particularly in the direction of the dip of strata on which their observatories are situated.

Shide, Isle of Wight, England. JOHN MILNE.

Solar Eclipse—April, 1912.

A FEW years ago I read a short paper before the British Astronomical Association, in which I suggested that certain eclipse observations should be made, not at the centre line of the path of the shadow, but as near as possible to its two edges; and seeing that the forthcoming eclipse is unsuitable, on account of its short duration, for the usual observations, I hope that the astronomers of Europe will devote their attention to determining the position and width of the shadow. If they can do this with the exactitude which I anticipate, then, in a single day, full information will have been collected with which a profile of the earth's surface can be drawn along a line extending from Portugal through Spain, France, Belgium, Holland, Germany, and Russia to Siberia, which profile would have the advantage that it would be unaffected by local variations of gravity.

My suggestion is that enlarging cameras should be attached to the observing telescopes, and that images of the northern and southern edges of the sun and moon should be thrown on sensitive films, which would have to be moved in a north and south direction (say at the rate of 1 mm. per second). An observer stationed outside the shadow would obtain a negative image consisting of a black band with one gap at either edge; the horizontal (east and west) distance between the edges of these gaps would be the width of the chord on the sun's disc which is traversed by the moon's north or south edge; the vertical (north and south) distance between the gaps would represent the time taken in traversing this chord. An observer stationed inside the moon's shadow would obtain a negative image, which would be a black band crossed by a white "bend," the horizontal width of which would represent the length of the chord on the moon's disc traversed by the edge of the sun, and the vertical distance would represent the time taken in traversing this chord.

The length of the chord being known either by measurement or by calculation from the time, the overlapping of the northern or southern edges of the sun and moon could easily be calculated. The moon's apparent semi-diameter is about 1000″, and its actual semi-diameter about 1000 miles. If the enlargement be such that 1 mm. = 1″, then if one of the observers should find that the length of the chord is, say, 100 mm. on the film, equal to 100″, or 100 miles, then the amount of overlap is $50^2 : 2000 =$ 1·25 mm., ″, or miles, and he will know that he was stationed one and a quarter miles, or 2 kilometres, from the edge of the shadow. A more fortunate observer, who may obtain a length of chord of only 10 mm., would know that he was stationed at one-eightieth of a mile from the edge. If, as seems likely, the photographic records can be measured with an accuracy of one-fifth millimetre, then the latter observer will feel sure of his position to within one two-thousandth of a mile, or, say, to within 1 metre.

As the angle at which the shadow strikes the earth will nowhere be less than, say, 50°, it is evident that a small difference of level of only a few metres between two observers would make a perceptible difference in their photographic records, and these would, therefore, afford the means for accurately fixing their relative heights along a line extending from Portugal to Siberia. Future eclipses, both total and annular, would enable a network of such profiles to be determined not only across continents, but also across oceans. C. E. STROMEYER.

"Lancefield," West Didsbury, October 25.

Khartoum for an Observatory.

AT a time when search is being prosecuted in northern Africa (NATURE, September 21, p. 393) for an observatory site, it may not be out of place to direct attention to the merits of the Khartoum vicinity, so far as this can be done by one who is not an astronomer. Its features may be enumerated as follows:—

Position.—Latitude 15° 36′; it is some degrees nearer

the equator than Salisbury in Rhodesia. The importance of a low latitude has been illustrated by the success of Helwan Observatory in obtaining the earliest photograph of Halley's comet, owing to the longer night near Cairo in summer as compared with Greenwich or Heidelberg. This advantage would be still further marked in the case of Khartoum, some 14½° south of Helwan, or relatively about as far as Barcelona is from Edinburgh.

Altitude.—Precise determinations have been made by levelling, and the land near the river has been found to stand about 385 metres above sea-level.

Climate.—So far as I am aware, the "seeing" qualities of the atmosphere have not been tested. Ordinary experience shows that it is remarkably clear, and it is no uncommon thing near the Italian boundary in these latitudes to see Jebel Kassala (4400 feet) and some of the Eritrean hills at distances up to a hundred miles. These districts are at no great height above sea-level, and the clearness of vision must in large measure be due to the pureness and homogeneity of the air.

Relative humidity is a factor presumably of great importance as regards the "seeing" qualities of the air; and those interested may refer to Captain Lyons's "Physiography of the Nile and its Basin," where they will find the data for Khartoum and many other stations concisely summarised. More recent data are available in the annual meteorological reports, &c., published by the Egyptian Survey Department. Suffice it to say that the mean annual relative humidity is 31 per cent., and this figure is only exceeded for three months in the year. The Khartoum observations have been made within a short distance of the river, and no doubt the humidity results are higher than would have been obtained at a station a mile or two away. The air is often dry enough, even near the river, to desiccate moist calcium chloride. There are very few cloudy nights.

During the summer months violent dust-storms occur, but these are generally of short duration. Situated on the southern edge of the desert, it has a rainfall of about 6 inches a year, almost confined to the months of August and September. Temperature conditions are extreme, but owing to the intense dryness heat is seldom oppressive to the individual.

Communication.—Several mails a week carry letters to London in nine or ten days, and the outward journey can be done in eight and a half days. The railway to the Red Sea enables goods from outside to reach Khartoum with only a single handling at Port Sudan.

It seems improbable that there is any other locality in an equally low latitude offering the advantages of a clear, dry atmosphere combined with a fair altitude and such ready means of communication with European centres of learning. As an actual site in this vicinity the Abu Meru Hills may be suggested, as rising about 100 metres above the river at a distance of some eight miles north-west from Omdurman. The place is far enough to avoid any local humidity due to the river, as well as the dust-raising traffic converging on the towns. The prevalent winds are from the north and north-west, and traverse hundreds of miles of unbroken desert before reaching the hills.

In conclusion, I have to thank Mr. Rolston for directing my attention to the search being undertaken by the French Geographical Society. Our friends across the Channel have extensive possessions in northern Africa, and no doubt these have first claim for consideration; but if they are unable to exploit Khartoum, perhaps it may be kept in view and tested when munificence can be found to provide for the equipment and maintenance of a new observatory.

G. W. GRABHAM.

Khartoum, Sudan, October 15.

The Scientific Misappropriation of Popular Terms.

I ENTIRELY agree with Dr. Harmer (NATURE, October 26) that the extension of priority to groups larger than genera is undesirable, and the use of the word insect should be judged solely by practical convenience.

If the restricted use of the word insect were as generally accepted as that of deer there would be no objection to its use. I understand, however, that the use of deer for small mammals was abandoned in Middle English, and that the phrase "mice and rats and such small deer," quoted by Dr. Harmer, was intended by Shakespeare and later authors to be a joke, like the railway porter's classification of the tortoise as an insect.

The same explanation is not available for the remark in Prof. Adam Sedgwick's "Text-book of Zoology" (vol. i., p. 502) that "all spiders are predaceous and suck the juices of other insects."

I cannot agree with Dr. Harmer that the word insect is, or ever has been, generally used in the restricted sense either in popular literature or in technical works other than zoological. For example, agriculturists always seem to speak of insect in the wider sense, and agricultural literature generally does the same. Nor do I find any agreement on the subject among zoologists, and the tendency seems to be for them to abandon Insecta as a class name in favour of Hexapoda. Sir Ray Lankester expresses the matter admirably in the new edition of the "Encyclopædia Britannica." He rejects Insecta as the class name of the "so-called 'true insects,'" and regrets that Lamarck, who invented the "very appropriate name Hexapoda," did not insist on it; and "so the class of Pterygote Hexapods came to retain the group-name Insecta, which is, historically or etymologically, no more appropriate to them than it is to the classes Crustacea and Arachnida." He refers with obvious disapproval to "the tendency to retain the original name of an old and comprehensive group for one of the fragments into which such group becomes divided by the advance of knowledge, instead of keeping the name for its logical use as a comprehensive term, including the new divisions, each duly provided with a new name" (Sir Ray Lankester, "Encyclop. Brit.," vol. ii., 1910, p. 673).

Those, therefore, who use the word insect in its older and etymologically more correct sense have the support of high zoological authorities.

J. W. GREGORY.

4 Park Quadrant, Glasgow, October 28.

The Colour of a Donkey.

ON October 5, at 7 p.m., the moon being high up and almost obscured by a thick high haze, giving a diffused ground light with no shadows, I was crossing an open field by a footpath. The field is about a quarter of a mile across, and the hedges all round it, with tall elms, were marked out in broad dark masses. The grass, dried by the hot summer, is straggly and grey, with short green undergrowth. There were a number of cows—red and red and white—scattered over the field, visible in the dim light up to 80 yards by measurement. One could apparently see everything within that radius.

I was brought to a halt by hearing an absolutely invisible animal noisily cropping the grass a few feet away. On going nearer I found a grey donkey. On his starboard quarter at 4 yards' distance his dark head appeared as a moving blur, but "stern on" at that distance he was completely invisible—an "airy nothing"—though, like Polonius, "at supper." It was most extraordinary to hear the animal feeding and to be unable to see a vestige of him. At 2 yards' distance he was a mere ghost. The lighter under-colour of the ventral surface certainly diffused what light there was, after the manner of the vanishing duck in the Oxford Museum. That may be partly the explanation.

Returning by the same path at 7.30, I tried by walking across the field in every direction to find the donkey, but failed, though the cows were all plainly visible, feeding or lying down, and the donkey was in the field all night.

The striped zebra, invisible in the moonlight, is cited as an example of protective coloration. I merely record the above facts without venturing upon any explanation of them.

There is an old rhyme describing the palpitations of a villager followed at night across a field by an invisible creature with audible footsteps—

> "And much he feared that dreadful ghost
> Would leap upon his back."

That was also a donkey, and the rhyme, like Gilpin's ride, may be the jocular record of a fact. My donkey was ghostly enough, and suggests possibilities.

Waterstock, October 24.

E. C. SPICER.

Non-Euclidean Geometry.

As many mathematicians give very little thought to the theory of sets, it is perhaps worth while dwelling for a moment on Dr. Sommerville's possibly misleading remarks in NATURE of October 5. He, quite correctly, points out the one-one correspondence between the aggregates of integral numbers 1, 2, 3, &c. (n), and even numbers 2, 4, 6, &c. ($2n$). Thus the part appears equivalent to the whole. This statement loses the character of a paradox to all who will bear in mind that the notion of "the part cannot equal the whole" has its origin in the contemplation of *finite* quantities.

Again, the sets of numbers of the form $4n$ and $4n+2$ constitute aggregates of the same type; they are equivalent to each other as well as to n itself and $2n$. I fail to see that Dr. Sommerville shows the part to be larger than the whole. An aggregate A would be larger than A′ if A contained a set equivalent to A′, while A′ does not contain a set equivalent to A.

HAROLD M. SADOW-PITTARD.

SS. *Caledonia*, October 14.

IN drawing a parallel between Legendre's proof and the paradox concerning infinite aggregates, I had not thought it necessary to point out the fallacy, which consists, as in Legendre's proof, of transferring to infinities notions which are derived from a study of finite magnitudes.

Of the two propositions, a part is (1) equal to, and (2) greater than, the whole; the one is just as much a paradox as the other until the meaning of the terms equal, greater, and less has been extended and modified for infinite aggregates; and the proofs which I gave are equally in accordance with notions derived from finite aggregates. Neither of them was intended as a valid proof, though the first happens to be in agreement with the usual extension of the meaning of equivalent. D. M. Y. SOMMERVILLE.

The University, St. Andrews, October 23.

Dew-ponds and the Dry Season.

WITH reference to the remark in NATURE of October 26 (p. 559), I paid a visit to the Chanctonbury Dew-pond about the end of last August, and was surprised at its flourishing condition.

The water-level was, of course, much below the normal, and the surrounding water plants were much trodden under by sheep and cattle. There still remained, however, a good fringe, and the usual pond plants seemed to be in a satisfactory state. I could not get to the water's edge owing to the moist and boggy nature of the ground, usually submerged.

Some other dew-ponds met with in the course of a few days' walk west of Chanctonbury were quite dry, so far as I remember. J. P. CLATWORTHY.

University College, Reading, October 30.

CHARLES DARWIN'S EARLIEST DOUBTS CONCERNING THE IMMUTABILITY OF SPECIES.

IN view of the great revolution in scientific thought which was inaugurated by the publication of the "Origin of Species," the story of the evolution of ideas in the mind of its author must always have a deep fascination for the student of the history of science—and the question of the nature of the initial stage of that evolution is one especially worthy of attention.

In his autobiography, Charles Darwin has declared his belief that, before leaving England for the memorable voyage in the *Beagle*, he was quite indifferent to any speculations upon the subject of evolution—and this in spite of his admiration for his grandfather's "Zoonomia" as a literary production.[1] Now concerning the exact period in his life when Darwin ceased to feel this indifference, and had his interest aroused by that "mystery of mysteries"—to the solution of which his whole after-life was to be devoted—there have been very marked differences of opinion.

Huxley stated his conviction to be that no really important fruits of the observations made during the voyage of the *Beagle* could have been gathered by the ardent but untrained young naturalist until after he reached England, and had the opportunity of consulting specialists concerning the specimens which had been sent home by him from time to time.[2] But, on the other hand, Dr. Francis Darwin and Prof. Seward maintain that during the voyage, and especially towards its close, when the Galapagos Islands were visited, Darwin's observations and his meditations upon them had already begun to bear fruit, and had led him to lose his absolute faith in the immutability of species.[3] I am myself convinced, as the result of a careful consideration of letters written at the time, that *very early indeed in the course of the voyage* certain observations and reflections had given rise in Darwin's mind to *serious misgivings* concerning the fixity of species, although, writing nearly fifty years afterwards, he dismissed them lightly as nothing more than "*vague doubts*."

It was this statement in Darwin's correspondence to which Huxley appears to have attached very great importance. It occurs in a letter to Dr. Zacharias and is as follows:—

"When I was on board the *Beagle* I believed in the permanency of species, *but as far as I can remember, vague doubts occasionally flitted across my mind.*"[4]

It should be borne in mind, however, that as these lines were written as late as 1877, to one of his very numerous casual correspondents, we may not improbably infer that Darwin penned them somewhat hastily and without any deep thought or reflection concerning the interpretation that might be put upon them if published. For it must be remembered that nearly twenty years before this he had written and *printed* the following:—

"When on board H.M.S. *Beagle* as naturalist, I was *much struck* with certain facts in the distribution of the inhabitants of South America, and *in the geological relations of the present to the past inhabitants of the continent.*"[5]

Seeing that these words form the first sentence of the introduction to the "Origin of Species," and must therefore have expressed the result of very deliberate thought and consideration, that they would certainly have been frequently scanned by the author before publication, and that they are repeated without change or qualification in every succeeding edition of the book, it is undoubtedly only fair to attach far greater weight to them than to a sentence hastily indited to a casual correspondent so many years afterwards.

In that marvel of candid introspection, the "Autobiography," Darwin wrote in 1876 as follows:—

"During the voyage of the *Beagle* I had been *deeply impressed* by discovering in the Pampean formation great fossil animals covered with armour like that of the existing armadilloes."[6]

And this he enumerates as the *first*, though *not the most important*, of the observations which turned his thoughts in the direction of evolution during the voyage. When writing to Haeckel in 1864 he says:—

"*I shall never forget my astonishment* when I dug out a gigantic piece of armour like that of the armadilloes."[7]

Owing to a singular blunder, for which Darwin was in no way responsible, I shall have to point out that

1 "Life and Letters of Charles Darwin," vol. i., p. 38.

2 "Collected Essays," vol. ii., p. 271.

3 "More Letters of Charles Darwin," vol. i., pp. 37-39. See also "Foundations of the Origin of Species," p. xv.

4 "More Letters of Charles Darwin," vol. i., p. 367. The italics in this and succeeding passages are our own.

5 "Origin of Species," p. 1. 6 "Life and Letters," vol. i., p. 82.

7 "History of Creation," vol. i., p. 134.

the significance and importance of this *fateful* discovery—for such I believe it to have been—has to some extent been overlooked; but concerning the time and place that it was made, and all the circumstances connected with it, we fortunately have ample information.

During the first six months that he spent in South America (March to September, 1832), Darwin tells us that he had "procured a nearly perfect collection of mammals, birds, and reptiles" in the districts around his two great centres of work at this time, namely, Botofogo Bay, near Rio de Janeiro, and Maldanado, near Monte Video.[8] In doing this he could not fail to be greatly struck by the peculiarities of the fauna, with its sloths, ant-eaters, and armadilloes. From the journals both of Fitzroy and Darwin, we learn that questions concerning the several species of armadilloes and their geographical range were at this time engaging their attention.[9]

It fortunately happened that, during the autumn of 1832, the *Beagle* was delayed for some weeks in Blanco Bay. The energetic young captain (Fitzroy was at this time twenty-seven years of age, only four years older than Darwin himself), finding that, in his own ship, he could not safely survey the shallow waters of the South American coast, purchased, at his own expense, two tiny undecked sealing craft and placed them under the command of two of his officers who volunteered for the service. While the alteration, refitting, and rigging of these dirty little vessels was in progress, the *Beagle* was delayed at her anchorage, and Darwin found an opportunity of which he took splendid advantage.

Near Punta Alta, on the shores of the Bay of Bahia Blanco, there is a cliff about 20 feet high extending for the distance of a mile; the beds exposed in this cliff consist of false-bedded gravel, sand, and marl, in which were many shells which Darwin recognised as belonging to existing species. But in the midst of these sands and gravels could be seen a lenticular bed of red mud, in which the bones of great quadrupeds occurred in such abundance that remains of nine large mammals were disinterred from an area of 200 square yards.[10]

Under the date of September, 1832, Captain Fitzroy wrote in his journal as follows:—

"My friend's" (Darwin's) "attention was soon attracted to some cliffs near Point Alta, where he found some of those huge fossil bones, described in his work, and notwithstanding our smiles at the cargo of apparent rubbish which he frequently brought on board, he and his servant used their pick-axes in earnest, and brought away what have since proved to be most interesting and valuable remains of extinct animals."[11]

Doubtless, while his other shipmates were content with exhibiting mild amusement at the eagerness of "the Flycatcher," as Darwin was called by them, the martinet first-lieutenant, as is recorded in the "Life and Letters," would be moved to wrath by the state to which his decks were being reduced by these strange proceedings, and driven to employ choice nautical language concerning "the d——d beastly devilment," not forgetting to add, "If I were skipper, I would soon have you and all your beastly mess out of the place."[12]

It was probably on this occasion that Darwin experienced those pangs of "despair with which he had to break off the projecting end of a huge, partly excavated, bone, when the boat waiting for him would wait no longer"—a sorrow which, as his son tells us, he often recalled and spoke of in after-life.[13]

We must bear in mind that Darwin collected from this treasure-house of mammalian remains at Punta Alta on two different occasions, first in September, 1832, and secondly in August, 1833.

That it was on the *first* of these occasions "the gigantic piece of armour like that of the armadilloes was procured" is fortunately proved by a letter written by Darwin to Henslow, dated November 24, 1832, and communicated to the Cambridge Philosophical Society before the *Beagle* had returned to England.[14] The opportunities which the young naturalist then enjoyed of having boats and men at his disposal to transport these great bones of the Pampas formation to the ship, appear to have been unique.

In the very important letter to which I refer, Darwin speaks of finding "fragments of at least six different animals," including "a large surface of the osseous polygonal plates, which 'late observations' (what are they?) show belong to *Megatherium*." In writing thus, Darwin was evidently, to some extent, the victim of a mistake into which naturalists had been betrayed at the beginning of last century. Whether, in using the words, placed between inverted commas by him, Darwin was quoting from some author, I have vainly endeavoured to discover by an examination of the books which he would probably have in his little library on the *Beagle*; but the query, which he puts in brackets, clearly shows that he suspected that an error had been committed. And this conclusion is confirmed by the sentence which follows:—

"Immediately I saw this I thought they must belong to an enormous armadillo, living species of which genus are so abundant here."

The history of the origin and spread of the idea that the dermal armour of the Glyptodonts belonged to the Megatherium is a very curious one.

It has been suggested that Dr. Buckland was responsible for the unfortunate error,[15] but the passage quoted in support of this view is taken from the "Bridgewater Treatise," which was not published until 1836, and indeed contains a reference to Darwin's own work in South America. Buckland, like other geologists and zoologists of that day, merely followed the lead of Cuvier in this matter.

The remains of the gigantic fossil sloths of South America had found their way to Europe before the end of the eighteenth century, and both Megatherium and Mylodon were described by Cuvier in his "Ossemens fossiles" in 1812. But while preparing the fifth volume of the second edition of that great work in 1823, he received from a colleague, the botanist August de Saint-Hilaire, a letter sent with specimens from South America, by D. Damasio Larranãga, curé de Montevideo. This letter, apparently without being carefully scrutinised by Cuvier and his assistants, was printed in a footnote,[16] and contains the words "Je ne vous écris point sur mon dasypus (Megatherium, Cuv.)." The worthy priest, who was evidently not a zoologist, confounded Dasypus (the armadillo) with the Megatherium; and, strange to say, Cuvier not only allowed the passage to stand, but added the suggestion that Megatherium might have possessed bony armour like the armadillo, and that he awaited impatiently further information on the subject from Larranãga. As bones of the giant sloths from South

[8] "Journal of the *Beagle*" (1839), p. 46.
[9] "Voyages of the *Adventure* and *Beagle*," vol. ii., p. 107; vol. iii., p. 112.
[10] "Geological Observations on South America" (1846), pp. 82–85.
[11] "Voyages of the *Adventure* and *Beagle*," vol. ii., pp. 106–7.
[12] "Life and Letters of Charles Darwin," vol. i., p. 223.
[13] *Ibid.*, vol. i., p. 276, *note*.
[14] This letter was read at a meeting held on November 16, 1835, and was privately printed.
[15] "More Letters of Charles Darwin," vol. i., p. 12, *note*.
[16] "Ossemens fossiles," second ed., vol. v. (1823), p. 191, *footnote*.

America were often accompanied by portions of the bony armour, which occur in the same deposit, it is perhaps not surprising that the erroneous identification was caught up and repeated in other works on the subject.

It was not until 1840 that Owen in this country and Lund in Germany established the existence of the several genera of the Glyptodontidæ, and showed that these bony plates really belong to extinct forms allied to the armadilloes. It is therefore very interesting to find that the "untrained" naturalist of twenty-three years of age had divined the real truth on the subject so long before.

