THURSDAY, MAY 19, 1910.

THE COMPARATIVE PHYSIOLOGY OF RESPONSE IN ANIMALS.

Umwelt und Innenwelt der Tiere. By Dr. J. von Uexküll. Pp. 259. (Berlin: J. Springer, 1909.) Price 7 marks.

THIS is one of the most interesting summaries of biological work that has appeared recently. Written by one who has had a large share in physiological research, it deals in an intimate manner with the comparative physiology of reflexes among the lower animals and with the adaptation of structure and function to varying habits in the case of allied genera. The influence of Sherrington's work is very obvious, and is suitably acknowledged, but whereas "the integrative action of the nervous system" is a profound study of the higher animals, the present work attempts the same analysis of action in various lower types, and then synthesises conduct in the light of the reactions so displayed. The anatomical knowledge required for this purpose is not great, and the technical physiological difficulties of terminology, though more formidable, are not insuperable. When these are acquired, the analytic skill of the writer in delineating the inwardness of animal movement becomes a source of real pleasure.

The main theme of the book is to discriminate (1) the effective external stimuli that constitute the "Umwelt" of each selected group or typical example; (2) the nervous stimuli set up within these creatures and forming the "Innenwelt," and (3) the sense of perception or "Gegenwelt" that arises in the "brain" of the higher groups. What part of its environment really affects an amœba, a sea-anemone, or a jelly-fish can only be determined by a study of its reactions, by an analysis of its neuro-muscular activities. Hence the need for a renewed analysis of muscular action and of nervous control. Accordingly, in each chapter the author, with a few vigorous sentences, sketches out the habits and movements of the type selected, and the dominant features of its muscular and nervous topography. A more detailed account of its reactions in relation to its mode of life is then given. Finally, the muscular action in relation to nervous stimulation is dealt with in detail, and the effective outer and inner world of the creature is summed up in a few lines.

The nature of protoplasm and the origin of structural organisation form the problems of the first chapter. "Does protoplasm possess a structure or is it a fluid?" is a question that has been varyingly answered for the last eighty years. Even if we agree with Bütschli and Rhumbler in assuming a certain structure in fluid protoplasm when at rest, the behaviour of "streaming" protoplasm (as in Amœba and cyclosis) forbids the assumption that any structure persists when the mass flows and points to its essentially fluid unorganised nature. Thus the first paradoxical property of this living substance becomes apparent, namely, its power of converting a fluid into an organ, into a series of organs, and then of withdrawing these and resuming its structureless condition. The Amœba or the digestive cell of a lowly worm "puts out" a highly organised process made from fluid unorganised protoplasm, and, having therewith enclosed some food, withdraws this appendage. The undifferentiated egg of animal or plant becomes organised, and the organisation may become resolved under adverse conditions into a structureless mass (as in the "brown-bodies" of Polyzoa), which is reorganised as more favourable conditions recur. This property of morphogenesis and regeneration separates living things from all machines, and when taken together with the phenomena of "regulation" (physiological changes in organisms consequent on stimulation), it shows, in the author's words, the supra-mechanical nature of the origin of structure, however mechanical the functions of organisation may be

The physical basis of life is indeed a paradox. Its organisation hinders rather than helps additional complexity, for that which is to constitute the addition has to be made, not out of what is already organised, but out of what has been left over of the unorganised protoplasm, and in this process not a present, but a future, mechanism determines the process. We think of action as the relation of precedent to consequent, but in protoplasmic action, what is consequent determines the initial stages of change. Animals and plants arise like a musical composition in which the later parts condition the earlier ones, even though they are only reached through the opening bars or movements. They are not like machines, unities in space only. They are also unities in time. In this sense von Baer's metaphor is magnificently expressive. Organisms arise, he says, like a kind of melody.

From this preface the author passes to a systematic treatment of invertebrates. On the basis of Jenning's researches, he concludes that Amœba (or at least *Amoeba terricola*) responds only to three kinds of stimuli—mechanical, chemical, and luminous. Paramecium, by a series of delicately poised adjustments, "rests more safely in its environment than a child in its cradle." It is so adjusted that all happenings bring it luck except the arrival of a carnivore of its own kind (Didimium). Far lower than these Protozoa in poverty of response is the ascidian Ciona. The effective environment of this creature during its active larval stage has not been analysed, but the adult sea-squirt is apparently dead to every impulse save one. Only mechanical shocks are recognised, and these in successional order. An interesting study of sea-anemones brings the writer to reflex-actions, of which these animals exhibit three—contraction of the circular muscles, secretion of slime, and contraction of the longitudinal muscles. The influence of tides and of light are certainly felt in littoral species, though in the case of the Mediterranean forms studied by the author their effect is apparently extremely slight. We feel, however, that the light-reactions will prove vastly more important than is here assumed, for the

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simple reason, overlooked by von Uexküll, that these anemones are infected by symbiotic algæ.

The effect of wave-action is analysed in a most interesting section devoted to the higher medusæ. The simpler nature of the muscular reflex in Rhizostoma is first explained. It is shown how contraction of the circular muscles of the bell-margin, together with that of the stomach-wall, subserves at once locomotion, respiration, and nutrition. The food of Rhizostoma (Diatoms) is obtained by filtering the sea-water through the minute pores into which the oral aperture is converted. Especially attractive is the contrast in this section between the two allied genera, Rhizostoma and Gonionemus. The first leads a life of one stimulus. The rhythmical pulsation of its bell is its only act, its one stimulus. Gonionemus, on the other hand, though not structurally very diverse, leads a full life. It responds to light and to darkness, to gravity, to chemical and mechanical stimuli. The same world environs each animal: but an organism is, as it were, a wonder-world shut off from this environment, and only the right key opens it. When there is no lock there is no key, and such is the plight of Rhizostoma. Gonionemus has many doors, each with its special key.

From jelly-fish the author passes to the study of sea-urchins, and here he is thoroughly at home, leading the reader through a study of bionomics to an analysis of muscular contraction that is of the greatest importance to physiologists.

Of the author's analysis of the movements of the earthworms, leech, and Sipunculus we have no room to speak, but recommend it to the attention of all physiologically minded biologists; but a word must be said on Jordan's recent work on the locomotion of the mollusc, Aplysia. The body of this creature is enclosed in a muscular sac provided with a thick nerve-network. Each nerve is connected with this diffuse nervous system as well as with the ganglia. The extraordinary thing about the stimulation of this system is that, if the pedal ganglion be stimulated, the effect upon the network and muscular sac is entirely different from that proceeding from the cerebral ganglia. The "brain" inhibits motion; it acts as a brake. These animals, and possibly all Mollusca, resemble such machines as give rise to an excess of steam in all their parts, which excess is allowed to escape by numerous exits. The idea of a group of animals which acts in this way is an entirely novel one.

The further studies on crabs and dragon-flies are of great interest, and we wish it were possible to reproduce their conclusions. Enough, however, has been said to indicate the value of this work. If only the nature of the author's views on reflexes were expressed more clearly we should be inclined to place this book among the most attractive, as it certainly is one of the most illuminating, comparative studies that have appeared. It should appeal to the physiologist and psychologist as much as to the naturalist, and if translated (with a glossary appended) would be eagerly read by a much larger public than will appreciate it in its present form. F. W. GAMBLE.

SCIENCE AND BELIEF.

Science and Religion in Contemporary Philosophy. By Prof. Émile Boutroux. Translated by Jonathan Nield. Pp. xi+400. (London: Duckworth and Co., 1909.) Price 8s. net.

