THURSDAY, SEPTEMBER 27, 1906.

SOME RECENT WORKS ON PHILOSOPHY.

(1) *Herbert Spencer.* By Prof. J. Arthur Thomson. English Men of Science Series. Pp. ix+284. (London: J. M. Dent and Co., 1906.) Price 2*s.* 6*d.* net.

(2) *Reconnoitres in Reason and the Table-book.* By Norman Alliston. Pp. 280. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1906.) Price 5*s.* net.

(3) *Eine Untersuchung über Raum, Zeit und Begriffe vom Standpunkt des Positivismus.* By Eberhard Zschimmer. Pp. 54. (Leipzig: Wilhelm Engelmann, 1906.) Price 1*s.* 6*d.* net.

(4) *Beiträge zur Einführung in die Geschichte der Philosophie.* By Rudolf Eucken. Pp. iv+195. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1906.) Price 3.60 marks.

(5) *Apollonius of Tyana, and other Essays.* By Thomas Whittaker. Pp. 211. (London: Swan Sonnenschein and Co., Ltd., 1906.) Price 3*s.* 6*d.* net.

(6) *Das Gefüge der Welt, Versuch einer kritischen Philosophie.* By Hermann Graf Keyserling. Pp. viii+382. (Munich: F. Bruckmann A.-G., 1906.) Price 5 marks.

(7) *The Sub-conscious.* By Joseph Jastrow. Pp. ix+549. (London: Archibald Constable and Co., Ltd., 1906.) Price 10*s.* net.

(1) "YET this much is conceded by most," writes the author, "that Herbert Spencer was an unusually keen intellectual combatant, who took the evolution-formula into his strong hands as a master-key, and tried (teaching others to try better) to open therewith all the locked doors of the universe—all the immediate, though none of the ultimate, riddles, physical and biological, psychological and ethical, social and religious."

It is from that standpoint that his work is here viewed, and the subject could not have fallen into better hands than those of Prof. Thomson, who writes clearly, argues cogently, and never fails to leave his reader interested and informed.

A fourth of this volume deals with Spencer's life and characteristics; the rest discusses and criticises his chief contributions to several scientific and philosophic problems. Prof. Thomson notes, of course, his want of indebtedness to previous writers, *e.g.* the fact that he read nothing of Locke and Mill, and that when he borrowed the term "social statics" from Comte he knew no more of the great positivist than that he was a French philosophical writer; he notes, on the other hand, the great influence exerted on Spencer by von Baer's formula "expressing the course of development through which every plant and animal passes—the change from homogeneity to heterogeneity." The main criticisms passed on Spencer in the course of the work are these:—(*a*) In accepting the von Baer formula, Spencer thought of the germ-cell and other lowly structures much too simply; for the germ-cell is far from being homogeneous, and as for the spermatozoon, students of physics "tell us that the picture of a *Great Eastern* filled with framework as intricate as that of the daintiest watches does not exaggerate the possibilities of molecular complexity in a spermatozoon, whose actual size is usually very much less than the smallest dot on the watch's face." (*b*) Spencer does not prove his case that sperm-cells and germ-cells do not possess powers fundamentally unlike those of other cells—at any rate, they may be *very* unlike them. (*c*) Spencer argued, "No inheritance of acquired characters, no Evolution." Prof. Thomson thinks the transmission of acquired characters is not proven, that there is a strong presumption that they are not transmitted, and that the scientific position should remain one of active scepticism, leading on to experiment. (*d*) As to the general philosophic position of Spencer, he holds that he was not a materialist, but was at the same time guilty of gross materialisms, *e.g.* in his universal evolution-formula, which is wholly in terms of matter and motion.

(2) Mr. Alliston wishes to rouse us all from our dogmatic slumber, and here submits to the play of his dialectic a number of ordinary beliefs too hastily accepted. Thus, for example, in his essay on contraries, with which this volume opens, he assails the common practice of distinguishing contraries as positive and negative, and so establishing what proves to be a false precedence among them. He contends that any one of two contraries always refers by implication to its opposite and depends on it for point. With some contraries, he goes on to say, no mean is possible. Aristotle is wrong in making courage the middle term between rashness and timidity.

> "Rashness is really opposed to caution, and not to timidity, of which courage is antonym; and in short, in any example from this source of three chosen terms, it will be found that one of them is not strictly in the same category as the other two, but expresses differences of another kind."

The essay on the limits of determinism elaborates the thesis: "Everything that happens, happens necessarily; but it has got to happen first," *i.e. before* an event happens there is a real choice of possibilities, and thus "before a man has come to a decision, the motive or adequate cause necessitating it cannot be present, or as adequate it would have already brought about the event." Other essays deal with eventuality, the perversity of the will, force, personal credit, the abstract idea, and the like. Mr. Alliston is always acute, ingenious, and convincing so far as he goes, and one wonders only how a complete metaphysic from his pen would read.

The later part of the volume contains a number of disconnected paragraphs and aphorisms, more or less paradoxical, on a number of topics that seem to interest Mr. Alliston. So long as he does not take himself too seriously, and so long as he remembers that Mr. Chesterton is our one chartered acrobat, there is no harm in his indulging the *cacoethes scribendi* in this fashion.

(3) Herr Zschimmer here discusses some of the fundamental conceptions of philosophy from the standpoint of positivism, the principle of which is "first facts, then words." There is nothing very novel in the statement or argument of the volume, much of which is occupied with criticism of isolated points in Kant, Schopenhauer, and others. Time and space, it appears, are severely actual, and when a clock strikes the hour of four, and we remember the strokes as distinct though they are identical in tone, what causes this "ist eben das mit ihnen verschmolzene, Mitgegebene Zeittatsächliche." Consequently "pure," "*a priori*," "forms of perception," and many other beloved formulæ become unnecessary nonsense.

Towards the end of the book there is a somewhat elaborate account of the formation of concepts (*Begriffe*). The author defines *Begriff* as "die im Vergleich von Vorstellungen hervorgebrachte Verknüpfung eines Gemeinsamen Bestandteiles mit anderen Elementen (Merkmalen des Individuums) zu verschiedenen individuellen Systemen." The relation between the triangle before me and the concept of triangle is not badly discussed, the question, *e.g.*, as to what prevents me from regarding the essential and conceptual elements in my perception of the triangle before me as the concept of triangle generally. Causality and similar problems are rather hastily dealt with, and no part of the book displays remarkable depth or insight.

(4) Prof. Eucken's writings are all so excellent and stimulating that to commend him is needless and gratuitous. The present volume is a second and enlarged edition of "Beiträge zur Geschichte der neuern Philosophie," which appeared in 1886. In its newer form it contains, unaltered, some essays on old German philosophy, *e.g.* on Paracelsus and Kepler, and one "Über Bilder und Gleichnisse bei Kant." Two other essays, one in commemoration of Adolf Trendelenburg, and another on the various schools of philosophy, have been considerably changed; altogether new are those entitled "Bayle and Kant" and "Gedanken und Anregungen zur Geschichte der Philosophie." Bayle (of dictionary fame) and Kant seem to our author very similar in their outlook on life; according to Bayle, he writes, "a great contradiction has been set up in human nature: truth and virtue are demanded of us, and the demand finds an expression in the laws of conscience and of thought, but it cannot have its own way and produce a corresponding reality: knowledge entangles itself in irresoluble contradictions: moral judgment, it is true, is saved from these, but in man it cannot overcome the natural force of the instincts and the passions." How very similar this is to much Kantian doctrine will be at once apparent.

(5) Three of the six essays in this volume are historical, and deal with Apollonius of Tyana, Celsus and Origen, and John Scotus Erigena. They consist for the most part of a running analysis of some works, not too widely known, of patristic and scholastic times, and as their author has studied the neo-Platonists to some purpose, his account is not lacking in subtlety.

The other three essays are constructive. One of them, entitled "Animism, Religion and Philosophy," seems cast in a Comtean mould, and elaborates the thesis that man's thinking on the causes behind or immanent in the visible order of things goes through three stages, the animistic, the religious, and the philosophical. The author has apparently no faith in religion as the satisfaction of a permanent and legitimate craving of human nature. He confidently believes that philosophy has transcended the historic religions, and that, though it is the height of rashness to forecast the future of religion, whatever form religion may take, it will be the right and duty of philosophy to maintain its independence. Another essay, on the classification of the sciences, reprinted from the pages of *Mind*, amends Comte's well-known list of positive sciences, *e.g.* by omitting astronomy, by inserting animal psychology and human psychology, and by offering, as preferable to Comte's linear series, a circular scheme, in which one may, proceeding according to the didactic order, start with formal logic, go round the objective sciences, come back to the subjective sciences, and end with metaphysics.

The last essay, "Teleology and the Individual," is the most suggestive in the book. The author concludes that "the strength of the ancient and modern philosophies derived from Plato and Aristotle lies in their having retained the teleological point of view, conceived in a scientific sense, within a highly speculative system, but not at the summit"; that we may conceive the possibility that permanent individual subjects may have successive lives through which may be seen a teleological order; and that, though there are systems of ends, mutually adapted so as to form one system, this system has no end, and there is, therefore, no evolution of the universe as a whole.

There is a great deal of strenuous thinking in this book. Its merits will, we trust, not be obscured by its strong anti-theological bias.

(6) This work professes to be no more than an introduction or an overture to a music which has still to be composed. Its author writes in an excellent style, and is very well informed on a great variety of subjects, from modern views of matter and electricity to the æsthetic ideas of William Blake and Mr. Walter Pater. The philosophies that have chiefly influenced him are those of Plato, Kant, and Mr. Houston S. Chamberlain (the author of a German work on Kant), whose name is probably not so familiar in this country as those of the other two; but this *fidus Achates* lauds him on almost every page. That the book is laid down with no distaste for the author or for Mr. Chamberlain is creditable to both.

An analysis of the first two chapters will show the point of view. The author discusses some of the vain attempts to introduce unity into our view of the universe; the relations of different forms of force to one another, *e.g.* the impossibility of bringing gravitation into relation with electricity; the difficulty of arriving at consistent views of æther. In the end he comes to the conclusion that matter, force, and life are three ultimate and distinct categories for

thought; it is impossible, for example, to resolve life and matter into force. Their unity can only be a formal one, *i.e.* the unity of law which pervades them and which is apprehended by man. Just as in mathematics "we can from the projection of a very complicated figure, one for example whose extremities may lie in infinity, derive without error the laws according to which it is composed," so we can project the complicated universe on the human mind, and trace the laws which are its formal framework. The second chapter discusses the two great formal schemes of thought, the logical and the mathematical, and a preference is given to the mathematical as being synthetic and not analytic. This leads naturally to a discussion of continuity and "discreteness," and the relation between these two is compared in a suggestive fashion with that between geometry and arithmetic, perception and thought, being and becoming. From the mathematical standpoint there is given also a new expression for life, which represents it as the hypotenuse of a right-angled triangle of which the two sides are matter=being and force=becoming.

Later chapters discuss the problem of spirit and the large question of freedom. An epilogue asks, What is truth? and it appears that in the existence of an abstract, objective truth our author has no faith. Amid much fancifulness and some obscurity there is not a little that is instructive and highly interesting.

(7) The main conclusion of the work before us is that man does not live by consciousness alone. "The processes of perception of the external world," writes the author, "are in the ordinary use of our faculties as typically sub-conscious as conscious in their mode of functioning." This is revealed in many ways; there is, for example, the well-known experiment in which two equal lines have added to them pairs of shadowy strokes, divergent and convergent respectively, the result being that the one line appears considerably longer than the other.

"Now reduce the shadow-strokes to such a degree of faintness that the eye fails to detect their presence, and continue to judge (naturally with diminished confidence) which seems the longer, and it will be found that the undetected shadows incline the judgments in accord with the illusion which their observed presence induces."

Further, when we talk of crystal-gazing, thought-reading, dissociated consciousness, and the other phenomena so often exploited by charlatanism, we have to remember that, obscure and weird as at first sight they appear, they often reveal themselves on analysis to be but "the exaggerated elaboration of possibilities inherent in every human mind."

Prof. Jastrow discusses all these problems in a very sane and convincing manner, and his work is a valuable contribution to the subject. Occasionally the treatment is a little prolix. The first part deals with the normal aspect of the subconscious, the second with the abnormal, and the closing chapters discuss the theory of the matter. Dissociation is explained as "the partial presence, with impaired relations, of factors normally fully associated and integrally co-ordinated"; and to show precisely in what such impairment of relations is seen, he defines the three privileges of mature psychic procedure as "incorporation, orientation and initiative." The theory which meets with his most vehement opposition is that of the subliminal self, which he finds to be "but slightly restrained by exacting allegiance to the large body of normal data," and which further indulges in all manner of mediæval epicycles whenever facts refuse to fit themselves to it. His main objection to the subliminal self lies in the difficulty of accounting for its maintenance amid the evolutionary conditions under which our consciousness has reached its present form.

SEA-FISHERIES ADMINISTRATION AND RESEARCH.

British Fisheries. Their Administration and their Problems. A Short Account of the Origin and Growth of British Sea-fishery Authorities and Regulations. By James Johnstone. Pp. xxxi+350. (London: Williams and Norgate, 1905.) Price 10*s.* 6*d.* net.

THIS book may be described as a summary and critical analysis of all that has been or is being done for the sea-fisheries of this country by means of legislation and scientific investigation. The first part of the book deals with the history of legislation, and the second part with scientific investigation.

The history of the early legislation is a record of failure, as was proved by the repeal of more than fifty repressive Acts (mostly relating to herring trawling) at the suggestion of the Royal Commission of 1863. That commission, of which Huxley was a member, took a very optimistic view of "the resources of the sea." The Trawling Commission of 1882 was not quite so optimistic; at least it showed that certain inshore grounds had been affected by too much beam trawling. Finally, the Select Committee of 1893 was definitely pessimistic. It felt "that the subject of the diminution of the fish supply is a very pressing one, and the situation is going from bad to worse."

Mr. Johnstone has a good deal to say about the constitution of the various sea-fisheries committees, and finds that, "on the whole, the system of local regulation of the fisheries, as originally contemplated by the Sea-Fisheries Regulation Acts, cannot be said to be very successful." Where amalgamation has taken place "the administration has been most successful"; but "it is generally agreed that the system under which the regulation of the fisheries is obtained by rates levied on the maritime counties is not altogether a fair one."

The author is lavish in his praise of the Fishery Board for Scotland, its administration, scientific work, and "perfect system" of statistics, and has, by way of contrast, some very hard things to say about the English authority, its "inertia," lack of scientific investigation, and imperfect statistics. As for the former body, one's admiration, though genuine enough so far as it goes, is tempered by reflections on the very questionable success of its wholesale closure policy. In regard to the English official

statistics, Mr. Johnstone's severe criticism rather "misses fire" at present, when definite steps have been taken to improve them. It is difficult to see how he can have read the report of the inter-departmental committee of 1902, in which the recommendations for improvement—which have since been largely carried out—were made, and yet say of that report that "it left the question of statistics in almost exactly the same state as it was."

In the second part of this book the life-histories of fishes are dealt with in a chapter of twenty-five pages of large type, and necessarily very briefly. In another chapter, on the metabolism of the sea, an account is given of the work of Hensen and Brandt in regard to the quantitative estimation of the resources of the sea. There are also important and well-reasoned chapters on the impoverishment of the grounds, the destruction of immature fish, and marine pisciculture.

The following contribution to the discussion of that perennial puzzle, "What is over-fishing?" may be worth quoting:—

"If a boat (either steam trawler or smack) catches fewer fish in the course of the year, it can mean nothing else than this, that *on the portion of the sea-bottom swept by her trawl-net there are fewer fish now than was formerly the case*, that is, the density of fish per unit of area in the North Sea fishing grounds is less than it was thirty years ago. This is a real impoverishment of the fishing grounds."

The author sums up the present situation as regards the relation of scientific research to legislation in the following words:—

"It would appear then that we are not yet prepared to give thoroughly convincing reasons for the adoption of legislative restrictions on those modes of fishing in which small fishes are destroyed to a notable extent. At the same time there can be no doubt that what we do know of the life-histories of fishes does justify us in recommending the adoption, as a tentative measure, of some of the remedies proposed—say the imposition of size-limits on the fishes landed in certain districts," &c., but he thinks that on the whole "it is better to press for investigation on a much more adequate scale than has hitherto been contemplated before recommending any drastic change in the fishery laws."

Students of fishery problems will be familiar with most of the arguments and criticisms in this book. These have appeared before in one form or another, but have never been more incisively stated than in the present volume.

AN ENCYCLOPÆDIA OF PHYSICS.

Handbuch der Physik. By Dr. A. Winkelmann. Zweite Auflage. Dritter Band, Erste Hälfte: Wärme, pp. viii+536; Vierter Band, Zweite Hälfte: Electrizität und Magnetismus, I., pp. xiv and 385–1014; Sechster Band, Zweite Hälfte: Optik, pp. xii+1404. Illustrated. (Leipzig: Barth.) Prices 16, 20, and 30 marks.

PORTIONS of the second edition of this well-known handbook have already appeared and been noticed in these columns. The characteristic of the treatise is that each part is written by a specialist (under the general editorship of Dr. Winkelmann), and consequently it partakes of the nature of an encyclopædia.