The specimen which excited such intense interest in Darwin's mind was described by him in 1846, after consultation with Owen, as follows:—

"A double piece, about three feet long and two wide, of the bony armour of a large Dasypoid quadruped, with the two sides pressed nearly close together: as the cliff is now rapidly washing away, this fossil was probably lately much more perfect; from between its doubled-up sides, I extracted the middle and ungueal phalanges, united together, of one of the feet, and likewise a separate phalang: hence one or more of the limbs must have been attached to the dermal case when it was embedded." [17]

This fine specimen, which would undoubtedly have been of great historical interest, from the effect it produced on the young naturalist's mind, is unfortunately no longer in existence. Darwin says "It was so tender that I was unable to extract a fragment more than two or three inches square." [18] Owen, in his memoir on the fossil bones sent home by Darwin, describes and figures two small fragments—"the portions of the tesselated bony dermal covering of a Dasypoid quadruped," and these are identified as belonging to the specimen in question by the statement that they "were discovered folded round the middle and unguel phalanges," which are also figured on the same plate.[19]

As evidence of the special interest which Darwin attached to this discovery, it may be mentioned that he at once sent home a fragment of this (or of a similar specimen) to his family, for we find him writing to his sister Catherine, on May 22, 1833:—"I am quite delighted to find the hide of the Megatherium" (he uses the term by which such specimens were then generally known) "has given you all some little interest in my employments." [20]

Now, in order to appreciate the extraordinary effect of this discovery on young Darwin's mind, we must remember what were the opinions current among geologists when it was made. The views of Cuvier at that date were regarded as not less authoritative in geology than they were in zoology, and in the introduction to his *magnum opus*, the "Ossemens fossiles," the opinions of the great comparative anatomist were pronounced with no uncertain note. He contended that each geological period must have been brought to a close through the sweeping out of existence, by a great cataclysm, of all plant- and animal-life, this being followed by the creation of a perfectly new assemblage of living beings. Cuvier's teaching was made as widely known in this country as it was on the Continent, for Jameson issued a number of editions of a translation of the famous introduction, under the title of "An Essay on the Theory of the Earth"; and, as von Zittel justly remarks, "Cuvier's catastrophic theory was received with special cordiality in England." [21] By none certainly was it adopted more unreservedly than by Darwin's teachers and friends, Henslow and Sedgwick.

Among the books in Darwin's library, now piously preserved at Cambridge, is a copy of the fifth edition of the translation of Cuvier's "Essay," bearing the date of 1827,[22] and I think there can be no doubt that this book was one of those constituting the little library of reference in the chart-room of the *Beagle*, where Darwin worked and slept. Nor can there be any hesitation in concluding that with the contents of this book he would be thoroughly familiar.

This being the case, Darwin found himself confronted at Punta Alta with the two startling facts which he so clearly indicates in his letter to Henslow.

First, the bones of gigantic and undoubtedly extinct mammals were seen to be associated in the same deposit with shells of living species. He tells Henslow at the time, "They" (the bones) "are mingled with marine shells which appear to me identical with what now exist." (He, in fact, collected twenty-five species, all of which D'Orbigny afterwards pronounced to be still living.) How, on Cuvier's theory, could such a state of things arise? The cataclysm that destroyed the mammalian must surely have been equally fatal to the mollusca!

But the *second* fact was even more striking and significant. Not only did Darwin obtain the armour of "an enormous armadillo," but among the other remains he identified the jaw of another of the Edentata, and the teeth of rodents similar to those now living in the district.[23] His recent collections had made him familiar with the peculiar mammalian fauna of South America, and the striking characters which distinguish it from that of all other portions of the globe, and here, he states, was evidence before his eyes that the mammals of the period immediately preceding our own, though differing in being more gigantic, presented a striking family likeness to them. This was a fact quite inexplicable on the theory of wholesale destructions and brand-new creations, but most suggestive, and capable of simple explanation, if the recent forms were descended from the fossil ones, or both were representative of common ancestors.

When Charles Darwin arrived home in 1836, and engaged in the preparation of his journal for publication, he found that almost simultaneously with his own discovery a similar one had been made with respect to the Australian continent. Clift had identified a number of bones collected in caves in that island as belonging to extinct marsupials, and Jameson had pointed out the significance of their relations with the existing fauna.[24] There can be no doubt, however, that Darwin was quite unaware of this publication while he was in South America, though he refers to it in writing up his journal. Facts like these, so familiar to us at the present day, were then quite novel.

But it is by no means improbable that the mind of the young naturalist was in a specially receptive condition, when it encountered the shock of this important discovery. Darwin has again and again insisted on the revolution produced in his mind on geological questions by the study of the first volume of Lyell's "Principles of Geology," which he took

17 "Geological Observations in South America" (1846), p. 84.
18 *Ibid.*, p. 86.
19 "Zoology of the *Beagle*," "Fossil Mammalia,' plate xxxii., and description.
20 "Life and Letters of Charles Darwin," vol. i., p. 245.
21 "History of Geology and Palæontology" (English translation), p. 141.
22 "Catalogue of the Library of Charles Darwin," p. 19.
23 "More Letters of Charles Darwin," p. 12.
24 "On the Fossil Bones found in Bone Caves and Bone Breccias in New Holland," *Edinb. New. Phil. Journ.*, vol. x. (1831), pp. 390–7. In this paper the list of species is by Clift, but the remarks are by the editor, Jameson. The arguments are somewhat weakened by the larger marsupial bones having been mistaken for those of elephant or rhinoceros. It is remarkable that most authors, including Darwin himself, give Clift the credit for the generalisations, but this is not borne out by an examination of the paper.

with him from England. In his dedication of the second edition of his "Journal," Darwin wrote, "The chief part of whatever scientific merit this journal and the other works of the author may possess has been derived from studying the well-known and admirable 'Principles of Geology.'"[25]

In a letter to his friend, at the same time, Darwin clearly explains the nature of his indebtedness to the "Principles." He says, "Those authors . . . who, like you, educate people's minds as well as teach them special facts, can never, I should think, have full justice done them except by posterity, for the mind thus insensibly improved can hardly perceive its own upward ascent."[26] And shortly before this he had written to Leonard Horner, "I have always thought that the great merit of the *Principles* was that it *altered the whole tone of one's mind*, and therefore that, when seeing a thing never seen by Lyell, one yet saw it partially through his eyes."[27]

It has been pointed out, both by Huxley and Haeckel, that when Lyell had completed the first volume of his great work he had arrived at the logical conclusion that the same principle of continuity or uniformity which he had demonstrated for the inorganic world must apply also to organic nature and even to man. This is clearly shown in the correspondence that has been published,[28] which also makes it manifest that some among Lyell's contemporaries who thought deeply on the subject could not avoid the same conclusion. Sedgwick clearly perceived this, and it moved him to rage and to making wild charges of "infidelity." Whewell saw it too, and shrank from accepting Lyell's doctrines because he could find no border-line between what he called "uniformitarianism" and evolution; but Herschel appears, at the time, to have been ready to go as far as Lyell himself. And the young naturalist on board the *Beagle*, did he begin to perceive, however dimly, "through Lyell's eyes" that evolution could not stop with the inorganic world? We have no evidence on this point; we can only conjecture it as possible.

This much, however, is certain, that Darwin, after completing his excavations at Punta Alta, returned to Monte Video, and among the articles sent from home which were awaiting him there, found the second volume of the "Principles," and wrote in it "Monte Video, November, 1832." The volume treats of the "Changes in the *Organic* World now in Progress." It is true that Lyell had been so far influenced by his friend Cuvier that he commenced the book with a very trenchant criticism of the theory of Lamarck, but he then goes on to discuss a number of problems of extreme interest and importance to the evolutionist—the limits between species and varieties; variation under domestication and in nature; the effects of crossing and the characters of hybrids; the geographical distribution of plants and animals, and the agencies by which it has been brought about; extinction and the appearance of new forms; the struggle for existence; the origin of instincts; and the bearing of all these and similar questions on the interpretation of the geological history of past times. Great as was the influence of the first volume on the mind of Darwin with regard to geological questions, I think no one can now read this second volume without realising that, in respect to biological problems, it must have exercised at least an equally profound effect upon him. It could be easily shown from the "Journal" that all these problems were, from this time forth, ever in Darwin's thoughts, and as new observations were made by him, he delighted to think, as shown by his letters, that they would "interest Mr. Lyell," who was at that time not personally known to him.

I am very far from suggesting that the collection of the fossil bones at Punta Alta and the perusal of Lyell's second volume made Darwin an evolutionist. On the contrary, I fully admit, with Dr. Francis Darwin, that it was the series of wonderful relations revealed to him towards the end of the voyage, by his study of the faunas of the Galapagos Islands, that had the preponderating influence in moulding Darwin's views; and I am convinced that anything like a definite formulation of those views did not take place until after his return to England. It was then that, by the re-examination of his collections and the revision of the observations in his notebooks and journal, he was led to bring into close array the various facts and reflections bearing on "the species question," and thus the scattered gleams of light on the subject which he had from time to time caught were first brought to a focus in his mind; nevertheless, it is true that the first of those gleams were those that came to him at Punta Alta and during the perusal of the "Principles."

There is a passage in one of Darwin's letters to Bentham the significance of which, I think, has been somewhat overlooked. Speaking of the fluctuations of opinion on the question of the immutability of species, he says:—

"I, for one, can conscientiously declare that I never feel surprised at anyone sticking to the belief of immutability. . . . I remember too well my endless oscillations of doubt and difficulty. It is to me really laughable, when I think of the years which elapsed before I saw what I believe to be the explanation of some parts of the case; I believe it was fifteen years after I began before I saw the meaning and cause of the divergence of the descendants of any one pair."[29]

Fifteen years after 1832 would bring us to 1847, a period at which Darwin was fully immersed in the task of "making and unmaking species" among the Cirripedes, and in their classification; and it may well have been the consideration of "one pair" of these that led him first clearly to realise "the meaning and cause of divergence." In his autobiography he wrote, "Long after I had come to Down" (which was in 1842) "whilst in my carriage to my joy the solution occurred to me," and "I can remember the very spot in the road."[30] Although, as Dr. Francis Darwin has shown,[31] his father had come very near to this idea of divergence when he wrote the 1842 sketch,[32] and the same is true with regard to the essay of 1844,[33] it was clearly after these dates that the full significance of the principle revealed itself to his mind, and that it was the result of pondering on questions of classification is shown by his letter of September, 1857, to Asa Gray, which he communicated to the Linnean Society in 1858. He there wrote:—"Each new variety or species when formed will generally take the place of and so exterminate its less well-fitted parent. This I believe to be the origin of the classification or arrangement of all organic beings at all times."[34]

If this reasoning be correct, we obtain the date of a crisis in Darwin's mental development to which he himself attached the greatest importance. However this may be, the letter to Bentham proves what is often overlooked, that Darwin's mind vacillated

[25] "Naturalist's Voyage Round the World" (1860).
[26] "Life and Letters of Charles Darwin," vol. i., pp. 337-8.
[27] "More Letters of Charles Darwin," vol. ii., p. 117.
[28] "Life and Letters of Charles Lyell," vol. ii., pp. 36, &c.
[29] "Life and Letters," vol. iii., p. 26.
[30] *Ibid.*, vol. i., p. 84.
[31] "Foundations of the Origin of Species," p. xxiv.
[32] *Ibid.*, p. 37.
[33] *Ibid.*, pp. 208-11. See also "Origin of Species" (1859), chap. xiii.
[34] "Linnean Society-Darwin-Wallace Celebration," p. 97.

for many years before reaching full conviction on the question of evolution. Nor is this surprising; no one can read the suggestive series of letters to Sir Joseph Hooker without realising how great and numerous were the "doubts and difficulties" through which the veteran botanist battled his way towards final acceptance of his friend's views. The publication of the Lyell correspondence showed that the author of the "Principles" at the time of the publication of the first volume was perfectly satisfied as to the truth of organic evolution; this has been insisted upon both by Huxley and Haeckel. Yet, while writing his second volume, Lyell fell so strongly under the influence of Cuvier (whose palæontological work naturally fascinated him) that he not only rejected Lamarck's hypothesis, but at times seemed to hesitate about the evolutionary theory altogether. Again, no one reading Herschel's address to the British Association in 1845, in which the "Vestiges" is so severely handled, could realise the fact that in 1836 he was writing to his friend Lyell that he was satisfied that the principle of continuity was applicable to organic as well as inorganic nature. It is no disparagement to either of these great thinkers to admit that, while weighing carefully the arguments for and against evolution, they inclined sometimes towards one side and at other times to the opposite view, and, in the words of Darwin, underwent "endless oscillations of doubt and difficulty."

JOHN W. JUDD.

ANTHROPOLOGICAL RESEARCH IN NORTHERN AUSTRALIA.

ALL friends of anthropology will rejoice to learn that after an interval of some years Prof. W. Baldwin Spencer, F.R.S., has resumed his researches among the aborigines of Australia. The following particulars as to his work and his plans are extracted from a letter addressed to Mr. J. G. Frazer on September 13.

The Commonwealth Government of Australia is about to undertake measures for the settlement of the Northern Territory, and during the present year it sent a small party to make preliminary investigations in that region. The leadership of the party was entrusted to Prof. Baldwin Spencer. The members of the party went to Port Darwin, and from there across to Melville Island; then they returned to Port Darwin and travelled south about two hundred miles, after which they crossed the continent to the Gulf of Carpentaria. Amongst all the tribes examined by the expedition the belief in the reincarnation of the dead is universal, and the same is true of the notion that sexual intercourse has nothing, of necessity, to do with the procreation of children. "The latter fact," says Prof. Spencer, "is interesting because we now know that this belief exists amongst all the tribes extending from south to north across the centre of Australia." On the other hand, Prof. Spencer found among these northern tribes none of the *intichiuma* or magical ceremonies for the multiplication of the totems which form so important a feature in the totemism of the central tribes; nor could he discover any restrictions observed by the natives in regard to eating their totemic animals and plants. "The absence of *intichiuma* ceremonies," he adds, "is doubtless to be associated with the fact that the tribes in the far north live under conditions very different from those of the central area. They never suffer from drought or lack of food supply. This seems to show that the *intichiuma* ceremonies are a special development of tribes that live in parts such as Central Australia, where the food supply is precarious."

In one or two tribes along the Roper River a very curious totemic system was discovered. Among these people a man must marry a woman of a particular totem, but the children take a totem different from both that of their father and that of their mother. For example, a man of the Rain totem must marry a woman of the Paddy-melon (a species of small kangaroo) totem, and their children are of the Euro (a species of kangaroo) totem. Again, a Porcupine man marries a Lizard woman, and their children are Bats. In these tribes each exogamous class has certain totems associated with it. Again, in these tribes the natives are convinced that the spirit children know into what woman they must enter, so that the offspring shall have the proper totem. Everywhere, too, among the tribes traversed by the expedition, the women and children believe that the sound of the bull-roarer is the voice of a great spirit who comes to take away the boys when they are initiated; but during the initiatory ceremony, when the boys are shown the *churinga* for the first time, they are informed that the noise in question is not made by a spirit, but by the *churinga*, or bull-roarer, which was used in the past by one of the mythical ancestors of the tribe. Lastly, Prof. Spencer could detect among these tribes no trace of anything like a belief in a supreme being. On the whole, he considers that, with minor variations, the beliefs of these northern tribes are closely similar to those of the central tribes.

Prof. Spencer hoped to start about November 1 for another expedition to Melville Island, the inhabitants of which he is particularly anxious to study, as they are hitherto practically uncontaminated by European influence. His intention is to reside among them until February. All anthropologists will look forward with keen interest to the publication of Prof. Spencer's fresh inquiries in this promising region. It is much to be regretted that his former colleague in research, Mr. F. J. Gillen, has been prevented by the state of his health from taking any part in these new investigations.

THE TAAL VOLCANO.

THE latest publication received from the Weather Bureau of the Philippines is entirely devoted to a violent eruption of the Taal Volcano, which took place on January 30 of this year. This volcano, which lies thirty miles south of Manila, is represented by a crater in a small island which rises from the centre of Lake Bombon. As this lake joins Taal in its activities it also must be regarded as an active crater. If its waters could be removed by the deepening of the channel of the river which now drains it, we should have a replica of Mount Aso, in South Japan, viz., a large crater about twelve miles in diameter with an active cone in its centre. The craters of these two mountains rank among the largest of which our world can boast, but they are by no means comparable with the largest in the moon. If, however, the crater plains of Taal and Aso could be lowered to the level on which these mountains grew, they would closely resemble many lunar volcanoes.

The written history of Taal commences in 1572. Since that time the volcano has been fifteen times in eruption, the last being that now under consideration. Often it has obliterated hamlets and villages round the lake, but its last effort has practically cleared out everything. The number of dead is given as 1335, but because so many were buried beneath the ash and mud the exact number will never be determined. Of all the inhabitants round the lake the only survivors appear to have been those who were absent from their

homes. It was exactly the same in 1888, when an innocent grass-covered mountain called Bandai, in Central Japan, blew away its head and shoulders and filled up a valley thirteen miles in length with mud and stones. It buried everything.

Now these calamities are not always such sudden visitations as is popularly supposed. Most, but not all, dogs growl before they bite. Bandai, although it had not erupted for more than a thousand years, gave premonitory signals. From time to time it rumbled and slightly shook. Krakatoa, before it blew three-quarters of an island to the four winds, and opened a red-hot mouth at sea-level to fight two oceans, issued signals of uneasiness. So it was with Taal. On January 27, 1911, it seems to have been the origin of 24 small shocks. Next day the number increased to 197, and on January 29, 113 were counted. What came next we are not told, but at 2 a.m. on January 30, Taal burst forth with terrific energy, and a roar was heard at a distance of 310 miles. A great black cloud crossed with flashes of lightning and illumined with explosions which may have been of electric origin, but in a globular form, rose from the crater from which two or three times a deep red glow appeared.

Baragraphs at a distance of 242 kms. were greatly disturbed. An analysis of these showed that a depression had travelled at a rate of 112 miles per hour. This depression appears to have been formed by the inrush of air towards the hot volcanic throat. Between twenty-two and thirty-nine miles from this the fall amounted to 2 mm., or 0·8 inch. The inference is that near the mountain the inrush of air must have had a hurricance force and given rise to a real though short-lived tornado. Round the crater everything was "wiped out" or buried in mud. It was not "destruction," but "annihilation." No lava issued. It was Bandaisan over again, a hurricane or whirlwind had levelled houses, torn up trees or stripped them of their leaves and bark. With it all there may have been a *fiery cloud*, like that which issued from Mount Pelée and destroyed St. Pierre. Two days later Father Masò approached the volcano to find it "very peaceful, with puffs of white vapour succeeding each other at intervals of ten to thirty seconds." Nevertheless, as on that day the Observatory in Manila recorded 130 shocks, Father Masò thought "there was still ground for fearing a fresh outburst." The giant was evidently resting after his angry exertions. May he do so for many years, and when he dies the Philippinos will gladly write R.I.P. above his head.

JOHN MILNE.

FIG. 1.—Crater of Taal Volcano before the eruption (seen from the E.S.E.).

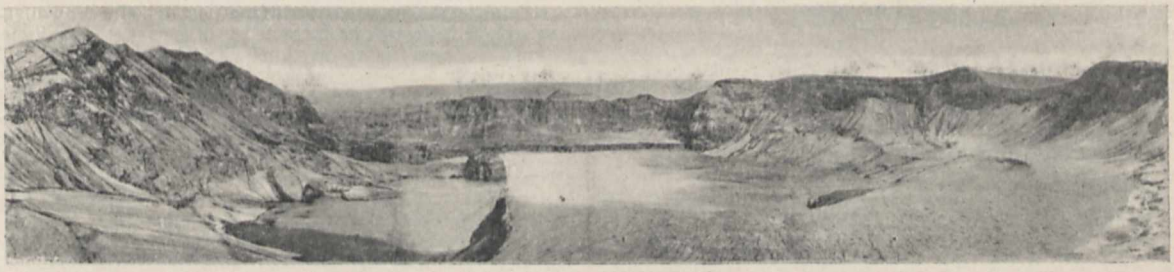


FIG. 2.—Crater of Taal Volcano after the eruption (seen from E.S.E.).

THE SOLAR PHYSICS OBSERVATORY.

IN April last a departmental committee was appointed to consider and report upon alternative schemes for transferring the Solar Physics Observatory, now at South Kensington, to Fosterdown (Caterham) or to Cambridge. The report of the committee has just been published as a Parliamentary paper (Cd. 5924).

The committee was composed of Sir Thomas L. Heath, Assistant Secretary of the Treasury (chairman), Mr. F. W. Dyson, F.R.S., Astronomer Royal, Dr. R. T. Glazebrook, C.B., F.R.S., director of the National Physical Laboratory, and Prof. Arthur Schuster, F.R.S., chairman of the executive committee of the International Union for Solar Research, with Mr. F. G. Ogilvie, C.B., as secretary. The terms of reference were:—

To consider the alternative schemes for locating the Solar Physics Observatory at Fosterdown and at Cambridge respectively, and to report which of the two schemes is likely to secure the best results for an annual expenditure of approximately the same amount as is now incurred for the work done under the direction of the Solar Physics Committee.

The conclusions and recommendations of three members of the committee, viz. Sir T. L. Heath, Mr. Dyson, and Prof. Schuster, are as follows:—

We are of opinion that, on a balance of considerations, and especially having regard to the advantage to the progress of solar physics which may be expected to accrue from the establishment and support by the University of a real school combining the studies of solar physics and astrophysics, the Cambridge scheme is calculated to give

the better results for an expenditure of approximately the amount now available for the Solar Physics Observatory.

We recommend, therefore, that the solar physics work be transferred to Cambridge, with an initial grant for buildings and a fixed annual inclusive grant-in-aid to the University, provided that the University will agree to the following conditions :—

(1) That the professor of astrophysics be the director of the Solar Observatory.

(2) That there be a committee or syndicate nominated by the University with functions similar to those of the Board of Visitors of the Royal Observatory at Greenwich.

(3) That the Astronomer Royal and the director of the Meteorological Office be *ex officio* members of the committee or syndicate.

(4) That the University undertake to carry out at the new observatory the necessary amount of routine work on the general lines indicated in paragraph 14 (*b*) and (*c*).