THIS book is an able study of the various attempts which have been made since the beginning of the great scientific movement of the nineteenth century to comprehend science and religion in one system. The writers considered fall into two groups, according as they approach the problem from a naturalistic or spiritualistic standpoint. As representatives of the former M. Boutroux takes Comte, Spencer, Haeckel, the psychologists and the sociologists. The inclusion of Haeckel was perhaps due to his popularity; his dogmatism and inconsistencies are too crude to be worth the attention of an analyst so subtle as M. Boutroux. The discussion of the others might be said to be a discussion of three suggested unifying notions—the notion of humanity, that of the unknowable, and that of fact. The first M. Boutroux finds too narrow, for science refuses to accept an ideal from practical human need, and the essential object of religion is something that is more than man. The concept of Spencer gives liberty at the cost of significance; M. Boutroux shows very clearly that Spencer was led to it by a false standard of knowledge, the standard of pure objectivity, according to which to know the absolute would be to know it as one thing among others. As for the psychologists, who show that the scientific and the religious activities are amenable to common psychic laws, their reconciliation ignores the difficulty, which is the disparateness of the specific ideals inspiring these activities. The sociologists are in no better case; for the given social ends to which they propose to make religion and science both subservient are being by these continually recreated.

M. Boutroux's analysis of the spiritualistic efforts to solve the problem is equally searching. He deals first with the apologists. Some, like the Ritschilians, appeal to immediate internal conviction as the sufficient defence for religion; there are others who, by a criticism of science, show that it is ultimately founded on certain practical beliefs, and contend that science cannot object to religion merely as belief. But the first, since they have discarded all theory, can do nothing but indicate a mere subjectivity, and the second can offer only what appear to be arbitrary beliefs as against the verified hypotheses of science. Next is considered that philosophy which professes to find in activity a principle of unity deeper than the level of our intellectual contradictions, and regards science and religion as complementary but independent expressions of that unity. M. Boutroux points out here a dilemma; if the activity is indeterminate it is without meaning; if it is concrete it returns to us the problem with which we started. Finally, the hypothesis of James that religious experience belongs to the subconscious realm is discussed; the objection is made that the subconscious must be mediated by the conscious, and that hence its import will again be conceived under the limitations of ordinary cognition.

The concluding chapter dwells on the relative and symbolic nature of science and its subordination to life; on the insufficiency of human life in itself as an end; on the ideal of duty which summons us beyond the specifically human to a noble struggle and a great hope, an ideal which implies faith and love, which demands a God, and a God with whom we can be in communion. It is in the "living reason" interpreted in the light of duty that science, without which we cannot live, and religion, without which we do not wish to live, find their reconciliation. It must be admitted that this chapter, fine as it is, could not endure the rigorous logic which M. Boutroux has applied to others. His duty is formal, and though a formal notion may, as he says, be efficacious, that concrete efficacy is psychological; we are no nearer a logical synthesis than we were, say, with the notion of concrete activity. But the failure of this effort at construction does not diminish the success of the book in its main intention of critical estimation. M. Boutroux is, like most French writers, a master in exposition; he excels especially in revealing that natural logic by which a biassed view tends to correct itself, an excellence which indicates both the generous critic and the trained philosopher. Probably no book has been written on the subject which will so well repay the student's attention.

THE CHEMISTRY OF THE SUGARS.

The Simple Carbohydrates and the Glucosides. By Dr. E. Frankland Armstrong. Pp. ix+112. (London: Longmans, Green and Co., 1910.) Price 3*s*. 6*s*. net.

CHEMISTS as well as physiologists will welcome the latest addition to the monographs on biochemistry, for there is no other branch of the subject which has afforded so many brilliant examples of successful synthesis or shed so much light on the intricate problems of enzyme action.

The editors have been fortunate in securing the collaboration of Dr. E. F. Armstrong, who has made a special study of the chemistry of the carbohydrates, and writes with an intimate practical knowledge of his theme. At the first glance through the pages of this volume one receives the impression that the author starts on too high a plane, and assumes an acquaintance with the methods and problems of stereochemistry which the biochemical reader may not possess; but one realises on reflection that if he has to compress into ninety-two pages the substance of a subject upon which volumes have been written, he has determined wisely in concentrating into this restricted space those modern developments of sugar chemistry which are of special interest to the biologist, and in leaving other things to take care of themselves.

It is, no doubt, for this reason that the main attention is directed to the natural sugars and glucosides, and that the artificial products are only touched upon where questions of a more general nature are concerned.

The first two chapters are devoted to the structure and properties of glucose, and are followed by one describing the natural hexoses and pentoses, whilst the fourth contains a description of the disaccharides. The succeeding two chapters contain an account of problems with which the author is more closely identified, and furnish much the most interesting reading. In the first of these the subject of configuration in its relation to enzyme action is discussed, and includes the selective action of maltase and emulsin on the glucosides to which Fischer first directed attention, and the selective oxidation of alcohols and sugars by the *sorbose bacterium* described by Bertrand.

Under "Hydrolysis and Synthesis," in which reference is made to the rate of hydrolysis of the disaccharides by acids and enzymes, the author discusses his stereochemical hypothesis, based on a series of interesting numerical data. Such a hypothesis, which may be tested experimentally, can only enlarge our outlook, and the same may be said of the mechanical similes of templates (p. 71) and glove fingers (p. 58), provided we regard the latter, as Fischer did his lock and key, as similes only and nothing more. The writer would, however, like to raise a mild protest against a fusion of the two ideas which the author makes use of in the formula on p. 58, where the atoms of enzyme and substrate are represented as interlocked, a theory which, on the one hand, can never be tested experimentally, and, on the other, can offer no advantage over the lock and key or other mechanical simile.

On the whole, the subject is well and clearly written, and there is very little with which the critical reader can find fault. Here and there certain passages occur which might be improved by expansion or modification, and in this connection reference may be made to the following paragraphs:—

On p. 66 we are told that the difference in the hydrolytic behaviour of enzymes and acids is "due mainly if not wholly (1) to the superior affinity of the enzymes for the carbohydrates; (2) to the very different behaviour of the two classes of hydrolysts toward water—which is a consequence of the colloid nature of the one and the crystalloid nature of the other." One would like to know more precisely how the "superior affinity" and "colloid nature" act in favour of the enzyme.

On p. 70 the author refers to Fenton's reduction of carbon dioxide to formaldehyde by magnesium as a deeply significant observation when considered in relation to Willstätter's discovery that chlorophyll contains magnesium. Are we to suppose that the magnesium in chlorophyll plays the part of the free metal? If not, what is the deep significance of the observation?

There is a slip on p. 59, where α-carbon atom should be "first carbon atom," and on p. 68, where it is stated that sorbose is derived from mannitol. Xylose is not limited to straw, but is found in most kinds of wood (p. 37). In the separate description of the disaccharides, for some reason not given, three members in table viii. are omitted. On the first page of the introduction the author says, "The members of the sugar group are usually distinguished by names having the suffix *ose*." This being the case, it seems a little unfortunate that the termination "ide" for the generic names of the groups should have crept into our system of nomenclature. It is equally unfortunate that our present system recognises no means of distinguishing rotatory sense and configuration, and an official revision of both is urgently needed.

In conclusion, a word must be added in praise of the excellent bibliography at the end of the volume, the usefulness of which would be greatly enhanced if the references were numbered to correspond to those in the text. Under the present arrangement, reference to the source of information necessitates a reference to the chapter, then to a long list of names, and, finally, to the contents of a whole volume or series of volumes and original papers. J. B. C.