In the heat part appear the following sections:—thermometry (Profs. Pernet and Winkelmann); expansion of solid bodies, liquids and gases, thermo-electric and electric resistance, measurement of temperature, specific heat (Winkelmann); thermal radiation and conductivity (Graetz). Throughout there is carried out a very complete system of references to original sources, with critical comments. This is certainly very well done in general; but in the account of constant pressure gas thermometers we look in vain for any reference to the thermometer of Prof. Callendar, and discover no recognition of the work of the same experimentalist in the development of methods of temperature determination based upon the measurement of electrical resistance. We presume that it is intended to recur to this subject in some other portion of this voluminous treatise.

In the electrical part appear the following sections:—electrical conductivity of electrolytes, by Dr. R. Luther; electricity and gases (ionisation and electrification, characteristics of the electrical current, migration of ions, kathode and canal rays, forces on ions, thermal, chemical, and optical actions), by J. Stark; radio-activity, by J. Stark; atmospheric electricity, by H. Gerdien; thermoelectricity, by Dr. F. Braun; thermal effects of currents, by M. Cantor; Pyro- and piezo-electricity, by Dr. F. Pockels; theory of the galvanic cell, by M. Cantor; electrolysis and migration of ions, by R. Luther; electrical endosmose and convection currents, by L. Graetz; galvanic polarisation and accumulators, by M. Cantor.

From this summary it will be seen that many of the sections relate to subjects in which there has been a tremendous amount of work done in recent years. The subject of radio-activity has, indeed, been *originated* since the previous edition appeared, and so rapidly is progress taking place in our knowledge of this subject that it may be considered a moot point as to what extent it is advisable to introduce such quickly changing matter into a volume which has the stability that a treatise of this kind necessarily possesses. The references extend into the year 1904; but even so it is impossible to praise this section as representing the present state of knowledge. The best that can be said is that there is not much recorded which is now known to be untrue. We think this is much as it should be. An encyclopædia should contain little which has not been sifted and sifted again until there is little doubt of it being an established fact. To more protean volumes should the task be left of pourtraying the latest phases of any department of knowledge.

These remarks apply—though perhaps not so completely—to other sections of the volume. The subject-matters happen throughout to be those in connection with which development is now most pronounced; but at the worst we have here a magnificent account of the branches of physics named above.

The optical portion is probably of more stable character than the rest, although here also have

great developments to be recorded. We think that the inclusion of such subjects as photography (fifty-five pages) has helped to swell the volume to unnecessarily large proportions. The technics of a special branch such as this seems scarcely at home in its surroundings. We welcome in particular the articles of Drude on the nature of light, on the theory of light for transparent media at rest, for absorbing media, and, finally, for media in motion.

The book is replete with references to original papers, and may be taken as being as complete a handbook for the professional reader as has yet appeared.

GARDEN-BOTANY.

Hortus Veitchii, a History of the Rise and Progress of the Nurseries of Messrs. James Veitch and Sons, together with an Account of the Botanical Collectors and Hybridists employed by them and a List of the more Remarkable of their Introductions. By James H. Veitch. Pp. 542; illustrated with fifty photogravure plates. (Chelsea: James Veitch and Sons, Ltd., 1906, for private circulation.)

THIS is one of the most sumptuous volumes which have ever emanated from a business house, but if it were simply a business publication it would claim no special notice in these columns. It is, in fact, a most important contribution to the history of horticulture during three-quarters of a century or more, and a valuable work of reference for the systematic botanist and the hybridist. It illustrates in a remarkable degree the service which the enterprise of a great commercial firm is capable of rendering, and in this case has rendered, to botanical science. As the author appropriately says:—

"To the representatives seeking unknown plants at one period or another in almost every clime, fortune has not invariably been kind, but the work of such men as Thomas Lobb, William Lobb, the late John Gould Veitch, Charles Maries, and E. H. Wilson has been a gain in every way; whilst the efforts in hybridising and selecting of John Dominy, John Seden, V.M.H., and John Heal, V.M.H., have given a wider interest to all cultivators."

With the history of the firm and its various members as given in the introduction to the present volume we are not here concerned, but we may indicate that it would furnish valuable data for Mr. Galton's science of eugenics. The biographical sketches of the twenty-two travellers employed by the firm are so interesting that we could have wished them longer. Whilst very many of the plants introduced into cultivation by the energy and zeal of these men have proved of first-rate importance from a gardener's point of view, as shown, amongst other things, by the fact that no fewer than 422 plates representing Veitchian introductions have been published in the *Botanical Magazine* under the editorship of the two Hookers and their successor, Sir William Thiselton-Dyer, thousands of herbarium specimens have been generously presented to the national botanical establishments and to individual botanists engaged in the study of particular groups.

When we come to the section relating to the hybridists who have achieved success in Messrs. Veitch's nursery we are again disposed to regret that fuller details were not given, but in view of the magnitude of the book and the immensity of the task we are by no means surprised that the author has felt it necessary to give indications only. Certain it is that the students of hybridisation, variation, and heredity will find inexhaustible materials for study in the results obtained by Messrs. Veitch. It is a noteworthy fact that at the present time, when orchids are so popular, greater interest is felt in the hybrid "creations," in the production of which John Dominy was the pioneer, than in new introductions. When we read of a thousand pounds and more being paid for one of these specimens we can but regret that orchid lovers do not contribute more to encourage scientific research into the history and nature of the plants in which they take such keen interest. The list of species of orchids introduced by Messrs. Veitch occupies no fewer than forty-seven pages. A large proportion of these were described by Lindley, by Reichenbach, and subsequently by Rolfe, and short descriptions and historical notes are afforded in these pages. Orchid hybrids are treated in like manner, the particulars relating to them filling fifty-seven pages, exclusive of an appendix giving historical details, and occupying six pages of small type. The information here given will be of special value to those engaged in the study of hybridisation.

Space will not allow us to do more than mention the sections relating to stove and greenhouse plants, to which eighty-three pages are devoted, to the various species and hybrids of Nepenthes, the ferns, the coniferous trees, the deciduous and evergreen trees and shrubs, the herbaceous plants, the bulbous plants, the Amaryllis, the Begonias, the greenhouse Rhododendrons, the Streptocarpus, and, lastly, the fruits and vegetables, all exclusively the result of the enterprise or of the skill of Messrs. Veitch and of their assistants. With such a vast amount of material it is evident that severe compression has had to be effected, but even so the record is a marvellous one. Happily an excellent index is provided.

Throughout it is obvious that great pains have been taken in the preparation of the volume, the solid worth of which is enhanced by the excellent manner in which it has been produced.

OUR BOOK SHELF.

Avogadro and Dalton. The Standing in Chemistry of their Hypotheses. By Dr. Andrew N. Meldrum. Pp. 113. (Edinburgh: W. F. Clay, 1904.) Price 3*s.* net.

THIS book may be read with interest by all chemists, and with special profit by students who have got into confusion with the difficult piece of chemical history of which it treats.

Dr. Meldrum sets himself to define the true relationship and standing of the hypotheses of Dalton and Avogadro. Prof. Japp, in his preface, states that he has nowhere else seen the true ratiocinative order of precedence of the molecular and atomic hypotheses

"expounded with such wealth of illustration and with so exhaustive a knowledge of the fundamental literature of the subject." This praise is, we think, fully deserved. Dr. Meldrum brings stern logic to bear on the question, and approaches his task with a grim earnestness which imparts an unintentional tinge of humour to his book. He is no respecter of persons, and he handles with some severity all those who, in his opinion, have been unfaithful to the facts. "The atom," says Dr. Meldrum, "in the modern theory of chemistry is a 'dependency of the molecule.'" "Avogadro's hypothesis being the fundamental hypothesis of chemistry, other doctrines concerning molecules and atoms are to be subordinated to it." "The atom can be defined with reference to the molecule; it is doubtful if any other definition is sufficient." These quotations will perhaps suffice to indicate Dr. Meldrum's view. Dalton's hypothesis came first, but since 1858, when Cannizzaro appeared on the scene, Avogadro's hypothesis has been the fundamental one. We do not think that this can be seriously contested, taking the words strictly in the sense intended by Dr. Meldrum. At the same time there is surely some danger of a too pedantic insistence on this question of "ratiocinative precedence." If we look upon the progress of chemistry, and not merely on its present state, it is hardly a crime to speak of that hypothesis as fundamental which has been the immediate cause of another that has ultimately proved more general, comprehensive, and fruitful, and whilst no doubt there has been some laxity on the part of chemical writers in their choice of words, the great fact that Dalton came first, and that without Dalton there is no reason to suppose there would have been an Avogadro's hypothesis, will still be regarded, we suspect, as a justification for some of the statements which Dr. Meldrum criticises so severely.

In saying this we do not wish for a moment to underestimate the service which Dr. Meldrum has rendered by giving us this very searching and able review of the bases of modern chemical theory.

A. S.

Die radioaktiven Substanzen und die Theorie des Atomzerfalles. By Prof. Paul Gruner. Pp. 103. (Bern: A. Francke, 1906.) Price 1.60 marks.

THIS little book of 100 pages, we learn from the preface, had its origin in courses of lectures delivered by the author at the University of Berne during the session 1904–5, and is designed to give a complete yet short review of the whole field covered by the title, including the most recent investigations. The subject is presented from the point of view of the disintegration theory, and the phenomena connected with the induced activity are treated at length. The physiological action of radio-active substances, and their existence in springs, &c., are not considered except in passing.

The author is to be congratulated on having fully carried out his intention, and has succeeded in producing a very readable account of the subject from the physical standpoint, which is thoroughly up to date; but the value of the work would have been much enhanced by more diagrams. Only three are included, illustrating the decay and growth curves of the induced activity of radium, and not a single diagram of any experimental piece of apparatus is shown. Practically nothing is said of the methods of measurement in use in the laboratory, although perhaps this is as well in a subject of this kind, where a little knowledge is apt to be a dangerous thing. On the other hand, the author has contrived to compress within the one hundred pages of his book a surprising amount of the best of the most recent literature, and this makes us venture to express the hope that in a future edition the author will rely less on the existing compilations in dealing with the earlier researches, and will extend to the whole literature of the subject the same careful and first-hand consideration he has shown in dealing with the latest researches.

Of criticism or comment there is little or none, but there is evidence of considerable skill in the selection of the material whereby the most important researches secure prominent treatment. With the exception of the recent work emanating from Australia on the α rays, of which perhaps the full bearing has not been sufficiently brought out, the living branches of the subject have been done full justice to. A reference to the parts dealing with the slow transformation products of radium, radio-thorium, the origin and ultimate product of radium, the work in Germany and France on the production of helium from radium and actinium, and radio-tellurium and polonium, shows that the author has included the best of the current work on the most important problems.

F. S.

Introduction to Astronomy. By Prof. Forest Ray Moulton. Pp. xviii+557. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1906.) Price 5*s.* net.

STUDENTS of astronomy will find in Prof. Moulton's volume an excellent text-book which, by its lucidity and wealth of detail, will enable them to obtain a fairly thorough grasp of their subject.

After two chapters dealing with general outlines and definitions we find a very useful chapter on the constellations, with special paragraphs on the more important stellar groups and simple methods of locating them. Four clearly printed maps, so bound that they open out flat when the book is opened, will be found very useful in the practical work which here and throughout the book is insisted upon as being essential.

Telescopes, their evolution and various types, are then discussed, whilst the earth, its movements, gravitation, and time are dealt with at some length in the four succeeding chapters.

Chapters ix. to xii. deal with the moon, eclipses, the solar system as a whole and its individual members, respectively. The chapter on comets and meteors which follows leaves little, if anything at all, to be said concerning the general phenomena and the historical apparitions of these bodies.

Probably in no branch of astronomy have such rapid advances been made during recent years as in solar physics, and of the results obtained therefrom Prof. Moulton takes the fullest advantage in the forty-nine pages of description and discussion which he devotes to the sun in chapter xiv. Again, as a pioneer worker on the probable evolution of the solar system, he is seen to great advantage in the next chapter, where he describes and criticises the Laplacian hypothesis, explains the work of Sir George Darwin, and summarises the theories advanced by Prof. Chamberlin and himself.

In the concluding chapter we have an epitome of our present knowledge concerning "the stars and nebulas," in which the facts and observations of most branches of sidereal astronomy are clearly stated and discussed.

The numerous questions placed at the end of each chapter and the excellent and up-to-date illustrations add greatly to the value and interest of the volume as a text-book.

W. E. R.

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.*]

The Recent Radium Controversy.

I SHALL be obliged by your making the following correction on an accidental misstatement of mine, quoted by Mr. Soddy (p. 517, line 3 from foot of column one) in his very interesting article on "The Recent Controversy on Radium," in your issue of September 20 (p. 516). In a letter to the *Times*, from which the quotation is correctly made by Mr. Soddy, I had written accidentally *four* instead of *five*. The corrected statement is that Prof. Rutherford had suggested that radium might be a compound of one atom of lead and five of helium. This is a suggestion wholly in harmony with chemical science. Rutherford is scientifically cautious in naming lead as possibly one of the ingredients of radium, but he names helium as demonstrated experimentally to be an ingredient, and considers five atoms as rendered somewhat probable by elaborate and important experimental investigations, of which he gives careful descriptions and very complete references in his book on "Radio-activity."

Netherhall, Largs, September 21. KELVIN.

Stress in Magnetised Iron.

IN NATURE, August 2 (p. 317), I observe under the above title a letter from Dr. Shelford Bidwell re-opening a question discussed in your columns ten years ago. As the originator of the discussion I feel indisposed to let Dr. Bidwell's letter pass unnoticed.

In my first letter (NATURE, vol. liii., 1896, p. 269) I directed attention to the fact that certain writers, including Dr. Bidwell, Dr. J. A. Ewing, and Dr. More, had stated explicitly or implicitly that the material of a magnet is subjected to a longitudinal *compressive* stress approximating to $B^2/8\pi$ when H/B is small, whilst other authorities, including Kirchhoff and Prof. J. J. Thomson, postulated a *tensional* stress of like amount. I remarked on the apparent inconsistency, and explained the reasons which led me to regard the last-mentioned view as the more plausible. My letter led to others. Dr. Ewing explained that he had changed his views. He left it, however, uncertain whether he believed that no such stress as $B^2/8\pi$ exists in iron, or whether he took the view that tensional and compressive stresses both exist, but in adjacent portions of the magnet. The latter view seems indicated by the illustration he advanced, viz. that of a man sitting in a clothes basket and pulling the handles. The medium in this case is obviously not free from stress, having a tensile stress in his arms and a corresponding compressive stress elsewhere. Prof. E. Taylor Jones wrote favouring a tensile stress, and referring to work by himself and Prof. Nagaoka on the subject. Prof. L. R. Wilberforce dwelt on the fact that the stress $B^2/8\pi$ most properly associated with Maxwell's name has its seat in a hypothetical ethereal medium, not in the material iron. Dr. Bidwell did not then give his views to the public, so far as I am aware. From his late letter I infer that they have remained unaltered since 1896.

Dr. Bidwell advances illustrations to explain his ideas. His arguments, however, seem really to amount only to this, that if *two* masses of iron, whether bars or spheres, close to one another be capable of *bodily* movement (*e.g.* if they rest on a smooth table or be suspended by long threads), and have between them some compressible non-magnetic medium (*e.g.* a finger), this interposed material will be squeezed if the iron becomes suddenly magnetic. This result is, however, equally consistent with either of the above theories; also it throws no light on the nature of the stress in the *iron*.

If, however, we suppose—as Dr. Bidwell ostensibly does—the two hypothetical masses of iron to be consecutive members of an infinitely long series, which seems the only hypothesis likely to represent the interior of a magnet, and suppose them to be separated by air or by a non-magnetic solid, there is obviously no reason why their centres should approach one another when the masses all become longitudinally magnetised. Number n mass is urged to the right, say, by the attraction of mass $n+1$, but to the left by the equal attraction of mass $n-1$, and there is no reason to move bodily one way rather than the other. If we regard the centres of the masses as fixed, then it is obvious if air gaps separate the mass n when unmagnetised from the masses $n-1$ and $n+1$, that after magnetisation it will—whether of extensible or highly inextensible material—suffer a *tensional stress* in consequence of the attractions exerted by its two next neighbours. If the intervals between n and its neighbours be filled by, say, lead, the lead will suffer no compression unless the mass n lengthens when magnetised. If the mass n lengthens, the lead will suffer compression; but the longitudinal stress in n, though less than if the lead were non-existent, will still be a tension. If we suppose that the poles of the hypothetical elementary magnets are not quite at their ends, and that the elements lengthen when magnetised, so that adjacent ends either meet across an air gap or else exert pressure on an interposed non-magnetic layer, then a compressive stress might be looked for, not merely in the layer, but also in the short terminal parts between the poles and the ends; tensional stress would, however, exist throughout the longer central portions. Whether these various hypothetical cases will do more than serve to show the inconclusiveness of Dr. Bidwell's illustrations is, I realise, very doubtful.