(5) That an annual report, to include a statement of the work done, and an abstract of the accounts of the Solar Observatory showing the application of the grant-in-aid, be presented by the director to the committee or syndicate, to be by them transmitted to the Treasury.

With a view to securing the permanence of any arrangement that may now be made, the committee desire to point out the importance of attaching the directorship of the Solar Observatory, if established at Cambridge, to a professorship which is not merely of a temporary character. The University may not be in a position, at present, to give any definite assurance that the professorship will be renewed at the expiration of the present tenure; but we consider it highly desirable that the Government should ascertain, before coming to a final decision, whether the University is willing at an early opportunity to consider favourably the establishment of a professorship of astrophysics on a permanent foundation.

Dr. Glazebrook dissents from these conclusions and recommendations, and remarks :—

I believe that the evidence placed before the committee and the facts detailed in the report lead to the conclusion that, on a balance of all the considerations, a scheme for locating the observatory at Fosterdown, under conditions similar to those outlined in section 23 of the report, could be arranged at an annual cost of 3000*l.* with a capital outlay of 5000*l.*, and would secure the best results.

The report is of a far-reaching character, and if approved will result in the abolition, and not merely in the transfer, of the Solar Physics Observatory, and the dismissal of its staff.

We believe that it has not yet been referred to the Solar Physics Committee, and that steps are being taken to bring disinterested scientific opinion to bear upon the question. So far as public opinion is concerned, *The Morning Post* and *The Daily Graphic* alone have dealt with the matter. The articles are as follows :—

Examination of the majority report of the committee appointed to inquire into the future of the Solar Physics Observatory at South Kensington must awaken surprise and dismay in the minds of those acquainted with the past history and present working of this institution. Founded forty years ago, when South Kensington was almost a vacant site, it was the pioneer in solar observation; the first observatory to examine the solar prominences; the first to observe sunspots systematically, and the first to attempt to correlate solar and terrestrial phenomena. The lead it gave has been followed by other observatories, and the methods it instituted are those which have been adopted by the Mount Wilson Solar Observatory in California, which is now the chief station for observations of the sun.

When the observations at South Kensington were first undertaken, it was understood that the institution was to be regarded as a Government institution, supported by Government contributions. The grant made was not a large one, though to the observatory and its servants it sufficed to make the work done there known all over the world. But it has remained at the insignificant figure of 3000*l.* a year, on the ground that it was useless to spend money for instruments at an observatory which was being so surrounded by high buildings that its opportunities for observation were yearly becoming more limited. That was reasonable, and the observatory, through its officials—as well as through the Solar Physics Committee, which was formed at Sir Norman Lockyer's initiative to coordinate the work of solar observatories—continually urged the removal of the observatory to a more suitable site. Such a site offered itself at Fosterdown, which is a distant fort on the Surrey Hills, 800 feet above the sea, and which became vacant through the abandonment of the obsolete defences of London. The site had the several advantages desirable and necessary in an observatory: it had a very wide sweep of horizon in all directions; it was removed from the glare of electric lights, from smoke, or vibration. Its concrete floors would have been suited in several instances to the requirements of the foundations of the beds of telescopes.

Fosterdown has, however, been rejected by the majority of the committee in favour of Cambridge, on the ground that at Cabmridge there would be closer association with men of science. The loss of efficiency which will result from giving effect to the decision is signal. Cambridge lies in a flat country, and the observatory is in a river valley. The elevation of the observatory there is 70 feet; it is near enough a road to suffer from vibration. Its night observations are prejudiced by the glare of the Cambridge electric lights; its daylight observations by a town's smoke. If it were only on account of the absence of elevation the site of the observatory would be unsatisfactory. Nearly every great observatory in the world has sought elevation. Paris (Meudon) has gone from 194 feet to 534, Potsdam from 112 to 318. Chicago, the Lick Observatory, Mount Wilson, Flagstaff, Nice, Washington, Madras, Mount Etna, are all at an elevation of 1000 feet or more.

Moreover, the committee themselves admit that Fosterdown is the preferable site, a very inadequate expression of the difference between Cambridge and Fosterdown in view of the evidence that was heard. For the Cambridge site is bound to deteriorate as buildings spring up around it and as the traffic on the road increases, causing vibration. Nor is there any proper provision made for the carrying on of the work. The present professorship is not a salaried post, and it is unlikely that a man of high position will be induced to fill the post as Mr. Newall has done, or that he will be attracted by the meagre emolument of 200*l.* offered in connection with the new post. The committee has apparently neglected the view that the true work of a university is to train and fit men to undertake work. For this Cambridge is already adequately equipped, and this is the legitimate work of a professor rather than the management of an important scientific institution for the conduct of research. As regards Fosterdown, the committee admit that it is probably as good a site as can be found in England.

Nor can the report of the committee be accepted with confidence. From the scientific standpoint the opinion of the Treasury representative can naturally carry no weight. The three other signatories of the report are all men of the highest standing, but they are all old Cambridge men, and without their being in any way conscious of bias, it is not improbable that they may have been unconsciously influenced in their view by their natural loyalty to Alma Mater. Even so, Dr. Glazebrook, who, as president of the National Physics Laboratory, has especial experience in the work of administration, has dissented from his colleagues, advocating the establishment of the observatory at Fosterdown, and recommending that it should be under a director who should give his whole time to the work.

Lastly, quite apart from the material disadvantages of the Cambridge site, there is the far more important one that the removal thither, which would make the Solar Physics Observatory an appanage of an observatory already existing, would imply the dissolution of an institution and the dispersal of a staff which is of international importance and repute.—*The Morning Post.*

In astronomical circles the recommendation of the departmental committee that the old Solar Physics Observatory at South Kensington should be removed to Cambridge has been received with surprise. Economy is the one practical reason for the recommendation; in the words of a well-known astronomer to a representative of

The Daily Graphic, "the choice of Cambridge seems to be because it is cheap."

All the great observatories of the world are moving upwards.

The Paris Observatory at Meudon has removed from 194 feet to 534 feet.

Sicily (Mount Etna), 155 feet to 9735 feet.

Berlin (Potsdam), 112 feet to 318 feet.

Madras (Kodaikánal), 23 feet to 7745 feet.

Vienna, 787 feet to a neighbouring mountain.

Washington (Mount Vernon), 200 feet to 1725 feet.

Chicago Observatory is 1105 feet, the Lick Observatory 4209 feet, Mount Wilson 5712 feet, Flagstaff 7293 feet, Nice 1240 feet.

It has become imperative, in the interests of the accuracy which modern astronomical observation demands, to take the observations well above ground, mist, and fog; and to remove them to sites as distant as possible from the smoke of towns by day and the glare of their lights by night; and their vibration at all times. Not one of these advantages will be derived from the suggested site which the new Solar Physics Observatory would occupy at Cambridge, which lies in a river valley. The observatory would be near a road; there is the smoke of the town, not to speak of the cement works at Cherry Hinton; and there is the glare of the town's electric lights at night. This is easily perceptible five miles away at Little Shelford. Moreover, the height at which the observatory will be stationed is only 70 feet above sea-level. That is perhaps better than the present site at South Kensington, which is only 27 feet above river-level, but not much. The site which was suggested by the Solar Physics Committee was Fosterdown, near Box Hill, in Surrey. That is 800 feet above the sea, and is one of the best sites for astronomical purposes in England. It has wide horizons, no lights near, no traffic, no smoke. Nor is it very dear. The land is Government land, being part of the ground lately occupied by one of the obsolete forts for the defence of London.

More serious, or at least as serious as the rejection of the Fosterdown site in favour of one at Cambridge, is the proposed dissolution of the integrity of the old Solar Physics Observatory, which will henceforward become a mere branch of Cambridge Observatory. It is a very poor reward for services and work done lasting over a generation. The pioneer observation of the South Kensington Observatory is known all over the world, and has been a model for other observatories to follow. One cannot believe that the astronomical world will hear of its dissolution without disappointment and indignation.—*The Daily Graphic*.

NOTES.

REPLYING to Mr. Sandys in the House of Commons on Monday last, Colonel Seely made an important announcement on the subject of military aviation. He stated that the War Office has a progressive policy in the matter, and has hitherto only hung back because it wants to be quite sure, in buying a great number of machines, that they are of the most useful type. The Service now possesses sixteen aëroplanes of eleven different types, of which seven are biplanes and four monoplanes. It is proposed to pay officers who obtain the Aero Club certificate a sum of 75*l*. towards their expenses, and such officers will be attached to the Army Aëroplane Battalion for a course of special instruction, which will include navigation and map-reading. They will then be expected to pass for a certificate similar to the French superior military certificate. The intention is, finally, to provide an efficient service of aërial scouts both for the Navy and for the Army. One hundred officers will be trained immediately as pilots and observers, and non-commissioned officers and other ranks will also be trained. In the discussion that followed, Mr. R. Gwynne asked whether the War Office intends to subsidise experiments, but no answer was given. As comment on the foregoing, it may be interesting to enumerate what machines the Government actually possesses. They are as follows:—*Biplanes:* one original Wright, presented by the late Hon. C. S. Rolls (never flown, and now dismantled); one Howard Wright, purchased from Captain Maitland (broken up); one Paulhan (broken up, capable of repair); one de Havilland (worn out, must be entirely rebuilt); one experimental Voisin Canard type (broken up); one Farman (out of date); one Bréguet; and several Bristols. *Monoplanes:* four Valkyries, presented by Mr. Barber (one broken and two without motors, leaving one effective); one Nieuport; and one Blériot (formerly the property of the late Lieut. Cammell). With regard to the French superior military certificate, the rules for this were issued by General Roques last June, and lay down that military aëroplane pilots must possess the Aero Club (F.A.I.) certificate and the military aviator's certificate. The latter is granted to officers, non-commissioned officers, and men of the regular or of the reserve and territorial army who, possessing the Aero Club certificate, have passed a series of tests to be determined each year in accordance with aëronautical progress. For the present year candidates must have accomplished three closed circuits at a height of at least 300 metres, each circuit comprising a cross-country flight of 50 metres, the landing being made at the starting place. The aëroplane must be of a military type, and carry an overload. Candidates have also to pass an examination on aëroplane motors.

THE notices of aviation feats and fatalities which appear in the daily Press do not often afford the scientific inquirer much indication of any advances in our knowledge of the principles of mechanical flight. The remarkable glide which Mr. Orville Wright performed on October 24 reminds us that there is still much to be done with gliders, and that flight as a sport does not necessitate a costly motor-driven aëroplane. The glide in question, which lasted about ten minutes, was performed at "Kill Devil Hill" in a wind blowing at about fifty miles an hour. By careful manœuvring Mr. Wright caused the wind to pick him up from the top of a sand dune, and in successive gusts he rose 150 feet, finally gliding to the ground. Mr. Wright stated that he had proved that a man can remain in the air without a motor provided there is sufficient wind. The question which naturally suggests itself is how far this feat was due to upward currents caused by the wind blowing up the sides of the dunes. It is one thing to hover round a hill top under such conditions, but it would be a very different task to make use of Langley's "Internal Work of the Wind" in a flight across a bare plain or over the sea.

IN the House of Commons on Monday, October 30, the Home Secretary was asked whether his attention had been directed to the views expressed by Sir William Ramsay in his presidential address to the British Association concerning the exhaustion of the coalfields of this country, and whether the Government anticipated taking any steps tending to the conservation and lessened waste and export of this source of energy supply, having regard to the extent to which the nation's commercial position and the support of the industrial population were dependent on it. In the course of his reply, Mr. McKenna said:—The president's forecast of the probable duration of the coal supplies of the country does not take into consideration certain factors which have an important bearing on the question. In the first place, the estimate took no account of the large amount of coal in fields unproved at the time of the inquiry of the Royal Commission, nor of the amount of coal lying below the depth of 4000 feet which the commission took to be the present limit of workable coal, but which it may be

found possible hereafter to exceed. These two sources the commission estimated at more than 39,000 million and 5000 million tons respectively, or together nearly half as much as the amount of coal estimated to exist in the proved coalfields. In the second place, the estimate was based on the assumption that the output of coal would continue, at any rate for some time, to increase at the same rate as in the past. The commission, on the other hand, considered that at a time not far distant the rate of increase of output would become slower, to be followed by a period of stationary output, and then a gradual decline. The suggestion which Sir William Ramsay is reported to have made, that Parliament should impose a penalty on wasteful expenditure of energy supplies, would involve an amount of control over the industries of the country which, under present conditions, it would be impossible for any Government to undertake. The commission looked forward to the introduction of considerable economies in the future; and I am advised that both in the working and in the using of coal progress is being made in this direction.

M. HENRI MARTIN presented to the Paris Academy of Sciences on October 16 a note on the skeleton of Neanderthal man discovered by him at Quina, in the department of Charente, during September last. This is the fourth find of Neanderthal man which has been made in the south-west of France during the last four years. Former discoveries were made in the valley of the Dordogne, or of its tributary the Vézère, while the present has been made in the valley of a tributary of the Charente, fifty miles further to the north. The stratum of sandy clay in which the skeleton was found is regarded by M. Martin as a former bed of the adjacent stream, and as corresponding in date to the lower strata of the Middle Quaternary deposits. In former discoveries of this nature there was evidence that the remains had been buried or been naturally entombed, but in the present case the evidence points to the remains having been embedded during the formation of the deposit in which it was found. In the same stratum were found flint and bone implements, which M. Martin ascribes to the older Mousterian civilisation. The teeth are very similar in character to those found recently in a cave in Jersey, and described in the current issue of *The Journal of Anatomy and Physiology* by Messrs. Keith and Knowles. The skull, which has become broken along the sutural lines, is said to show the well-known characters of the Neanderthal race in a very pronounced degree. The remains of the skeleton have been transported to Paris still embedded in the blocks of loam in which they were discovered, and will ultimately be added to the collection in the Muséum d'Histoire naturelle.

AGRICULTURISTS will regret to learn that M. Gaston Gautier recently died at Narbonne, at seventy years of age. M. Gautier, who was brother of M. Armand Gautier, president of the Academy of Sciences, was a member of the Société de botanique de France, and had published several botanical memoirs. But his great claim to fame is that he introduced the culture of the vine into a region that had been little better than a huge pestilential swamp round Narbonne. The first efforts at reclamation were made on his own estate of Craboules, and finally met with such success that many of his neighbours followed his example; by degrees the swamp gave way to fruitful vineyards.

THE death is announced, at ninety years of age, of Mr. John C. Fuller, whose name is familiar to electricians in connection with the Fuller bichromate battery. A correspondent of *The Times* points out that Mr. Fuller was at one time an assistant of Faraday. He joined the Electrical and International Telegraph Company in 1854, and during his connection with it worked with Latimer Clark and Sir William Preece. One of the results of Mr. Fuller's early studies was the invention of the universal battery system, by which one set of cells works a whole group of circuits. He invented several other forms of battery. About 1857 he assisted Messrs. Silver and Co. (the founders of the India-rubber, Guttapercha, and Telegraph Works Company) in applying indiarubber to telegraph purposes. Here he designed the machines and methods for covering wire and made vulcanite insulators. Later, before founding his own firm, Messrs. John C. Fuller and Son, he assisted Mr. W. T. Henley, the submarine cable manufacturer. At this time he invented and patented the mercury bichromate battery.

IT is with deep regret that we learn of the premature death, at fifty-four years of age, of Prof. Alfred Binet. Prof. Binet was director of the laboratory of physiological psychology at the Sorbonne, and was very well known among psychologists—above all as an ardent investigator of the first rank into problems of child psychology. He founded "L'Année Psychologique" in 1897, in which appeared, year by year, highly important articles from his own pen. Among many well-known books of his upon psychological topics may be especially mentioned "L'Étude Expérimentale de l'Intelligence," "La Suggestibilité," "L'Âme et le Corps," and "Les Idées modernes sur les Enfants" (his latest publication). The science of psychology has suffered a severe loss in his death.

THE annual Huxley memorial lecture of the Royal Anthropological Institute will be delivered on Thursday, November 23, in the theatre of the Civil Service Commission, Burlington Gardens, S.W., by Prof. F. von Luschan, whose address will be on "The Early Inhabitants of Western Asia." Mr. Alfred P. Maudslay, president of the institute, will occupy the chair.

THE council of the Institution of Civil Engineers has made the following awards in respect of papers published in Section ii. of the Proceedings for the session 1910–11:—Telford premiums to Messrs. S. M. Dixon, H. J. F. Gourley, J. Holden, A. Rogers, A. E. Griffin, Dr. F. C. Lea; and a Crampton prize to Prof. W. E. Dalby. The Indian premium for 1911 has been awarded to Mr. C. E. Capito, and the Webb prize to Mr. F. W. Bach.

THE list of lectures to be given on Mondays and Thursdays during the present session at the London Institution, Finsbury Circus, London, E.C., has been circulated. Among the numerous subjects of interest to be dealt with in the lectures we notice the origin of life question, by Dr. H. C. Bastian, F.R.S.; life on the high mountains of Mexico, by Dr. H. F. Gadow, F.R.S.; man under the microscope, by Dr. Alex. Hill; storm rains, by Dr. H. R. Mill; alchemy, by Mr. M. M. Pattison Muir; and waves of the sea, by Dr. Vaughan Cornish.

AT the meeting of the London Section of the Society of Chemical Industry, to be held on Monday, November 6, at Burlington House, Dr. E. G. Acheson, of New York, will read a paper on deflocculation as affecting lubrication. Dr. Acheson is well known as the inventor of lubricants consisting of deflocculated graphite—"Aquadag" and "Oildag" of carborundum, &c. The paper should be of interest to all who are concerned with lubrication and lubricants. Dr. Acheson will also give an address to the Faraday Society on Wednesday, November 8. Non-members of the society will be admitted by ticket, to be

obtained upon application to the Secretary, 82 Victoria Street, S.W.

THE council of the Royal Institute of Public Health has accepted an invitation from the Chief Burgomaster of Berlin to hold the congress next year in that city on July 25–28. The congress will include the following sections and presidents:—State medicine, Sir T. Clifford Allbutt, K.C.B., F.R.S.; bacteriology and comparative pathology, Prof. G. Sims Woodhead; child study and school hygiene, Sir James Crichton-Browne, F.R.S.; military, colonial, and naval, Major Sir Ronald Ross, K.C.B., F.R.S.; and municipal engineering, architecture, and town planning, Mr. P. C. Cowan. Facilities will be afforded for visiting the various public health and educational institutions in Berlin in connection with the Imperial Board of Health, the Municipality, and the University.

IN connection with the 200th anniversary of the foundation of the Spalding Gentlemen's Society, in 1709, the society has recently built a home for its library and museum, which also includes a magnificent lecture theatre, committee rooms, &c. The new building was opened on October 25 by Sir Henry H. Howorth, K.C.I.E., F.R.S., who referred to the extraordinary fact that a society should have carried on its work for two centuries and should then be in a position to purchase a building for its treasures. In the evening there was a public lecture on "The Romans in Lincolnshire," by Mr. T. Sheppard, in which he described many thousand relics of the Roman period, now in the museum at Hull, from a little-known site on the north Lincolnshire coast. Sir Harry Howorth occupied the chair. During the day Mr. Sheppard also gave an address on the use and value of local museums.

IN *The Quarterly Review* for October M. Salomon Reinach reviews the present condition and progress of mythological study. He shows how the earlier explanations of myths suggested by writers like Fontenelle, De Brosses, David Hume, and Dupuis gave way before the researches of Grimm and Mannhardt, to be succeeded by the theories of Kuhn and Max Müller. These last, in their turn, were superseded by the anthropological school, under the leadership of "that wittiest of scholars and most scholarly of wits," Mr. Andrew Lang. This revolt against the philologists was largely due to the advance in the knowledge of philology, which no longer accepts the identifications of the names of many Greek and Roman deities with those of India advanced by Max Müller himself and extended by his more ardent followers, like De Gubernatis and Sir G. Cox. It was also the result of the colonial policy of England which tended to extend the horizon of research from Aryan gods to the mythologies of savage races. The methods of the anthropological school were still further extended by W. Robertson Smith and J. G. Frazer. But the views of these last authorities are already disputed by the psychologists and sociologists. M. Reinach closes his instructive survey of the situation by the remark that "underlying and stimulating the work of criticism, as applied to the chief results of the anthropological school, I see, at all events in my own country, the ever-active upholders of tradition and established creeds."

AT a meeting held in Norwich on October 26, 1908, a society was established for the study of prehistoric archæology, especially with reference to the eastern counties, and shortly afterwards it adopted the title of "The Prehistoric Society of East Anglia." We have lately received the first part of its Proceedings, an octavo of 121 pages, containing a report of the work of the first two sessions, with several original papers printed in full. In a communication on the flint implements of sub-crag man, Mr. J. Reid Moir describes his well-known discovery of flints, reputed to have been worked by man, in deposits that, in some cases, are admitted by distinguished geologists to be undisturbed Red Crag. Dr. W. Allen Sturge, M.V.O., the first president of the society, contributes not only an appropriate inaugural address, but also a rather voluminous paper on the chronology of the Stone age. Although the views expressed in this paper are based to a large extent on the study of his extensive collection at Icklingham Hall, in Suffolk, as well as on local field-work, they are likely to evoke no little opposition, both from the geological and the archæological sides. The superficial scratches on many worked flints of Neolithic age he refers to glacial action, and thence concludes that an ice period, with several phases, must have occurred in Britain since the incoming of Neolithic man. Similar evidence in the case of certain palæoliths is accepted as proof of at least one Glacial period during Palæolithic times. Dr. Sturge ventures to suggest that the Neolithic age may have begun about 300,000 years ago, and the Palæolithic perhaps a million years ago. In forming these startling conclusions, he relies on Croll's hypothesis, which, although abandoned by most geologists, he does not admit to have been yet disproved.

Naturen for October contains an article by Prof. A. W. Brogger on prehistoric stone implements, the rock-shelters where some of them were found, and the remains of mammals and birds by which they were accompanied.

ACCORDING to the report of the New Zealand Scenery Preservation Board for 1910–11, a total of 25,442 acres was reserved during the year under review, this bringing up the total of the reserved areas to 65,989 acres. It is pointed out "that by virtue of past legislation all scenic reserves and national parks in New Zealand are practically sanctuaries for the native birds and game, and no shooting or killing whatever is permitted on them. The greatest care is taken to keep them free from noxious weeds, and wherever practicable and advisable the fencing of the external boundaries has been proceeded with, particularly when the reserve adjoins settled land or a road in general use."