A PROSPECTOR'S HANDBOOK OF MINERALS.

The Recognition of Minerals. Being a Collection of Notes and Simple Tests for the Use of Travellers and Prospectors. By C. G. Moor. With Monographs on Geology, Ore Deposits, &c., by Donald A. MacAlister. Pp. vii+231. (London: The *Mining Journal*, n.d.) Price 7*s*. 6*d*. net.

THE old days of prospecting, when scanty equipment and slender knowledge, if backed by sufficient perseverance, were all that was requisite, have gone never to return. The insatiable demands of present-day life for purposes both of peace and war —may be for a filament for an electric lamp of improved efficiency, or a new alloy to impart exceptional hardness to steel—have enormously increased the range of mineral substances which a successful prospector must bring within his purview. In fact, it is necessary for him to have at hand more knowledge than can be conveniently or accurately assimilated by the memory, and he is compelled either to prepare for himself a series of notes or to put in his pocket a book such as that which Mr. Moor has prepared. Himself a traveller, Mr. Moor writes with the understanding of one who knows what exactly is the information required, and many of the sections, for instance, those dealing with the subjects of "panning" and "vanning," contain much detail of great practical value which may save the novice much time, trouble, and annoyance. To give that basis of theoretical knowledge which makes the radical difference between an intelligent understanding of the principles of the methods and merely blind rule-of-thumb working, several important monographs by Mr. MacAlister have been incorporated in the book. He has followed the customary treatment of the subjects, and discusses them in sufficient fulness for the purpose in view.

In the recognition of minerals, which, as the title tells us, forms the main subject of the book, reliance is placed upon the colour as an initial criterion. It is, as Mr. Moor points out, far from a constant character of most species, and, moreover, suffers from the disadvantage that the terms in which it is expressed are wanting in precision, and that the appreciation of delicate differences varies considerably with the individual. On the other hand, it is the most obvious of the physical characters, and suffices for a preliminary separation. The range is subsequently narrowed by the crystalline form, if any, and by determinations of the hardness and the specific gravity, until the identity of the mineral is established; the conclusion may be confirmed by the application of a few simple blowpipe and other chemical tests which are possible with a prospector's outfit. A full description of each mineral is given under the colour which most commonly characterises it, but cross-references are added under the less usual colours. The data that are given for each species include the hardness and the specific gravity, the ordinary chemical reactions, the localities where it has been found in workable quantity, and its commercial value. At the end of this section useful lists are added of minerals soluble in water, hydrochloric acid, and aqua regia, and of minerals which are unaffected by these liquids.

The section that follows on the metallic and non-metallic elements is particularly useful, because this information is not contained in a text-book on mineralogy. Under each element is given a list of the principal minerals in which it occurs, their physical and chemical characters, and particulars of its commercial use and value. Other sections deal with the important subjects of the working of the lodes and the extraction of the metal desired; a special section in the appendix is devoted to the extraction of gold. Mr. Moor mentions the precious stones, but gives few details, and refers the reader to two works the scope and nature of which he describes in the appendix. Of these one is quite satisfactory, though costly and too large for a traveller to carry about; but the other is full of mistakes in facts and principles, and is likely to prove a broken reed; it is strange that Mr. Moor should so strongly recommend it.

The book originally appeared in parts in the columns of the *Mining Journal*, and this fact may, perhaps, account for the eccentric pagination, the first page coming in the middle of the introduction, and for the division into sections and not into well separated chapters. The text is printed on the right-hand page only, the other being left blank, presumably for the addition of notes; interleaving would have been a neater and equally effective method. The index is fairly complete, but why should an irrelevant advertisement have been sandwiched between it and the text?

ELECTRIC DISCHARGES THROUGH GASES.

Conduction of Electricity through Gases and Radio-activity—a Text-book with Experiments. By Dr. R. K. McClung. Pp. xvi+245. (Philadelphia: P. Blakiston's Son and Co., 1909.) Price 1.50 dollars net.

THOSE teachers of physics who are considering the desirability and practicability of introducing into their more advanced courses of laboratory work some experiments on the discharge of electricity through gases and on the phenomena of radio-activity will find this book a useful guide. Believing that our knowledge of the fundamental facts has now become sufficiently definite to justify the step, Dr. McClung has arranged a series of experiments designed to give a practical knowledge of the methods employed and the results obtained in these newer developments of electrical science. The description of the book as a text-book with experiments indicates the plan on which it is written. A connected account of the subjects considered is given from an experimental point of view, with descriptions and diagrams of suitable apparatus by means of which students may perform the experiments and test the results stated, without unnecessary complications. Thus the book provides a convenient summary of the results of recent researches, and is not a volume for the laboratory only.

The book is divided into two parts; chapters i.–vii. deal with electric discharges through gases, and chapters viii.–xvi. with radio-activity. In part i. accounts of kathode and Röntgen rays and a sketch of the ionisation theory are given, while descriptions of a few experiments on ionisation by ultra-violet light and by incandescent solids are added. We commend to the notice of those beginning research in this department the valuable chapter on the apparatus and instruments used in the investigations. The practical hints on the manipulation of electrometers and electroscopes, given by an experienced worker, cannot fail to be helpful. In part ii. experiments on the radiations and emanations from radio-active substances, on induced activity, and on the radio-activity of the atmosphere are described, and a sketch of the disintegration theory is added. A list of 125 experiments is given at the beginning of the book; the author suggests that the more difficult experiments, of which twenty are indicated, may be reserved by the student for a later stage.

We think that students contemplating research in these branches of physics would find the course a valuable preparation for their work. From the nature of the experiments, however, it will be evident that most of them could be undertaken profitably only by those who, as a result of their previous experience of practical work in electricity, have acquired considerable skill in manipulation; for it would be useless to set a student who was unable to manage a galvanometer to struggle with the difficulties of an electrometer. To set up the apparatus and perform the whole of the experiments would require a considerable time; but a student who worked through even a small number of experiments selected from the list would gain a valuable insight into the methods of investigation in use in this part of the subject. The provision, *for purposes of instruction*, of the apparatus which is necessary would, we fear, form a difficulty in some physical laboratories, and, paradoxical as it may seem, not least in those in which researches dealing with the subjects of the book are in full progress.

A few of the definitions in the theoretical sections require more careful statement, and the remarks on the law of decay at the end of chapter xii. need revision. The book is also capable of considerable improvement in literary style.

TWO BIOLOGICAL TREATISES.

(1) *Die Selektionstheorie.* Eine Untersuchung von August Weismann. Pp. vi+69. (Jena: Gustav Fischer, 1909.) Price 2 marks.

(2) *Experimentelle Studien zur Soma- und Geschlechts-Differenzierung.* Erster Beitrag. Von Prof. Johannes Meisenheimer. Pp. vii+149. (Jena: Gustav Fischer, 1909.) Price 6.50 marks.

(1) AMONG the most welcome effects of the Darwin commemoration held last year at Cambridge has been the reappearance of Prof. Weismann in the lists as a champion of the doctrine of natural selection, a cause which for the last fifty years he has never ceased to defend with the whole weight of his authority and learning. But for the invitation from Cambridge to contribute to the memorial volume published on that occasion, the veteran professor, as he informs us in the preface to his "Selektionstheorie," would scarcely have undertaken to add anything to his former writings on the subject. Now, however, he has not only enriched the Cambridge "Festschrift" with the English essay in which his views are so admirably stated, but he has published the same treatise in German, substantially unaltered, but with the addition of certain passages in which his conclusions on the subject of the reality of the selection-process are driven home with fresh force and cogency.