In practice there are usually complications from free ends and want of symmetry. We may, at least theoretically, avoid such complications by taking some endless solid, the simplest being an anchor ring, preferably of small section but large aperture. Is there a "hoop" stress in such a ring when magnetised which did not exist prior to magnetisation, and, if so, what is its sign? If there is a "hoop" tension, then the case is so far analogous to that presented by a ring rotating about an axis through its centre perpendicular to the plane of its aperture. If we imagine a short element of the rotating ring bounded by planes through the axis, the *tensions* across the end faces will give an *inwardly* directed radial resultant which is balanced by the "centrifugal force." A stationary Saturn ring of continuous material, under the attraction of a planet at its centre, similarly gives a case of a compressive "hoop" stress; the *pressures* over terminal faces of an element give an *outwardly* directed resultant, balanced by the planet's attraction and that of the ring on itself. In the Saturnian as in the rotating ring (when reduced to a statical problem), the hoop stresses are really excited by a radial action. Is there anything equivalent to this in the magnetic problem? If there is no radial action there will naturally be a change of aperture, unless, like Dr. Bidwell, we suppose the magnetic material absolutely "rigid." With change of aperture there will be change in the intermolecular distances, and so in the intermolecular forces. It would obviously be difficult to distinguish between the stresses due directly and those due indirectly to magnetisation.

I might add that Dr. Bidwell's remarks on the "uniformly magnetised rod" divided transversely seem to me to confuse tensile with compressive stress. He deduces a stress from iron to air gap, which seems really a tension on the iron. If he supposes the two fragments of iron held so as to prevent them doing more than just touch, he will, I think, realise this. Again, his remarks in reference to his spherical model do not seem to draw a sufficiently clear distinction between stress and strain. A "rigid" body, if such an entity could be realised, might be under stress though exhibiting no strain. On the other hand, in an elastic body the signs even of the stress and strain in a given direction may differ.

During the ten years that have elapsed since the controversy began I have been too busily engaged in other matters to follow the developments of magnetic and electrical theory. I hope that the recognised leaders in these developments will not turn a deaf ear to Dr. Bidwell's appeals for further light. C. CHREE.

September 15.

The Rusting of Iron.

DURING the past few months the study of the chemical changes involved in the rusting of iron has been coming to the fore. In 1888 Crum Brown pointed out that iron remained free from rust in an atmosphere of oxygen, carbon dioxide, and water vapour so long as liquid water was prevented from condensing on its surface. Whitney, in 1903, confirmed the opinion that liquid water alone had no effect on the metal at ordinary temperatures. No mention was made, however, of the purity of the iron used. Last year Dunstan, Jowett, and Goulding confirmed these results for polished iron plate (99·94 per cent. iron) in a series of carefully planned experiments. Since iron of such great purity as this is seldom used for commercial purposes, it seemed to me desirable to try the effect of water alone on different samples of varying qualities. Three such were chosen:—(1) cast iron from a piece of old piping; (2) wrought iron; (3) fairly pure iron (99·5 per cent.). The pieces were polished, and measured approximately 1 cm. long by 3 cm. broad and 0·2 cm. thick. They were dropped into flasks of boiling distilled water, and after five minutes the latter were closed with tightly-fitting india-rubber bungs, in the way indicated by Whitney. It was found that whilst the pure and wrought iron were unchanged, the cast iron invariably turned a shade darker in tint. The experiment was varied by employing thin glass tubes instead of flasks, and the surface of the metal was in some cases roughened with a coarse file. After the admission of the iron, the tubes were drawn out and finally sealed off. The results were invariably the same. I have kept these tubes for several months, but no further changes have taken place. This seems to indicate that, whilst neither warm nor cold water has any effect upon the purer forms of iron, they exert some slight action on the coarser cast iron.

Many and various are the theories which have been suggested from time to time to account for the process of rusting. Crum Brown pointed out that carbon dioxide was necessary. This dissolved in the water and attacked the iron, forming ferrous carbonate, $FeCO_3$, or perhaps the soluble ferrous hydrogen carbonate, $FeH_2(CO_3)_2$. The hydrogen gas set free combined with any dissolved oxygen, forming water. The oxygen of the air would convert the ferrous hydrogen carbonate into rust, with the liberation of carbon dioxide. Thus a small amount of carbon dioxide in the presence of water and oxygen would be capable of converting an infinite amount of iron into rust.

During the present year Moody has confirmed this theory by showing that if elaborate precautions are taken to remove every trace of carbon dioxide, pure iron (99·98 per cent.) may be kept for an indefinite time in the presence of air and liquid water without undergoing the slightest visible change. He has also directed attention to the fact that when a piece of pure iron is introduced into a dilute solution of distilled hydrogen peroxide the latter is decomposed slowly, evolving a steady stream of oxygen, whilst the iron is unchanged. This again demonstrates the fact that oxygen and water alone have no action on pure iron.

I have repeated the experiments with hydrogen peroxide, using the different samples of iron already referred to. The peroxide was from Merck, and guaranteed to be pure. It was diluted to thirty times its volume with freshly-boiled distilled water. On introducing the iron, it was found that the pure sample remained perfectly bright, a slow stream of oxygen being evolved. After some hours an odd speck or two of rust appeared. No further alteration occurred even after the lapse of one or two weeks. The wrought iron decomposed the peroxide rather more rapidly, and the specks of rust were more numerous. The cast iron decomposed the peroxide with astonishing rapidity, and in a few minutes was covered with rust. This was, no doubt, due to catalytic action.

We thus see that the purer the iron the less is the action of the peroxide upon it. Had such pure iron as that used by Moody been employed, I have no doubt my result would have exactly coincided with his.

It is not impossible, therefore, that while carbon dioxide, oxygen, and water are essential for the rusting of pure iron, the last two alone may be sufficient to cause rust in the coarser forms, such as cast iron.

J. NEWTON FRIEND.

The Mixed Transformation of Lagrange's Equations.

THE history of the formula

$$L = \mathfrak{T} + \mathfrak{Z}(\Theta\dot{\theta}) - \mathfrak{R} - V \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

is as follows. About twenty years ago I read two papers by Lord Rayleigh and Prof. W. M. Hicks in which certain problems relating to the motion of a cylinder in a liquid, which possesses cyclic irrotational motion, were solved. Both authors employed the old-fashioned method of calculating the forces due to the pressure of the liquid; but I at once perceived that some form of Lagrange's equations must exist which would enable the problems to be solved without introducing internal forces. I accordingly examined all the works on dynamics to which I had access, including Dr. Routh's treatises and Prof. J. J. Thomson's recently published papers in the Phil. Trans., 1886 and 1887, but without finding what I wanted. The necessary clue was at length obtained by means of a theorem of Lord Kelvin's published in the Proc. Roy. Soc. Edin., vol. vii., p. 668 (about 1872 or 1873), which enabled me to establish the formula in question.

Dr. Routh ("Rigid Dynamics," pp. 319 and 320, fourth edition) has given some rather formidable determinants, by means of which it is conceivable that (1) might be deduced by a more or less lengthy analytical process; but in their present form I have never been able to make any use of them. The procedure explained in §§ 418–420 could not apparently be employed when the velocities which are to be eliminated are either unknown or would be inconvenient to introduce.

A. B. BASSET.

Fledborough Hall, Berks, September 21.

Suspended Germination of Seeds.

SOME years ago it was reported that charlock seed had germinated upon the site of a Norman church in Kent. Is there any similar record of foxgloves awakening from a long sleep? Last February I removed an ancient wall circling the top of a very bare hill on a north country farm. We took out the large foundation stones. As the spring advanced, the site of the wall became carpeted with seedling foxgloves; if the cattle permit, a thick foxglove hedge will round the crown of the hill next year.

There were no foxglove plants within several hundred yards, and even had there been roots there would be no seed in February. The wall was formerly the fence of an oak wood, which was felled and turned into pasture forty years ago. The seeds were unquestionably as old as that date; but my own strong opinion is that they were right underneath the foundation stones of the wall, and had lain there ever since it was built. I examined the site very carefully, and also noted that disturbance of the neighbouring turf, outside the site, did not produce any foxglove crop. I believe that the oaks were planted and fenced by a man named Stephen Green between 1600 and 1610.

Another less pleasing instance occurred on the same farm. I took some cartloads of turf and loam—top-spit from an old pasture traditionally called the "Barley Field"—and spread it on another part of the grass; whereupon there came up thousands of corn-weeds, such as fumitory and sun spurge, which were previously unknown in the pastures.

H. B. P.

Optical Illusions on Electric Fan.

A REVOLVING electric fan with gilt blade is illuminated by the light from a window. When we look fixedly on the revolving face an irregular patch of greyish-purple colour appears on the yellowish ground. The patch shows an amœba-like motion, and its size seems to increase with the speed of the fan. The border of the patch is coloured pale. In its centre a bright spot is often discerned. If we look at the fan after having closed or turned aside our eyes for a while the patch has disappeared, and it takes a few seconds before it reappears.

Several other experiments on illusion can be made conveniently by means of the fan. If the blade be covered with red papers and revolved slowly, a white paper looked at through the revolving face appears greenish, and a greenish one greyish.

T. TERADA.

Physical Laboratory, Tokyo, August 26.

Aquatic-dwelling Weevils.

IN NATURE of September 6 there is a note (p. 472) on Dr. Nelson Annandale's papers on the fresh-water fauna of India, ending with the words "an aquatic weevil, which, so far at any rate as habits are concerned, is altogether unique." If this sentence is intended to mean that water-dwelling weevils were previously unknown it is incorrect.

Mr. J. H. Keys and myself took specimens of the weevil *Eubrychius velatus*, Beck, from a pond near Plymouth in September, 1905, which were as thoroughly aquatic as any of the typical water-beetles (*e.g.* Dytiscidæ), most of their time being spent in crawling under water on the leaves and stems of Myriophyllum. Fowler has an interesting note on this species, to the same effect, in his "Coleoptera of the British Islands," vol. v., p. 373.

Mr. Keys also states that *Tanysphyrus lemnae*, F., and the various species of Bagous are all more or less aquatic.

E. E. LOWE.

Museum and Art Gallery, Beaumont Park, Plymouth, September 11.

Remarkable Rainbow Phenomena.

THE letter of Mr. M. Spence in NATURE of September 20, describing a bifurcated rainbow, reminds me of a similar phenomenon which I saw some time during the winter of 1897–8. On that occasion the phenomenon was not so complete as that described by Mr. Spence, only the left-hand portion of the bow being visible. The arch rose from the horizon as a single column to a height of about ten degrees, and then bifurcated into two distinct branches, which, however, did not extend far from the join.

As I was playing in a football match at the time it was impossible to study the effect at all closely; but, so far as I remember, the lower branch sprang out of the main regular bow, making with it an angle larger than that described by Mr. Spence. My incomplete observations were not alone of much value, but in confirmation of Mr. Spence's fuller description they may be worth recording now.

GEORGE C. SIMPSON.

Manchester University.

Is it not the case that the second rainbow seen by your correspondent (p. 516) was caused by the reflection of the sun in the sea? If this were so, naturally persons some miles west of Deerness, or inland, would not have seen it. I once saw the appearance of double rainbows beautifully manifested in Ranenfjord, on the coast of Norway, and the explanation which I have given is that which found most favour with the passengers on our steamer.

C. S. TAYLOR.

Banwell Vicarage, September 21.

SOME SCIENTIFIC CENTRES.

IX.—THE METALLURGICAL DEPARTMENT OF THE SHEFFIELD UNIVERSITY.

NEARLY fifty years ago Sir John Brown, the famous engineer and steel manufacturer, with Dr. H. C. Sorby, the father of the introduction of the microscope for the examination of thin sections of rocks and of polished or polished and etched surfaces of iron and steel, attempted to establish in Sheffield a school of practical science; but as yet Britain held undisputed sway in the world of engineering and of metals; and the help of science, proffered by these far-seeing men, although just as desirable then as now, was rejected by such easy victors in the wars of commerce. The sum of 200*l.* was spent in advertising, with the result that only one student entered. Several years' perseverance never produced more than five students, so far as Dr. Sorby's memory serves him. Sixteen years later the added personal influence of such men as Mr. Mark Firth, Sir Frederick Mappin, Sir Henry Stephenson, and Mr. J. F. Moss failed to find a response, and although in 1879 Mr. Mark Firth founded Firth College to facilitate university extension work, it was not until 1883 that another special meeting was held, at which Dr. Sorby used the following pregnant words: "I do not see why we should not make the teaching of metallurgy a speciality of the town, nor why we should not make Sheffield the centre of metallurgical instruction."

In 1885 the Sheffield Technical School was fairly launched in a separate building, but as a department of Firth College, with chairs of engineering and of metallurgy both held by the late Prof. W. H. Greenwood. Until 1889 the department of metallurgy was in connection with the Science and Art Department, and its work consisted of courses of lectures on fuel, refractory materials, iron, steel, and general metals, with assaying and experiments in a laboratory fitted with analytical benches, wind and muffle furnaces similar to those in the Royal School of Mines of that date. In 1889, Prof. Greenwood having resigned his chairs to undertake the management of the Birmingham Small Arms Factory, John Oliver Arnold was appointed to the chair of metallurgy which he holds to-day. He began at once to inaugurate revolutionary changes, the fundamental aims of which seemed to be: (1) to increase the science of the metals themselves, the art being then in great preponderance; (2) as the industries of the district were mainly of iron and steel, to pay special attention to these, assured that science could be as truly served and minds as fruitfully trained on metals of immediate interest to the district as on the wider range; and (3) to keep the ideal ahead of having available on a small scale, but by a manufacturing method as distinct from a laboratory method, examples of as many types of metallurgical processes as possible, so that the students might examine the whole course of each process from beginning to end in the comparative calm of an educational establishment. A start was made by erecting a two-hole crucible steel-melting furnace fully equipped as a small works, and differing only from the large works in the city in that theirs would consist of so many dozens or hundreds of holes of the same size. The effect on the attendance was electrical, and the available laboratory accommodation was at once completely filled. A difficulty here arose in that the Science and Art Department objected to the course, but a very simple solution was found in cutting the laboratory adrift from Government control, the public men supporting it guaranteeing against any resulting financial difficulty. It ought in justice to be said that in those days the department did sounder work for pure science than it seems to be the present fashion to acknowledge, although its influence on metallurgy in Sheffield was not good.

The complete success of this first part enabled Prof. Arnold to induce the members of the governing committee to commence the more ambitious part of his scheme, though with some misgivings, and during the session 1890–91 the students had the rare privilege of following the erection of, as well as working, plant consisting of a 25 cwt. acid Siemens furnace, with gas producers and all necessary hydraulic power for lifts, a No. ½ Stewart rapid cupola, foundry with drying stove for sand and "compo" moulds, and a falling weight test apparatus. As showing the curious features which sometimes govern a problem, although the No. ½ cupola worked well it had soon to be replaced by a No. 1, as when the lining began to wear it was only with the utmost difficulty that even a temporary assistant of the staff could be obtained sufficiently attenuated to be able to effect the necessary repairs, and at any time inspection of the lining was somewhat of an acrobatic performance. A 50-ton Wicksteed mechanical testing machine for tensile, trans-

verse, crushing, bending and torsion tests was installed jointly with the engineering department under Prof. W. Ripper, and whilst this machine formed a solid meeting ground it may also be considered as emblematic of the relationships existing between these two departments from the beginning, namely, that the metallurgical should, so far as possible, make all metallic materials for the engineering department, and in return know of the behaviour of the materials supplied.

In 1890 the technical school, apparently finding it too difficult to impress its needs on the college authorities, became an independent institution, and was thus free to work out its own ideals until 1896, when the two again joined for the purpose of applying for

FIG. 1.—Prof. J. O. Arnold in the Micro-laboratory.

a charter to become a university college, which charter was received in May, 1897. That its isolated progress produced a result acceptable, not only to practical, but to university men, was shown when application was made to enter the then Victoria University (an application to the making of which the present writer was firmly opposed); the report of the University Commission as published in the newspapers distinctly stated that the technical department was the only part fit for inclusion in the university.

It is impossible justly to estimate the influence of the metallurgical department, but the task must be attempted, as therein lies its soul. Thirty or so researches worked out in the department have been published by Prof. Arnold, his staff and students since 1889. "The Influence of Aluminium on Occluded Gases in Steel" (Arnold) was the first subject attacked, because of the many conflicting statements as to this influence. The experience gained in this work made possible the manufacture of a series of extraordinarily pure steels, the first research on which resulted in "The Influence of Elements on Iron" (Arnold), which combated Roberts-Austen's atomic volume theory as applied to steel, and Osmond's theory of the hardness of steel being due to a flint hard β iron apart from any carbon contained. Incidentally the micro-constituents FeS and MnS were discovered. The almost pugilistic vigour of the tone of this paper and criticisms which had preceded it seemed to turn many listeners, used to more gentle ways, into opponents without examination of the arguments, and it undoubtedly took many years to dispel the feeling, which still remains in the minds of some of the more unthinking or erratic, as seen from the way in which in a recent paper simple quotations from a well-known writer were treated in the discussion as attacks on him. "The Chemical Relations of Carbon and Iron" (Arnold and Read, 1893) was the result of work done to examine the discovery of the carbide of iron by Abel and Müller, and their results were fully confirmed, the carbide being obtained in chemically pure crystalline plates. In 1895, in "The Influence of Carbon on Iron" (Arnold), the discovery of the saturation point of steel was

announced, and the quantitative composition of Sorby's pearly constituent determined. This paper is admitted on all sides to be a classic.