IN *Himmel und Erde* for October (Jahrg. 24, Heft 1) M. Ficker contributes the first of a series of popular articles on the bacteria as the friends and foes of man. After a brief historical introduction, the classification and structure of the bacteria are considered, with illustrative figures.

A BULLETIN (No. 146) has been issued by the Agricultural Experiment Station of the Rhode Island State College, U.S.A., on the cholera-like diseases occurring among poultry. It is shown that, in addition to the well-known micro-organism of chicken cholera, first studied by Pasteur and Toussaint, several other microbes cause similar diseases among poultry, some of which possess extreme power of infecting.

BOTANISTS engaged in systematic work, or interested therein, will find in the catalogue No. 22, "Botanica Geographica," issued by Messrs. Dulau and Co., Soho Square, London, an extensive assortment of second-hand literature offered for sale. The items are most numerous under the sections devoted to Europe and North America; contributions to the botany of Africa are also well represented.

A SECOND contribution to their studies of Indian fibre plants, prepared conjointly by Mr. and Mrs. A. Howard,

deals with *Hibiscus cannabinus*, popularly known as Deccan or ambari hemp, and *H. Sabdariffa*, the Rozelle plant; it is published in the Memoirs of the Department of Agriculture in India as vol. iv., No. 2, of the botanical series. The investigation was primarily directed towards analysing the ordinary crops with the view of eliminating cross-fertilisation and securing uniformity of product. Five varieties, showing differences in the seedling and early vegetative stages, were isolated; descriptions of these and coloured figures are supplied. Two of the types are regarded as specially promising, and it is intended to develop these by pure-line cultures. The account of *H. Sabdariffa* is confined to comparative notes on pollination and the descriptions of four varieties.

THE interesting chapter on the history of fossil botany, chosen by Dr. D. H. Scott as the subject of his presidential address to the Linnean Society at the close of the last session, dates back three-quarters of a century, to a time when Witham in England and Cotta in Germany were prominent investigators, and the more illustrious Brongniart was engaged upon his earlier researches. Morphological elucidation was the guiding principle of Brongniart's studies, and in most cases he found it necessary to discover the required morphological data himself. His "Histoire des Végétaux Fossiles" contains in the introduction a definite recognition of four successive geological periods characterised by different types of vegetation. Witham's chief service was to demonstrate the early prevalence of gymnosperms, and he was also the first to describe the structure of the historic fossil *Lepidodendron Harcourtii*, although it remained for Brongniart to identify the ring of wood. To Cotta credit is due for the foundation of the genus Medullosa, and a virtual recognition of its polystelic character.

IN the *Naturwissenschaftliche Wochenschrift* for October 1 there is an article on the geological study of earthquakes, by Dr. Erwin Scheu, whose name is well known in connection with catalogues published by the International Association at Strassburg. The article deals with macroseisms, or earthquakes which can be felt. The intensities of these should be referred to a scale; but as seismologists are already troubled with sixteen different scales of intensity, it is not clear why Dr. Scheu should add to their number. He, however, suggests one which, he remarks, might be suitable for Europe, but hardly suitable for the tropics. An earthquake which is not felt should, according to the new scale, be indicated by the numeral I, whilst one accompanied by complete destruction, which refers to a megaseism rather than a micro- or macroseism, has an intensity of VII. In a map of isoseists for the earthquake of Jókeö, January, 1906, some of them are, however, marked VIII and IX. In connection with the construction of isoseists, we are told that the intensity of movement exhibited in hard rocks like granite is greater than it is in materials like marl and clay. So far as destructivity is concerned, our impression has been that this is generally the reverse. The influence of fault lines, as, for example, those in the Rhine Valley and mountain ranges, upon the distance to which earthquake motion may be propagated is pointed out. Illustrations are given of the destruction caused to buildings, and the displacements, vertical and otherwise, of land surfaces. Dr. Scheu's article is distinctly popular, and as such suggests phenomena to be observed at the time and after the occurrence of an earthquake.

THE meteorological charts of the North Atlantic and Mediterranean for November, issued by authority of the Meteorological Committee, contain an instructive account of the behaviour of a heavy storm in the North Sea, illustrated by synoptic charts. Between September 28 and 29 a small cyclonic system seems to have formed near 50° N. and 30° W.; on the morning of September 29 the chart for that day shows that the centre was about 57° N. and 25° W., and was advancing towards the coast of Ireland, increasing in velocity and intensity as it travelled eastwards. On the morning of September 30 the centre was near Spurn Head; during the gale an extreme force of 10 (Beaufort scale) was recorded at several stations on the East Coast, and at 6h. p.m. the centre passed over the north of Holland. An interesting point in this storm is that apparently the wind force experienced by vessels in the North Sea was greater than that at many of the land stations in telegraphic communication with the Meteorological Office. The numerous casualties to shipping would also seem to show that the high seas must have been exceptional.

IN *Symons's Meteorological Magazine* for October Mr. W. Sedgwick continues his interesting notes on the weather in the seventeenth century: part iii., autumn (see NATURE, June 1). He points out that at this season of the year such phenomena as heat waves, severe frosts, &c., are not likely to occur, at any rate near London. It is not surprising, therefore, that Evelyn and Pepys made fewer comments than in the case of the other seasons. To those who still firmly believe that the climate of England has changed, the month of October presents special interest, owing to the comparatively high temperatures experienced in that month in recent years. In a paper read before the Royal Meteorological Society on April 19, on variations in English climate, it was shown that for the last fourteen years (1897–1910), except only in 1905, the temperature was above the average in October. So far as can be judged from the chronicles above referred to, this variation in recent years is merely a periodic change, as they do not show that the weather of that month was noticeably colder than at the present time. Frequent references are made to the pleasant weather experienced; only one October (1692) was referred to as a cold month; Pepys described that of 1668 as "the most summer weather that was ever seen." The general character of the weather in November also, as described by Evelyn, was very similar to that of the present time.

IN a paper by Prof. Henry Louis on the mutual developments of metallurgy and engineering, read before the University of Durham Philosophical Society, and published recently in its Proceedings, much interesting information is given about the history of metallurgical processes. It seems to be fully proved that the Assyrians were not only well acquainted with iron, but had attained some considerable skill in its manufacture, having advanced far enough to make chain mail; thus, so far back as 900 B.C., iron manufacture had long passed the rudimentary stages. The only other common metals known to the ancients were lead, copper, and tin, all of which are easily reduced from their ores; brass was known for a very long time before it was discovered that zinc was one of its constituents, it being always made direct from zinc ore; Roman brass coins have been analysed, and found to contain more than 25 per cent. of zinc, so that the material was certainly known to them, although they did not know its true composition. The metallurgy of lead was relatively far advanced; quite a number of pieces of lead of Roman age have been found in this country, the earliest date about 44 A.D., and several of these are marked "EX. ARG.," or desilverised; it is also evident from the composition of articles of Roman lead that the metallurgists of that day

were tolerably well advanced with their methods of desilverisation.

The Electrical Review for October 13 discusses in a leading article the question as to whether there is or is not at the present time a demand for technical men in the electrical engineering profession. After reviewing the evidence afforded by recent letters to the Press, it concludes that the overcrowding of which there have been complaints is confined to the lower branches, and that it is due to the large class of men who have had no technical training. While the general impression that the profession was overcrowded has led to a decrease in the entries of students in the electrical engineering colleges, a decrease which has now gone on for several years, there is to-day, as a matter of fact, a greater demand for technically trained men than the colleges can supply.

In order to clear up the small differences which still exist in the determinations of the melting points of metals like zinc and cadmium by even the most accurate observers, Drs. Holborn and Henning, of the Reichsanstalt, have compared together a number of platinum thermometers and two constant-volume gas thermometers of Jena glass 59 III., and of quartz glass filled in turn with nitrogen, hydrogen, and helium. Both the Jena and the quartz glass were slightly porous to the helium above 200° C., but the former showed no signs of being permeable to hydrogen up to 450° C. The constant δ of the platinum thermometers lay between 1·486 and 1·510, but in no case did the temperature between 200° and 450° C. determined by the platinum thermometers with the use of the δ formula differ by 0·1° C. from the temperature given by the gas thermometers. The following melting and boiling points were obtained:—tin, 231·8°; cadmium, 320·9°; zinc, 419·4°; naphthalene, 217·96°; benzophenone, 305·89°, on the thermodynamic scale.

Furs which are moth-proof owing to the substitution of indiarubber for animal tissues would seem at first sight to be a fantastic stretch of the imagination only. A curious invention recently recorded, however, would appear to render rubber-backed fur a possible and practical article of the near future. Large skins, or small pelts sewn together, are stretched upon a frame with the fur uppermost in a large flat-bottomed receptacle, which is then filled with water and placed in a freezing chamber. The plate of ice is then removed, and with suitable machinery a thin layer is sawn from the bottom, thus removing the skin, which after thawing is sold for the purposes of leather. The lower surface of the remaining plate is then melted until the fur is slightly exposed, when a coating of rubber solution is applied layer by layer. When the requisite thickness is obtained the rest of the plate containing the fur is melted, and a large seamless pelt, with a sheet of rubber at its base, is the result. Cheapness is one of the many advantages claimed by the inventor. Ladies with valuable furs, which annually cost a considerable sum for cold storage, will wish every success for so ingenious an invention.

Some interesting observations regarding the formation of hydrocyanic acid during the germination of seeds are contained in a paper by C. Ravenna and M. Zamorani in the *Gazzetta Chimica Italiana* for September 19 (vol. xli., ii., p. 74). The old experiments of Jorissen and the more recent ones of Soave have shown that some seeds, such as sweet almonds and the seeds of *Mespilus japonica*, form considerable quantities of hydrogen cyanide at the beginning of active life. On the other hand, the experiments of Guignard with *Phaseolus lunatus* point to a destruction of hydrocyanic acid at the commencement of germination, especially in the case of etiolated plants. The experiments now described were made on two species of seed, viz. *Sorghum vulgare*, which does not contain appreciable traces of hydrogen cyanide, and a variety of linseed, which contained it in considerable proportion. In the case of the former, hydrogen cyanide was elaborated during germination up to a certain point, beyond which it appeared to undergo progressive destruction; in the latter case a continuous increase of hydrogen cyanide was observed without a point of decomposition being attained. In all cases the rate of production of the cyanide was greater in the green than in the etiolated plants; but on watering the latter with a 2 per cent. solution of glucose during growth, the proportion of hydrogen cyanide formed was increased up to the level of the green plants. The amount of carbohydrates in the seed thus greatly affects the formation of the hydrocyanic acid. The source of the nitrogen remains to be investigated.

The council of the Institute of Chemistry has inaugurated a series of lectures, the first of which was delivered by Mr. Bertram Blount at King's College on October 26. The chair was taken by Prof. J. Millar Thomson, F.R.S., who said the lectures were an extension of the work of the institute on lines directed to benefit advanced students of chemistry. Except for one or two lectures delivered in its early history, the institute has not assumed in any way the functions of a teaching body, though the charter provides for such functions. Mr. Blount limited his remarks to calcareous cements, and more particularly to the Portland cement industry. Calcareous cements, properly so called, while being plastic, are capable of hardening and are resistant to water. The common fallacy, that the setting of lime mortar is due to the action of lime on the sand with which it is mixed, was once more exploded. Some siliceous materials have an advantage over others as aggregates for mortar. These are known generally as "pozzolanas," and their usefulness depends on the hydrated silica or attackable silicates they contain, which interact with lime and form compounds resistant to the action of water. There seems to be no record that limestones were intelligently chosen for the hydraulic quality of the lime which they furnished until the time of Smeaton, who, in considering with what material he should build the Eddystone Lighthouse, ascertained that Aberthaw limestone was undoubtedly hydraulic. Those limestones which are most hydraulic contain the largest proportion of argillaceous material. This quality may be improved by the addition of what is capable of conferring hydraulic properties on ordinary lime. Mr. Blount also discussed the manufacture of so-called "Roman cement," a crude form of Portland cement made by burning lumps of clayey limestone. Starting with the notion of imitating Roman cement, the progenitors of the Portland cement industry arrived at the idea that when chalk and clay were mixed and burned an hydraulic material was produced which, when ground, would set and form a strong, sound cement.

OUR ASTRONOMICAL COLUMN.

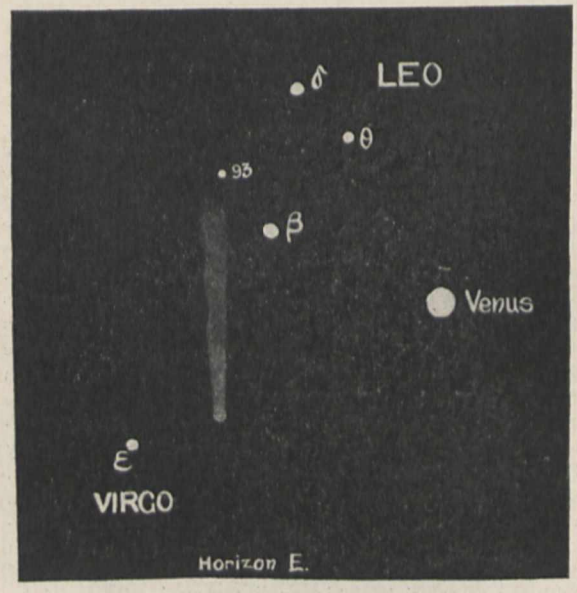
Astronomical Occurrences for November:—

Nov. 6. 3h. 37m. Moon eclipsed, partly visible at Greenwich.
,, 12h. 11m. Saturn in conjunction with the Moon (Saturn 4° 18′ S.).
7. 7h. 19m. Mercury in conjunction with Jupiter (Mercury 1° 50′ S.).
,, 20h. 50m. Mars in conjunction with the Moon (Mars 2° 53′ S.).
9. 18h. 0m. Saturn at opposition to the Sun.
10. 21h. 31m. Neptune in conjunction with the Moon (Neptune 5° 52′ S.).

11. 13h. 0m. Ceres in conjunction with the Moon (Ceres 0° 48′ S.).
16. 6h. 58m. Venus in conjunction with the Moon (Venus 1° 13′ S.).
18. 4h. 0m. Jupiter in conjunction with the Sun.
21. 20h. 24m. Mercury in conjunction with the Moon (Mercury 1° 28′ N.).
24. 17h. 0m. Mars at opposition to the Sun.
25. 5h. 41m. Uranus in conjunction with the Moon (Uranus 4° 44′ N.).
,, 20h. 0m. Venus at greatest elongation W. of the Sun.

OBSERVATIONS OF COMETS.—It appears from a note by Mr. Knox Shaw, in No. 4531 of the *Astronomische Nachrichten*, that the discovery of Borrelly's comet, 1911*e* (1905 II.), was made with the Reynolds reflector, but was a visual observation, photographs being secured later; the comet's magnitude on September 19 was 13·0 to 13·5, and there was no marked nucleus.

Messrs. Innes and Wood describe the Johannesburg observations of comets 1911*b* (Kiess) and 1911*d* (Encke) during August and September, and Mr. Innes compares the reduced places of Encke's comet with the positions given in Dr. Backlund's ephemeris. The smoothed O–C difference in R.A. increases from 28·3s. on September 3 to +47·3s. on September 14, the corresponding figures for



Brooks's Comet (1911*c*), October 27, 4h. 45m. a.m.

declination being −4·7′ and −6·2′ respectively. The magnitude of the comet early in September was 9·5, and the photographs were taken by Mr. Wood, with the Franklin-Adams star camera, in exceedingly difficult circumstances. Kiess's comet was of about fifth magnitude, and showed no tail on August 17, and then rapidly faded to mag. 11·5 on September 17.

Brooks's comet, 1911*c*, has been quite a conspicuous feature of our early morning skies during the past week. A naked-eye observation by Mr. Rolston at Gunnersbury on October 27 showed a straight tail some 15° long, at times seen to extend to 93 Leonis. The head was a little less conspicuous than δ, but brighter than θ, Leonis; thus its magnitude would be about 3·0. As is shown in the accompanying illustration, the comet, at 4h. 45m. a.m., formed a striking triangle with β Leonis and the very brilliant Venus. At 5 a.m. on October 31 a tail some 12° long was seen, and at times a further extension was suspected. The head, seen through opera-glasses of low power, had the appearance of a fairly bright homogeneous disc; to the naked eye it was no less conspicuous than γ Virginis (mag. 2·8).

CHANGES ON MARS.—M. Jarry-Desloges, in a communication to the *Astronomische Nachrichten*, No. 4531, states that there is a bright area on the Mare Tyrrhenum similar to that already noted on Libya, and that the regions of Hesperia and Ausonia are completely modified since October 12. This message is dated October 15 from the new observatory at Sétif, North Africa. In the same journal there is a paragraph stating that observations have been carried on at this station since the end of September; its position is long. = 3° 4′ 21″ E. of Paris, lat. = 36° 11′ 19″ N., and it is situated at 1113 m. (3650 feet). At such an altitude the air is quite clear and suitable for astronomical observations, and M. Jarry-Desloges hopes to be permitted to confirm observations of the Martian surface made at other observatories. To this end he asks for early and brief communication of the detection of any remarkable phenomena; the address for letters is: Astronome de Service à l'Observatoire Jarry-Desloges, Sétif, Algeria; and for telegrams: Observatoire Sétif, Algeria.

COLOUR PHOTOGRAPHS OF SATURN.—Having secured the colour photographs of Mars recently described in these columns (October 19), M. Tikhoff turned his attention to a similar study of Saturn. It had been remarked, some years ago, by M. Belopolsky that the spectrum of the rings of Saturn appeared to extend further into the ultra-violet than did the spectrum of the disc, and this suggested the use of colour screens. With screens prepared by M. Tikhoff, M. Belopolsky therefore employed the 30-inch refractor in 1909 and during the earlier months of the present year to secure colour photographs of the planet. Two parts of the spectrum were used, the "indigo-violet" (390–450 μμ) and the "yellow-green" (495–620 μμ). M. Tikhoff examined the plates, and arrived at the following general conclusions. Passing from red to violet, the difference in intensity of the edges and centre of the ball diminishes, and finally disappears; the equatorial band is most brilliant in the red and darkest in the violet. The behaviour of the rings is directly opposite to that of the ball, but the edges of the disc and the contiguous parts of the rings are equally intense in all radiations. Observations of the spectra of the various parts confirm these conclusions, which may be explained by the presence of an atmosphere about the disc and none about the rings. It would also appear, from their similarity of transmission, that the particles forming the rings and those forming the atmosphere about the disc are of similar magnitude; that is to say, the pulverulent particles of which the rings are built up have diameters which, in the mean, are less than wave-lengths of light.

AURORÆ IN MIDDLE LATITUDES.—Referring to Sir Lauder Brunton's letter describing a pseudo-aurora seen at St. Beatenburg, Switzerland, Dr. Krebs sends us a card saying that he too saw flashes of light in the north, as seen from Grossflotbek, at 9h. 10m. (G.M.T.) on August 21. The sky was then nearly three-parts covered with cloud, and thunderstorms prevailed about that period. As a possible explanation of the phenomenon he refers us to an article by himself in *Urania*, No. 9 (February 26, 1910), where he describes a light which he saw off Nantucket on May 15, 1909, which was seen from Blue Hill at a corresponding time. As seen by him it was in the N.E.–N.W. region, but seen from Blue Hill it was south of the E.–W. line; thus it lay between the two stations, between lat. 40·5 N. and 42° N. Perturbations of the compass accompanied the apparition, and it is suggested that a charged cloud capable of giving these and emitting the flashes of light passed somewhere between the two stations.

THE MINOR PLANET 1911 M.T.—Dr. Palisa's description of how he found the new and important minor planet 1911 M.T. is given in No. 4530 of the *Astronomische Nachrichten*. He first drew it on his chart on September 29, but found its position empty on October 3. When seen on this date the object appeared to present a nebulous appearance, suggesting the possibility of its being a comet, but a further observation on October 4 negatived this.

GEOLOGICAL WORK IN THE UNITED STATES.

THE papers dealt with under this heading are merely representative of a large amount of literature devoted to the understanding of the ground on which the United States have become founded. Whether from an educational or from a more economic point of view, this wide territory continues to be actively explored, and the existence of State surveys, side by side with that centred in Washington, testifies to the value set upon geological research. The thirtieth and thirty-first annual reports of the U.S. Geological Survey, issued by the director, G. Otis Smith, in 1909 and 1910, show how the survey has often preceded its topographers in the field. These reports now indicate the main features of administration and publication during a fiscal year, the scientific papers being wisely issued in a separate form. J. M. Nickles supplies bibliographies of North American geology for 1908 and 1909 (Bulletins 409 and 444), with useful subject-indexes.

As a sample of the present convenient form in which the Geologic Atlas is obtainable, we may mention folio 169, the Watkins Glen-Catatonk Folio, by H. S. Williams, R. S. Tarr, and E. M. Kindle. In the "field edition," with its low price of 25 cents, the maps are folded into a pocket in the octavio memoir, which supplies an illustrated description of the district, occupying 242 pages. Two topographic contoured maps are given, and are followed by two showing "areal geology" and two showing "surficial geology," printed in colours over the topographic groundwork. The district, lying in the Allegheny Plateau, between Lake Ontario and the Pennsylvanian border, furnishes R. S. Tarr with a good field for glacial investigation. He traces two epochs of ice-advance, the first being especially accompanied by overdeepening of the valleys.

S. R. Capps describes, in Bulletin 386, the "Pleistocene Geology of the Leadville Quadrangle, Colorado." Here, again, considerable overdeepening and widening of valleys has occurred (p. 12), and the country includes typical topographic features due to glacial erosion and deposition (Fig. 1). W. M. Davis has already examined some of these, and his influence may be felt in the explanatory passages with which the present memoir introduces us to the district. The bulletin is eminently one for scientific students who may travel in central Colorado. W. R. Calvert describes (Bulletin 390) the Lower Cretaceous coal-bearing strata of Lewistown, Montana, in a district where Carboniferous and Jurassic beds are also represented. P. S. Smith (Bulletin 433), in the Seward Peninsula of Alaska, has encountered (p. 97) the phenomena of soil-cap movement that have been somewhat grandiloquently styled "solifluction" by Swedish authors. He describes independently how the frozen earth receives a burden of detritus, and how this burden flows downhill when the ice below it begins to melt. Materials from various levels of the hills thus become mixed, to the annoyance of the prospector, who seeks his gold in the stream gravels that are liable to be covered by an "earth run." Vegetation flourishes in places on soils laid down, by streams or by earth-sliding, on beds of ice, which originated in ancient snowfalls. The maps in this bulletin show well the auriferous gravels, and the uplifted coastal plain on Norton Sound. In Bulletin 435, N. H. Darton records "a reconnaissance of parts of north-western New Mexico and northern Arizona," and illustrates once more the famous cañon country. The problem of the sandstone crater of Coon Butte (p. 72), which is 3900 feet in diameter and 600 feet deep, is believed to be best met on the volcanic hypothesis of a steam-explosion.