In this production Weismann's dialectical ability and literary skill shine out as conspicuously as ever; and it would be difficult to find, within the same compass, an equally convincing presentment of the case for Darwin's conception of the action of natural selection in the formation of species, or one more aptly illustrated by examples drawn from many departments of organic nature. While so much continues to be written which tends to overcloud and confuse the simplicity of the Darwinian position, it is refreshing to see how Weismann goes straight to the point, brushing aside those objections that proceed from imperfect appreciation of the facts to be explained, and quietly putting in their proper place, as subordinate to the selection-theory, certain well-attested phenomena which have in some quarters been supposed to be hostile to Darwinian interpretations. All this is done with the utmost candour and courtesy, and without the least trace of arrogance or contempt for adverse opinion. In full agreement with both Darwin and Wallace, Weismann here holds, as he has always done, that adaptation is a universal principle in the world of life, and that of this principle selection affords the one and only possible explanation. After reading the masterly defence of the position to be found on pp. 48–69 of the present treatise, those younger biologists who may have allowed themselves to be troubled with doubts as to whether, after all, the theory of adaptation by selection has not been overdone may well take fresh courage and renew their confidence in Darwin's solution of the teleological problem.

Sexual selection, to which Darwin attached much importance, has been vigorously attacked from many quarters. Some of the staunchest upholders of natural selection, including Wallace himself, look askance at the theory which seeks to explain certain features of colouring and other ornamentation in male animals as the result of female preference. Here also Weismann ranges himself unhesitatingly on the side of Darwin. Sexual selection is to him a real and active transforming force, as demonstrable as natural selection itself, and passing into the latter by an easy transition. A specially interesting section of the present essay deals with the scent-producing organs of male Lepidoptera, the perfume distributed from which is now known in very many cases to be as agreeable to the human perception as it presumably is to that of its possessors or their mates. Weismann's own ancillary theory of germinal selection, suggested to some extent by Roux's conception of the "struggle of parts," is here lucidly expounded. Whether the theory be accepted or not—and many, it must be admitted, have found it unconvincing—there is no doubt that it would account for many facts at present not easy of explanation.

(2) The second treatise is of a different character. It contains a detailed account of elaborate experiments on the removal and transplantation of the primary sexual organs in the larva of *Lymantria dispar*, commonly known as the "gipsy-moth." Meisenheimer has succeeded, by the help of the galvanic cautery, in destroying the reproductive glands in larvæ of both sexes at various periods of growth, beginning with the earliest stage after emergence from the egg. In partly-grown larvæ he has been able to transplant the male primary reproductive organs into the body of a female, and *vice versa*. As principal results of his experiments he considers himself to have proved the inability of the reproductive organs, as distinct from mere sex-characters, for regeneration; and also the absence of any formative stimulus for secondary sex-characters, emanating from the primary sex-organs themselves. A transplanted ovary is shown to have no impeding effect on the development of the male reproductive apparatus, while the ovary itself can reach its fully mature condition when artificially inserted into the body of the male. The regeneration of sex-characters, where this takes place, is entirely unaffected by the absence of the primary sex-organs of the individual concerned, or by the presence of those of the opposite sex. The conditions obtaining in hermaphrodites naturally occurring among the Articulata are similarly adverse to the theory of a special formative stimulus for the secondary sexual characters. Meisenheimer is, of course, well aware that the experimental evidence derived from vertebrates seems, *prima facie*, completely at variance with his own results; but he adduces much ingenious argument with the purpose of showing that the "internal secretion" of the testis and ovary, which is certainly a reality, has nevertheless no such specific influence on sex-characters, whether somatic or psychic, as has been supposed. It is, according to him, entirely a matter of enhanced or impeded exchange of material (Stoffwechsel). Metabolism is partially checked by castration, and can be restored by the artificial reintroduction of generative products, not necessarily of the same species. But this metabolism is not specially concerned with the sex-apparatus or secondary characters, and any effect it may have thereon is incidental and not essential. The author's facts are undoubtedly striking, and his criticisms of adverse views are weighty. But his argument as regards vertebrates is not entirely convincing.

F. A. D.

OUR BOOK SHELF.

Metalography (Printing from Metals). Being a full consideration of the Nature and Properties of Zinc and Aluminium, and their Treatment as Planographic Printing Surfaces. By Charles Harrap. Pp. xvi+170. (Leicester: Raithby, Lawrence and Co., Ltd. 1909.) Price 3*s*. net.

THIS treatise professes to be a text-book on the subject of printing from metal plates instead of stone, and is addressed to the lithographic trade. The term "metalography" is a word invented to specify this particular form of printing as distinct from "metallography" as used by metallurgists in a general sense.

Although metal has been in use with more or less success during the past century, it is evident that it is fast coming into more general demand. Zinc was first used, and is still used very largely, but aluminium has more recently been employed as the basis for taking or holding the design to be printed from. The readiness to which either metal lends itself in bending or curving has in turn suggested the manufacture of printing machines of a rotary character, and the result is that there has been a remarkable development in the presses used in producing printed work by the lithographic method.

For some classes of work the stone is still preferred, and probably better results can be obtained from this material in some instances; but if the question of first cost of stone as compared with metal plates is to be studied, the latter are the more economical. Again, the question of space occupied and the great weight of stones for both storage and carriage must be considered. As already indicated, the introduction of metal plates has allowed more scope for the machine-builder, which has quickened and cheapened the output. With the ordinary lithographic stones, which must be printed from the "flat," it was hardly possible that the old forms of presses could be much improved upon.

One other important development has been the introduction of the rotary off-set presses by several manufacturers, which may be used in connection with one or more colours in printing. Either zinc or aluminium plates may be used, and these are fastened round a cylinder, which gives its impression or off-set to another cylinder fitted with a rubber sheet or blanket. The paper to be printed is then conveyed by grippers to a third cylinder, which in motion receives its impression from that which is covered by the rubber.

Very good results are given on cards, or even rough paper, without previous dampening of either material; this obviates the employment of glazed or calendered surfaces, which is a decided advantage. The finished sheets are delivered automatically and the printed face upwards, so that the work can be easily watched in course of production. Such machines as these will produce 1500 or more copies per hour, fed in singly by hand, but the output may be considerably increased by adopting an automatic feeder.

The author has treated the whole subject in a very practical manner, and his long experience as a technical teacher enables him to put the book into a succinct form, suitable alike for the worker and for the student. The volume is also to be recommended to the general seeker after knowledge of the printing arts.

Modern Telephotography; a Practical Manual of Working Methods and Application. By Captain Owen Wheeler. Pp. 80. (London: Ross, Ltd., 1910.) Price, paper, 1s. 6d.; bevelled boards, 2s. 6d.

CAPTAIN OWEN WHEELER is an enthusiastic and successful user of telephotographic lenses, and in this small volume he sets down his experiences in plain language, and gives the rules that he has found serviceable. He refers only to the lenses issued by the publishers, but this is the only drawback to an eminently practical and useful treatise. Seeing that the one advantage of a telephotographic lens is that it gives the image on a larger scale, without the need for an equivalent length of camera, and that it is as applicable to near as to distant objects, the photography of near objects is very meagrely dealt with. But this is rather an advantage than otherwise, as it indicates that the author treats only with those matters of which he has had considerable experience.