In 1896, in "The Influence of Impurities on Gold and Copper" (Arnold and Jefferson), the first micrographic investigation of gold alloys was described, and the discovery of brittle intercrystalline cements rendered void atomic volumes as an explanation of the results. 1897 produced "The Influence of Sudden Cooling on Nearly Pure Iron" (Arnold), and "The Permeability of Steel-melting Crucibles" (Arnold and Knowles), which showed a method for quantitatively measuring the volume of gas permeating the walls of crucibles ¾-inch thick during metallurgical operations. "The Micro-chemistry of Cementation" was read in 1898, and the discovery of the cause of the decay of certain metals used in marine construction in connection with the disastrous explosion on the S.S. *Prodano* was given in a report to Lloyd's. "The Diffusion of Elements in Iron" (Arnold and McWilliam, 1899) divided the elements of steel into fixed and migratory groups and confirmed Prof. Campbell's diffusion of sulphide phenomena. During this research two very important phases of carbide interpenetration at different temperatures were discovered, and also a hitherto unsuspected segregation point which has cleared up some of the occasional mysterious failures of the highest grade cutting edge steel.

"The Properties of Steel Castings, Part i." (Arnold, 1901) dealt with pure iron and carbon castings, and showed their unsuitability for general commercial work. "The Micro-structure of Hardened Steel" (Arnold and McWilliam, 1902), amongst other things, first showed the cementite in the so-called austenite martensite structure. "The Elimination of Silicon in the Acid Open Hearth" (McWilliam and Hatfield, 1902) is an interesting study, under works conditions, of chemistry at high temperatures in the reaction of metal and slag on each other, in which a balance point in the composition of the slag was discovered, such that with more base C, Si, and Mn were eliminated from the metal, whilst with more acid C could still be eliminated, but Si and Mn were reduced and returned to the bath. "The Influence of Sulphur and Manganese on Steel" (Arnold and Waterhouse) and "On the Dangerous Crystallisation of Steel" (Arnold) were produced in 1903, and in the latter the author announced his now well-known method for recording results of steel under alternating stress, the stress being greater than the elastic limit instead of less, as is the case in other methods. "Acid Open Hearth Manipulation" (McWilliam and Hatfield, 1904) is another high temperature chemistry study on a 25-ton furnace, with unusual bases, in which also it was shown that the nature of the ingot is not merely a function of its composition as ordinarily determined, but varies with the history of the charge in a special manner shown. "The Thermal Transformations of Carbon Steels" (Arnold and McWilliam, 1904), too complex to describe in a sentence, shows the nature of the transition forms of the constituents of steels by quenching so as to trap several forms in one small section, where they can be studied somewhat after the manner of examining rock changes over a tract of country. Winder and Brunton did early work on open hearth chrome steel castings; Longmuir here worked out what had been borne in upon him by his works experience, resulting in his two researches on "The Influence of Casting Temperature on the Properties of Metals and Alloys"; Baker did his work on "The Influence of Silicon on Iron," and half the work resulting in Ibbotson and Brearley's well-known book on "The Analysis of Steel Works Materials" is of this laboratory. The above is not by any means a complete list, but is intended to indicate the principal and to give a good idea of the original work done, which has been acknowledged by practical as well as by professional men to have had great and important influence.

With regard to the students trained, every works of any importance in the district has its quota of them, and many are reflecting great credit on their school by the success with which they are holding responsible positions. There is no doubt that all firms of importance, having ready at hand well-trained men, formed a potent factor in the signal success with which Sheffield not only repelled the American invasion of high speed steel, but was able promptly and successfully to carry the war into the enemy's territory. The associateship in metallurgy has always been kept up to about the standard of an honour examination, no second classes being allowed, and the fight for the Mappin medal and 15*l*. premium given to the head associate of the year is long and severe. This medal and premium was founded by Sir Frederick Mappin, Bart., who has consistently for more than twenty years used not only his wealth, but his great influence with others, and his foresight and dogged perseverance, in furthering the cause of this technical department. His recent purchase and practical presentation of the adjacent Caledonian Works has enabled the authorities to apply their fifteen years' experience during the erection of a new and magnificent teaching plant, which has been so recently described that it need not have further mention here. Finally, as to the attitude of manufacturers, few who followed with interest the doings of fifteen years ago would have prophesied that steel makers would send for associates at the end of each session, or that some even would ask for "your medallist of the year if possible," but such is the fact to-day.

All Sheffielders asked feel certain that but for the continued success of this and the technical department as a whole, Sheffield would never have successfully demanded a university, and that, indeed, the university inaugurated by the King on July 12, 1905, may be taken as a monument to one of the influences of the technical department. Twice in its history has this progressive department had to sever its connection with constituted authority, and many are looking, somewhat anxiously it must be confessed, to its progress under the cumbrous machinery of university government, with its several forms of outside interference. Change and progress are not now decided upon by those immediately interested, for at least a majority of a governing body, composed of professors of all and sundry, must sanction all decisions, and in its effect on this hitherto uniformly progressive and successful department university government is undoubtedly on its trial, so far as its influence on the application of science to industry is concerned.

EARTH-EATERS IN INDIA.

UNDER the name of geophagy or earth-eating are comprehended a number of customs of very different origin and meaning. In practically every part of the world is found the habit of eating finely divided mineral substances in bulk, and not merely in small quantities as condiments; but the purpose differs no less widely than the condition of the eaters as regards age, sex, or health before and after acquiring the habit. We learn from Pliny that the Romans mixed corn with chalk from near Puteoli; Lemnian and Armenian earths, on the other hand, were famous for medicinal purposes—the use of the former has been continued to our own day; in South America clay supplies the place of food during floods; in Borneo and

Indo-China it is a surrogate for confectionery, and in parts of India, America, and elsewhere its use is due to the perverted taste often found in dyspepsia and hysteria, or to the strange abnormalities associated with pregnancy.

In the paper here noticed [1] the composition of the earth, marl, clay, or shale has been carefully analysed; the main constituents are silica (the percentage varying from 84 per cent. to 22 per cent.), lime (61 per cent. to a mere trace), alumina (26 per cent. to 2·5 per cent.), and ferric oxide (20 per cent. to a mere trace). But as a rule there is little definite information, other authors being content to speak of clay or earth without closer definition. We know, however, that steatite is favoured by the Indians of Hudson's Bay, and ferruginous clay by the Ottomacs, by the negroes of the Antilles, and by the Batanga of West Africa; earth rich in diatoms is used in North Europe, and the New Caledonians resort in time of famine to a mineral rich in lime, and ants' nests, with or without the larvæ, are eaten in Africa. The physiological basis of the habit varies probably in some degree with the different composition of the earths. On the Gold Coast white clay is used as a sweetmeat; in India the taste or odour is often the attractive feature; it may be noted in this connection that steatite (one of the minerals mentioned above) is not only eaten by wolves, reindeer, and other animals, but actually used as bait for attracting them. To the pleasant taste may be due the Roman use of chalk mentioned above; we have a parallel in the Bolivian Indian's use of a sauce of clay with his potatoes. In this category, too, we may range the German workman's "Steinbutter," and perhaps the salty earth used in Persia. In Senegal ochreous earth is mixed with rice, but it does not appear whether this is due to its pleasant taste or to a desire to increase the mass available for ingestion so as to produce a feeling of repletion.

In Rajputana the latter cause is undoubtedly the main factor; for only in times of famine are ashes, powdered steatite, clay or mud mingled with bark-meal. On the other hand, it is not so much actual famine in Persia as the desire to keep the digestive organs at work without suffering inconvenience from an over-supply of nourishment which is said to lead to the use of the two kinds of earth frequently sold in bazaars; one is described as a fine, white, "fatty" clay, the other as forming hard and irregular lumps. The material of ants' nests, like the Bergmehl (Kieselgur) of North Europe, is rich in organic matter, and may have real nutritive value; but on this point little positive information is available.

Especially in India the habit of earth-eating is indicative of a morbid condition, either anterior to the acquisition of the taste or after it has been adopted from imitation or some other cause. The same conditions seem to prevail widely in South America, where not only Indians and negroes, but whites, are slaves to the practice; it is even said that masks are put on children at night to restrain them from pulling mud or plaster from the walls and eating it.

The medicinal use of earths is a wide subject on which a large literature exists; our authors quote, among others, El-Baitar, who gives a list of the earths used in Spain in the thirteenth century; but the use of mineral substances in medicine hardly belongs to the same category as the other facts with which they deal; the same may be said of the ingestion of earths for magical purposes.

The effects on the eater seem to differ widely. In West Africa no bad effects follow, according to some authors; but when the negroes reached the West Indies they found that ill-health resulted from their indulgence in decomposed porphyroid lavas as substitutes for their African earths. In India and South America anæmia and early death seem to follow as a matter of course, but the anæmic diathesis often exists before the habit is acquired, and may be the actual cause of it.

The quantity of earth or clay consumed is often considerable. Half a pound daily is the allowance for the Ottomacs; six ounces is recorded from Bengal. They are sometimes eaten raw, sometimes roasted; one of the most curious features is that the earth or clay is sometimes made up into cups, figurines, and other forms; thus the Lemnos earth used in Spain in the sixteenth century was cup-shaped, so is the clay used to-day in Bengal; in Bolivia figures of saints are among the forms, and the Javanese eat figures of men and animals. In these cases a magical element may perhaps be present. But the commoner form is that of powder; the only edible earth of which the present writer can speak from personal experience was in this shape; it was alkaline and more like tooth-powder than anything else. N. W. T.

[1] "Earth-eating and the Earth-eating Habit in India." By D. Hooper and H. H. Mann. (*Memoirs of the Asiatic Society of Bengal*, vol. i., No. 2, pp. 249–270.)

NOTES.

DR. L. A. BAUER'S resignation from the United States Coast and Geodetic Survey took effect on September 1. As already announced in NATURE, he has accepted the permanent directorship of the department of terrestrial magnetism of the Carnegie Institution of Washington. All his correspondence should be addressed to "The Ontario," Washington, D.C.

AT the annual meeting of the Hull Scientific and Field Naturalists' Club just held, Mr. T. Sheppard, who for thirteen years has been the honorary secretary, was elected president of the society.

PROF. A. H. CHURCH, F.R.S., will give six lectures on chemistry at the Royal Academy of Arts on Mondays and Thursdays, beginning on October 1 at 4 p.m. The subjects of the lectures are:—Paper, canvas, panel, and other grounds; composition and classification of pigments; tests and trials of pigments; selected and restricted palettes; vehicles and varnishes; and methods of painting.

A NOTE from the Rev. Guy Halliday recording the discovery of *Goodyera repens* near Holt, in Norfolk, was referred to in NATURE of September 6 (p. 472). Mr. W. A. Nicholson, honorary secretary of the Norfolk and Norwich Naturalists' Society, informs us that the plant was found at Holt so far back as 1891, and at Westwick in 1885. It has since been noted in two other places in Norfolk.

A REUTER message from Palermo states that earthquake shocks were felt on September 19 at 11.20 a.m. and 1.38 p.m., principally at Trabia and Termini. A message from Lima reports that shocks were felt on September 18 at Huarmey, Alija, and Casma.

AN International Congress for Cancer Research was opened at Heidelberg on Tuesday by the Grand Duke and Grand Duchess of Baden in the presence of numerous representatives of medical, scientific, and municipal institutions of the world. At the same time, a new hospital and scientific laboratories for investigations into the cause and cure of cancer was opened. We learn from the *Times* correspondent at Heidelberg that the new buildings occupy nearly an acre, and are fitted with all the latest improvements, both for the treatment of operable cases and for

investigation. The institution has already cost more than 40,000*l.*, which was derived partly from public and partly from private sources.

PROF. HERMANN COHN, the well-known ophthalmologist of Breslau, died recently at the age of sixty-eight. His contributions to ophthalmic science and practice had reference more particularly to the eyesight of school children. He was one of the first to press the needs of many reforms with the object of conserving the pupils' vision, and he was a strenuous advocate of the systematic examination of the eyes of school children, his knowledge and experience in this connection being of the greatest value in evolving and perfecting the practical details of an important branch of work. In 1883 he was honoured by receiving the State gold medal of hygiene. He lived to see much good fruit result from his labours, and it may justly be said that with him there passed away one who served well both his own and future generations.

A PLEA for the preservation of natural scenes and objects in Germany was put forward a couple of years ago by Prof. H. Conwentz, director of the West Prussian Provincial Museum at Danzig, in a work on "Naturdenkmäler," described in these columns in November, 1904 (vol. lxxi., p. 73). By Naturdenkmäler is meant the whole natural landscape, with its various soil formations, its water courses and lakes, its special plant and animal communities, as well as single rare species and individuals of the original flora and fauna. Prof. Conwentz proposed that these results of nature's handiwork in the different States of the German Empire should be placed on record so as to make them known, and that provision should be made for their protection. The Prussian Minister of Instruction has just consented to the establishment of a central office for this purpose. For the present the office will be at Danzig, and will be under the direction of Prof. Conwentz.

IN his presidential address at the annual congress of the Sanitary Inspectors' Association at Blackpool on September 13, Sir James Crichton-Browne dealt particularly with the rapid and remarkable fall in the birth-rate of Blackpool. It was in 1895 that a turn in the tide in the birth-rate of England and Wales was first recorded, since when it has gradually decreased, until in 1904 it dropped to 27·9, the lowest on record. In Blackpool the decline did not begin until 1898, when the rate was 27·74, showing a slight increase on the previous year; but since then it has been precipitous, reaching 20·30 per thousand for 1905. Many facts suggest that this decline in the birth-rate has occurred especially among the more intellectual, more cultured, and more prosperous classes of the community. Bearing in mind that 25 per cent. of the married population produce 50 per cent. of the next generation, and that mental and moral traits are not less hereditary than corporeal appearances, it is impossible to exaggerate the importance of the problems that are raised by the figures adduced. If we are recruiting our population from the poorer and mentally and physically feebler stocks of the community at a greater rate than from the better and more capable stocks, then gradual deterioration of the race is inevitable.

THE "coming of age" of the Royal Geographical Society of Australasia was celebrated at Brisbane at the end of June last by a festival extending over four days. On June 26 a reception and luncheon were given by the Mayor (Mr. J. Crase), and at an evening meeting addresses of congratulation from other societies were presented, and the secretary, Dr. J. P. Thomson, gave an account of the history of the society. At an evening meeting on June 27 a paper by Dr. H. R. Mill, on the present problems of geography, was read. A garden-party was given at Government House in the afternoon of June 28, and at the evening meeting a paper by Prof. R. E. Dodge, Columbia University, on school geography, was read, Lord Chelmsford taking part in the discussion. A conversazione was given on June 30, at which it was announced that a paper by Sir John Murray, on the oceanography of the south-western Pacific, had been received too late for reading at the business meetings, but would be included in the society's Transactions. The Royal Geographical Society of Australasia was founded in 1885, chiefly on the initiative of its present secretary, Dr. J. P. Thomson. Its activities include the whole range of geographical work, and it has published twenty-one volumes of Proceedings and Transactions containing communications, of which "about 80 per cent. are original contributions to geographical literature, the remainder being the result of research work, in contradistinction to mere compilations."

THIS is the season for great hurricanes within the northern tropical belt. Thus far the West Indies have escaped, but the China Sea region was last week the scene of two very violent and destructive typhoons. On the morning of September 18 there does not seem to have been anything in the aspect of the weather at Hong Kong to suggest the proximity of a storm. People went about their business as usual, suspecting no danger, and the authorities at the observatory found nothing in the reports to justify the hoisting of the warning signals, expecting only moderate winds to prevail during the day. At about 10 a.m. the neighbourhood was startled by the sudden bursting of a storm of great violence, which maintained its strength until midday. In these couple of hours it occasioned enormous damage ashore and afloat. Many war vessels, merchant steamers and sailing ships, lighters, junks, and other craft were severely crippled or totally lost, and one of the latest estimates places the loss of life at 10,000 Chinese and several Englishmen and other Europeans. The Governor, Sir Matthew Nathan, has decided to appoint a committee to inquire into the failure of the observatory to give due warning of the approach of the typhoon, but he is confident that Dr. Doberck is not to blame in the circumstances. Four days later, on September 22, news was received of the Philippines, south of Manila, having been struck by a typhoon. The information to hand at present is very meagre, owing to the destruction of the telegraph wires, but a gunboat was driven ashore, and the arsenal and the shipping at Cavité suffered considerably.

A PAPER, by Messrs. B. Stracey and F. W. Bennett, on the felsitic agglomerate of Charnwood Forest, is the most important of the contributions relating to natural science contained in vol. x., part ii., of the Transactions of the Leicester Literary and Philosophical Society.

ACCORDING to the report for 1905–6, the Manchester Museum, Owens College, recently received a valuable collection of mammals from N.E. Rhodesia, but funds are lacking for mounting and encasing a representative series of these in the gallery. The museum will shortly also receive a collection of insects made in the same district. The well-known and extensive series of stone implements collected during the last forty years by Mr. R. D. Darbishire has been presented by that gentleman to the

museum. It is satisfactory to learn that the financial condition of the institution has materially improved since the date of the previous report.