N. H. Darton has also studied the geology and water resources of the Black Hills region in S. Dakota and Wyoming (Professional Paper 65), in continuation of his report of 1901. This district includes, among other bold buttes left by erosion on the plateaus, the remarkable columnar mass known as the Devil's Tower (Fig. 2), which the author believes to be connected with an underlying vent. The nature of the "igneous rock" is not stated.

Professional Paper 72, by L. C. Glenn, on "Denudation and Erosion in the Southern Appalachian Region," includes a useful essay on erosion for the non-geological reader, with illustrations from areas under vegetation and those from which grass and forests have disappeared. The disastrous effects of sulphuric acid fumes from smelting furnaces are shown in views near Ducktown, Tennessee (Plate xvii.). The paper is thus of interest for geographers, and includes photographs of stream-meanders and river-flood phenomena.

Palæontology is represented by several bulletins. E. M. Kindle (No. 391) treats of the Devonian fauna of the Ouray Limestone in Colorado. The upper part of this limestone is marked off by its fossils as Mississippian (L. Carboniferous). Several new species and a new genus of Brachiopods (Syringospira) are described. R. Arnold (No. 396) writes on the "Palæontology of the Coalinga District, California," where strata from the Franciscan (Jurassic?) series up to freshwater Pliocene beds are represented. The eight unconformities indicate the instability of this western region. G. H. Girty describes (No. 436) the fauna of the Phosphate Beds of the Park City formation in Idaho, Wyoming, and Utah, and points out the existence of a specialised type of Carboniferous fauna widely distributed through the west (p. 10). Brachiopods are scarce, and molluscs are unusually common. G. H. Girty has also (No. 439) reported on the "Fauna of the Moorefield Shale of Arkansas," a Mississippian zone which he allies with the Caney Shale of Oklahoma.

FIG. 1.—Spur truncated by glacial erosion, near Crystal Lake, south-west of Leadville, Colorado.

Economic geology is properly dominant in other bulletins. T. N. Dale (No. 404) writes on the granites of Vermont, with illustrations of their utility in the arts. F. L. Ransome, W. H. Emmons, and G. H. Garrey collaborate in a report (No. 407) on the "Geology and Ore Deposits of Bullfrog District, Nevada," an arid region where gold, derived from pyrite, occurs in a series of oxidised ores. Crystalline schists have been developed from Ordovician or

older sediments by pressure and by the intrusion of pegmatite along the planes of foliation (p. 27). Rhyolites form stratified masses on the surface, and contain spherulites (p. 39) up to 4 feet in diameter. These and the desert scenery are well illustrated. Bulletin 417, by F. H. Moffit and A. Knopf, on "The Mineral Resources of the Nabesna-White River District, Alaska," is mainly concerned with the geology, and contains pictures of the piedmont glaciers. Bulletin 420 deals with "The Feldspar Deposits of the United States," and is a practical introduction to the industrial use of pegmatites. T. L. Watson (No. 426) describes, with adequate illustration, the granites of the south-eastern States. The orbicular gabbro-diorite illustrated on p. 145 is proposed for ornamental purposes. The papers on water-resources show, as usual, a close alliance between the work of the Survey and the living interests of the people.

We may mention here a paper issued by the U.S. Department of Agriculture in 1911, by W. H. Waggaman, on the phosphate fields of Florida, in which it is

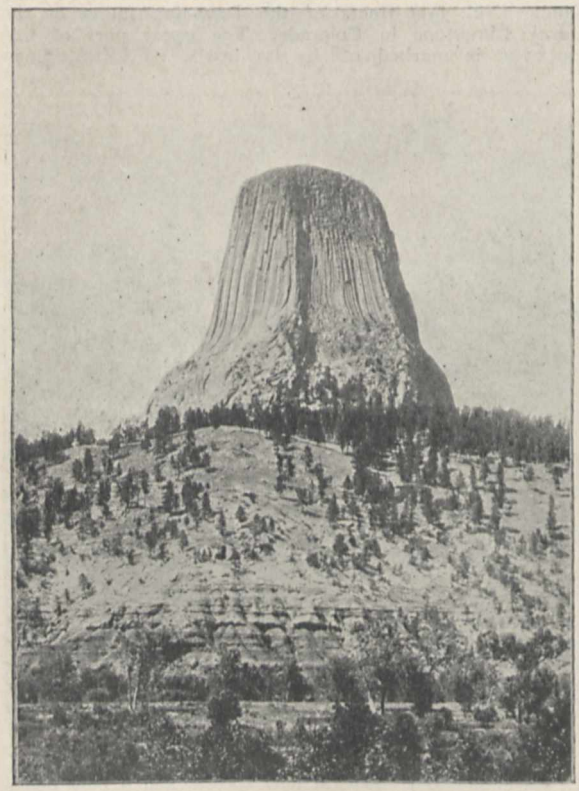


FIG. 2.—The Devil's Tower, south of Hulett, Wyoming.

estimated that the deposits of detrital pebbly phosphate, probably of Pliocene age, are "almost inexhaustible." For all that, we may well fear the energy of the modern agriculturist.

The United States Survey (Bulletin 465) has supplied us with a history of the various Geological Surveys organised by separate States, and we may now mention some recent publications of these bodies. Maryland has issued vols. vii. and viii. of her handsome cloth-bound series. Great attention has been given to road-metal, for roads have now a new meaning in the wealthier States. It is to be regretted that the only way of preserving certain roads in Maryland from the destruction due to uncontrolled motor-traffic is the formation of depressions across them, which check any attempt at furious driving. As in our own islands, legislation is regarded as powerless to remedy the evil. Vol. vii. is concerned with a topographical re-survey of the boundary between Maryland and Pennsylvania, first marked out in 1763.

Wisconsin supports a joint Geological and Natural History Survey, and has recently issued several maps of the lead and zinc mining district, on the large scale of 4 inches to the mile, with contour-lines at intervals of 10 feet.

The annual report of the Iowa Geological Survey for 1909 (received in 1911) contains much matter of interest to the glacialist. The papers written by the geologists, and notably that on Hamilton and Wright counties, by T. H. Macbride, are addressed to any intelligent citizen. They cannot fail to arouse interest in the features that diversify the great flat lands of this central State, nearly four-fifths of which are occupied by prairies. The State is being described county by county, and B. Shimek, in Harrison and Monona counties, illustrates the loess deposits, which often form conspicuous bluffs. Land-shells form the immense majority of the molluscan fossils of these beds, and the author strongly supports (p. 399) the æolian view of their accumulation. The survey of these two counties has led to the discovery (p. 309) of a rich mammalian fauna in the Aftonian interglacial stage, including elephants, horses, and Mylodon. The freshwater molluscs of the same beds are mostly still living in West Lake, Okobozi, Iowa. The botanical report (pp. 426–483) on the prairie flora and its conditions of growth will interest students of plant-distribution. The huge granite boulders of the earlier or Kansan drift, illustrated by M. F. Arey in Plate xi., remind us of those of the North German plain, and the intelligent citizen before mentioned may like to learn more as to how they came into the ice-sheet.

Bulletins 1 and 2 of the Colorado Geological Survey, published in one volume, bound in cloth, describe two mining districts, with the aid of coloured maps.

The Colorado School of Mines issues a "Quarterly," reviewing the mining progress of the State, and geological papers may also be found in the "Studies" published at Boulder by the University of Colorado. J. Henderson writes in the latter (vol. viii., 1910–11, p. 33) on "Extinct and Existing Glaciers of Colorado," with good illustrations and a general introduction to the subject. The glaciers are, of course, interesting on account of their small size and evidences of retreat.

Among papers that have reached us from private sources, we may mention several on Pleistocene features by F. Carney. His inaugural thesis for his doctor's degree at Denison University (Bull. Den. Univ., vol. xiv., p. 335) treats of the glacial phenomena and resulting topography of a part of New York State. The destructive effect of continental ice upon well-bedded and jointed strata beneath is illustrated in Figs. 25 and 26. The same author (*ibid.*, p. 262) has studied the "Raised Beaches" of parts of Ohio, which seem to be glacial lake-terraces rather than raised beaches in the customary sense. They were formed in bodies of water along the frontal margin of the Wisconsin ice-sheet, when it had retreated to the basins of Lake Erie and the other great existing lakes. In accordance with the author's geographic outlook, the terraces are connected by him with the agricultural economics of Ohio. He has also described "Geographic influence in the development of Ohio" in a paper in the *Popular Science Monthly* for November, 1909.

The Grand Cañon of Arizona has attracted D. W. Johnson (Proc. Boston Soc. of Nat. Hist., vol. xxxiv., p. 135) and L. F. Noble (Am. Journ. Sci., vol. xxix., p. 369). The former believes, with W. M. Davis, that the faulting of the district is in the main of ancient date, that is, older than the course of the river. His expedition was chiefly concerned with the examination of this important question. Some modification of Huntington and Goldthwait's report is suggested (p. 157). L. F. Noble's contribution deals with new points in the pre-Cambrian and Palæozoic stratigraphy of the cañon.

C. D. Walcott's progressive Cambrian studies have been referred to more than once in NATURE (see vol. lxxxvii., p. 423). The Smithsonian Miscellaneous Collections have been enriched by them for some years past, and now include (vol. lvii., No. 1) a contribution on the "Abrupt Appearance of the Cambrian Fauna on the North American Continent," presented before the International Geological Congress of 1910. Walcott's view is that life-forms, primarily pelagic, adapted themselves to littoral conditions in Algonkian times, and were first brought over on to the

continental area by the Cambrian marine transgression. Their ancestors are thus to be looked for beneath the existing oceans. The fossils now known from the American Algonkian may have been of fresh or brackish water types; littoral forms were occasionally imported among them from the series continuously developing in the seas. Walcott's studies of the Cambrian faunas of China are continued, with illustrations of new species of trilobites (vol. lvii., No. 4). Evidence is given (*ibid.*, No. 3) that certain medusiform fossils from the Middle Cambrian of British Columbia are in reality holothurians, being characterised by a large spiral alimentary canal. The descriptions and illustrations of these forms possess great interest for all workers among Older Palæozoic strata.

G. A. J. C.

STEREOSCOPIC VISION AND INSTRUMENTS.

WE have received a copy of a brochure entitled "Stereoskopisches Sehen und Messen" (pp. 40, price 1 mark), by Carl Pulfrich. This is the German version, or rather original, of the article "Stereoscope" in the recent new edition of the "Encyclopædia Britannica." A little more detail is given here and there in the German pamphlet than in the "Encyclopædia" article, and the former concludes with a very useful bibliography of papers published in the present century relating to binocular vision, which is not given in the "Encyclopædia." This is to be taken as supplementary to the bibliography in von Rohr's well-known work "Die binokularen Instrumente" (see Supplement to NATURE, March 5, 1908) of memoirs published up to 1900.

The pamphlet gives a concise, but clear and interesting, account of the more important points in the theory of stereoscopic vision; but its main value lies in the brief description which follows of the important modern developments and applications of stereoscopic methods, to which the author has himself so largely contributed. Not the least interesting among these are the well-known stereo-comparator and the so-called "blink" microscope, the latter of which has proved so valuable in the detection of new planets and variable stars. We think it is desirable that attention should be drawn to the very imperfect, not to say unintelligible, translation of Pulfrich's text which constitutes the article in the "Encyclopædia Britannica" above referred to. It is surprising that both translator and editor should have allowed passages to pass which are so far astray from the original. Thus we read: "The reason for this [double images] is that when P (or H′) is *fixed*, the images of H′ (or P) are always separated from one another by the centre of the yellow spot." *Fixed* should be "focussed" (no doubt "fixiert," but the original is here paraphrased). Again: "The power of perception of depth in man is most accurate. *This has been ascertained* by the approximately equal keenness of vision of all normal-sighted people and by the interpupillary distance." This is quite incomprehensible until one learns that the words in italics (ours) are a perversion of "Es wird bestimmt." "Parallax" (Parallaxe) appears as "parallel axis."

It is impossible briefly to convey an idea of the confusion in the mind of the reader caused by numerous errors of this description; but we would strongly recommend all those interested in the subject-matter of the article to refer to Pulfrich's German memoir.

THE TECHNICAL COLLEGE, BRADFORD.

AN important extension of the buildings of the Bradford Technical College was opened by Lord Rotherham on October 25. The extension takes the form of a model experimental mill, in which all processes involved in the production of woollen and worsted cloth, from the raw material to the finished article, can be carried out on a practical scale. The building comprises a three-storey front block 175 feet long, devoted to lecture-rooms, textile testing-room, museum, experimental rooms, &c. Behind this are two large sheds, each 90 feet by 70 feet, one containing the combing, carding, and spinning machinery, and the other the looms. The equipment for the production of yarns of various types is very complete, consisting of Preparing Box, Worsted Carding Engine, Noble Comb, French Comb, French, Cone, and Open Drawing Sets, Flyer, Cap and Ring Spinning Frames. In a separate shed are warping mills and dressing frames, while the power looms include examples of all types. The wool-washing room contains three bowls of a total length of about 80 feet. The practical dyehouse and finishing rooms each have an area of about 300 square yards, and are equipped with full-size machines for the treatment of loose wool, slubbing, yarns, and piece goods.

A detached building houses the power plant, which includes a 30 foot by 8 foot boiler, with superheater, economiser, &c. The engine-house contains four prime movers, a suction gas engine of 125 horse-power, a slow-speed cross-compound engine of 200 horse-power, a high-speed inverted vertical engine of 75 horse-power, and a steam turbine of about the same power. Each of the three engines drives a direct-current generator, while the turbine is coupled to a three-phase alternator. Both engine- and boiler-houses are fitted with a complete set of testing apparatus; but while primarily intended for educational work, the power plant will provide light and electrically transmitted power for three large buildings—the main college block, the extension, and the school of art.

The new buildings have been erected at the cost of about 20,000*l.*, and for the equipment an additional sum of about 14,000*l.* has been provided, which sum would have been much increased but for the generosity of most of the machine makers, who have supplied the equipment on very favourable terms. Much of the machinery throughout the building has been specially designed, so that while of a thoroughly practical character, experimental work not possible in a mill can be carried out.

ZOOLOGY AT THE BRITISH ASSOCIATION.[1]

SECTION D presented a full and varied programme, and the attendance at the several sessions was above the average of recent meetings. This meeting was undoubtedly one of the best of recent years.

As in previous years, there were two lectures of a semi-popular character, which were highly appreciated. Mr. Fred Enock lectured on the "fairy flies" (Mymaridæ), hymenopterous insects of small size and with peculiar delicate wings, without veins, but fringed with long hairs. Mr. Enock, who has devoted many years to the study of this family, illustrated his account by means of a beautiful series of original drawings, shown by the lantern. He described the principal characters of the male and female, and traced the life-history of *Anagrus incarnatus*, the eggs of which are laid in the egg of the frog-hopper.

In his lecture on the fossil reptiles of the Oxford Clay of Peterborough, Dr. C. W. Andrews gave an account of the remarkable assemblage of reptiles occurring in that deposit. The beds in which the remains were found are of Middle Jurassic age, and were probably laid down not far from land and near the mouth of a large river. The horizon at which the remains occur is that characterised by ammonites of the "ornate" group, *Cosmoceras gulielmi* being a common species. Among the remains are those of land reptiles carried down by the river and of many marine forms of several distinct orders. Cetiosaurus, a terrestrial dinosaur allied to Diplodocus, attained a length of 60 feet, the greater part being made up of the greatly elongated neck and tail. Another, but smaller, dinosaur, Stegosaurus, and a pterodactyl, Rhamphorhynchus, were also found. The marine reptiles were more numerous, and of astonishing variety of form; for instance, ichthyosaurs, plesiosaurs of many types, and numerous marine crocodiles of the genera Metriorhynchus and Steneosaurus. The ichthyosaur Ophthalmosaurus was remarkable for the fact that in the adult the teeth were extremely small, and in some cases perhaps absent, so that the food of this animal must have been very different from that of its relatives. In many cases the skeletons were found in a nearly complete condition; in others the carcases seem to have been torn to pieces by predaceous reptiles, the bones being deeply scored by their teeth. Dr. Andrews exhibited a series of lantern-slides showing the actual remains and reconstructions based upon these. He stated that the

[1] "Some Recent Work on Sex" and an account of the discussion on the origin of mammals will form the subject of separate notices.

collection is almost entirely due to Mr. A. N. Leeds, who for the last forty years has closely watched the clay-pits, and has collected most of the specimens, a large series of which is exhibited in the gallery of fossil reptiles in the Natural History Museum at South Kensington.

Momentum in Evolution.

In his opening remarks on this subject Prof. Dendy mentioned that Dr. Smith Woodward, in 1909, had directed attention to the fact that many groups of the animal kingdom, in the course of their evolution, have shown a strongly marked tendency to enormous increase in size, often accompanied by the development of grotesque and apparently useless excrescences. Prof. Dendy instanced as analogous phenomena the extraordinary development of the beak and helmet in the hornbills and of the tusks in the babirusa. In these, and in many other cases which could be adduced, either the entire body or some particular organ appears to have acquired some sort of momentum, by virtue of which it has continued to grow far beyond the limits of utility, although perhaps in some cases a new use may have been found which has assisted the species in maintaining itself in the struggle for existence. An enormous increase in mere bodily size, however, seems in the long run to be always fatal to the race, the place of which will be taken by smaller and more active forms. Prof. Dendy thought there was some ground for believing that a race of animals may acquire a momentum of the kind referred to which may lead ultimately to its destruction, that there is some brake applied to the growth of organs and organisms, but that there are occasions on which the brake may be removed, with results which ultimately prove fatal. He pointed out that the growth of different parts of the animal body is controlled by internal secretions, or hormones, the products of various glands. Disease of the pituitary body leads to acromegaly, one of the symptoms of which is great enlargement of certain parts. Prof. Dendy held that there is good reason for believing that, in the absence of certain specific secretions, the growth of the various organs will continue far beyond the normal limits. He saw no reason why this principle should not be extended to the race, and, paradoxical as it might seem, he thought it possible to explain the growth of the organism as a whole and of its various organs beyond the limits of utility as an indirect result of natural selection.

When a useful organ is first beginning to develop or to take on some new function for which an increase in size will be advantageous, natural selection will favour those individuals in which it grows most rapidly and attains the largest size in the individual lifetime. If growth is normally inhibited by some specific secretion, natural selection will favour those individuals in which the glands which produce this secretion are least developed or least efficient, and, this process being repeated from generation to generation, these glands may ultimately be eliminated, or at any rate cease to produce the particular hormone in question. Moreover, this elimination may take place long before the organ the growth of which is being favoured by natural selection has reached the optimum size. When it has reached this optimum it is certainly desirable that it should grow no larger; but there is no longer any means by which growth can be checked. The inhibiting hormone can no longer be produced; the brake has been taken off, and further growth takes place irrespective of utility, until, when the size of the organ, or it may be of the entire organism, becomes incompatible with the well-being of the individual, natural selection again steps in and eliminates the race. Is it not possible that, the normal checks to growth being thus removed along certain lines by the action of natural selection, a definite direction may be given to the course of evolution which the organism will continue to follow to the bitter end, irrespective of natural selection?

The Food Supply of Aquatic Animals.

Dr. W. J. Dakin directed attention to some of the recent work on the nutrition of marine organisms, first citing the work of Pütter, who showed that there is more organic carbon present in solution in sea water than in the plankton contained in that water. With the view of showing that aquatic animals do use the food in solution, Dr. Dakin adduced the following observations. A specimen of the sponge Suberites, of 60 grams weight, requires as food 22 milligrams of carbon per day, to obtain which the sponge would need to capture 7,400,000,000 *Thalassiosira nana* (or an equivalent of other organisms), and would therefore need to filter several thousand times its own volume of water per hour; but if the food in solution in the sea water be also used, a much more rational quantity of water would suffice to supply the animal's needs. Extraordinarily large numbers of copepods would be required to provide the food of the larger Rhizostomes; but it seems impossible that copepods are captured in such large numbers, for copepod remains are so seldom found in the medusæ. Goldfish living in tap water, without solid food, were able to exist forty-one days; but with soluble organic bodies added to the water the fishes lived seventy-eight days, and the amount of oxygen consumed was found to be in excess of that calculated from the loss in weight of the fish, that is, some oxygen must have been used for the oxidation of substances in addition to those stored in the tissues. Many other facts, *e.g.* that crabs, living in sponges, with only filtered water at their disposal, and that Daphnia can be kept living and growing in solutions containing only dissolved food matter, seem to be in favour of Pütter's theory. Dr. Dakin believed that, though solid food is necessary, food in solution forms part of the normal food supply of aquatic organisms.

Prof. Hartog remarked that there was still much to discover regarding the nutritive apparatus of the lower invertebrates, and that, if Pütter's theory be true, the accessory intestine of some worms and echinoderms, and the rectal pumping apparatus of worms and Crustacea, may serve not only a respiratory, but a nutritive, function. Prof. Herdman suggested that the figures advanced by Pütter were not sufficient either to prove or disprove his contentions, and that renewed investigations are necessary. He also pointed out that copepods, which for a long time were believed not to take solid food, feed on minute diatoms, which, owing to their very small size, had until recently not been observed in the gut of these Crustacea. Prof. Dendy referred to the crabs which live in cavities of sponges, and stated that in most of these cases the crab probably feeds on the sponge, and the latter regenerates as quickly as it is eaten away. Dr. Gemmill stated that one of the difficulties in the way of his accepting Pütter's theory arose from the fact that he was not aware of any soluble organic food material likely to be present in sea water which would not be immediately attacked and broken down by bacteria. Mr. D. J. Scourfield pointed out the great difficulty of estimating the numbers of organisms, and therefore of solid food, present in water, remarking that the rate of increase of smaller organisms, *e.g.* algæ, bacteria, is so enormous that their presence in sufficient numbers in any one catch is not necessary for the explanation of the feeding of the larger organisms, for the small organisms may very soon become so abundant as to provide the necessary amount of food for the larger ones.