The two details that the author's name is chiefly associated with are the use of a hood in front of the lens to cut off extraneous light, and the use of negative lenses of different powers for different magnifications, instead of trusting to variations in the length of the camera. It is hardly too much to say that, trivial as these details appear, Captain Owen Wheeler has by means of them revolutionised the practice of outdoor telephotography. He truly claims that his photographs bear no sign of their special method of production, the flatness and fog so often present being completely obviated. The long hood that he first caused to be available had a rectangular opening in front, and was of liberal dimensions—here he seems to refer only to telescoping tubes little, if any, larger than the outside of the lens mount. If this is so, it is distinctly a step backwards in efficiency, though the aluminium tubes may be more appreciated by the manufacturing optician. Concerning the choice of lenses, with an ordinary half-plate camera and a lens of about seven inches focal length, and a camera extension of fourteen inches, the author advises negative lenses from about 2½-inches to 1-inch focal length, the last giving an equivalent focal length of about 8 feet, or a magnification of about fourteen diameters. The aperture of such a combination obviously must be small, but he does not find diffraction to interfere vitally with definition, even at an aperture of f/480. There are many excellent illustrations in the book, and a final chapter on telephotography as applied to the special requirements of the army and navy.

C. J.

A Text-Book of Nervous Diseases. By Dr. W. Aldren-Turner and T. Grainger Stewart. Pp. xvii+607. (London: J. and A. Churchill, 1910.) Price 18s. net.

THIS book has been written for the purpose of providing the practitioner and senior student with a short and practical account of the diseases of the nervous system, and is not expected to take the place of the larger works on the same branch of medicine. Owing to the limitation placed upon the size of the book, the description of certain disorders, such as myxœdema and acromegaly, usually contained in works of this description, has been omitted. This we cannot but regard as an advantage, for there seems no scientific reason why diseases of ductless glands should be catalogued with diseases of the nervous system.

It is of the utmost importance, in dealing with organic nervous affections, that the student should possess an efficient knowledge of anatomy, and be acquainted with some methodical plan for the clinical examination of the nervous system. We are happy to find in this work a short but clear and satisfactory description of the various tests which are available to inform us as to whether a given system is normal or not. There is no obfuscating mass of detail from which the student has by long experience to abstract the useful and eliminate the comparatively unimportant, but a clear, succinct presentment of all that is really essential. The anatomical chapters are similarly well rendered. The book, so far as organic nervous disorder is concerned, is singularly replete, and we can think of no recognised affection which has escaped adequate attention. Considering the relative proportion of the incidence of organic and of the so-called functional disorders, we cannot but regard it as rather a pity that more space has not been devoted to the symptoms, diagnosis, and treatment of the latter class. Herein, however, the authors are only following the trend of British neurology, which has always been rather in the direction of the study of organic disease. In these days, when such an enormous amount of work is being done by non-scientific bodies in the treatment of functional maladies, it becomes very necessary for the trained physician, with his infinitely superior opportunities, to make himself familiar with therapeutic measures suitable for such ailments. Only in this way can unfortunate sufferers be saved from those errors of diagnosis which untrained and self-constituted professors of certain modes of therapeutics are frequently making, and which are so often of fatal consequence. The illustrations and diagrams with which the book is garnished are admirable, and are most helpful in illuminating the text. The work cannot, we think, fail to be of assistance to those for whom it is intended, that is, to the student and practitioner.

Australasian Medical Congress. Transactions of the Eighth Session held in Melbourne, Victoria, October, 1908. Vols. i., ii., iii. (Victoria: J. Kemp, Melbourne, 1909.)

THESE three volumes of transactions are sure evidence, if that were needed, of the activity of our kinsfolk over the sea in matters medical. It is quite impossible in a short space to deal with their subject-matter, which embraces the whole range of medicine, surgery and gynæcology, anatomy and physiology, pathology, bacteriology and public health.

Dr. Julian Smith discusses the opsonic test and its applications to tuberculosis. He considers that in competent hands opsonic determinations are trustworthy and accurate, and in many cases invaluable as an aid in diagnosis and a guide to therapeutic measures. Various papers deal with tuberculin and sanatorium treatment in tuberculosis. Prof. Welsh, Dr. Chapman, and Mr. Storey discuss some applications of the precipitin reaction in the diagnosis of hydatid disease. It was found by Welsh and Chapman that the blood serum of a patient suffering from hydatid disease, which is relatively common in Australia, gives a precipitate with the fluid of the hydatid cyst. In the present paper the extension of the test by the use of old hydatid fluids is discussed. Hæmogregarine parasites in a marsupial flying squirrel and in the native cat are described by Drs. Welsh, Barling, Dalyell, and Burfitt, and Dr. Elkington describes a new cestode worm (*Dibothriocephalus parvus*) obtained from a Syrian patient. The volumes are well printed, and illustrated with many excellent plates.

Atlas of Japanese Vegetation. With explanatory text. Edited by Prof. M. Miyoshi. Set xiii., plates 86–92, pp. 6: *Coast Vegetation of Middle Japan.* Set xiv., plates 93–101, pp. 7: *Mountain Vegetation of Northern Japan.* (Tokyo: L. P. Maruya and Co., Ltd.; London: W. Wesley and Son. 1909.)

THE series of botanical plates illustrating Japanese vegetation, of which the two sets under notice are late numbers, are phototype reproductions illustrating plant-landscapes and a few cultivated plants, arranged for the most part topographically. The thirteenth set contains photographs of a temperate region, in which *Pinus Thunbergii* is a typical tree along the coast. It is shown with a foreground in one case of *Rosa rugosa,* and in another of *Calystegia soldanella.* Another photograph represents a broad expanse of the Calystegia, and two plates show a curious segregation of male and female plants of *Carex macrocephala.* The nine plates forming the fourteenth set are taken from three different mountains. Two photographs taken on Mount Azuma depict *Rhododendron Albrechtii* and a natural double-flowered variety of *Rhododendron brachycarpum.* The scenes from Mount Iide include a fine spread of *Phyllodoce aleutica* interspersed with *Geum dryadoides,* and an association of *Geranium davuricum* with *Adenophora polymorpha.* Mount Iwate is the station which provides an unexpected combination of *Rhododendron kamtschaticum* and *Pinguicula vulgaris.* The illustrations, measuring about nine inches by six inches, are remarkably sharp and well defined, and are highly creditable to Prof. M. Miyoshi and Mr. G. Nakhara, who are responsible for the original negatives.

Actualités scientifiques. By Max de Nansouty. Pp. 380. (Paris: Schleicher Frères, 1909.) Price 3.50 francs.

THIS interesting "annual" of M. Max de Nansouty, the sixth to appear, will be welcomed by the general reader anxious to acquaint himself, in as pleasant a manner as possible, with the more popular of the recent advances in science. It is natural in this issue to see great prominence given to the problems in connection with aviation and to electricity in its applications, but readers will find that most branches of science have been drawn upon to produce an interesting miscellany. The volume may be recommended specially to students of science anxious to keep up their French without neglecting their own special work unduly.

Mathematical Tables: with Full Tables of Mathematical and General Constants. By R. W. M. Gibbs and G. E. Richards. Pp. 17. (London: Christophers, n.d.) Price 8*d.* net.

THESE conveniently arranged tables provide all that pupils in ordinary secondary schools and technical classes require in their mathematical and science lessons. They include logarithms and antilogarithms, natural and logarithmic sines and cosines, tangents and cotangents, and tables of formulæ and data.