PROF. HICKSON'S letter on remarkable cœlenterates from the west coast of Ireland in NATURE of November 2, 1905 (vol. lxxiii., p. 5) is reprinted in a volume just issued on Irish fisheries (Scientific Investigations, 1905, v.). This is followed by a notice of a leach parasitic on torpedoes taken on the Irish coast, and this, again, by the mention of a mollusc of the genus Lamellaria captured in a trawl off Cork. The particular species, which is common to both sides of the Atlantic, is new to the Irish fauna. Finally, Mr. S. W. Kemp adds ten species of long-tailed crustaceans to the marine fauna of Ireland.

THE report of the Danish Biological Station for 1903 and 1904, recently issued at Copenhagen as a translation from Fiskeri-Beretning, deals with the distribution and dispersal of the young and eggs of fishes which at one period or another are pelagic. From the study of the Icelandic seas it has been found that three belts may be distinguished in the neighbourhood of land, the first of which is characterised by the presence of pelagic eggs and the minute fry of species with demersal (deep sea) eggs, while the second is inhabited by the young fry of species with pelagic eggs and the older fry of those with demersal ova. In Danish waters the conditions appear to be somewhat more complex, but, speaking generally, it may be stated that the area within the Skaw approximates in its fauna to the first belt, and that outside the Skaw to the second zone.

WE have to acknowledge the receipt of a copy of the first part of the "Bergen's Museum Aarbog" for the current year. In the first paper Mr. J. Rekstad discusses the terraces and raised beaches of western and northern Norway. Among the more noteworthy remains are nodules, from more than one locality, containing beautifully preserved specimens of the skeleton of young coal-fishes (*Gadus virens*). In a second article Mr. C. F. Kolderup records the occurrence in Norway during 1905 of twenty-three earthquakes, all of which were, however, small and local. The capture, in the middle of January, 1904, of no less than forty-seven killer-whales (*Orca gladiator*) at Bildöströmmen is recorded by Mr. J. A. Grieg, who furnishes an illustration of the landing of one of these cetaceans. Several skeletons were preserved, of some of which the author gives measurements and descriptions. In addition to papers by other authors, Prof. R. Collett communicates notes on bottle-nosed whales (Hyperöodon) and white whales (Delphinapterus).

THE sixth number of the *Kew Bulletin* for this year contains the diagnoses of new plants, published under the title "Decades Kewenses, XLII.," of which one, described by Dr. Stapf, forms the type of a new genus Diandrolyra, order Gramineæ. Mr. J. M. Hillier contributes articles on East Indian dragon's-blood, chiefly the produce of species of Dæmonorops and Ogea gum obtained from the genera Daniella and Cyanothyrsus. The account by Mr. W. Watson of a visit to some well-known Irish gardens makes special mention of the magnificent development of the trees, showing how well the climate is suited to forestry. A historical article on the Sydney Botanic Gardens, written by Mr. J. H. Maiden, is reprinted from the Sydney *Morning Herald*.

THE review of Mr. Luther Burbank's work written by Prof. H. de Vries in the *Biologisches Centralblatt* (September 1) gives the opinions of the foremost scientific plant-breeder on the work of one of the most successful practical plant-breeders. While fully recognising the remarkable acumen of Burbank's judgment and the practical value of his work, Prof. de Vries finds a marked contrast between the aims and methods of the two types of worker. Careful experiment in the cultivation and crossing on a limited scale of pure types with definite characters is the task of the scientific investigator; the hope of the nurseryman lies in the chance possibilities arising out of the production and selection from a vast number of variations; for instance, Mr. Burbank selected his plums from 300,000 hybrids. One of the most important features of Mr. Burbank's work has been the cultivation of remote species with possibilities that have escaped the consideration of less conventional cultivators. The stoneless plum was obtained from crossing some plants, "prunes sans noyau," at one time cultivated in France. An intuitive genius for selection of promising varieties is the key to Mr. Burbank's success.

TWO examples of "fluctuating variation" as met with in certain New Zealand plants are noted by Dr. L. Cockayne in vol. xxviii. of the Transactions of the New Zealand Institute. In the first case, two Celmisias were found, one growing on the coast, the other in the alpine region, both very similar, except in the proportions of the leaf and general appearance. The question arises whether they should be regarded as distinct species. This, Dr. Cockayne points out, can best be determined by ascertaining whether the two forms reproduce "true." The second paper refers to leaf variation in *Coprosma baueri*. When exposed to sun and wind, the plant bears glossy, recurved, or rolled leaves, whereas in the shade they are thin, flat, and much larger. There is no question of two species in this case, as the two types of leaf may be observed on the same plant, but it suggests a starting point for the evolution of two distinct species.

ALTHOUGH not far distant from the North Island of New Zealand, the flora of the Poor Knights Islands had not been explored until Dr. L. Cockayne was enabled to get ashore for a very brief period last year. Distinguishing three formations of cliff, tall scrub, and meadow, Dr. Cockayne was particularly impressed by the luxuriance of the foliage of the arborescent plants in the scrub, and especially of the dominant plants *Suttonia divaricata* and *Macropiper excelsum*. Apart from the fertility of the soil and the shelter afforded by the dense growth, it was not apparent why such luxuriance should be developed. Another ecological contribution by the same writer, describing the subalpine scrub of the seaward Kaikouras, in the South Island, is published with the former in the Transactions of the New Zealand Institute, vol. xxviii. The peculiarity of this formation, that lies between the forest and the subalpine meadow, consists in the dominance of the composite shrub, *Cassinia albida*, found only in the Kaikoura Mountains, and in the occurrence of a Ranunculus growing under the scrub that Dr. Cockayne separates as a distinct species, *Ranunculus lobatus*.

THE third and final part of a series of papers on sands and sediments, by Messrs. T. Mellard Reade and Philip Holland, appears in the volume of the Proceedings of the Liverpool Geological Society for 1905–6. The earlier parts were published in the two preceding volumes. The papers describe a number of experiments made upon modern and ancient sediments to determine the behaviour of the particles when suspended in water and in various solutions;

most of the material was also analysed. The principal conclusions derived from their experiments by the authors are:—(1) that in many sediments of all ages extremely fine particles, especially "quartz-dust," play an important part; (2) that most of the quartz-dust has been produced by the collision and abrasion of quartz grains while suspended in water, and that the perfect rounding of some quartz grains, usually assumed to be due to wind action, may be largely due to this subaqueous abrasion; (3) that carbonate of lime may often be present in suspension in considerable amount in natural waters; and (4) that the microscopic suspended matter is probably an important item in the total solid content of the waters of the open sea. In the same volume Messrs. T. Mellard Reade and Joseph Wright have a short paper on the Pleistocene clays and sands of the Isle of Man, which is mainly occupied by lists of the Foraminifera found in the drift.

On May 15 the city of Nuremberg opened a national exhibition in commemoration of the centenary of its subjection to the Bavarian Crown. The exhibition, which will remain open until October, has proved eminently successful. It contains a good display of Bavarian manufactures, and is of special interest from the admirable manner in which the mineral resources of the kingdom are shown. The mineral deposits represented include the iron ores of the Fichtelgebirge, coal from the Palatinate, iron pyrites and galena from Bodenmais, salt from Berchtesgaden, copper ore from Imsbach, and graphite from Passau.

The Engineering Standards Committee has issued its standard specifications for material used in the construction of railway rolling stock. This report, No. 24 (London: Crosby Lockwood and Son, price 10*s.* 6*d.* net), covers sixty-two folio pages, and is undoubtedly one of the most complete and valuable of the publications of the committee. It contains specifications for locomotive crank axles and straight axles, carriage and waggon axles, tires, springs, steel forgings, steel blooms, steel castings, copper plates, rods and tubes, brass tubes, and steel for plates, angles, and rivets. In each case specifications are given, with and without chemical analyses. The committee has also issued a standard specification for steel conduits for electrical wiring (report No. 31, price 2*s.* 6*d.* net), and a report (No. 28, price 2*s.* 6*d.* net) on British standard nuts, bolt-heads, and spanners.

In the Journal of the Franklin Institute (vol. clxii., No. 2) Mr. Clifford Richardson concludes his elaborate memoir on the petroleums of North America, in which he compares the character of those of the older and newer fields. Those of the earlier days of the industry, from the Appalachian field, were paraffin oils, free from sulphur, specially valuable for the production of illuminants. The petroleums of north-western Ohio and Canada, next developed, being sulphur oils, were far less valuable. The California oil is composed of such a series of hydrocarbons, of a non-paraffin nature, that its value is comparatively small. The oils from the more recently developed fields of Kansas and Texas are of variable character. Those from the Gulf Coastal Plain of Texas and Louisiana are so strongly asphaltic as to be of value only for the production of lubricants, for use as fuel, and as gas-oil.

"The Effects of Civilisation upon Climate" is the title of an interesting article by Mr. S. L. Bastin in the September number of the *Monthly Review*. As the author points out, the subject is by no means new, and is a matter upon which many authorities find themselves at variance. As one instance of how a locality may be influenced by some artificial feature the smoke of London is referred to, the effect of which is visible in the hilly villages of Oxfordshire when the wind is in the right quarter. Again, it is well known that in large cities the average annual temperature is higher than in the surrounding country, while the reduction of the amount of marsh land, *e.g.* in the Fen district, has probably had a decided effect upon the temperature. But these are local instances; whether the climate has changed generally is another matter. Hann and others have shown that there are evidences of changes of small amount sometimes in one direction and sometimes in another, *e.g.* the fluctuations in the size of European glaciers. The author assumes that British winters are later in coming than they used to be, and quotes that of 1894–5, "when the rigours of the season were scarcely felt until February, and were extended well into March." A discussion of this frost in the Journal of the Royal Meteorological Society shows that the cold period commenced on December 30 and ended on March 5, with a break of a week's mild weather from January 14–21. On January 8 the temperature fell to −3° at Braemar, and was below 10° over the central part of north Scotland; after February 20 no readings below 10° were recorded. As to the influence of forests, we can have no better authority than Hann; they do reduce the mean air temperature, especially during the warmer part of the year, but whether they increase the amount of rainfall, and, if so, to what extent, cannot yet be definitely answered. We hope with Mr. Bastin that special attention will be given to this important subject in the future, and that, with better data at command, valuable conclusions may be obtained.

In the *American Journal of Science* (vol. xxii., p. 176) Mr. S. E. Moody gives an account of experiments on the hydrolysis of iron, chromium, tin, cobalt, and nickel salts by solutions containing alkali iodide and iodate. In this reaction an equivalent quantity of iodine is set free, the estimation of which may be used for the quantitative determination of any of the above metals. In the case of zinc salts, the hydrolytic decomposition is only partial, and a basic salt is precipitated instead of the hydroxide.

In the *Annalen der Physik* (vol. xx., p. 677) Dr. E. Marx gives an account of an experimental investigation relative to the velocity of Röntgen rays. It is estimated that the method and apparatus employed permit the velocity to be determined with an accuracy represented by a probable error of 1 per cent. Within this limit the velocity of propagation of Röntgen radiation is equal to that of light. This result furnishes strong evidence in favour of the view that Röntgen radiation consists in electromagnetic pulse transmission through the ether.

The velocity of the α particle emitted by radium C at various points of its path has been recently measured by Prof. Rutherford (*Phil. Mag.*, xii., 134). After traversing 7·0 centimetres of air the α particle is no longer capable of exerting any sensible photographic action, although its velocity is still approximately four-tenths of the velocity with which it is emitted from the active source. The much more rapid decrease of the photographic effect of the particle towards the end of its path as compared with the alteration in its kinetic energy necessitates the assumption of a certain critical velocity below which the particle is unable to produce the characteristic effects, or of a very rapid decrease in the velocity when this reaches a certain value.

In the *Zeitschrift für Elektrochemie* (vol. xii., p. 513) Prof. W. Kistiakowsky points out the existence of a relationship between the surface-tension values of different liquids which is analogous to the well-known Trouton's rule. If k denote the capillary constant of a liquid at its boiling point, m the molecular weight, and T the boiling point on the absolute scale, then mk/T is constant and equal to 0·0116 for about forty non-associated liquids which have been examined. In the case of associated liquids, such as the alcohols and fatty acids, the value of mk/T is much smaller, and on account of the considerable change in the value of the factor it appears to be eminently suited for ascertaining the existence of association in the liquid state of aggregation.

The report of the principal chemist of the Government Laboratory for the year ending March 31 furnishes some interesting reading. The total number of samples examined at the laboratory at Clement's Inn Passage during the year was 106,779, the greater part being in connection with the revenue departments. In the Customs the increase in the number of samples examined, as compared with last year, was 2389, the Excise showing an increase of more than 18,000. Special attention was given to establishing a systematic check on the "obscuration" of enumerated spirits, that is, the change in the apparent strength of spirits, as determined by the hydrometer, caused by the presence of solid matters in solution. It is noteworthy that, in the case of tea, the evidence of deliberate adulteration was extremely rare. A small proportion of the tea entering the country was declared to be unsound and unfit for human consumption. Such condemned tea does not pay duty, and, after being denatured by the addition of lime and asafœtida, is allowed to be used in the manufacture of caffeine. Little improvement is shown in the freedom from adulteration of the beer supplied by publicans; 11·1 per cent. of the samples taken were found to be diluted. There is good reason, moreover, to believe that a notable amount of butter adulteration takes place in this country. A considerable increase is shown in the quantity of duty-free spirit used in colleges for purposes of research.

Since the atomic weight of silver is the basis upon which most of the atomic weights of other elements are founded, even a small change in the accepted value is not without importance. The *Comptes rendus* for September 10 contains a note on this subject by P. A. Guye and G. Ter-Gazarian. Owing to the great improvements in recent years in the methods of dealing with gases, physicochemical methods of determining atomic weights, originally only used as a rough guide for the purely chemical methods, have reached an accuracy at least equalling the latter. If the atomic weights of carbon, hydrogen, nitrogen, and chlorine related directly to oxygen by physicochemical methods be taken as a basis, the value 107·89 is obtained for silver instead of 107·93, obtained by Stas by the use of chlorates, bromates, and iodates. The authors give a summary of the work done by various workers on the latter compounds, and note a possible cause of error in the presence of potassium chloride in the potassium chlorate used. They show that these two compounds, on account of the fact that the chloride forms a solid solution of nearly constant composition, are very difficult to separate. They find that potassium chlorate, purified as far as possible by re-crystallisation, contains 2·7 parts of chloride per 10,000. Applying this correction to Stas's figures, an atomic weight of 107·89 is obtained, nearly identical with the figures of Marignac in the analysis of silver chlorate; of Dixon and Edgar, by the direct determination of the ratio H : Cl; and of Richards and Wells, the ratio Ag : AgCl. In this way the results of the chemical and physicochemical methods are brought into agreement, leading to the conclusion that the atomic weight of silver should be lowered from 107·93 to 107·89.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in October:—

Oct. 2. Pallas (mag. 8·0) in opposition to the Sun.
3. 9h. 19m. Minimum of Algol (β Persei).
4. 15h. 35m. to 16h. 52m. Moon occults μ Ceti (mag. 4·4).
6. 12h. 30m. to 15h. 28m. Transit of Jupiter's Sat. III. (Ganymede).
9. 16h. 0m. Jupiter in conjunction with Moon (Jupiter 2° 12′ N.).
15. Venus. Illuminated portion of disc = 0·333; of Mars = 0·976.
18–22. Epoch of October meteoric shower (Radiant 92° + 15°).
23. 11h. 1m. Minimum of Algol (β Persei).
25. 6h. 49m. to 6h. 56m. Moon occults ι Capricorni (mag. 4·3).
,, 19h. 0m. Venus at greatest brilliancy.
26. 7h. 50m. Minimum of Algol (β Persei).
,, Saturn. Major axis of outer ring = 42″·62; minor axis = 4″·73.
29. 13h. 0m. Jupiter stationary.

The Total Solar Eclipse of January, 1907.—In a letter to the *Observatory* (No. 374), Mr. W. T. Lynn discusses the accessibility and suitability of Andishan as a place wherefrom to observe the total eclipse of the sun which will take place in January next year. This town is situated to the north-east of Samarkand, in the Khanate of Khokand, its approximate position being long. = 72° 17′ E., lat. = 40° 50′ N. It is on the Russian Central Asiatic Railway, about 170 miles south-east of Tashkent. As a new line of railway runs to the latter place from Orenburg, the journey from Europe should prove a comparatively straightforward one. Andishan lies in the fertile valley of Ferghana, at the junction of the river Kara Darya (a tributary of the Syr Darya) and a smaller stream, so that there should be little difficulty in finding a suitable observing site for the eclipse parties. The eclipse will take place on January 14, 1907 (civil time), and the shadow track will be very narrow, thus limiting the choice of stations; the duration of totality will be about two minutes. By an obvious slip, the date is given as January 4 and the duration of totality as two *seconds* in Mr. Lynn's letter, as published in the *Observatory*.

Observations of Phœbe in May and June, 1906.—Circular 118 of the Harvard College Observatory gives the positions of Phœbe, the ninth satellite of Saturn, as determined from six photographs obtained between May 18 and June 28, with the 24-inch Bruce telescope, at Arequipa. The places thus obtained are compared with those given by the ephemeris published in the Nautical Almanac for 1906, the differences (O–C) in R.A. and declination being given.