The Systematic Position of the Cyclostomes.

Dr. W. W. F. Woodland introduced a discussion on this subject. He described in considerable detail the innervation, musculature, and cartilages (especially the lingual) of the head of cyclostomes, and held that recent work showed that the sub-ocular arch and lingual cartilages could not be regarded as homologous with the palato-pterygo-quadrate bar and glosso-hyal element of gnathostomes. As the musculature of the piston cartilage is innervated by the mandibular nerve, and not by the hypoglossal, modern upholders of the gnathostome ancestry have revived the opinion that the piston cartilage represents the much modified and displaced mandible of gnathostomes, the so-called hyoid representing a quadrate element. Dr. Woodland pointed out that the piston cartilage is not paired, that it does not surround the mouth as mandibular elements should, and held it difficult to believe that it could be a reduced jaw apparatus. The development of the piston musculature and cartilage in the mid-ventral line is inconsistent with the view that they were formerly paired laterally placed mandibular muscles and rami, and the extension of the myotomes laterally in an unbroken series to the extreme end of the head proves that a jaw

apparatus could never have been developed. Dr. Woodland believes, with Balfour, that the branchial skeleton of cyclostomes is not homologous with that of gnathostomes, since, for one reason, in the former the skeleton is developed external to the ventral aorta and the gill vessels, while in the latter it is internal. He concluded that, considering the visceral arches as a whole, it is incredible, if the cyclostomes have originated from a gnathostome stock, that the first two visceral arches should exhibit the differences in development (in time and form) and relationships to nerves and muscles shown by the sub-ocular arch, piston, and styloid cartilages, &c., when compared with the jaw and hyoid arches of gnathostomes.

Prof. Dendy, while agreeing generally with Dr. Woodland's position, pointed out that the lampreys and hags differ markedly from each other. The brain of Petromyzon is primitive, and in Geotria there are two pineal eyes—a very primitive character; the brain of Myxine is highly modified, and pineal organs are wanting. These and other facts suggest that the two subdivisions of the cyclostomes have either had a separate origin or have diverged early from one another.

Mr. E. S. Goodrich held that the absence of jaws in cyclostomes was not proved; the piston apparatus is supplied by the fifth nerve, and this region would therefore seem to be homologous with the mandibular region of the gnathostomes. The gill arches of larval lampreys resemble those of gnathostomes, and though the relations of the branchial basket of lampreys and the gill arches of gnathostomes are not identical ventrally, their relations dorsally are very similar, and therefore the homology of these structures is not disproved. Mr. Goodrich suggested that the piston cartilage of Petromyzon might be homologous with the median cartilages of the branchial apparatus of gnathostomes. He demurred to the suggestion that lampreys and hags have been independently derived from the primitive vertebrate stem, for the two series present certain common characters, *e.g.* the structure of the gills and heart, asymmetry of the vascular system, horny teeth and piston apparatus, hypophysial sac in relation to the nasal organ, which it is unlikely can have been developed independently. He regarded the cyclostomes as monophyletic, and as having diverged very early into two branches, the lampreys and the hags.

Communications on Protozoa.

Prof. Herdman contributed a note on the occurrence of the peridinian *Amphidinium operculatum* at Port Erin. This flagellate organism had not been previously recognised in British waters, and was known only from the coasts of Norway and Belgium. It was first observed at Port Erin early last year, forming brown patches in the troughs of the ripple marks on the beach about half-tide level. The patches varied in size, but were observed for about three weeks. Examination of the sea water in the neighbourhood of the patches showed that the organism was not living in the water; it lived only in the wet sand. The brown patches consisted of an almost pure culture of Amphidinium, the only admixture being a very few examples of a diatom (Navicula). Later in the year brown patches of similar appearance were again observed on the sand, but on examination they were found to consist entirely of Navicula. The Amphidinium had disappeared, but the Navicula had multiplied abundantly. Prof. Herdman cited this as a striking instance of the change in the organisms inhabiting the beach, a change which might readily be, and no doubt had long been, overlooked.

Major C. F. Bishop described his recent examinations of sheep suffering from louping ill, and of ticks which had fed on the sheep. On a film made of blood squeezed from a tick, taken from a sheep which was said to be a typical case of louping ill, he found a single "trypanosome," about 22 μ long, in which the trophonucleus was nearly central and anterior to it the large kinetonucleus. Trypanosomes have not yet been found in any of the sheep examined, but Major Bishop considered it probable that the organism described was connected with the disease in the sheep. He also described other forms which he considered to be blood parasites, and regarded as flagellates, in films of blood from sheep.

A New Hydroid, Epizoic on a New Parasitic Copepod.

Prof. H. F. Jungersen (Copenhagen) described a new hydroid, *Ichthyocodium sarcotretis*, which covers more or less of the exterior of the parasitic copepod *Sarcotretes scopeli*, n.sp., which is deeply sunk into the body of the fish *Scopelus glacialis*. The hydroid consists of polyps, without tentacles, arising from a network of delicate tubes. From the base of the polyps arise medusa-buds which develop into free medusæ (Anthomedusæ). This new hydroid is a corynid, related to *Hydrichthys mirus*, Fewkes, epizoic on the fish *Seriola zonata*. Prof. Jungersen gave a full description of the characters and life-history of the copepod, which belongs to the family Lernæidæ. There is first a "cyclops stage," capable of moving about on the host and attaching itself by means of its strong cheliform antennæ; the pupa stage is passively fixed to the host by means of a hardened secretion from the rostrum. Within the last pupal phase the copulatory form was observed. The latter probably is for a time free-living; after impregnation the female assumes parasitic life anew, but in a more intense form; it pierces the skin of a Scopelus, and, gradually growing, it penetrates the muscles, and finally reaches the intestine. This copepod is found on examples of Scopelus from the eastern part of the Atlantic, and the triple association—hydroid, copepod, fish—seems to be a regular one. The loss of tentacles of the hydroid polyps seems to indicate that the hydroid in some way or other depends on the fish for obtaining its food.

Variation in the Medusa Mœrisia lyonsi.

Mr. C. L. Boulenger gave an account of variations in this Egyptian lacustrine medusa. About 15 per cent. of the individuals examined were abnormal. The abnormal examples fall into two groups: (1) those which deviate from the normal four-rayed symmetry, and (2) those with the normal number of radial canals and primary tentacles, but possessing, in addition, secondary tentacles which are not connected with the stomach by means of radial canals. Some of these multitentacular forms are asymmetrical, and it seems that each quadrant is capable of forming secondary tentacles quite independently of the other quadrants.

The Crop of the Leech.

Prof. Marcus Hartog directed attention to the structure of the septa in the crop of the leech. The crop is divided into chambers separated by distinct simple septa passing inwards from the obvious external constrictions and perforated by a central aperture, circular under ordinary conditions, but vertically elongated in distension. The septum is puckered at the free edge, and contains a circular sphincter, but no divaricator fibres. This structure has probably been so long overlooked because it is inconspicuous in ordinary dissections, and is not easily recognisable in the usual thin transverse sections; it is well seen on examining successive thick slices of a hardened, distended leech.

The Lantern of Aristotle as an Organ of Locomotion.

Dr. J. F. Gemmill gave an account of his observations on the locomotor function of the lantern of Aristotle in the sea-urchins *Echinus esculentus* and *E. miliaris*. The animal progresses, when out of the water, by a series of steps or lurches, more or less well defined, in each of which the urchin is raised on the tips of the teeth as on a powerful central stilt. The steps have a length varying from half an inch downwards, and are repeated at intervals of fifty seconds or less, according to the size of the urchin. There is a rhythmic backward and forward swing of the lantern in the direction of progression. The backward swing is accompanied by powerful protrusion of the tightly closed teeth against the supporting surface, which causes pushing or poling forward of the urchin. The movement is aided by pushing on the part of the spines, and, after a certain stage, by the action of gravity. The forward swing of the lantern is marked by retraction, with opening of the teeth, and serves to bring the latter into position for initiating a new lurch. Experiments on loading, recording surfaces, inversion, equatorial section, rotation, removal of spines, &c., were also briefly noted, and examples of tracks

left by the spines and teeth on a smooth plasticine surface were exhibited with the help of the lantern.

Healthy urchins, moving under water over approximately horizontal surfaces, do not, as a rule, use the lantern for movement, the greater part of their weight being neutralised by the water. There are, however, certain conditions, both normal and experimental, in which the lantern plays an important part in locomotion. Dr. Gemmill brought forward evidence in favour of the view that the locomotor action of the lantern is a particular manifestation of a fundamental rhythmic activity, which can also subserve feeding, boring, respiration, and circulation, and possibly, in addition, the maintenance of turgescence within the ampullæ of the water-vascular system.

Dr. Gemmill also gave a lantern demonstration on the development of the star-fish, *Solaster endeca*.

Echinoderm Hybrids.

Mr. H. M. Fuchs presented observations on the experimental control of dominance in echinoderm hybrids, using *Echinus miliaris* and *E. acutus*. Dr. Shearer and Mr. de Morgan had found that when these two species are crossed the characters of the hybrid larvæ are always the same as those of the maternal parent, and this was found by Mr. Fuchs to hold good also when the eggs were kept, during the cleavage period, in sea water with increased and decreased OH ions.[1]

The Gonads of the Urchin Echinocardium cordatum.

Prof. Caullery (Paris) traced the annual cycle of changes in the gonads of this urchin. From July to the end of the year the gonads are almost entirely composed of large cells, each of which contains a vacuole and numerous spherules of reserve substance. In males these cells exhibit, among the reserve material, numerous spermatozoa, agglutinated into pockets, which have been ingested by the cells; in females, fragments of degenerating ova are seen between the cells. At the periphery of the gonad there are either small masses of spermatogonia or oocytes. Growth of the genital products takes place, in part owing to the presence of the reserve-laden cells, at the end of winter, and the period of maturity, at Wimereux, extends from April to the end of May. The reserve-containing cells are gradually pushed towards the centre of the acini, and in some localities, *e.g.* Naples, disappear, but at Wimereux they do not fully disappear. Up to the end of May there have been formed, in the testes, for example, only the sexual cells, but henceforward there are produced numerous cells, each of which elaborates groups of granules and contains a large vacuole. This is the new reserve tissue, which soon forms a continuous peripheral layer. By the end of June the sexual elements in course of formation exhibit signs of degeneration, *e.g.* fragmentation of the oocytes and pycnosis of the spermatogonia, but ripe sexual products are for some time longer emitted. After July the emission ceases, and the sperms remaining in the testis become agglutinated and are ingested by the reserve cells, which gradually occupy the whole gonad. In star-fishes there is no reserve tissue, and the gonads, after having almost filled the arms, become so much reduced as to be almost imperceptible.

Observations on Boring Molluscs.

Mr. W. T. Elliott and Miss B. Lindsay described observations on *Zirphaea* (*Pholas*) *crispata* and *Saxicava rugosa*, made on the shore at St. Andrews, which confirm the statement of Prof. McIntosh that the method of boring of these molluscs is mechanical, and not chemical. Both molluscs work by means of a partial vacuum produced by cooperation between the mantle and foot, supplemented by scraping movements of the shell, which in Zirphæa are continuous and progressive during the time of boring. Reference was made to the importance of boring organisms in connection with coast erosion.

[1] These experiments were prompted by recent work of H. D. Tennent (1909, 1910) who crossed Hipponoe ♂ × Toxopneustes, ♀ and T. ♂ × H. ♀, obtaining in both cases larvæ with a preponderance of Hipponoe characters. By keeping the eggs, during the cleavage period, in sea water with increased and decreased concentration of OH ions he claims to have altered this dominance and states that a decrease of OH ions gave Toxopneustes characters.

The Species of Balanus Collected by the "Siboga."

Dr. P. P. C. Hoek (Haarlem) gave an account of some of the species of Balanus collected in the Malay Archipelago during the cruise of the *Siboga*. Of the twenty-seven species collected, nineteen are new. Few species were brought up from great depths; most of them were taken at a not greater depth than 90 metres. Some were brought up from 564, 289, 216, 275, 304, and 390 metres respectively, but the species represented in the first three cases were collected also at a depth of less than 100 metres. Dr. Hoek described some of the features, especially the labrum, which he had used in classification.

The Renal Organs of Squilla.

Dr. W. N. F. Woodland described the renal organs—maxillary glands—of Squilla. In an Erichthus larva 2 mm. long the gland consists of a short narrow tube, opening externally on the maxilla and ending internally in a slightly dilated end sac. In an older larva, 12 mm. long, the gland has become divided into two thin-walled compartments—the kidney proper and the end sac—lying side by side and communicating by a small aperture at their posterior ends. A little later the walls of the gland become invaginated, forming internal lamellar folds containing extensions of the hæmocœle, a process which continues so extensively that, in the adult, the cavity of the gland is almost entirely broken up into a network of spaces. Other features of the internal anatomy were also referred to, namely, the presence of a well-developed nauplius eye, rectal glands, and a very short proctodæum, which forms a wide cloaca-like cavity.

A Reconstructed Trilobite.

Dr. Malcolm Laurie gave an account of the anterior end of a trilobite (Calymene), which he has studied by means of grinding away definite and very thin layers of the fossil, photographing each exposed surface and reconstructing the specimen in wax on an enlarged scale. He exhibited the reconstruction, and pointed out that, although the mouth has been considered as opening behind the hypostome, the size and form of the latter render it improbable that the mouth opened behind it. Apparently the anterior margin of the hypostome projected ventrally, while the inturned margin of the neighbouring carapace also projected ventrally, the two forming lower and upper lips respectively to the mouth. In a line between the lateral margin of the glabella and the eyes there is a long conical structure, more than two-thirds the length of the carapace, divided into joints by annular thickenings. It is impossible to state certainly whether this is *in situ*, but its structure resembles that of an antenna. If it be such it must have been attached to the body behind the hypostome, as otherwise it could not have been withdrawn when the animal rolled itself up. This appears to be another instance of a post-oral appendage assuming an antennary function, as in Phrynus and Thelyphonus.

British Symphyla and Diplopoda.

Mr. R. S. Bagnall gave a rapid survey of the British Symphyla, pointing out the characters of the genera Scutigerella and Scolopendrella and of some of their species. A year ago only one species of the former was known from Britain; in 1904, when Hansen's monograph of the order appeared, eight European forms were recognised; of these, six have now been found in the north of England, and there have also been discovered four other well defined and apparently new forms. Mr. Bagnall recognises four species of Scutigerella and seven of Scolopendrella. He also recorded four diplopods from the north of England, each of which represents a genus previously unknown to the British fauna, and, from the same locality, a new pauropod, the first British example of the Eurypauropodidæ.

Mimicry in African Butterflies and Moths.

Prof. E. B. Poulton exhibited three groups of mimetic butterflies collected at Entebbe, Uganda. These groups were centred round species of the distasteful family Acræinæ. Among the mimics were species of Acræinæ, showing that members of this family acted as mimics and models, a fact supporting the theory of Fritz Müller as

against that of Bates. There were also acræine mimics which mimicked other species of the same family, themselves mimics of the primary acræine models. The rest of the exhibit was concerned with examples from Lagos, among which was a caterpillar of a well-known moth (Nyctemera), which before becoming a chrysalis secreted and covered itself with a mass of bubbly froth, which on hardening resembled the cocoons of a braconid parasite, and probably acted as a protection against insectivorous birds or lizards.

The Scent Patches of Lepidoptera.

Dr. F. A. Dixey described the scent patches of certain butterflies and their associated tracheæ. The males of many butterflies possess the power of emitting a scent, which is apparently attractive to the female. The scent patches are best distributed in Pierinæ (*e.g.* the orange tip). The apparatus consists of specialised scales scattered over the upper surface of the wing of the male. The scent is elaborated by cells in the wing membrane; the oil enters the specialised scale at its basal foot-stalk, and escapes by fimbriæ at the distal end of the scale. In other cases (*e.g.* the clouded yellow) the scent scales are aggregated into patches, so arranged that, in the ordinary position of rest, the patches of the fore- and hind-wings are coincident. The scales of these patches have neither foot-stalk nor fimbriæ. In some species of Catopsilia there are two specialised scale patches, which Dr. Dixey found to be provided with a special tracheal supply derived from the larger tubes in the wing veins. On reaching the scent patch the main tracheal trunks were found to break up into branches, the ultimate distribution of which was not ascertained, but appeared to bear a definite relation to the scent scales. Dr. Dixey suggested that the tracheæ were concerned in the dispersion of the perfume through the scales, acting in the manner of a *vis a tergo*.

The Biology of Eels.

Dr. Johs. Schmidt (Copenhagen) gave an account of five years' Danish investigations on the biology of eels. These have shown that the biology and reproduction of the conger and eel are more complicated matters than they seemed after the publication of Grassi's work. In the case of the eel, the youngest stages found are 4 cm. in length, and it is therefore not yet possible to state exactly where in the Atlantic the eel spawns, except that it must be outside the continental slope. All the larval stages, even the youngest (but not the eggs), of the conger are known, and it can now be stated that the conger spawns everywhere in the Mediterranean and in the Atlantic west of Gibraltar: how far west is not yet ascertained, but the half-grown larvæ of *Conger vulgaris* have been taken near the Azores. These investigations have not confirmed the earlier suppositions (of Grassi) that the larval development of eels takes place at the bottom of the sea or in great depths. All the murænoid eggs (several thousands) were taken near the surface of the sea, as were also the youngest pre-leptocephalic stages, *e.g.* of *Conger vulgaris* and *C. mystax*. The full-grown larvæ of the eel and conger also occurred in the upper layers. Murænoid eggs were found not only in the Mediterranean, but also right across the Atlantic between 20° and 40° N. lat. Evidently, therefore, some eels spawn there, but how far from the surface has not yet been ascertained. Dr. Schmidt illustrated his remarks by charts and a beautiful series of larval and metamorphosing examples of several species.

The Dorsal Vibratile Organ of the Rockling (Motella).

The dorsal vibratile fin of the rockling, which has been believed to be a lure, is regarded by Dr. J. Stuart Thomson as an organ for producing a current of water over numerous terminal or taste buds situated in the skin of that region of the body, which thus functions as a gustatory organ. These taste organs are distinguished from the lateral line organs by certain structural differences and by the fact that they are innervated by the recurrent facial nerve, the root of which is in the facial lobe of the medulla, which lobe has been described by Herrick as part of the gustatory tract. Dr. Thomson's experiments indicate the existence of a gustatory reaction in the rockling, some of the most successful responses being obtained on placing Arenicola in proximity to, but not in contact with, the taste buds of the region under consideration.

A Remarkable Egg of the Kestrel.

Prof. Patten commented on an egg laid by a tame kestrel, which has been in his possession eight years. The egg is normal in size, but milky-white in colour and almost unspotted except at its larger end; there are spots and blotches of rich purple-brown intermixed with greyish-purple, the whole pigmentation forming a broken zonular band. Dr. Patten suggested that a highly nutritious hearty meal, coming after a fast, and in a warm change of weather, may have toned the bird to such a physiological state that the ovaries became sufficiently active to induce ovulation.

Prof. R. J. Anderson brought forward a number of details regarding the constitution of, and variation in, the manus and pes of Primates, and contributed a note on the manus of a young Indian elephant.

J. H. ASHWORTH

OLD AND NEW VIEWS ON THE TREATMENT OF CONSUMPTION.[1]

DR. THEODORE WILLIAMS stated that 255 years had elapsed since William Harvey instituted this festival, and that orations had been delivered in Latin or English ever since in commemoration of benefactors, and with Harvey's exhortation to the fellows and members to study out the secrets of nature by way of experiment, and to continue in mutual love and affection among themselves. He then proceeded to review the various steps of Harvey's great discovery of the circulation of the blood, and remarked that its author, in spite of the severest criticism, lived to see it firmly established in the annals of medicine and to witness the conversion of the greater number of his opponents. The seed sown by this discovery, based on observations and experiments, and put forth with convincing logic by this most accurate observer, had revealed to the world further scientific truths, which have been elaborated by Harvey's successors in the arts of medicine and of surgery, and have brought forth a harvest of improvements—physiological, clinical, pathological, and therapeutical—which added immensely to the total sum of human health and happiness. Dr. Williams instanced as examples the administration of anæsthetics, intravenous and hypodermic injections, and treatment by vaccines, while auscultation and the graphic methods of measuring blood pressure and rhythm might also be counted as outcomes of the knowledge initiated by Harvey's discovery.

Harvey's views on tuberculosis are not known, though his lost "medical observation" may have treated of these; but the lecturer sketched the doctrines held by his contemporaries on this subject, and the treatment in vogue, the former being somewhat obscure and the latter mingling with hygienic and dietetic rules, which were to some extent reasonable, prescriptions containing woodlice, crabs' eyes, the simple powder of crabs' claws, red coral and white amber in the form of powders or julep to "temper the sharpness of the blood." The Royal touch for the King's Evil continued to be believed in until a much later date. Most of the theories of that time assigned the cause of consumption to errors of digestion or in the formation of lymph or chyle or blood, or to defective respiration; but they chiefly dwell on the inflammatory origin, and though long suspected, the *vera causa*, viz. the tubercle bacillus, was never definitely proved until Robert Koch appeared on the scene. Laennec and other observers had meantime given scientific accounts of the morbid anatomy of tubercle, and the treatment had changed from an anti-inflammatory *régime* depending largely on blood-letting to a tonic and building-up system,

[1] Abstract of the Harveian Oration delivered at the Royal College of Physicians on October 18 by Dr. C. Theodore Williams.

fortified by a liberal dietary, by the use of cod-liver oil and by climatic treatment.

Dr. Theodore Williams, at the express wish of the president of the college, proceeded to sketch the evolution of the treatment of consumption as it had come under his own cognisance during his nearly fifty years of professional experience. He spoke of the effects of climate, and especially of that of high altitudes; then of the open-air life which had first been advocated in England by Bodington and Henry MacCormac, and was now accepted as essential in cases of tubercular disease. Dr. Williams had personally studied the climates most advantageous for the treatment of consumption in the New and the Old Worlds, and had given a full trial to mountain climates, having recorded their effects on more than 400 of his private patients, and studied the results of the diminished barometric pressure, of the diathermancy of the air, and of the asepticity, or freedom from pathogenic germs, which are characteristic of high-altitude climates.