Weighing and Measuring. A Short Course of Practical Exercises in Elementary Mathematics and Physics. By W. J. Dobbs. Pp. ix + 176. (London: Methuen and Co., 1910.) Price 2*s.*

THOUGH there is little that is new either in the method or contents of this book, teachers will find here a clear, well-arranged set of practical lessons on the measurement of length, area, volume, mass, and density. An abundant provision of questions—original and otherwise—has been made, especially for candidates in the Army Qualifying Examination.

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.]*

A Sponge with a Siliceous and Calcareous Skeleton.

IN Willey's "Zoological Results," part iv., 1900, J. J. Lister described certain small columnar coral-like organisms from 35–100 fathoms off Lifu and Funafuti as calcareous sponges. He named them *Astrosclera willeyana,* and, on account of their isolated position, placed them in a new family—Astroscleridæ. The skeleton was formed of minute calcareous spherules, separate above, but welded below into solid walls and blocks, the spherules being formed each in a single cell.

Recently Dr. C. W. Andrews obtained from 46 fathoms off Christmas Island four more specimens of this sponge. A decalcified section showed that Astrosclera was probably a siliceous Ectyonine sponge, for its canal walls were bristling with spiny nail-shaped siliceous spicules (Fig. 2). I concluded that this siliceous sponge had formed a supplementary calcareous skeleton from foreign particles which had been picked up from outside, so extremely improbable did it seem that a sponge could secrete both lime and silex. Later preparations, however, have shown

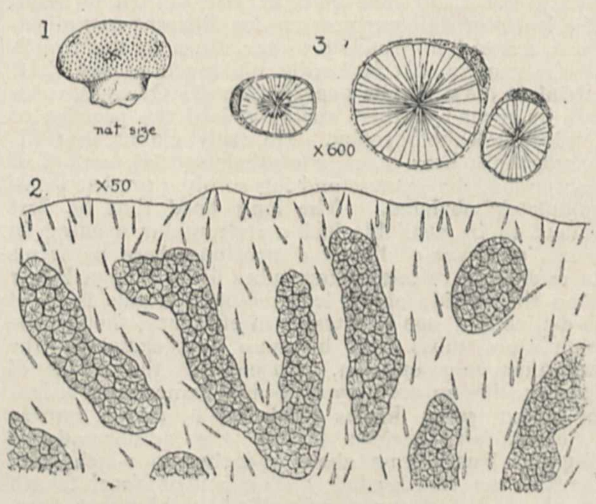

FIG. 1.—A specimen of *Astrosclera willeyana,* Lister. Natural size.
FIG. 2.—Section showing laminæ and masses of calcareous spherules, and nail-shaped siliceous spicules. × 50.
FIG. 3.—Nucleated cells containing calcareous spherules. × 600.

me that Lister was right, and that each spherule (apparently of conchite) is formed in a single cell (Fig. 3).

Fig. 1 is that of a living specimen and not of a dead stock, and yet I can find no trace of anything else than sponge tissue and spherule cells. Further, the superficial stellate grooves which are excavated in the calcareous mass are formed by the terminal exhalant canals of a sponge.

I continue to regard Astrosclera as a siliceous sponge, though I have just become aware that an eminent German zoologist has a very different opinion concerning its nature. Assuming that my theory is correct, Astrosclera may possibly owe its unique character to an ancestral habit of picking up foreign particles—in this case—of calcareous detritus, for the sponge has only been found on coral reefs. Some of the lime would dissolve and become re-crystallised in the connective tissue cells. When once this character had been acquired, the clumsy method of the sponge choking itself up with débris would be replaced by the more "scientific" process of elaborating lime direct from the sea water. I hope soon to set forth in detail the *pros* and *cons.* of this theory.

R. KIRKPATRICK.
British Museum (Natural History), South Kensington.

A Difference in the Photoelectric Effect caused by Incident and Divergent Light.

IN a letter dated April 26 which appeared in NATURE of May 12, Mr. Stuhlmann, of Princeton University, U.S.A., describes some experiments which he has carried out on the photoelectric effect of incident and emergent light. I should like to mention that I have been carrying out some experiments on the same subject at the Cavendish Laboratory, Cambridge, and obtained the same effect as that described quite recently by Mr. Stuhlmann. The experiments were completed more than two months ago, and the results obtained described in a paper communicated by Sir J. J. Thomson to the Royal Society on March 25. In view of the appearance of the above letter they may be briefly described here.

A thin quartz plate was covered with a very thin film of platinum in a discharge tube by directing the discharge from a platinum kathode on to it. The kathode radiation per unit time from the film under the influence of ultra-violet light was measured (1) when a constant beam of ultra-violet light was incident at right angles to the film; (2) when the beam emerged from the film, passing in this case first through the quartz plate. The intensities of the kathode radiations were found to be as 1 to 1·16, while the intensities of the incident and emergent beams were as 1 to 0·5. The conclusion that can be drawn from the experiments is that an electron liberated by ultra-violet light has a component of motion in the direction of propagation of the exciting light.

Cambridge, May 14. R. D. KLEEMAN.

Steam Tables.

IN NATURE of April 21 a review appeared of Profs. Marks and Davis's excellent new tables of steam properties, in which it is stated, without qualification, that the new calculations of the total heat of saturated steam are based upon a second-degree equation $H=a+bt+ct^2$. Both in the explanatory notes to the tables, and still more emphatically and repeatedly in a paper printed in the Proc. Am. Acad. Arts and Sciences, March, 1910, the authors state that this equation does not apply outside the limits 200°–400° F. Simple numerical tests also prove that the tabular figures do not agree with this formula outside these limits, and the formula would give H its maximum value at 72½° F. higher temperature, and four heat units more in quantity, than the tables make it. Mr. Davis says that no formula yet discovered will apply throughout the full range, and above about 450° F. the figures given are not credited with a high degree of accuracy or certainty.

Basing upon these new tables, I constructed a formula for total heat, which was published on December 24, 1909, in the *Engineer*, and gives the tabular results with practical exactitude from 70° to 500° F., that is, from 0·36 to 684 lb. per sq. inch absolute pressure. This formula is

$$H=1826+t-10^7\div 8(1620-t).$$

The following are its "errors" as compared with Marks and Davis's tables :—

t° F.	30	50	60	70	80	100	150	200
H Diff.	−2·7	−1·6	−1·2	−0·7	−0·5	0	+0·4	−0·1

t° F.	250	300	350	400	450	500	600
H Diff.	−0·2	−0·1	+0·3	+0·1	−0·4	+0·9	+24·9

The order of accuracy aimed at in this formula is further illustrated by the factors 0·9938, 0·997, 1·0066, and 1·055 having been tried for the term in t instead of 1, and having failed; while, in place of $10^7\div 8=1,250,000$, one of the factors which was tried and failed was 1,251,150.

The maximum value of H given by this formula is 1210, which is identical with that of the tables, but it occurs at 502° instead of 480°. Exactitude in placing this temperature of maximum H by the purely graphic analysis of a very few experimental results in its neighbourhood which was used by Marks and Davis, is evidently impossible. The tables do not venture to give any values of H above 600° F. My formula may very likely give considerable errors near the "critical point," which is somewhere near 690° F. Here other physical influences probably become prominent, as also, very probably, at low temperatures near that of maximum water density. ROBERT H. SMITH.

3 Thirlmere Road, Streatham, S.W., May 2.

I NOTICED at the time of its publication in the *Engineer* Prof. Smith's communication of the discovery of an empirical formula which would represent the values of the total heat even more accurately than that of Messrs. Marks and Davis. When speaking of their own formula the authors remarked (pp. 100–1):—"It has been used for the range above 212 in these tables"; but they evidently meant to limit the range to 400° F., although this is not clearly expressed in the paragraph from which the above extract is taken.