The Colours of Sun-spots.—In the September number of the *Bulletin de la Société astronomique de France* M. Th. Hansen, of Praestö, Denmark, states that from many years' observations of sun-spots he is convinced that sun-spots exhibit colours proper to themselves, and not merely the results of instrumental chromatism. He observes that the spot nuclei are rarely, if ever, a dead black, but generally are of a decided violet colour. The preceding part of the spot is most often of a yellow colour, whilst red is generally predominant in the "following" parts, although green is also seen there. On August 11, 1903, a small but dazzling white facula appeared in the centre of a black spot whilst M. Hansen was drawing the same. Two plates showing the colours observed in the large spot of November, 1903, accompany the communi-

cation, and M. Hansen suggests that the colours of spots may eventually be differentiated by spectroscopic observations.

COLOURS AND MAGNITUDES OF DOUBLE STARS.—It is a generally accepted statement that when the magnitudes of the components of a binary-star system differ considerably their colours are also very different; similarly a slight difference in magnitude is usually accompanied by a similarity of colour.

Whilst preparing his recently published and valuable memoir on the double stars of Struve's "Mensuræ Micrometricæ" Mr. Lewis has gathered striking evidence that these statements are true, and in No. 373 of the *Observatory* he gives a table of physical pairs, from which it is seen that a gradual increase in the differences of magnitude is accompanied by constantly increasing differences of colour. A discussion of fifty double stars situated in the southern hemisphere corroborates this evidence.

ROTATION PERIOD OF JUPITER'S EQUATORIAL REGION.—In No. 4117 of the *Astronomische Nachrichten* Mr. Denning publishes the rotation periods, derived from a number of spots situated on the equatorial side of the southern equatorial belt of Jupiter, as determined by him at Bristol in the years 1898 to 1905–6 inclusive. From the tabulated statement given it is seen that the rate during 1905–6 was several seconds slower than in previous years. During 1880–3 the rotation period was from eighteen to twenty-seven seconds shorter than during 1905–6.

GEOLOGY AT THE BRITISH ASSOCIATION.

IT is only natural that the salient geological features of the district in which the association meets should in some degree influence the character of the papers presented to Section C. Yorkshire, being rich in glacial and post-glacial problems, it is not surprising that special attention was directed to the more recent episodes in the earth's history. The presidential address dealt with British drifts and the inter-glacial problem, and, after a review of all the evidence bearing on the question, Mr. Lamplugh pronounces that no proof of mild inter-Glacial epochs, or even of one such epoch, has been discovered during the examination of glaciated districts in England, Ireland, and the Isle of Man. The "Middle Glacial" sands and gravels of our islands afford no proof of mild inter-glacial conditions or of submergence. In most cases, if not in all, they represent the fluvio-glacial material derived from ice sheets. Most of the fossiliferous beds regarded as inter-glacial contain a fauna and flora compatible with cold conditions of climate, and, in the exceptional cases where a warmer climate is indicated, the relation of the deposits to the Boulder-clays is open to question.

Prof. Kendall followed the president's address with a full and comprehensive account of the general geological structure of the country round York, and dwelt specially on the glaciation of the Vale of York and the Cleveland Hills. During the meeting the members were enabled to visit the York moraine and study the glacier lakes and overflows in the eastern part of the county under the guidance of Prof. Kendall.

Other local glacial papers dealt with the Kirmington Drift deposits, recent exposures of glacial drift at Doncaster and Tickhill, post-glacial deposits at Hornsea, and the plain of marine denudation beneath the drift of Holderness.

Contributions dealing with drift problems farther afield were presented by Mr. F. W. Harmer, who continued his work on the glacial deposits of the east of England, and in another paper he applied the brilliant results obtained by Prof. Kendall in the Cleveland district to support his theory regarding "Lake Oxford" and the origin of the Goring Gap.

The Rev. W. Lower Carter applied the same results to explain a dry valley which had been a glacier-lake overflow at Cwm-Coed-y-cerig, in South Wales, and gave a detailed account of the local glaciers which formerly existed in the valleys of the Usk and Wye.

Mr. R. D. Oldham brought forward a criterion of glacial erosion of lake basins, and Prof. J. W. Gregory initiated a discussion on the problems connected with the Palæozoic glaciation of Australia, India, and South Africa. He pointed out that in Australia we have evidence of three horizons at which glacial beds occur, the Cambrian, the Carboniferous, and the Pleistocene. The Cambrian glacial beds near Adelaide range 400 miles north and south, and are interbedded with marine sediments containing a rich Cambrian fauna. Evidence of Pleistocene glaciers has only been found on the mainland near the summit of Mt. Kosciusko, the highest mountain of Australia. The Carboniferous glaciation is the most important, and presents points of the greatest interest. While in the State of Victoria there exists undoubted evidence of land ice riding over an irregular land surface, in New South Wales, West Australia, and in India the glacial beds include some that were laid down below sea-level. Beds presumably of this age are also found in South Africa, South America, and perhaps on the eastern flanks of the Urals. Prof. Gregory pointed out the inherent probability of these beds having formed part of a once continuous sheet of glacial deposits. No proof is forthcoming that they were synchronous, and in Africa and Australia the glacial evidence disappears to the north, ending about the southern tropic, and begins again in the northern hemisphere in latitude 17° 20′ N., increasing in strength northwards to Cashmere.

After a critical survey of the three theories which have been advanced to explain this problem, viz. (1) the shifting of the earth's axis (Oldham and Penck); (2) a universal refrigeration of the world due to a change in the composition of the earth's atmosphere (Arrhenius); and (3) local concentration of snowfall in consequence of a different distribution of land and water, Prof. Gregory concludes that the last is alone adequate to explain the facts.

In the discussion which followed, Prof. Edgeworth David and Mr. T. H. Holland argued in favour of Arrhenius's theory, as the cause must have been world-wide, and the phenomena could not be accounted for by local changes in topography. Mr. R. D. Oldham favoured Prof. Chamberlain's adaptation of Arrhenius's carbonic acid theory, and pointed out the analogies between the great revolutionary epochs of the earth's history, all of which are associated with glacial phenomena.

The stratigraphical papers certainly showed a bias towards the Carboniferous period. No less than five papers were read, dealing mainly with the faunal succession and zoning of beds of this age. The recent work of Dr. Wheelton Hind, Dr. Vaughan, Prof. Garwood and others, as detailed in their papers, shows great strides towards the completion of what, at one time, seemed a hopeless problem.

A discussion on the origin of the Trias was opened by Prof. Bonney and Mr. J. Lomas. Prof. Bonney considers the Bunter to be chiefly of fluviatile origin, the rivers carrying the materials having their origins in Scotland, the extreme north of Ireland, and another flowing from the south-west. The Keuper he regards as indicating the setting in of inland-sea conditions, and the Red Marl as having been deposited in a great salt lake. The physical and climatal conditions of the Trias were probably to some extent comparable with those now existing in certain of the more central parts of Asia, such as Persia or Turkestan.

Mr. Lomas compared the Triassic deposits with those now forming in desert regions. He pointed out that the dominant feature of deserts is concentration. The wind acting on loose material concentrates particles of equal size in one place, an arid climate tends to concentrate the salts brought down by rivers in solution in shallow pools held up by the irregular disposition of sand dunes, and animal and plant life is concentrated in those regions where water is more or less permanent. Taking the various divisions of the Trias, he showed that in the Bunter the pebble beds of the Midlands may be compared with those of Lancashire and Cheshire, the only difference being that the former may have been subject to the sifting action of wind, which has removed the smaller sand particles, while the latter has, in part, escaped this action, and has been augmented by material from the south. The Upper Bunter he cited as a striking example of concentration of particles of even size. The Keuper shows evidence of similar sift-

ing, and is characterised by an increasing frequency of Marl bands. These he regards as evidences of shallow lakes, and compares them with similar pools now found in the desert regions of South Africa. The muds forming the floors of these pools, both in the recent and older examples, contain Estheria, and afford impressions of foot-prints, raindrops, and desiccation cracks. The Keuper Marls he compares with the Loess of eastern Europe, and the beds of salt, gypsum, and other salts he regards as the result of evaporation in lakes.

Mr. Holland referred to certain phenomena in the Rajputana desert that supported Mr. Lomas's views with regard to the processes of concentration in arid regions, and gave evidence of the sifting action of wind in India. Similar bands of silt and mud are found filling in hollows in the Archæan rocks. He was not prepared to admit that the features of the British Trias were due only to wind action, but in the main they were due to conditions prevailing in desert regions. Prof. Cole pointed out that, in dealing with the British Trias, we must not forget the great sea eastwards and the likelihood of the establishment of a monsoon system on its margin. This might set up an intense rainy season for, say, three months in the year, followed by a dry season. Sheets of pebbles without well-defined water channels are compatible with general evidence of desiccation. Mr. R. D. Oldham showed that the only agency forming pure sands comparable with the Trias is wind. Mr. Clement Reid compared the peculiar stiff-stemmed flora of the desert with those found in the Trias.

The papers dealing with palæontology were more than usually interesting. Mr. C. G. Danford exhibited and described a fine series of ammonites from Speeton. Mr. A. C. Seward dealt with the Jurassic flora of Yorkshire, and Dr. H. Woodward, in describing a wonderful collection of arthropods from the Coal-measures at Sparth Bottoms, showed what an enthusiastic band of collectors can do, when work is taken in hand in the spirit which characterises the Rochdale geologists.

The report on the fauna and flora of the Trias included an important paper by Dr. A. Smith Woodward on *Rhynchosaurus articeps*, and Mr. H. C. Beasley and Mr. Lomas described the great finds of Triassic foot-prints which have recently been discovered at Storeton, in Cheshire, and Hollington, in Staffordshire.

In petrology and mineralogy great interest was shown in the announcement by Prof. Edgeworth David that diamonds had been found embedded in the matrix near Inverell, New South Wales.

Mr. T. H. Holland demonstrated the peculiar properties of a variety of sodalite from Rajputana. When freshly broken it has a bright carmine colour, which changes to dull grey on being exposed to light. The carmine colour returns when the specimen is kept in the dark. Prof. H. S. Reynolds dealt with the igneous rocks in the district south-west of Dolgelly, and described the occurrence of a picrite from the eastern Mendips.

In general geology Mr. J. Parkinson gave an interesting account of the post-Cretaceous geology of Southern Nigeria, Prof. Cole outlined a scheme of geology suited to agricultural scholars, and Prof. J. Milne discussed certain earthquake relationships.

While the time of the section was fully taken up by the consideration of the above subjects, no less than thirty-seven papers dealing with strictly geological matters were read in other sections. J. L.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THE large attendance at many of the meetings of Section D was sufficient evidence of the general interest of the programme, which included discussions upon the Tanganyika problem, the nature of fertilisation, spicule formation in sponges, the bearing of scientific marine investigations on practical fishery problems, and a number of papers on special subjects, only a few of which can be noticed here.

The Tanganyika Problem.

The discussion on the Tanganyika problem was opened by Mr. J. E. S. Moore, who dealt, first, with the characters of fresh-water faunas in general, pointing out the wide distribution of many fresh-water organisms over the land surfaces of the world. He held that the difficulties in the way of the migration of these animals were so great that their wide distribution could not be attributed solely to such migration. He suggested that in all probability the sea is becoming more salt, and that this change may have been concerned in the production and separation of marine and fresh-water faunas. Whatever the actual cause of separation, as the general fresh-water fauna of the globe possessed certain archaic characters it would be convenient to name this the primary fresh-water fauna. To this primary fauna there are added in many places, *e.g.* in the Caspian Sea, animals which have, from their structure and affinities, been obviously derived from the sea, and have an origin independent of that of the fresh-water fauna of the region in which they occur. To these animals Mr. Moore applied the name halolimnic. There are in Tanganyika a number of animals peculiar to that lake, and regarded by Mr. Moore as halolimnic. The mollusca of the lake are represented by certain ordinary fresh-water forms, but, in addition, there are several not closely related to any recognised fresh-water type, nor does their anatomy suggest that they have been evolved from any African fresh-water form; there are four Polyzoa, only one of which is phylactolæmatous, and it may be inferred that the other three are derived from marine forms, while the occurrence of a medusa is also suggestive in this connection. There are three possible explanations of these faunistic peculiarities:—(1) that they are due to direct modifications of the general African fresh-water fauna; (2) that they are constituted by the presence in the lake of the remains of an extinct fresh-water fauna; (3) that they are due to the presence of halolimnic elements. Mr. Moore regarded the last as the correct explanation, and referred to the similarity of the shells of certain Tanganyika gastropods to those common in Jurassic seas. The evidence points to Tanganyika having been isolated a long time from the sea.

Mr. W. A. Cunnington gave a brief account of the third Tanganyika expedition, from which he had recently returned. 115 fishes are now recorded from the lake, 102 of which occur nowhere else. Twelve species of prawns (of which only one has been found elsewhere) are all specialised in the direction of reduction of gills, and the four species of crabs are all endemic. These facts are probably to be explained by the long isolation of the lake. It is curious that no Cladocera were met with in Tanganyika, though they are abundant in Victoria Nyanza and Lake Nyassa.

Prof. J. W. Gregory considered that there are no evidences of marine rocks in the plateau of equatorial Africa, though it is evident that the plateau is of great antiquity. The idea of the occurrence of the sea in the Tanganyika valley should be abandoned. He suggested that the "halolimnic" fauna is rather to be explained as a part of an ancient lake fauna at one time widely distributed over Africa, but now surviving only in Tanganyika.

Prof. Pelseneer pointed out that the external resemblances of shells are often illusory, and the results to which they lead quite uncertain, therefore only the study and comparison of the internal organisation of the molluscs can throw light on the question at issue. Messrs. Moore and Digby have suggested that some of the Tanganyika molluscs have affinities to certain marine forms, Chytra being related to Hipponyx and Capulus, Spekia to Lamellaria, and Edgaria (=Nassopsis) to the Architænioglossa; but Prof. Pelseneer held that there are really no affinities, in the usual sense of the word, between these forms, but only distant resemblances, such as are common to all the Tænioglossa, to which group these "halolimnic" forms belong. Nor do they present archaic characters to a greater extent than other fresh-water genera not "halolimnic," such as Ampullaria and Paludina. Prof. Pelseneer concluded that all the "halolimnic" gastropods belong to the family Melaniidæ or to closely related types, as is shown by their radulæ, otocysts, &c., and by special details of their biology—their fresh-water habitat and viviparity. The study of two genera (Giraudia and Lavigeria) the organisation of which has only just been investigated supports this conclusion. Both have in their otocysts multiple otoliths, one otolith being much larger

than the others in two species of Giraudia. Lavigeria, the only genus of which a female has been examined, is viviparous, and its radula most closely resembles that of the Melaniid genus Chiara, while the radula of Giraudia is clearly similar to that of the Melaniid genus Ancylotus.

Dr. G. A. Boulenger, in reviewing the evidence afforded by a study of the fishes, said that the Cichlid fishes, which form so large a proportion of the fishes of Tanganyika, are examples of an extraordinary modification of one type which has entered fresh water all over Africa, and that this lake seems to have served as a nursery for genera and species of this family. The Cichlids of Victoria Nyanza seem to have arisen, like those of Tanganyika, from a small number of generalised types. The fishes of Tanganyika indicate a long isolation of the lake, perhaps extending back to Miocene times.

The Nature of Fertilisation.

The discussion (conjointly with Section K) on the nature of fertilisation was initiated by Dr. V. H. Blackman, who gave a brief account of the recent work on which the present views of fertilisation are based, dealing specially with the *rôle* of the chromosomes, and taking as a starting point the theory put forward by Montgomery (1901), that in synapsis the maternal and paternal chromosomes unite in pairs and are later separated by the reduction division, which thus divides the somatic chromosomes into two groups. Fertilisation appears to be incapable of exact definition, for apogamy and parthenogenesis link it on to vegetative reproduction, and, indeed, nuclear fusions and reductions occur in plants apart from reproduction, *e.g.* in graft hybrids of Mespilus and Cratægus there is evidence that the fusing of vegetative cells has led to the mixing of characters.

Prof. Calkins described his experiments proving that it was possible to carry cultures of Paramœcium through a certain number of periods of depression, and to renew their vitality by means other than nuclear fusion (conjugation), he having been able to do this by treatment with beef extract and with extract of pancreas and brain. Prof. M. Hartog cited what he considered to be comparable cases of the orange, Funkia, &c., where cells of the nucellar tissue grow into the embryo-sac cavity, and, under the stimulus of the exceptional nutrition, grow into embryos which behave exactly like the normal embryos produced by the fertilised oosphere in the same favoured feeding place.

Mr. L. Doncaster gave a brief account of the maturation of parthenogenetic eggs, pointing out that many eggs which produce, not only one, but two polar bodies, may develop parthenogenetically. The fate of the polar nuclei varies considerably; in some cases they are cast out and lost, in others they remain in the egg, and (as in Artemia) one may conjugate with the egg nucleus, taking the place of the spermatozoon.

Dr. Rosenberg (Stockholm) described his experiments on the production of hybrids of *Drosera rotundifolia* and *D. longifolia*, the cells of the former having ten and of the latter twenty chromosomes. In certain of the daughter nuclei, ten, eleven, or twelve chromosomes move to one pole during division, the same number to the other pole, and between these lie a number of separate chromosomes, which are later taken into one or other of the division nuclei. In Hieracium, one polar nucleus returns to the embryo-sac cell and fuses with the egg-cell, producing a cell with unreduced number of chromosomes. Dr. Ostenfeld afterwards stated that Hieracium was able to produce fruits without ordinary fertilisation having taken place.