He found the effects on selected cases of chronic tuberculosis remarkable: many symptoms vanished, and muscular power increased largely, while the local improvement was even more striking, and in many early cases of consolidation the disappearance of physical signs was so complete that the physician had to refer to his notes to discover which lung was originally attacked! In fact, the high-altitude cases yielded the most favourable results of all his statistics, and, what is more important, the fewest relapses.

He then noticed the establishment and spread of sanatoria all over the world, and said that in Germany alone the insurance societies now maintain more than 16,000 beds for the working classes; and he directed attention to the methods pursued, including rest, with or without Liegehalle, good feeding, graduated exercise, and labour supervised to meet individual requirements, which have all been tried at different sanatoria, giving the results achieved thereby. He described the system pursued at some of the best English institutions, where the patients with limited tuberculous pulmonary lesions, when removed to thoroughly hygienic surroundings and compelled to lead a healthy life, their food, exercise, and rests being under minute skilled direction, may slowly and gradually recover, and, losing symptoms, be able to return home to active working life, ready and able to instruct those around them in the gospel of fresh air and wholesome living.

But Dr. Williams emphasised the need for discovering and treating *early* cases of the disease, and though agreeing in the general truth of the curability of consumption, he felt obliged to except the acute cases, which, however, fortunately form a very small percentage of the whole.

He contended that the pressing need is for more hospitals for consumption—England had been a leader in establishing these, and now it is recognised that the consumption hospital is required as a centre from which to draft off cases suitable for sanatoria, as well as for the treatment of more advanced and acute cases, which are thus isolated from the rest of the population and prevented from becoming centres of infection.

Dr. Theodore Williams spoke of the modern treatment of consumption by anti-tuberculous serums and vaccines, and gave the experience of others and of himself, concluding by the remark that everything points to the necessity for further investigation, and that such investigation can be best carried on in hospitals and sanatoria, where trained observers minutely watch the effect of tuberculin on the patient's system and control the inoculations and their results. He summed up with a bird's-eye view of the present state of the crusade against tuberculosis in this country and our means of pursuing the fight.

He reminded his audience of what had already been done by the blessed agencies of prevention, such as improved drainage, more cubic space, and less overcrowding, better food and more of it, more air and sunlight, cleanliness of house and person, and increased opportunities for play and exercise, and how, mainly by these means, the phthisis mortality had been reduced two-thirds in fifty years.

A good town-planning scheme should prove a fine weapon in the hands of the combatants. Education of all classes, including the children, must be promoted, and that with the tuberculosis exhibitions and popular lectures and tracts which now permeate and enlighten the country, will be found to be trusty armour and show the people how they can help themselves.

Prevention is naturally what is to be aimed at; but for the consumptives who are now among us are needed as links in the chain:—

(1) Well-equipped consumption hospitals to receive and isolate acute and advanced cases.

(2) The dispensary system, introduced by Dr. Philip, and now at work in several metropolitan boroughs, which, with the out-patient departments of consumption hospitals, can classify the patients, visiting them and contacts in their own homes, and connecting them with local government and philanthropic agencies.

(3) The sanatorium, and especially those institutions which make a feature of preparing the patient by various grades of labour for return to a workaday world.

(4) Labour colonies and exchanges to assist in the rehabilitation of those who have been smitten with the disease, or may be more liable to reinfection, or may require the safeguard of a changed and more healthy occupation.

The task of further reducing, and finally abolishing, tuberculosis is not a hopeless one, but it does not lie wholly with the doctors. It lies also with those who have it in their power to remove and lessen the principal causes of tuberculosis, viz. the overcrowding of our cities, the want of open spaces and of ventilation, the insanitary houses, the disgusting habit of spitting, and the lack of a good supply of water and of pure milk. Philanthropists, together with local government authorities administering under our Minister of Health, might remedy these defects and ensure that the number of phthisis cases should be in future comparatively small.

The great Harvey would smile with pleasure as he realised our successive advances in knowledge and the attempts to remedy our deficiencies, and he might well receive our laurel crown as the leader who showed the way to those who are now searching out the secrets of nature by way of experiment.

UNIVERSITY EDUCATION IN ENGLAND AND WALES.

ATTENTION has been directed already (NATURE, September 21, vol. lxxxvii., p. 407) to the Blue-book containing the reports for the year 1909–10 from those universities and university colleges in Great Britain which participate in the Parliamentary grant for university colleges. In the notes referred to, information was given as to the amount of the Treasury grant, particulars concerning the incomes of the various colleges, and similar data.

An introductory report by the Board of Education, with which the volume opens, contains much that deserves careful study by all who are interested in the progress of higher education. A number of extracts from this prefatory memorandum are subjoined.

The weakness of the appeal which university education makes in the present day to the imagination of the wealthy finds its counterpart in the apathy of the public at large, and this apathy is only too frequently reflected in the attitude of the local authorities. Some of the most important of these give far less than their proper share of support to the universities, and in one or two instances the maintenance at their present level of the grants made by local education authorities has been endangered. On the other hand, in two instances there has been a notable increase in the amount of the support received from this source. As the result of representations made by the Right Hon. Joseph Chamberlain, M.P., the Chancellor of the University, the City of Birmingham has promised to increase

its grant in aid of the University of Birmingham from ½*d.* to 1*d.* rate. The exact amount of increased support thus given to the University is, however, for the moment uncertain, because the University has been required by the municipality to devote an as yet indeterminable portion of the additional grant to the establishment of maintenance allowances and scholarships to poor students. Since the fees paid by students never equal the cost of the education they receive, it follows that the net amount of the increased aid to the University will be something less than the difference between the gross increase and the sum devoted to maintenance allowances and scholarships. If, as there is reason to hope will be the case, the grant is continued at the higher level for future years, the extension of the boundaries of the city will lead to a further increase in the amount received by the University unless this additional income has to be expended on scholarships or bursaries. The Corporation of Newcastle-upon-Tyne has recently made an additional grant of 1500*l.* a year for five years to Armstrong College. This additional grant is the more noteworthy because it has been made for the special purpose of developing the faculty of arts, a faculty which does not, as a rule, appeal so directly to local sympathies as do the faculties of pure and applied science.

The problem of university education in the metropolis does not grow easier as time advances; the need for that help and guidance which only a well-organised university can afford increases yearly. The many independent institutions and authorities working in the field of operations are conscious, each in its own way, of the growing demand for instruction of a high order, and of the urgent necessity for increased means of providing it, and it is not to be wondered at if they attack the problem as best they may, without considering too closely the effects of their action upon their neighbours. Yet no satisfactory issue is possible on these lines. The Board is endeavouring for the moment to avoid encouraging this confusion, but nothing really far-reaching can be attempted until after the Royal Commission appointed in 1909 has completed its labours.

This need for a proper scheme of coordination is perhaps especially urgent in the case of higher technological and professional work; it is not confined to London. Until the problem has been adequately dealt with, it is almost impossible to deal wisely with even the most urgent claims for further development. Yet there is undoubtedly a great need for considerable further provision of the highest type of instruction. The fifth annual report of the British Science Guild contains certain rough comparisons between the number of properly equipped day students attending the *technische Hochschulen* in Germany and the numbers of day students doing work of a kind more or less comparable in this country. The comparison shows that after making full allowance for the larger population of Germany, there are more than twice as many such students in Germany as in Great Britain and Ireland. If the inquiry could be more exact, and if only those students in this country were included who had received the same amount of previous general education, and were giving the whole of their time to higher technical studies, it is certain that the comparison would be even less favourable.

But if the problem in regard to technology is to discover how to make a wise increase in the amount of provision without the incidental waste which comes from unnecessary overlapping between competing institutions, the problem in connection with medical education is quite different. What is needed here is concentration and coordination of effort and the greater efficiency that will then alone be possible. There is probably more than sufficient provision made for medical education in these islands; it is a question whether, even now, after years of shrinkage in the numbers of men entering the medical profession, the output is not still in excess of the national needs. Nowhere is this excess of provision more evident than in the metropolis. The difficulties inherent in the position are obvious, particularly at the present moment, when public opinion has not yet been fully informed as to the true relationship between the hospital and the medical school, or as to the invaluable services which a progressive school renders not only to the treatment of the sick poor, but also to the national medical service. To the closeness of this relationship, on the other hand, is due the facilities for access to clinical study which London offers to a greater degree than any place in the world. Any change which endangered this advantage would be very dearly bought.

Of the twenty-three general medical schools in England, all but five (including Oxford and Cambridge) have now applied to the Board for grants in aid of the instruction they give. It is hoped it may be possible to include in the next volume of these reports returns from the medical schools in receipt of grant from the Board analogous to those now received from universities and university colleges in receipt of aid from the Exchequer. It is not unreasonable to anticipate that these reports will afford a valuable basis for a general consideration of the many problems in regard to medical education existing at the present time.

Reference was made in the introductory report last year to the tutorial classes which have been established on the initiative of the Workers' Educational Association. Although, as explained in that report, the education given in these classes cannot properly be called university education, yet the universities have throughout been so closely connected with their organisation that some further reference to them seems not inappropriate. During the current session there are nearly seventy of these classes at work, or nearly double the number in existence last session. The rapid growth of the classes continues to afford undoubted evidence of the extent to which they are meeting a real need. Further development was made last year, when a summer school was established for the first time. The school was held in Oxford during July and August, and was intended for students who had attended tutorial classes during the previous session. As students could only remain for a week, or at most a fortnight, the lectures and instruction for each week were arranged to deal with a particular subject or group of subjects. An important part of the students' work consisted in writing essays, which were subsequently read and discussed with special tutors. The arrangements were necessarily somewhat experimental, but there seems little doubt that the students greatly appreciated the establishment of the school, and derived much benefit from it. Grants were paid by the Board of Education in aid of the classes held during the session 1909–10, and also in respect of the summer school. During the session the Board arranged for a special inspection of some of the classes, and the report was subsequently made public. The report fully confirmed the high opinion already existing as to the value of the classes.

The accompanying table presents an analysis of the students under instruction in England and Wales during the academical year 1909–10. The revised form in which the returns of students has been compiled by the universities has rendered it possible to make this table more detailed than before. The table also gives more accurate figures than have been hitherto available as to the number of students being prepared by university institutions for matriculation examinations.

The number of part-time students of all kinds in England reaches the large figure of more than 13,700, or more than half again as large as the number of whole-time day students. Only about 1200 of these were reading for degrees or attending post-graduate courses. A considerable proportion of the remainder only attended short courses; but even so it is evident that there is as yet no sign of any relative decrease in the demand being made upon the universities for work which, excellent and useful as it is, cannot be described as university work in the strict sense of the term. It is to be hoped that as time goes on, and as the secondary schools of the country make their influence more clearly felt, the relative growth in the number of full-time students properly equipped for university studies will increase.

The number of day students under seventeen is but 2·5 per cent. of the total, and the number under eighteen is less than 10 per cent. of the whole number of day students. These figures are encouraging, and as compared with the figures for ten years ago, if these could be obtained, would probably show an increase in the age at which the majority of the students are entering upon university courses now. In proportion as the length of school life in the secondary schools increases, the percentage of day students entering the universities under

Analysis of Returns of Students under Instruction, 1909–10.

Name of University or College	Full-time Students: Degrees: Training College Students	Degrees: Other Students	Degrees: Total	Diplomas (Non-graduate): Training College Students	Diplomas (Non-graduate): Other Students	Diplomas (Non-graduate): Total	Post-graduates	Other Students	Total of Full-time Students	Matriculation Students	Total of Degree Students	Total of Diploma Students	Total of Post-graduate Students
ENGLAND.													
1. Birmingham University	113	414	527	134	81	215	30	50	822	—	527	215	66
2. Bristol University	57	197	254	195	91	286	14	4	558	27	260	322	32
3. Leeds University	141	285	426	6	106	112	20	148	706	—	454	132	37
4. Liverpool University	251	432	683	4	185	189	123	13	1008	—	703	209	153
5. Manchester University	204	736	940	55[1]	110	165	155	154	1414	31	1012	166	198
6. Sheffield University	79	123	202	1	67	68	6	69	345	5	211	244	18
London University :—													
7. University College	90	406	496	—	71	71	152	178	897	17	571	84	423
8. King's College	88	264	352	—	137	137	43	14	546	79	472	198	134
9. Bedford College	45	143	188	—	18	18	29	10	245	16	188	18	38
10. School of Economics	—	70	70	—	1	1	32	80	183	—	181	2	95
11. East London College	46	110	156	—	—	—	2	—	158	63[2]	278	—	21
Durham University :—													
12. Newcastle, Armstrong College	90	161	251	110	48	158	6	102	517	—	251	158	11
13. Nottingham University College	61	65	126	90	24	114	3	—	243	28	134	295	4
14. Reading University College	54	61	115	76	51	127	11	71	324	13	122	127	12
15. Southampton, Hartley University College ...	42	46	88	106	9	115	5	—	208	9	98	157	13
16. Totals—England	1361	3513	4874	777	999	1776	631	893	8174	288	5462	2327	1255
WALES.													
University of Wales :—													
17. Aberystwyth University College	140	297	437	—	8	8	11	15	471	11	437	8	11
18. Bangor University College	113	167	280	—	11	11	15	10	316	—	280	11	15
19. Cardiff University College	186	288	474	—	68	68	5	29	576	1	474	68	11
20. Totals—Wales	439	752	1191	—	87	87	31	54	1363	12	1191	87	37

[1] Eight of these were students in training who were reading for the Teachers' Diploma (post-graduate).
[2] Twenty-five of these were following degree courses though they had not matriculated.

eighteen will probably fall. In Wales secondary education has been organised for a greater length of time than in England, and this is probably one of the causes for the smaller percentage of day students under eighteen in the Welsh colleges.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At the annual general meeting of the Philosophical Society, held on Monday, October 30, the following were elected officers:—*President*, Prof. Sir George Darwin; *vice-presidents*, Prof. Newall, Prof. Hopkinson, Prof. Wood; *treasurer*, *Prof. Hobson*; *secretaries*, Dr. Barnes, Mr. A. Wood, Mr. F. A. Potts; *members of council*, Prof. Sir J. Larmor, Prof. Biffen, Prof. Pope, Mr. R. H. Rastall, Mr. K. Lucas, Mr. E. A. Newell Arber, Prof. Sir J. J. Thomson, Mr. J. E. Purvis, *The Master of Christ's*, *Mr. R. P. Gregory*, *Dr. Cobbett*, and *Mr. J. W. Mercer*. The names of the new members of the council are in italics.

At Christ's College, Dr. H. J. H. Fenton, F.R.S., and Prof. E. W. Brown, F.R.S., of the Yale University, have been elected honorary fellows. The same honour has been conferred at Emmanuel College on Mr. R. H. Biffen, prælector in agriculture, and on Mr. F. G. Hopkins, F.R.S., prælector in biochemistry at Trinity College, formerly fellow and tutor of Emmanuel.

T. G. Bedford has been appointed demonstrator of experimental physics, and J. A. Crowther and H. Thirkill assistant demonstrators.

The electors to the Allen scholarship give notice that they are prepared to receive applications from candidates. Any graduate of the University is eligible for the scholarship provided that his age on the first day of the Lent term 1912 does not exceed twenty-eight years. This year the scholarship is open to candidates who propose to undertake research in any branch of study which comes within the department of any of the following special boards:—medicine, mathematics, physics and chemistry, biology and geology. The emolument of the student is 250*l.*, or such smaller sum as the fund, after payment of all expenses, shall be capable of providing. Candidates must send their names to the Vice-Chancellor on or before February 1, 1912.

The electors to the Isaac Newton studentships give notice that an election to a studentship will be held in the Lent term, 1912. These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The persons eligible are members of the University who have been admitted to the degree of Bachelor of Arts, and are under the age of twenty-five years on the first day of January, 1912. The studentship will be tenable for the term of three years from April 15, 1912. Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1912.

The special board for biology and geology gives notice that the Gedge prize will be offered for competition in the Michaelmas term, 1912. The prize will be awarded for the best original observations in physiology. The essays are to be sent to the professor of physiology not later than October 1, 1912. The examiners may require every candidate to deliver his essay in the form of a lecture.

OXFORD.—The statute exempting candidates for honours in mathematics and natural science from compulsory Greek is approaching its final stages. On Tuesday, November 7,

it will come before Congregation, as amended in the course of last term. Should it pass Congregation, it will be submitted to Convocation, upon the decision of which depends its ultimate destiny. The date of the final struggle has not yet been made public, but it is practically certain that the present term will see the close of the long controversy.

THE board of trustees of Stanford University has announced, says *Science*, a gift of 2000*l*. made by Prof. Adolph Barkan, San Francisco, professor emeritus of the medical school, for the establishment of a special library dealing with diseases of the eye, ear, nose, and throat. A gift of 1000*l*. from Charles C. Stanford for medical library purposes is also announced.

AT the meeting of the council of the Royal Agricultural Society, held on October 25, the Duke of Devonshire reported the special committee's recommendation that the society's gold medal should be offered for original research on any agricultural subject or any of the cognate agricultural sciences. The medal will be awarded for a monograph or essay giving evidence of original research, and candidates must reside in Great Britain or Ireland, and must not be over the age of twenty-seven years or of more than five years' standing from the time of taking their first agricultural qualification, the qualification being a degree or diploma of a university or university college, or the National Diploma in Agriculture.

WE learn from *The British Medical Journal* that a new university has been founded by the United States in the Philippine Islands. There was already a University of St. Thomas, founded by the Spaniards in 1611, but it was thought that this old institution did not meet modern requirements. The new university comprises a college of medicine and surgery, which was opened in 1907, besides colleges of veterinary science, of agriculture, of the liberal arts, of law and political science, and of engineering. The seat of the new university is Manila. A clause of the Act founding the university is to the following effect:—"No student shall be denied admission to the university by reason of age, sex, nationality, religious belief, or political affiliation."

THE annual meeting of the Association of Teachers in Technical Institutions will be held at the Borough Polytechnic, Borough Road, S.E., on Saturday, November 4, the president, Mr. Barker North, in the chair. The annual report of the council, which will be considered at this meeting, deals with the large increase in the membership of the association in the past year, and with active work during that period. Branches have been formed in Ireland and Wales, so that the activities of the association now spread over the whole kingdom. After the consideration of the report a discussion will be initiated on the Board of Education examinations in science, by Mr. C. F. Smith, Manchester School of Technology, and Mr. J. Wilson, Battersea Polytechnic. To this discussion visitors are invited. Particulars can be obtained from the honorary secretary, Mr. P. Abbott, The Polytechnic, Regent Street, W.

THE Association for the International Interchange of Students is a body which exists to promote the intelligent study of other countries by the university students of Great Britain and the colonies. The organisation arranges tours during which students are brought into contact with the leading cities and citizens abroad, and are thus enabled to study at first hand the social, political, municipal, and university life of other countries. The first annual report contains reports of speeches made by some of the students who have availed themselves of the advantages the association offers, and gives ample evidence of the value of the movement. In addition to putting any class of student in touch with the best sources of information, the secretary, Mr. W. H. Crees, has succeeded in modifying the expenses of travel. Unfortunately, like many other institutions, the association has suffered from lack of funds, and is unable to carry out the proposal of travelling scholarships which were first of all contemplated.

THE Imperial Conference of Teachers' Associations convened by the League of the Empire is to be held on July 12–16, 1912. The list of agenda includes a variety of subjects, such as the training of teachers (professional and university); the recognition throughout the Empire of teachers' certificates; the migration of teachers for purposes of study generally and for temporary interchange of appointments; coordination in education; and the working of the scholarship system in different parts of the Empire. Besides these subjects, technical education in its relation to local industries and as a preparation for general scientific and trade research; the place of history and geography in education; the English language and literature; and physical education, will form subjects of discussion. Overseas teachers in particular will consider the best means of organising a rural school. Suggestions are constantly being received from overseas teachers' associations. It has been proposed to illustrate the agenda with observation work, and illustrated lectures will be introduced both before and after the conference. A short course of travel-study in England is also being prepared.

A COPY of the first volume of the calendar for 1911–12 of the University of Sheffield has been received. It contains full particulars concerning all the courses of work in the various faculties and the conditions under which the different degrees of the University are conferred. The arrangements in the faculty of applied science are of especial interest. These departments provide lecture and laboratory courses of instruction in the subjects of applied science required in the engineering, metallurgical, mining, and building industries. Students are in certain circumstances permitted to qualify for degrees in part by evening study. For example, students employed during the day in some metallurgical works or laboratory approved by the faculty are permitted to qualify in part by evening study for the degree of Bachelor of Metallurgy. We notice, too, that the council of the Institution of Civil Engineers recognises, under certain conditions, the degree of Bachelor of Engineering of this University as exempting from the institution's examination for associate membership. An arrangement has been made also with the Imperial College of Science and Technology by which the University of Sheffield is recognised as being in association with the Imperial College for such of their students as may desire to specialise in the study of the metallurgy of iron and steel for the associateship of the Royal School of Mines.

THE new laboratories at Shrewsbury School were formally opened on October 20 by Mr. Francis Darwin, F.R.S., who gave an address in the school hall, Lord Barnard presiding as chairman of the governing body. In order to emphasise the present attitude of the school towards science, Mr. F. Darwin repeated the well-known story of his father as a Shrewsbury boy being publicly rebuked by Dr. Butler, the headmaster, for wasting his time in the study of chemistry at home in an improvised laboratory. The contrast between this state of things and the present curriculum, in which every boy in the school has to go through a course of practical scientific training, is sufficiently striking. The need for new laboratories is due to the prominence given to science by the headmaster, Mr. Alington, and at the present time 270 boys are passing through the science school under the guidance of five masters. The recent additions, which have been named the Darwin Buildings, consist of three rooms, two for physics and chemistry, respectively, and the third for nature-study and physical measurements, and all are excellently fitted for their various purposes. At the end of his address Mr. F. Darwin pointed out that the method adopted in the science school at Shrewsbury is in harmony with the motto of the Royal Society, *Nullius in verba*, since the essence of laboratory work is that the pupil learns by observation and experiment rather than from the assertions of his teacher.