I agree with Prof. Smith that it is too much to expect any empirical formula to predict what will occur at the "critical point." THE REVIEWER.

Fireball in Sunshine.

ON May 10, at 7h. 52m. a.m., a magnificent meteor was seen by many observers in the Midlands. I have read a considerable number of descriptions of the object, but they are not very definite. The meteor was witnessed by persons not well versed in astronomy and exact positions for the apparent flight. It was a brilliant object with a bluish nucleus and tail of red sparks; the observed velocity was moderate. Though the sun was shining the meteor shone with conspicuous effect, and more than one person supposed it to be Halley's comet, or, at any rate, a fragment of that body.

Seen from Birmingham, the meteor's path was from the north-east to north-west, and one good observation ascribes to it an altitude of 30 degrees in a perfectly horizontal course. It is difficult to assign the real path, but an approximate computation places the height at from about 83 to 32 miles along a luminous trajectory of nearly 100 miles at a velocity of 20 miles per second. The position of the radiant point is doubtful, but several of the observations indicate it in Auriga or Perseus. The meteor travelled over the region of Yorkshire or Lincolnshire towards the district of Liverpool, but in the absence of more exact materials it is quite impossible to derive the path with certainty.

No stars being visible in the bright blue of the May morning which presented this unusual celestial phenomenon, the observers could not locate the position with the required accuracy; but it is hoped that further observations will come in from the northern counties of England. The "daylight fireball" of May 10 last reminds us of a similarly brilliant object which flashed out amid the sunshine on October 6 last at 9.40 a.m. W. F. DENNING.

Observations of Halley's Comet and Venus.

IT may interest readers of NATURE to know that the planet Venus was visible—plainly visible—in Natal all day to-day up to the time of its setting. The air was wonderfully clear and free from dust or moisture. At four o'clock in the morning Venus was unusually brilliant, the light therefrom shining into my bedroom. Halley's comet rose above the horizon at about 4.30, and, although distinctly visible to the naked eye, was pale and insignificant compared to the planet. By six o'clock the comet was no longer visible, having paled away before the sun had actually risen. At mid-day excited groups of natives and Europeans were gazing with wonder at what was mistakenly considered to be Halley's comet visible in broad daylight! Venus was then in the zenith, her glory defying the power of the mid-day sun. E. T. MULLENS.

Pietermaritzburg, Natal, April 22.

Earwigs of India.

IN NATURE of April 14 was published a review of my half-volume on the Dermaptera in the "Fauna of British India" series, in which the reviewer directed attention to a most regrettable oversight on my part in omitting to allude to the British Museum when acknowledging the various sources which supplied me with material.

Fortunately, the frequent references in the text betray my indebtedness, but I should be glad to take advantage of the hospitality of your pages to make amends, at the same time thanking your reviewer for pointing out this extraordinary omission, by expressing now my appreciation of the invariable and well-known courtesy of my good friends among the officials of the museum.

Eastry, Kent, May 5. MALCOLM BURR.

THE TOTAL SOLAR ECLIPSE OF MAY 9, 1910.

IT was reported in last week's NATURE that, owing to very unfavourable weather conditions, the eclipse of the sun, visible from Tasmania, could not be observed at all. In spite of the fact that the weather conditions in that month were not considered to be very favourable, the parties that set out from England and Australia did not expect to have to contend with the very abnormal weather that they actually experienced. Indeed, the southern part of Australia has, according to recent mails, been suffering also from weather frolics, so that these exceptional conditions were not limited to the eclipse stations.

Those who have been out on eclipse expeditions can quite understand the amount of work involved in the erection and adjustment of several high-powered instruments. Under such conditions as "only two fine days in the last fortnight; terrific gales and thunder frequent," as Mr. Frank K. McClean reports from his station, an idea will be gathered of the difficulties under which he and his party had to labour.

Although the results of the eclipse are negative, it is nevertheless of interest to place on record the elaborate instrumental equipment which Mr. McClean took out with him to use. They consisted in the main of two spectrographs for obtaining photographs of the spectra of the chromosphere and corona, and three coronagraphs of different powers for securing records of the form of the corona. In connection with these instruments he took with him a large 21-inch siderostat and a 16-inch coelostat, to feed the above instruments with light from the eclipsed sun. In addition to these, he had several instruments of minor importance. With such a fine equipment and such willing helpers it is a pity that it was not possible to make an attack on the eclipsed sun.

It will be remembered that the eclipse track traversed the southern part of Tasmania. As the Australian party occupied Bruni Island, Mr. McClean, in order to obviate any local bad weather condition, set himself the task of selecting another site. This scattering of eclipse parties along the path of the moon's shadow on the earth is usually done when possible; but sometimes, as in this case, very considerable extra labour and difficulties are met with, as it necessitates the additional equipment of the expedition with all the requirements for camp, food, extra help, &c. Such impediments were not likely to deter Mr. McClean from roughing it in some lonely spot away from all civilisation. In order to give the reader some idea of the trouble he took in selecting a site and some details of the spot he finally determined upon, the following communication I have received from him will serve this purpose. I may, however, preface this account by stating the names of the members, up to the date of his letter, which formed his party:—F. K. McClean, England; Joseph Brooks, Sydney; J. Worthington, England; H. Winkelmann, Auckland; Allan Young, England; S. G. Dowsett, Auckland; and Ernest Jeffs (steward), Auckland; Arthur Wilson (assistant steward and carpenter), Hobart.

April 4, 1910.

On arriving at Hobart on March 24 I found that Mr. Brooks and Mr. Worthington had already obtained much information about the possible localities for the Eclipse Camp. Mr. Worthington had also examined the east coast to the south of Hobart, and from him I learnt that there was no really good site to be obtained. Later we three made a short excursion south, and found that the whole of the country was mountainous and covered with bush, while, except for the road, which never went far from the sea, there was no possible means of communication. At Dover, on Port Esperance, there was a gap running through these mountains, and from Hope Island in the harbour a fair view could be obtained, giving for some 20° in azimuth a horizon not rising more than 3° above the horizontal. This was a possible place, but owing to the presence of Adamson Peak, 4000 feet high, in the field of view, there was a great probability of clouds even with the rest of the sky clear. We did not visit Bruni Island as the Australian expedition had chosen their site there, and also because the altitude of the sun was only 6½° at eclipse. Having found that the east coast offered no reasonable site for observation, the south-west coast was next visited. To do this it was necessary to take the train to Launceston and Burnie on the north coast, and the following day travel by Zeehan to Strahan, also by rail. Mr. Hughes, the manager of the Union Steamship Co. at Hobart, had communicated through to arrange for their steamer, the *Wainui*, to call in at Port Davey after leaving Strahan on its way to Hobart, and we were met by Mr. Eva, the local manager of the company, who did everything possible to assist in the arrangement. Accordingly, on the next day we started on the *Wainui* under Captain Livingstone, and early the following morning found ourselves in Port Davey, and were on shore before sunrise.

FIG. 1.