Prof. Hickson considered that the evidence that the chromosomes are the sole bearers of the hereditary characters had been much weakened during recent years by the results of such experiments as those on enucleated eggs fertilised by the sperms of another species, which gave rise to larvæ showing sometimes paternal and sometimes maternal and mixed characters.

Mr. H. Wager pointed out that in many of the lower organisms the nucleus does not seem to be concerned, as in higher organisms, in the blending, during fertilisation, of two distinct lines of descent, but presides over the nutritional activities of the cell, and fertilisation is replaced by various nutritional devices.

Spicule Formation in Sponges.

Prof. Minchin discussed a number of facts bearing on spicule formation in calcareous sponges, and concluded that the form of primary spicules is in no way dependent upon the physical properties of the material (calcite), but is regulated solely by biological conditions. When, however, primary spicules are joined together to form spicular systems, the physical properties of the material may exert an influence upon the form of the spicule as a whole by determining the angles at which the rays join together. Prof. Dendy dealt more particularly with the evolution of the various forms of siliceous spicules in the Tetraxonid sponges, showing that they are all derivable from a primitive tetraxon form. He showed that these spicules originated singly in mother-cells, and endeavoured to explain their great diversity of form as the result of the action of variation, heredity, and natural selection. Mr. W. Woodland contended that the forms of spicules are not inherited, for such an inheritance of forms of spicules adapted to the architecture of the organism implies that wandering cells (scleroblasts) are severally able to produce a part of the adult organism, an organ, in fact, related in form to the other parts. The collection of scleroblasts disposed about the spicule forming the protoplasmic mould in which the spicule is deposited is the organ assumed to be inherited. Such a theory seems to be contradicted by the facts of experimental embryology, which shows that a blastomere can only give rise to an integral part of the adult organism in virtue of its localised connection with other blastomeres. Mr. Woodland concluded, therefore, that the form of the deposited spicule determines the disposition of the scleroblasts, and not *vice versâ* (as held by the advocates of the inheritance of spicule form), and that spicular phenomena may be fully explained by reference to known physical facts. He suggested that many spicules are probably closely allied in their mode of origin to the curious structures (colloidomorphs) formed by mineral substances deposited in colloidal media.

Fishery Problems and Marine Investigations.

Dr. E. J. Allen opened a discussion on the relations of scientific marine investigations to practical fishery problems. He pointed out that the great growth of the fishing industry during the last thirty years has been accomplished by practical fishermen, and, in some directions at least, science could even now help little, *e.g.* in the case of drift-net fisheries any attempt to increase the supply would probably be futile. In the case of trawl fisheries a diminution in the source of supply has taken place, but there is hope of increasing the actual supply of fish in the grounds by (1) regulation and restriction of fishing; (2) re-stocking exhausted grounds by hatching or by transplantation; and (3) destruction of the enemies of food fishes. Before such measures can be carried out with much hope of success, a complete and exact knowledge is necessary of the habits and life-histories of the fishes, and of the conditions under which they live.

Dr. W. Garstang discussed the question of the diminution of the stock of plaice in the North Sea, and the methods suggested for increasing the supply. The diminution is supposed to be caused by the excessive fishing of young fish. In the southern part of the North Sea (Flemish Bight) most of the fish caught are less than 30 cm. in length, while on the Dogger Bank most are more than 30 cm. long. From January to June the small plaice are found chiefly inshore and out to the 11-fathom line; from June to December they travel out to the 20-fathom line. This gives a rough idea of the migration of the young plaice outward into deeper water during the summer and autumn months, and is confirmed by the results of marking experiments. The migration of fish to the Dogger Bank is, therefore, not a direct and simple one, but takes place in at least two stages. Much more information is still required concerning the normal distribution of fishes of various sizes, the migration of young fish, and the causes which determine rapidity of growth.

Mr. G. L. Alward expressed his belief in the value of fish hatcheries, and also advocated the exploration of the area between Norway and Iceland in the hope that new fishing ground may be found so as to relieve the present

strain on the resources of the Dogger Bank. Dr. Masterman and others advocated the attacking of special problems, and thought that the more general questions might be for the present postponed.

Systematic Study of Oceanic Plankton.

Dr. G. H. Fowler put forward some suggestions for the more systematic study of oceanic plankton. Evidence that temperature appears to be the chief determinant in the distribution of plankton was cited, the highest depth of a species being the position of its maximum, the lowest depth that of its minimum, temperature at any given geographical position. It was urged that, for the solution of the problems demanding attention, oceanic expeditions should be confined to the systematic study of small areas instead of making long voyages, that the upper zones of water should be more carefully investigated than has hitherto been the case, and that standard tow-nets should be adopted internationally by all expeditions in order to afford means of comparison of the fauna in different seas and under different conditions.

Life Cycle of the Protozoa.

Prof. Calkins referred to some features in the life cycle of the Protozoa, and urged that the whole life cycle should be worked out before a new species could be regarded as safely established. This safeguard would prevent confusion and the undue multiplication of species. Prof. Calkins showed, for example, that two such well-known and apparently fixed species as *Paramoecium caudatum* and *aurelia* are no longer to be regarded as distinct. During the progress of a culture of *P. caudatum*, an individual appeared with all the characters of *P. aurelia* (including form of body and double micronuclei), but after forty-five generations, the organisms being watched daily, the *aurelia* characters were lost, and the entire race became *P. caudatum* again. In any such life cycle the organisms pass through phases of vitality comparable to the different age-periods of Metazoa. There are periods of (1) youth, characterised by great vigour of cell multiplication; (2) maturity, indicated by changes in the chemical and physical balance of the cell, accompanied by differences in size or protoplasmic structure, leading to the formation of conjugating individuals, with or without sexual differentiation; (3) in forms which do not conjugate, old age or senescence, ending in death. In many forms, especially where dimorphic gametes are produced, the period of sexual maturity leads directly to that of old age, and gametes which fail to conjugate soon die without further multiplication, as in the majority of Sporozoa and in many Rhizopods. In Ciliata, although failure to conjugate is finally fatal, many generations may be formed before death occurs, and in these may be studied the peculiar cytoplasmic changes which accompany protoplasmic senility. While working at the maturation phenomena in Paramœcium, Prof. Calkins and Miss Cull were able to show that the curious crescent form assumed by the micronucleus is the stage of synapsis, the chromosomes being double at this time, apparently by union side by side in typical parasynapsis. The two following maturation divisions have not yet, however, been completely followed. The speaker also dealt with the subjects of fertilisation and parthenogenesis, pointing out that the latter has only a limited success, acting merely to postpone or counteract physiological death (Hertwig). Physiological and germinal death in Protozoa are connected with exhaustion of vitality and of definite substances in the cell.

Infection of Monkeys with Guinea-worm.

Dr. R. T. Leiper described some results obtained by the infection of monkeys with guinea-worm. These confirm the view that *Filaria medinensis* gains access to the human host by introduction in the larval stage (while still contained within its intermediate host, Cyclops) into the stomach in drinking water. The larvæ are released and stimulated into activity by the gastric juice. A monkey which had been infected in this way was killed after six months, and five guinea-worms—three unfertilised females and two males (each of the latter 22 mm. long)—were found. No experimental evidence could be obtained in support of the theory which has, during recent years, been favourably received in this country, that the causal agent in the disease invades the body through the skin, nor was a repetition of Plehn's experiment of feeding monkeys with freshly discharged embryos attended with the slightest success.

Habits of Tube-building Worms.

Mr. Arnold T. Watson gave an account of the habits of tube-building worms. He showed how Sabella collects, by means of its branchial tentacles, particles which are applied by means of the collar lobes to the outside of a mucous tube secreted by the epidermis. As a safeguard against the intrusion of an enemy, the mouth of the tube usually collapses when the worm retracts, but in one of the rock-boring species the end of the tube rolls up like the frond of a fern. Terebella builds its tubes of sand, shells, or gravel, terminated by an arborescent arrangement composed of single grains of sand or other suitable material. Pectinaria produces the well-known conical sand-tubes, the material for which is selected with great care. Owenia constructs a flexible tube by attaching in an imbricating manner flat sand grains and fragments of shell to a membranous tube secreted by special epidermal glands. Panthalis weaves a massive tube composed of threads supplied by the parapodial glands. These tubes are open at both ends, but the worm is defended from attack by a series of internal valves at each end of the tube, which are automatically closed by the inrush of sea water immediately the inmate of the tube retracts itself.

Papers on Lepidoptera.

Prof. E. B. Poulton exhibited a series of forms of *Acraea johnstoni*, Godm., showing that each one of the protean series of varieties has been evolved in relation to a Danaine or Acræine model, the models and mimics occurring together on the slopes of Kilimanjaro.

Dr. F. A. Dixey exhibited butterflies, some possessing an epigamic scent, others an aposematic or warning scent, and others in which both kinds of scent existed independently. It is well known that the male of *Ganoris napi*, one of our common white butterflies, exhales a fragrant scent (compared to that of lemon verbena) which is probably epigamic in significance. Dr. Dixey has found similar, though weaker, scents in the males of other British Pierinæ, Satyrinæ, and Lycænidæ, and many of the native African species were also found to possess an agreeable odour suggestive of chocolate, vanilla, or the scents of various flowers. These scents are generally distributed by specialised scales (androconia), the distribution being, to some extent, under control, the perfume being economised when not needed in courtship. The offensive odours are more or less shared by both sexes, but are sometimes stronger in the female, and generally occur in forms which, on independent grounds, are believed to be protected. These aposematic odours are usually perceptible even in uninjured specimens, but are much more evident when the thorax is crushed.

Mr. G. T. Porritt read a paper, full of details, on melanism in Lepidoptera. He pointed out that melanism had increased with extraordinary rapidity in south-west Yorkshire and parts of Lancashire, and also occurred, to a less extent, in other parts of the United Kingdom. In some cases (*e.g. Amphidasys betularia, Odontoptera bidentata*) the change has been sudden, but in most cases there has been a gradual, though rapid, change from pale to black. More than thirty species are melanic in Yorkshire, most of which have become so during recent years, and there are other species which are tending in the same direction. Many of these melanic forms will probably, at no distant date, oust the ordinary pale forms. The variety *varleyata* of *Abraxas grossulariata* has, however, not increased, and, though known more than forty years ago, is as rare now as it was then, although melanism is so strongly impressed on the race that a brood reared this year, from a pair of moths from wild larvæ, were all of the extreme dark form, no single example showing any tendency towards the pale ordinary form. The reasons for and causes of the phenomenon were then discussed. The usually accepted theory is that the darker colour renders the insects less conspicuous as they rest upon the darkened (by soot, moisture, &c.) tree trunks, and, therefore, more

likely to survive and to perpetuate dark forms. Mr. Porritt did not believe that birds fed to any great extent on moths, and when they did they took them on the wing at night, when their colour similarity to trees would be of no service. Moreover, many melanic species do not affect tree trunks, *e.g. Larentia multistrigaria*, in which melanism has rapidly developed for no apparent reason. The theory that smoke and humidity in the manufacturing districts have caused melanism, although offering in many cases a likely explanation, seems to be rendered untenable by numerous exceptions. Mr. Doncaster remarked that melanism could not be explained as due to natural selection or as the result of external conditions, as the black forms in some cases arose suddenly, and quickly became numerous. The black form is dominant, that is, the offspring of a pair, one black and one pale, have a tendency to be dark. Dr. Dixey pointed out that in Pierines dark pigment is often substituted for light, the female being usually darker. There may even be two grades of colour in the females, a darker in the individuals found in the wet season, and a lighter in those found in the dry season. He considered that locality, altitude, and other conditions may have an influence in darkening the pigment.

Pineal Eye of Geotria and Sphenodon.

Prof. Dendy described the structure of the pineal eye of the New Zealand lamprey (Geotria), which agrees in most respects with that of Petromyzon, but the former is more complex in histological structure, its pigment cells being divided into inner and outer segments. The pineal nerve is connected both with the right habenular ganglion and the posterior commissure, and in all probability with Reissner's fibre, whereby it would become linked with the optic reflex apparatus described by Sargent. Prof. Dendy also directed attention to some newly observed details of structure in the adult pineal eye of Sphenodon. The rods of the retina project into the cavity of the eye, and are connected with a network of fibres, which is also connected with the "lens." The lens contains a large central cell which resembles a unipolar ganglion cell. Prof. Dendy concluded that, in both Geotria and Sphenodon, the pineal eye is a functional organ.

Formation of Nucleoli.

Prof. Havet (Louvain) traced the formation of true nucleoli or plasmosomes in the nerve cells and blood cells of Rana and Alytes. The central part of each is formed from a small, clear area situated in the centre of the telophasic figure, while the peripheral part is derived from the internal extremities of the chromosomes which remain when the rest of the chromosomes form the nuclear network. Occasionally chromosomes also become included in the central area, giving rise there to one or two chromatic structures.

Milk Dentition of the Primitive Elephant.

Dr. C. W. Andrews, in the course of a paper on the milk dentition of the primitive elephant, pointed out that in recent elephants, owing to the large size of the molars and the shortening of the jaws, the teeth have an almost horizontal succession, their manner of replacement differing widely from the vertical succession found in other mammals. But as the earlier relatives of the elephant are followed back through the various Tertiary horizons a gradual approximation to the ordinary mammalian type of tooth replacement is observed, until in the recently discovered Eocene Palæomastodon a form is reached in which the milk molars are replaced in the normal way by premolars, which, along with the permanent molars, remain in use throughout the life of the animal.

A New Conception of Segregation.

Mr. A. D. Darbishire directed attention to some essential but usually unrecognised features of the Mendelian theory. He pointed out that although half the total number of children born to hybrids were unlike their parents, the hybrids, according to that theory, bore no single germ cell containing an element representing an animal like themselves, and that if a hybrid could be made to multiply parthenogenetically it would produce no offspring like itself. An experiment for testing this theory in an individual case was described.

Mr. J. T. Cunningham spoke on the evolution of the cock's comb; Mr. H. M. Bernard, on a periodic law in organic evolution, with a re-estimation of the cell; and Dr. H. J. Fleure and Miss Galloway gave a detailed paper on the habits of the Galatheidæ in relation to their structure; but these and a few other papers do not lend themselves to the purposes of a summary.

J. H. ASHWORTH.

THE ROYAL PHOTOGRAPHIC SOCIETY'S ANNUAL EXHIBITION.

THIS exhibition at the New Gallery in Regent Street will remain open until October 27. The three rooms, the central court, and the balcony, indicate its five main divisions. The last of these is devoted to scientific and technical photography and its application to processes of reproduction, and the exhibits here naturally fall into three sections, namely, the ordinary exhibits, those contributed by special invitation of the council of the society, and a small collection of photographs that have no other interest than that they are good technical work, and represent subjects of more or less interest, chiefly architectural. We hope to see this kind of work more fully represented in future exhibitions, for between the more strictly technical and the ultra-pictorial it has been almost squeezed out of existence.

A series of beautifully made models of light-pencils, which show the various effects of aberrations that particularly concern photographic lenses, is shown by Mr. C. Welborne Piper, and has been awarded a medal. The three dozen models illustrate very clearly a subject that must always be a somewhat difficult one. Immediately following this are a large number of photographs of living things, but chiefly birds, which appear to be receiving a very undue share of attention just now. Of these, we notice particularly a series of twenty-four photographs of the stone curlew in different stages of its existence, by Mr. W. Farren. Of the other subjects, "A Study of Wych Elms," by Mr. Alfred W. Dennis, is among the more novel. It is a series of seven photographs that show the same pair of trees, leafless and in leaf, and on larger scales the details of the trunk, blossom, fruit, leaves, and winter buds. Dr. Vaughan Cornish sends a further series of waves; Mr. J. C. Burrow two coal-mine subjects, excellently rendered as usual; and Mr. Bagot Molesworth a telephotograph of Vesuvius in eruption, taken from a distance of eight miles.

In the invitation section, Mr. Douglas English shows some examples of mimicry in British insects, and a particularly realistic effect is obtained in some of them by making the original carbon print with a green tissue, and staining the insects with dyes to represent their natural colours. The Royal Observatory, Greenwich, has contributed several of its recent results, including some of last year's solar eclipse. Mr. F. E. Baxandall (for Sir Norman Lockyer) also illustrates the eclipse, and sends photographs of two British stone circles that were erected some four thousand years ago as astronomical observatories. Series of cloud photographs are shown by Dr. W. J. S. Lockyer and Captain D. Wilson-Barker. Photographs illustrating the investigation of crimes, such as forgery and burglary, and the detection of the criminals, by Prof. R. A. Reiss, of Lausanne, will be of very general interest. Mr. K. J. Tarrant shows a series of thirty photographs of high-tension electrical discharges. Mr. Edgar Senior has continued his study of the Lippmann method of colour photography, and although the image generally shows no grain under the microscope, he has by special illumination got the surface to appear covered with discs of light, though what these indicate is not very clear.