DR. ALFRED MUMFORD, in his annual report as medical officer to the governors of the Manchester Grammar School, states that he has been able to compare the physical development during the last five years (*i.e.* since the influence of the presentation of free scholarships to boys from the elementary schools has become felt) with the physical development of the boys of a generation ago, viz. during the period of 1881–6. He finds there has been a remarkable gain in nearly all directions, especially as regards height and weight, amounting to more than 1 inch in height between the ages of thirteen and sixteen,

and to an average increase of more than 4 lb. in weight. At the age of sixteen the boys are 1½ inches taller and 8 lb. heavier than a generation ago. The improvement is less marked at seventeen and eighteen years of age, and disappears in those who stay until nineteen. These calculations are based on more than 6000 measurements. This remarkable change probably has many causes, chief among them being the steady diminution or postponement of early infectious disease in childhood, due to the progressive operation of the Public Health Act of 1875. A second factor of equal, if not greater, importance has been the changed attitude towards athletics and physical exercise, particularly during the younger ages, that prevails throughout the school to-day. Other causes of the general improvement in physique are the better housing, the increased knowledge and better use of foods, and the greater insight into the meaning of parental responsibility as regards health, which are certainly affecting a considerable number of homes at the present day. In order to test the question as to whether the free scholars—two-thirds of whom come from the elementary schools—are of inferior physique to their companions, comparisons, based on 250 cases, were made between the two at successive years of life, and it is found that, though the "free scholar" is slightly smaller at eleven, twelve, and thirteen, yet by the age of fourteen he has equalled his companions in height, and in some cases surpassed them.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, October 18.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—T. W. **Butcher**: Structural details of *Coscinodiscus asteromphalus*. A paper describing the primary areolations with the secondary and tertiary markings, illustrated by a series of lantern-slides made from photomicrographs obtained at a magnification of 1100. In addition, slides were shown demonstrating a fine siliceous network, or veil, lying upon the outer surface of the valve, and others in series, from photomicrographs taken, at 5 or 6 consecutive foci, of the hexagonal cell layer with its "ringed" openings of Morland, to prove that these openings are clear and not obstructed by the finely perforated membrane recently reported by Mr. Nelson (Journ. Roy. Micro. Soc., October, 1910). The membrane being non-existent, its value as a test for a high-power lens is *nil*.—Rev. Hilderic **Friend**: New British enchytræids. *Enchytraeus minimus*, Bret., was described in the *Rev. Suisse de Zoologie* in 1899. Michaelson in *Das Tierreich*, 1900, suggested that it might be one with *E. argenteus*, Mich. (=*E. parvulus*, Friend). Bretscher examined the subject again in 1902, and decided that the two were distinct. The author, who had already described *E. argenteus*, has found *E. minimus* at Buxton, and holds with Bretsche. *Fridericia peruviana*, n.sp., was received in earth from Peru, and submitted to the author by the authorities at Kew. It is 5–6 mm. in length, and has two to five setæ, which are somewhat larger behind than before. Brain slightly concave posteriorly; œsophagus sharply marked off from intestine; dorsal vessel postclitellian in origin, with dilatations in segs. 7–9. Salivary glands not branched; long.—Walter **Bagshaw**: Instantaneous exposure in photomicrography. Flashlight illumination has been put to a novel use by Mr. Bagshaw for the photography through the microscope of objects in motion. A good negative of fresh-water polyzoa (*Lophopus crystallinus*) expanding its tentacles was secured by a charge of "Agfa Flashlight Powder" in one-thirtieth of a second. Gatherings of pond life, such as diatoms, larvæ, water fleas, also yielded successful results. Provision was made for replacing the ordinary lamp by flash powder put in the position previously occupied by the centre of flame, and ignition made with a red-hot wire.

MANCHESTER.

Literary and Philosophical Society, October 17.—Prof. F. E. Weiss, president, in the chair.—H. J. **Woodall**: Mersenne's numbers. In 1644 Mersenne published a book entitled "Cogitata Physico-Mathematica," in which it was stated that certain numbers obtained by raising 2 to the power p, where p is a prime number not greater than 257, and subtracting unity from the result, would be factorisable except in twelve specified instances. He left no clue as to how he arrived at this result, nor is any method known by which he could have done so. Subsequent examination has shown that the statement is incorrect in two cases, one case being prime where he said composite, and the other the reverse, but most of those which, according to him, are factorisable, have been proved to be so. Mr. Woodall gave a proof that the number obtained by subtracting unity from the 181st power of 2 is divisible by 43,441, the quotient containing fifty figures. He explained the method by which the divisor had been arrived at, and stated that the number of unproved cases is now reduced to sixteen (fifteen composites and one prime) out of a total of fifty-six.—S. **Hirst**: A collection of Arachnida and Chilopoda made by Mr. S. A. Neave in Rhodesia north of the Zambezi. The paper deals with the scorpions, Pedipalpi, Solifugæ, and centipedes collected by Mr. Neave. Four new species are described, two of which were obtained by Mr. Neave, the remaining two being specimens in the British Museum, that were obtained from the same area. The new species present no features of special interest, differing only in certain details of the appendages from already known forms. Two of the species obtained by Mr. Neave had only been captured once previously, and are thus of interest from this point of view.

PARIS.

Academy of Sciences, October 16.—M. Armand Gautier in the chair.—Ch. **Bouchard**: The velocity of parachutes. A certain time after starting a parachute the velocity becomes uniform, and this velocity depends on the ratio of P, the weight, and S, the horizontal projection, of the carrying surface. The application of the ordinary resistance formula for air, in which the resistance depends on the square of the velocity, to these measurements, gave unsatisfactory results, but a formula involving the square root of the cube of the velocity (V^3) was found to agree well with the experiments.—M. **Borrelly**: Observations of the Beljawsky comet (1911g) made with the comet finder at the Observatory of Marseilles. The positions are given for October 1 and 2. On October 1 the comet was very bright, and visible to the naked eye. The tail was well marked, and extended about 15° from the nucleus. On the following day the appearance of the comet had completely changed, the nucleus being surrounded by a circular halo, two aigrettes showing on the right and left.—M. **Nicolau**: The variation in the movement of the moon.—A. **Demoulin**: The R and S surfaces.—Etienne **Delassus**: The non-linear linkages and the movements studied by M. Appell.—Marcel **Brillouin**: An interferential method for the determination of the moduli of torsion of crystals. The deformation of the surface of a crystal plate under flexion can be studied by means of the interference fringes, the measurements being made with a metallographic microscope under a low magnifying power. It is shown that all the moduli can be calculated from such measurements.—Georges **Claude**: The volatilisation of the electrodes in neon tubes. It has been shown in a previous note that the gases obtained by the treatment with nitric acid of the film of volatilised metal contain, besides neon, a considerable proportion of helium. Three hypotheses may be put forward to account for this fact: the possible selective action of the volatilised metal on helium contained in the neon in a proportion too small to be detected by the spectroscope, the transformation of neon into helium, or the possible transformation of a portion of the neon into compounds retained by the nitric acid. The experiments described in the present paper support the first of these hypotheses, the selective action of the metal, and this conclusion is in accord with the results of Ramsay and Collie arrived at in a different way.—A. **Rosenstiehl**: The theory of complementary colours.—P. **Janet**, F. **Laporte**, and R. **Jouaust**: The determination of the electromotive force in absolute measure of the normal Weston element. In an earlier publication the electromotive force of the Weston cell had been found by the authors to be 1·01869, in terms of the true ampere and the international ohm. Comparison of the ohm used with those of foreign laboratories reduces this figure to 1·01859,

and a recalculation of the constants of the electrodynamometer used causes a further reduction to 1·01836 (at 20° C.), a value only slightly higher than values obtained in other laboratories.—Albert **Colson**: The theory of solutions. An adverse criticism of the van 't Hoff-Arrhenius theory of solutions.—L. **Gay**: The expansibility pressure of a normal fluid.—Marcel **Delépine**: The volatility of sulphur compounds. Many examples are known in which the replacement of oxygen in a compound by sulphur causes a lowering of the boiling point, and there is a general impression that this is always the case. The author suggests that the substitution of sulphur for oxygen always raises the boiling point of a compound, except in the case of the hydroxyl group of water and the lower alcohols, phenols, and acids.—Henri **Martin**: A human skeleton found in Charente (see p. 16).—R. **Lacasse** and A. **Magnan**: A bicephalous human monster.—Louis **Roule**: Some larvæ of apodal fishes.—R. **Koehler**: Antarctic echinoderms arising from the expedition of the *Pourquoi-Pas?*—Henry **Hubert**: An attempt at a geological map of western Africa.—Ch. **Moureu** and A. **Lepape**: The spectrophotometric estimation of xenon. Constancy of the xenon-argon and xenon-krypton ratios in natural gaseous mixtures. The basis of the method is the increase of intensity of the blue indigo xenon line 4671·4 when the proportion of xenon is increased in a mixture of xenon and argon.—M. de Montessus **de Ballore**: The application of the Cardan suspension to seismographs.

October 23.—M. Armand Gautier in the chair.—Remarks by the president on the work of De Romas, whose statue has just been erected at Nérac.—A. **Müntz** and E. **Laine**: The ammonia in the rain and snow at the observation stations of the Charcot expedition. The estimation of ammonia in eighteen specimens of snow and rain water showed that the distribution of ammonia in rain and snow in the Antarctic regions does not greatly differ from the amounts found at European stations.—Ch. **André**: The cosmogony of Laplace. A criticism of some calculations published by T. J. J. See adverse to the theory of Laplace. The author holds these conclusions to be untenable.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1911. Observations were possible on sixty-nine days. The results are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—J. **Bosler**: The spectrum of Brooks's comet. Three negatives were taken with exposures of twenty-five minutes, one hour, and one hour thirty-five minutes, the comparison spectrum employed being that of Vega. Besides the hydrocarbon and cyanogen bands there was a group of lines of wave-lengths 407, 405, 401, and 399. The spectrum of the tail was quite different from that of the head, and resembles the spectrum of the tail of the Daniel comet.—M. **Iniguez**: Observations of the Brooks comet made at the Observatory of Madrid.—Henri **Villat**: Certain integral equations of a new type and some problems relating to them.—E. **Jouguet**: The dynamical adiabatic law in the motion of wires.—Georges **Claude**: The commercial manufacture of pure nitrogen. In the preparation of calcium cyanamide by the action of nitrogen upon calcium carbide at a high temperature a very pure nitrogen is required. The quantities required on the large scale are such that chemical methods of preparation are out of the question, and the present paper gives an account of the method of preparing nitrogen by the fractional distillation of liquid air. It is necessary that the nitrogen produced should contain less than 0·25 per cent. of oxygen. Three installations of the type described in the paper have been set up, giving nitrogen of a purity of 99·7 to 99·8 per cent.—Jean **Villey**: The electric couple in electrometers.—Eugène **Fouard**: The osmometry of saline solutions and the ionic theory of Arrhenius. An account of experiments made with a differential osmometer against saccharose as a standard. The results with potassium sulphate are in accord with the Arrhenius theory; with potassium chloride, copper sulphate, and barium chloride, on the other hand, the results found are opposed to the ionic theory.—G. **Darzens** and H. **Rost**: The syntheses of some new hydroaromatic ketones. The chloride of the hydroaromatic acid is prepared by the action of $SOCl_2$, and this, diluted with ether, is treated with the organo-magnesium compound at a temperature of −10° C. The ketone, which is mixed with a small quantity of tertiary alcohol, is purified by conversion into the semicarbazone; the yields are good, from 40 to 60 per cent. Details are given of the preparation and properties of several ketones.—M. **Marage**: Various kinds of deaf-mutes.—Ch. **Gravier**: Some biological peculiarities of the annelid fauna of the Antarctic seas.—E. **Roubaud**: The evolution and history of the "Ver du Cayor," an African larva from the skin of *Cordylobia anthropophaga*.—Maurice **Piettre**: The melanic pigments of animal origin. The pigment was isolated from material from the horse, avoiding the use of strong acids or alkalis in the separation. Analyses of the pigment are given and of the substance derived from it by hydrolysis.—Stanislas **Meunier**: The chemical and lithological examination of the El Nakhla meteorite. This meteorite belongs to a new type allied to Chladnite, from which it differs by the substitution of hypersthene for eustatite.—J. **Thoulet**: The fall of sediments in oceanic waters.

MELBOURNE.

Royal Society of Victoria, September 14.—Prof. E. W. Skeats in the chair.—E. F. J. **Love** and G. **Smeal**: The psychrometrical formula. A modified formula for the wet- and dry-bulb hygrometer was suggested by Ekholm in 1908, viz. $x=\eta f-AB(t-t')$, where η is a proper fraction to allow for diminution of vapour pressure by hygroscopic action of the material on the wet bulb. The facts do not require any such interpretation, and the formula is tested by observations with several wet bulbs covered with different materials. A new large type of screen was used, and simultaneous readings show no difference to temperature, as would be the case if such action occurred; further, by comparison with a Regnault hygrometer, the value of η is found by least squares to be unity, confirming the usual theory.—Howard **Ashton**: Some new Australian Cicadidæ. The specimens come from northern Australia. The following are new:—*Cyclochila laticosta*, *Psaltoda pulchra*, *P. fumipennis*, *Macrotristria doddi*, *Owra insignis* (n.g. et n.sp.), *Thaumastopsaltria glauca*, *Melampsalta brevis*, *M. viridis*, *M. crucifera*, *Pauropsalta elgneri*, *P. subolivacea*, and *Prasia vitticollis*.—Prof. **Skeats**: Specimens from Heathcote showing all stages of metasomatism from diabase to quartz.—T. S. **Hall**: Graptolites from Preservation Inlet, west coast of New Zealand. These are of Lancefieldian (lowest Ordovician) age; Bryograptus, Clonograptus, and other genera are present. A most remarkable fact was the exact lithological resemblance of the rock, a blue-black silicified shale, to that of Lancefield (Victoria), though the localities are some 1200 miles apart.

BOOKS RECEIVED.

Monopoly and Competition: a Study in English Industrial Organisation. By Prof. H. Levy. Pp. xviii+333. (London: Macmillan and Co., Ltd.) 10*s*. net.

Essays and Clinical Studies. By Dr. F. G. Crookshank. Pp. 245. (London: H. K. Lewis.) 7*s*. 6*d*. net.

Experiments in Organic Chemistry. By Dr. F. J. Moore. Pp. vi+27. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd.) 2*s*. net.

The Art of Life: the Way to Health and Longevity. By Prof. Jogender Lal Chundra. With an introduction by Lieut.-Colonel R. L. Dutt. Pp. ii+240. (Calcutta.) 3*s*. net.

Allen's Commercial Organic Analysis. A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, &c., with Concise Methods for the Detection and Estimation of their Impurities, Adulterations, and Products of Decomposition. Edited by W. A. Davis and S. S. Sadtler. Vol. v. Fourth edition. Entirely rewritten. Pp. ix+704. (London: J. and A. Churchill.) 21*s*. net.

La Fécondation chimique (Parthénogenèse artificielle). By J. Loeb. Édition Française by Dr. A. Drzewina. Revue et augmentée par l'Auteur. Pp. x+366. (Paris: Mercure de France.) 5 francs.

Types of British Vegetation. By members of the

Central Committee for the Survey and Study of British Vegetation. Edited by A. G. Tansley. Pp. xx+416. (Cambridge University Press.) 6s. net.

First Book of Zoology. By T. H. Burlend. Pp. viii+159. (London: Macmillan and Co., Ltd.) 1s. 6d.

Macmillan's Reform Arithmetic. By P. Wilkinson and F. W. Cook. Book VI. Pp. 64. (London: Macmillan and Co., Ltd.) 4d.

Géologie du Bassin de Paris. By M. P. Lemoine. Pp. vi+408. (Paris: A. Hermann & Fils.) 15 francs.

Third Report on the Experimental Work of the Sugar Experiment Station for the Years 1908, 1909, and 1910, Jamaica. By H. H. Cousins. Pp. 135. (Kingston, Jamaica: Hope.)

Nouvelles Tables Trigonométriques Fondamentales (Logarithmes). By Prof. H. Andoyer. Pp. xxxii+603. (Paris: A. Hermann & Fils.) 30 francs.

The Natural History and Antiquities of Selborne in the County of Southampton. By Gilbert White. With illustrations in colour by G. E. Collins. Pp. x+476. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

Die Wirbeltiere. By Prof. O. Jaekel. Pp. viii+252. (Berlin: Gebrüder Borntraeger.) 10.60 marks.

Petits Contes Populaires. Adapted and edited with exercises by F. B. Kirkman. Pp. 52. (London: A. and C. Black.) 8d.

Wörterbuch der Biologie. By Dr. H. Schmidt. Pp. viii+581. (Leipzig: A. Kröner.) 10 marks.

L'Assaut du Pole Sud. By l'Abbé Th. Moreux. Pp. 221. (Paris: Jouve & Cie.) 1.50 francs.

Life in the Sea. By J. Johnstone. Pp. vii+150. (Cambridge University Press.) 1s. net.

New Zealand. By the Hon. Sir R. Stout and J. L. Stout. Pp. viii+185. (Cambridge University Press.) 1s. net.

Steam Turbine Design, with Special Reference to the Reaction Type, including Chapters on Condensers and Propeller Design. By Dr. J. Morrow. Pp. viii+471. (London: Edward Arnold.) 16s. net.

The Adventures of Jack Rabbit. By R. Kearton. Pp. xii+248. (London: Cassell and Co., Ltd.) 6s.

The Story of the Five Elements. By E. W. Edmunds and J. B. Hoblyn. Pp. viii+264. (London: Cassell and Co., Ltd.) 2s. 6d. net.

Ostwald's Klassiker der Exakten Wissenschaften, No. 179. Abhandlungen über Dialyse (Kolloide). By Th. Graham. Herausgegeben von E. Jordis. Pp. 179. (Leipzig: Engelmann.) 3 marks.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 2.

ROYAL SOCIETY, at 4.30.—Colour Blindness and the Trichromatic Theory of Colour Vision. Part III. Incomplete Colour Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—Note on the Iridescent Colours of Birds and Insects: A. Mallock, F.R.S.—The Behaviour of the Infusorian Micronucleus in Regeneration: K. R. Lewin.—An Inquiry into the Influence of the Constituents of a Bacterial Emulsion on the Opsonic Index: A. F. Hayden and W. P. Morgan.—The Morphology of *Trypanosoma gambiense* (Dutton and Todd): Colonel Sir David Bruce, C.B., F.R.S.—(1) Factors in the Interpretation of the Inhibitive and Fixation Serum Reactions in Pulmonary Tuberculosis; (2) Preliminary Report upon the Injection of Rabbits with Protein-free (Tuberculo-) Antigen and Antigen-Serum Mixtures: A. H. Caulfeild.

MONDAY, NOVEMBER 6.

SOCIETY OF ENGINEERS, at 7.30.—Two-cycle Engines: R. W. A. Brewer.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Norsemen in America: Dr. Fridtjof Nansen, G.C.M.C.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Deflocculation as Affecting Lubrication: Dr. E. G. Acheson.

TUESDAY, NOVEMBER 7.

INSTITUTION OF CIVIL ENGINEERS, at 8.—President's Address.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Alan A. Campbell Swinton.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Exhibition on the Moulting of the Arctic Fox: R. I. Pocock, F.R.S.—On the Moulting of the King's Penguin (*Aptenodytes pennanti*) in the Society's Gardens: D. Seth-Smith.—On the Presence of Two Ovaries in Certain British Birds, more especially the Falconidæ: T. E. Gunn.—Ontogenetical Transformations of the Bill in *Ardea cinerea*: Prof. P. P. Sushkin.—On some Collembola from India, Burma, and Ceylon, with a Catalogue of the Oriental Species of the Order: Dr. A. D. Imms.

WEDNESDAY, NOVEMBER 8.

FARADAY SOCIETY, at 8.—Address by Dr. E. G. Acheson.

GEOLOGICAL SOCIETY, at 8.—On the Interglacial Gravel-Beds of the Isle of Wight and the South of England, and the Conditions of their Formation: Prof. E. Hull, F.R.S.; The Gopeng Beds of Kinta, Federated Malay States: J. B. Scrivenor.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Some Problems in the Dyeing and Finishing of Silk Fabrics: W. P. Dreaper.

THURSDAY, NOVEMBER 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Modern High Voltage Power Transformers in Practice with special reference to a "T" Three Unit System: W. T. Taylor.

THE CONCRETE INSTITUTE, at 8.—Presidential Address: Sir Henry Tanner, C.B.

ROYAL SOCIETY, at 4.30.—*Probable Papers*—The Spectrum of Boron: Sir W. Crookes, O.M., For. Sec. R.S.—A Chemically-active Modification of Nitrogen produced by the Electric Discharge. II.: Hon. R. J. Strutt, F.R.S.—Production of Solid Oxygen by the Evaporation of the Liquid: Prof. Sir J. Dewar, F.R.S.—On the Gaseous Condensable Compound, Explosive at Low Temperatures, produced from Carbon Disulphide Vapour by the Action of the Silent Electric Discharge. II.: Prof. Sir J. Dewar, F.R.S., and Dr. H. O. Jones.—(1) Optical Dispersion: A Comparison of the Maxima of Absorption and Selective Reflection for certain Substances; (2) The Influence of the Solvent on the Position of Absorption Bands in Solutions: Dr. T. H. Havelock.—An Experimental Investigation of Gibbs's Thermodynamical Theory of Interfacial Concentration in the Case of an Air-water Interface: Prof. F. G. Donnan, F.R.S., and J. T. Barker.

LONDON MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Invariants of the Linear Partial Differential Equation of the Second Order in Two Independent Variables: J. E. Campbell.—On Invariants of a Canonical Substitution: H. Hilton.—The System of Lines of a Cubic Surface: C. T. Bennett.—The Relations between Borel's and Cesaro's Methods of Summation: G. H. Hardy and J. E. Littlewood.—A Method of Establishing the 27-line Configuration of a Cubic Surface: W. P. Milne. Mathematical Analogues of Mental Phenomena: H. Bateman.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY (at Finsbury Technical College) at 5.—Reflecting Polariscopes for the Study of Optical Stress in Materials: Prof. Silvanus P. Thompson and Prof. E. G. Coker; The Effects of Holes and Semicircular Notches in the Distribution of Stress in Tension Members (demonstrated by polarised light): Prof. E. G. Coker.—(1) A Surface-tension Phenomenon; (2) Temperature Rise in Drops as they Part; (3) Temperatures of Equidensity of Liquids: Mr. C. R. Darling.—(1) Exhibition of a Large Harmonograph; (2) Physiological Effect of an Alternating Magnetic Field; (3) Demonstrations of Acoustical Experiments, New and Old: Prof. S. P. Thompson.

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