There are a few photographs in "natural colours," but nothing better than, if quite so good as, has already been shown. Messrs. Sanger-Shepherd and Co., by preparing a more rapid and red-sensitive plate and special colour filters,

have made it possible to take the three negatives necessary for their method of colour photography in three seconds, including the time required for changing the plates and light filters, when the light is only moderate and the lens aperture $f/16$. In the central court, besides a great deal of apparatus and several demonstrations of processes, the Adhesive Dry Mounting Co. shows its method of mounting by warm pressure. The Ozotype Co. shows in the north room several examples of "ozobrome" prints. These are quite a new departure, a carbon print being produced by means of a bromide print without exposure to light, the silver image in the bromide print reducing the bichromate in the carbon tissue by mere contact. The original bromide prints and the carbon copies are shown side by side. C. J.

GEODETIC OPERATIONS IN SOUTH AFRICA.[1]

IT will be admitted that the Administration of Southern Rhodesia acted wisely in accepting the timely counsel which Sir David Gill brought under its consideration. Some ten years ago His Majesty's Astronomer at the Cape pointed out to Lord Grey, who then administered the government of the colony, the desirability of basing the land tenure on a properly established system of survey. The adoption of such a course would not only afford the means of supplying a sound and incontrovertible evidence of title to the possessor, but would protect the Government against the perpetration of fraud and tend to diminish future litigation. Sir David Gill does not hesitate to say that in Cape Colony large tracts of land have been stolen from the Government, either through the wilful shifting of beacon marks or from carelessness due to inadequate surveying. Sir David Gill did not lay any great stress upon the scientific value that necessarily attaches to accurate measurement conducted on a large scale; but this point was not neglected, and the work was planned so as to give the greatest assistance to economic requirements, and at the same time to forward scientific interests. The one purpose was effected by carrying a chain of triangles eastwards from Bulawayo, covering the most thickly populated and important parts of the country, the other by extending the chain north and south along the thirtieth meridian, so that it might form part of the great arc of meridian which it is proposed to extend from the south of Natal to the Mediterranean. The actual district surveyed extends from about 16° to 20° south latitude and from 28° to 31° east longitude.

Sir David Gill sketches the history of the work accomplished in successive years, from which can be gathered something of the difficulties which Mr. Simms and his assistants encountered and overcame. Abnormally wet seasons, illness among the staff, the necessary burning of the grass and the rising of the smoke preventing the measurement of horizontal angles, loss of cattle, and in one instance the destruction of the theodolite, are a few of the troubles that beset those who attempted geodetic operations in an unsettled country; but, notwithstanding these drawbacks, there remained only three stations south of the Zambezi which were not fully connected with the scheme of triangulation proposed. As the work is extended northwards these stations will be occupied, and thus form a useful link in the two systems.

A matter of great interest in the report from a scientific point of view consists in the critical examination of the Jäderin wires used in the measurement of the base lines. This apparently convenient form of measurement was, it is believed, adopted by the Russian geodesists in the work connected with the Spitsbergen base, but in this country the apparatus has not been submitted to any very thorough test, and figures for the first time on a large scale in the geodetic survey of South Africa. Two wires, one of steel and the other of brass, constitute a "pair," and, as a rule, were used in this form. Each wire is about 1·65 mm. in diameter, and is stretched by an accurate spring balance with a tension of 10 kilograms. The length of three pairs was each 80 feet, but two others of 160 feet and 320 feet respectively were used in crossing streams and gulleys. Another form of the same apparatus, occasionally used, consisted of a wire of "invar" nickel-steel and a wire of another alloy having a coefficient of expansion about the same as that of brass. The absolute length of each of these pairs was determined by repeated comparisons with a base line 80 feet in length, measured with a standard bar apparatus; but even the length of this base could not be assumed to be constant. The partially decomposed quartzose slate beneath the piers which carried the fiducial marks appeared to change slightly in position, especially after rain, and the length of this base as measured in the wet and dry seasons differed by half a millimetre. Constant measurement with the bars removed any source of error from this cause, since the change of length between the beginning and end of a set of wire comparisons was practically insensible.

But the real source of error in the use of the Jäderin wires lies in the fact that the ordinary steel and brass wires are liable to change of length, due to re-arrangement of the molecules of the constituent metals which takes place independent of temperature after these molecules have been violently disturbed. The tendency in all new drawn wires is to shorten, very markedly at first, and to diminish in amount as a more stable arrangement of the molecules is established. In a postscript, however, it is stated that, as the result of experiments conducted at the International Bureau of Weights and Measures, it is found possible by careful annealing and special mechanical treatment to render the arrangement of the constituent molecules of "invar" wires practically stable, and that such wires can be used as standards. Such wires, however, are not examined here. As an evidence of the change of length in the wires actually used, we may quote the following:—The length of a standard pair, at a temperature when both components were of equal length, was found to be in

April and May, 1898 ... ... 24382·07 mm.
October and November, 1898 ... 24381·84 ,,

Two base lines were measured in the course of the work, one of $11\frac{3}{4}$ miles and the other of $13\frac{1}{2}$ miles. The first, known as the Inseza base, was measured in three sections, the second in seven, each section being measured in opposite directions. As an indication of the accuracy attained we give the repeated measures in the shorter base:—

	Direct	Reverse	Discordance
	mm.	mm.	
Length of Section I.	4,509,571·88	4,509,554·47	1 in 259,000
,, ,, II.	6,200,765·86	6,200,732·18	1 ,, 184,000
,, ,, III.	8,196,927·19	8,196,928·28	1 ,, 4,746,000
TOTAL ...	18,907,264·93	18,907,214·93	1 in 378,000

We have not space to quote the results in the case of the Gwibi or longer base, but the results there are even more accordant, the average discrepancy amounting to only one in a million and a half. W. E. P.

[1] Report of the Geodetic Survey of part of Southern Rhodesia executed by Mr. Alexander Simms, Government Surveyor, under the direction of Sir David Gill, K.C.B., F.R.S., His Majesty's Astronomer at the Cape. Pp. xiv+146. (Cape Town, 1905.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE celebration of the four hundredth anniversary of the foundation of the University of Aberdeen began on Tuesday, and will continue for several days. The commemoration has been planned on a magnificent scale, and the arrangements have been perfectly organised. The formal proceedings opened on Tuesday morning with a service at King's College in commemoration of the founding of the University by Bishop Elphinstone. In the afternoon, at a reception given by the Chancellor (Lord Strathcona) and other high officers of the University, the delegates of the British, colonial, and foreign universities were presented to the Chancellor and delivered their addresses. In the evening a banquet was given by the Lord Provost and the corporation. Among the distinguished foreigners who are taking part in the celebrations are:—Prof. H. Becquerel, Prof. Behring, Dr. C. De

Candolle, Prof. Deissmann, Prof. Yves Delage, Dr. Anton Dohrn, Prof. A. Giard, Prof. H. Höffding, Prof. F. Hueppe, Prof. Jensen, Prof. Lombroso, Prof. Matsumura, Prof. Mendeléeff, Prof. Menschutkin, Prof. Hugo Münsterberg, Prof. W. Ostwald, Prof. Giuseppe Veronese, Prof. Paul Vinogradoff, Prof. J. W. Wijhe, and Prof. Weichselbaum. The lecture-rooms, laboratories, and other buildings which will be opened by the King to-day have cost more than 200,000*l.* to erect and equip. The new block completes the quadrangle, and includes new class-rooms and laboratories for physiology, geology, and agriculture; new rooms for education, medicine, modern languages, and other subjects; a new library for scientific literature, and new offices. We hope to give in our next number a description of this extension of the University, and an account of the brilliant ceremonies with which it has been inaugurated.

THE next session of the South-Eastern Agricultural College, Wye, will commence on October 1, and the inaugural address will be delivered by Dr. H. E. Armstrong, F.R.S., on October 2. A conference of fruit growers will be held at the college on October 22, when discussions on methods of planting, fungus diseases, insect attacks, strawberry culture, will be opened by Messrs. S. U. Pickering, F.R.S., E. C. Salmon, F. V. Theobald, and W. P. Wright. The chair will be taken by Mr. Laurence Hardy, M.P. Those wishing to attend the conference should send their names to the principal of the college.

ON October 11 Sir William Anson will distribute the prizes awarded to students in the evening classes of the Royal Technical Institute, Salford. The calendar of the institute for the session 1906–7 contains the announcement that all intending students under sixteen years of age will, before admission to the evening classes, be required to pass an entrance examination in elementary mathematics and English, or to satisfy the principal that they possess the requisite preliminary knowledge. Those who do not possess the knowledge necessary to pass the entrance examination are recommended to join one of the evening schools which have been instituted in various parts of Salford, and at which the required preparation is provided. It is intended that next year all under seventeen years of age shall furnish evidence of the possession of the requisite preliminary knowledge.

IN the early days of the movement for the higher education of women, one of its most active workers was Mrs. William Grey, whose death on September 19 at the advanced age of ninety years was announced in the *Times* of September 21. Mrs. Grey's name was from the first well known among those who advocated and carried to a successful result the foundation of high schools for girls by combined private effort; and the Girls' Public Day School Company (Ltd.) was the outcome of this movement. Springing out of the needs presently revealed by the high schools came the establishment of a system of training for secondary teachers. The idea was then comparatively new in England, and public opinion on the subject had to be formed and fostered, as it was largely through the work of Mrs. Grey. In recognition of her labours the well-known Maria Grey Training College for Women, now situated at Brondesbury, was named after her.

AN inspiring address on educational methods and their relation to science and industry, with particular reference to pottery, was delivered by Prof. H. E. Armstrong in the Town Hall, Longton, on September 19. In the course of his remarks, he said that workers in science have evolved a method, the scientific method, involving the gradual and cautious passage from the known to the unknown. Workers in politics have no such method at their disposal. Too often they are more or less ignorant of the real nature and extent of the problems which they deal with and seek to solve; sentiment masters their actions. The application of scientific method to public affairs is, consequently, becoming a matter of paramount importance. In all manufacturing districts science and industry must be brought into an effective alliance. On no other basis are prosperity and happiness possible, for the simple reason that, in these days, an industry that does not repose on a scientific basis is one which has no proper knowledge of itself, science being nothing more than organised systematic knowledge. Scientific training, training in method, is required by all. Scientific knowledge, true knowledge, must be public possession. The feeling is becoming general that something must be done to make our schools more effective than they are. In a recent report of the Consultative Committee, the Board of Education is advised that the schools have failed, in the past, to develop both the moral and mental qualities which are desirable, and that we must now strive to make the teaching far more practical, manual training being openly and strongly advocated. We read, moreover, "It would seem clear to the committee that the thing needed is not only knowledge, but a right attitude of mind, a mind confident in its own power to observe and think, and in the habit of observing and thinking—a mind in which interest makes for intelligence and intelligence for interest." "The course," it is stated, "should consist of three threads or strands, roughly to be termed humanistic, scientific, and manual, and, in the case of girls, domestic; all higher elementary schools should give this threefold instruction." Though these views have been urged by many educational reformers for thirty years or more, the doctrine they involve is really quite revolutionary coming from such a quarter, especially as it is directed to the Board of Education, which treats manual training as a special subject for the select few.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 14, 1905.—"Observations on the Development of Ornithorhynchus." By Prof. J. T. **Wilson** and Dr. J. P. **Hill**. Communicated by Sir William Turner, K.C.B., F.R.S.

The paper treats of certain stages in the intra-uterine development of the egg of Ornithorhynchus. The following are points of more special interest among those set forth in the extended paper:—

(*a*) The very early differentiation of the layer of yolk-entoderm surrounding the yolk-mass of the monotreme egg.

(*b*) The original entire independence of the primitive streak from the primitive knot and its "gastrulation-cavity."

(*c*) The subsequent intimate approximation of these structures.

(*d*) The early appearance of an area of special differentiation in the vicinity of the primitive streak in the early blastoderm, and the later conversion of this "primitive-streak-area" into an "embryonic area" proper, by the annexation of the region surrounding the "primitive" or "archenteric" knot.

(*e*) The precise mode of disappearance of the ventral wall or floor of the archenteric- or invagination-cavity.

(*f*) The occurrence of peculiar segmental cell-masses in the substance of the "primitive knot," where that constitutes the parietes of an archenteric canal or its representative.

(*g*) The diagrammatically clear demonstration of various features of neural development, including the well-marked neuromeric segmentation of the cephalic region of the flattened medullary plate, the differentiation of early plate-like ganglionic expansions of the neural crest in the cephalic region, the presence of various cellular connections between the cephalic ganglionic plates and certain of the neuromeric segments of the medullary plate.

(*h*) The relative insignificance of the "archencephalic" subdivision of the cephalic portion of the medullary plate, from which the fore-brain and most, if not all, of the mid-brain are derived.

June 28.—"Note on the Production of Secondary Rays by α Rays from Polonium." By W. H. **Logeman**. Communicated by Prof. J. J. Thomson, F.R.S.

The author describes results which were obtained in the course of some experiments on the slowly-moving negative

or δ rays emitted by polonium, and which indicate that negatively charged secondary rays are produced when an aluminium or copper plate is bombarded by a stream of α rays.

The method used may be briefly described as follows:—A polonium-coated copper disc was placed in a glass tube with its active side facing, and parallel to, a highly insulated metal disc of the same size, which could be connected to one pair of quadrants of a sensitive Dolezalek electrometer. The distance between the discs could be adjusted. The polonium disc could be raised to any required potential by connecting it to a battery of small secondary cells. The glass tube was evacuated by means of a mercury pump down to a pressure of about 0·001 mm. and then sealed off, and the vacuum was then rendered as high as possible by the use of Dewar's method. The apparatus was placed between the poles of an electromagnet in such a manner that a magnetic field could be applied in a direction at right angles to the straight line joining the centres of the discs. The charge acquired in a given time by the insulated disc, when different strengths of magnetic field were applied, and when the electric field between the discs had different values, was measured. Tables of results are given, and these are also plotted in the form of curves, showing the variation of the current between the discs with varying magnetic and electric fields. From the results obtained the author arrives at the following conclusions:—

(1) That under ordinary conditions, *i.e.* when not acted upon by an electric or magnetic field, the polonium gives off a larger amount of negative than of positive rays.

(2) Under the influence of a gradually increasing electric field more and more of the slowly-moving negative rays are stopped, and the charge carried by the α rays becomes more and more predominant.

(3) A potential difference of about 10 volts between the plates is sufficient to stop the last of the δ rays.

(4) The slowly-moving negative rays can also be prevented from striking the insulated plate by curling them up in a magnetic field. When they are stopped in this latter way, however, the quantity of positive electricity received by the insulated plate is only about one-fifth of that received when an electric field is used to stop the δ rays. The author explains this last fact as follows:—When the potential difference between the two plates is 10 volts or more (the polonium being positive), the positive current from the polonium to the other plate consists of two parts, viz. a stream of positive α particles in the direction of the current, and a stream of negative particles in the opposite direction given off by the insulated plate. A magnetic field curls up this latter stream of negative rays, as well as the δ rays given off by the polonium.

The author also points out that his results showing the magnetic and electric deflection of the δ rays are not in agreement with those obtained by Ewers with another sample of polonium.

PARIS.

Academy of Sciences, September 17.—M. Troost in the chair.—The International Congress for the Study of the Polar Regions: G. **Bigourdan.** The congress was held at Brussels on September 7, and was attended by delegates representing fifteen countries and eighty learned societies. Seven standing committees were formed, each concerning itself with a special group of sciences. The formation of an International Polar Commission was decided upon, and bye-laws drawn up.—The deviations from the vertical in the region of the Sahel, Algeria: R. **Bourgeois.** In the triangulation of Algeria, the summit of the Voirol column was taken as the junction of the network of triangles. The national observatory, founded some years later, is about 5 kilometres in a direct line from this column. If the astronomical latitude of the observatory is compared with the geodesic latitude of the same point, the calculation being made starting with the fundamental coordinates of Voirol, a relatively considerable discrepancy is found, indicating a strong deviation from the vertical at one or other of these two points. In the present paper it is shown that it is the Voirol station which is at fault, and hence all the data built on this as a starting point require re-calculation.—The action of fluorine on chlorine, and on a new method of formation of hypochlorous acid: Paul **Lebeau.** Attempts were made to combine fluorine with chlorine, under varying conditions, at temperatures ranging from 0° C. to −80° C. It was found that fluorine and chlorine do not combine directly. Liquid chlorine dissolves fluorine, but this fluorine is given off at the solidifying point of the chlorine. In presence of water, fluorine oxidises chlorine, the latter being completely converted into hypochlorous acid, thus giving a new method for the preparation of this acid.—Syntheses in the quinoline group: phenylnaphthoquinoline dicarboxylic acid and its derivatives: L. J. **Simon** and Ch. **Mauguin.**—The action of mixed organomagnesium compounds upon amides: Constantin **Béis.** To secure a reaction in all cases it is necessary to prepare the organomagnesium compound in the presence of the imide, the alkyl halide being added to a mixture of the imide, magnesium, and ether. Isoindolinones, isomeric with arylamidoketones, are obtained.—The hæmopoïetic activity of the different organs in the course of the regeneration of the blood: Paul **Carnot** and Mlle. Cl. **Deflandre.**—The experimental infection of trypanosomiasis by naturally infected *Glossina palpalis*: L. **Cazalbou.** Two out of seven specimens of *Glossina palpalis*, captured on the banks of the river Bani, a large tributary of the Niger, have infected dogs with trypanosomiasis. A cat was similarly infected.—The movement of the pole at the surface of the earth: Marcel **Brillouin.** A discussion of the curves published by M. Albrecht since 1890.

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