We first ascended the hills south of Bathurst Channel to get a general view of the country. In every direction rose hills and mountains from 600 feet to 2000 feet high, and between them were stretches of land-locked water leading out into Port Davey proper and the Southern Ocean. Some of the mountains were masses of almost bare rock, while others looked as though covered with smooth grass, which, however, when traversed, were found to be mostly scrub growth of 1 or 2 feet depth. The more distant mountains and those on the west side of the harbour were heavily timbered. In the valleys were patches of bush and small streams of water, brownish in colour. The place was without population, there being no food except that placed in a refuge for shipwrecked persons, and the country to the back being so mountainous and so thickly wooded that only a few persons have ever broken their way through to the east and north. There are said to be wallaby, wombats, and wolves (Tasmanian devil) in the neighbourhood, and also snakes, but we saw none, and fish are reported to be plentiful. We climbed to the top of Morning Hill and Mount O'Brien, and found that ground overlooking Davey Harbour and a sea horizon across the flat ground by Kelly Basin; but the slope of the ascent made it impossible of access with instruments, as for part of the way the slope was from 35 to 40 degrees. From the top it was possible to locate probable sites, and it was seen that there were only two, one at Spain Bay near Hilliard Head, and the other Hixson Point, or Sarah Island, in Bathurst Channel, the latter of which Mr. Brooks and Captain Livingstone were already examining. Spain Bay was open to the full force of the ocean, and was also very shallow, so that Hixson Point alone remained feasible. This on examination was found to answer all requirements. It was only 100 feet high, had deep water close in, and, except for a 6-foot bluff on the shore, had an easy gradient. It was protected from the sea by the Breaksea Islands, and from wind on the south by Morning Hill, and on the north by Mount Misery. There was water within a few hundred yards in a small bay where a camp might be set up, with a small amount of bush cutting. The top was flat for some 200 feet by 100 feet, and the angle of view from it covered the horizon from west to north-west, the actual figures for the low horizon being:—

South limit of view ...	98° azimuth from true south	}	Angle 32°
Sunset on May 9 ...	114° " "		
Eclipse	123° " "		
North limit of view ...	130° " "		

We therefore chose this spot for our eclipse observations, and returned to the ship by mid-day. From Port Davey we steamed along the south coast, passing through isolated rocks many hundred feet high, and along a coast-line of cliffs, sheer from the water's edge and crowned with trees, offering no possible landing, and of absolutely no use for astronomical observations.

Since there were no supplies at Port Davey we have had to arrange for provisions for the period of stay, in addition to tents, photographic materials, kitchen and dining utensils, &c. The danger that weather would prevent the steamer calling in made it advisable not to trust to outside assistance. This has kept us very busy, though we have been given every assistance. Mr. Hughes, of the Union Company, has made arrangements for the *Wainui* to drop us and our kit at Port Davey on April 9, and also to call in twice during our stay before it finally will take us away on May 10 or 11 to Melbourne.

Accompanying the above letter were several photographs of the region about Port Davey, with a large scale map of the vicinity. Three of the above photographs, which, when placed together, form a panoramic view looking towards the direction of the eclipsed sun (azimuth 123°), have been reduced, and are illustrated here in Fig. 1. From this the reader will be able to gather an idea of the appearance of the neighbourhood and the open view in the direction of the eclipse from the observing station at Hixson Point.

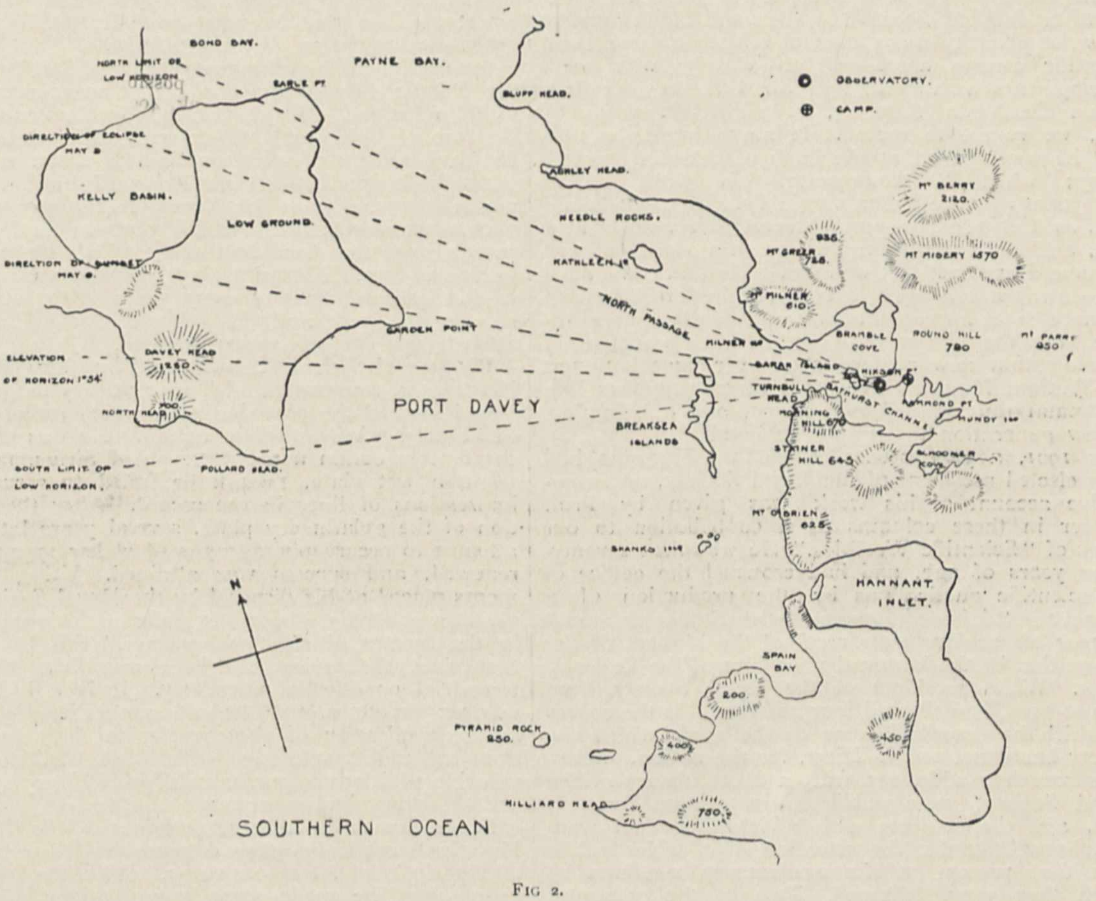

FIG. 2.

Fig. 2 illustrates a general plan of the neighbourhood, and shows, by dotted lines, the various azimuths mentioned in the above letter.

Up to the present time no information is at hand regarding the erection of the instruments, the camp life, and the rehearsals. This will no doubt be received soon, and will form the substance of a later contribution.

In conclusion, it may be mentioned that in the *Westminster Gazette* for May 12, a Reuter cablegram from Melbourne records the observation of the eclipse made at sea on the Oceanic Company's steamer

Corinthic. It reads as follows:—"The eclipse of the sun was witnessed on board the Oceanic Company's steamer *Corinthic*, 480 miles south-west of Hobart. Totality lasted from 2h. 50m. to 2h. 54m. The corona was unexpectedly structureless, being equally distributed round the circumference. There were no prominences, rays, plumes, or streamers. The chromosphere was dark red and of exceptional depth."

WILLIAM J. S. LOCKYER.

SIR WILLIAM HUGGINS, K.C.B., O.M., F.R.S.

ONE of the pioneers of the new era of astronomy opened by the application of the spectroscope and photographic plate to celestial bodies has just passed into silence, and though the memorial formed by his works remains with us, no new block can be added or detail elaborated by the hand of its builder. It is not given to many men of science to have their scientific careers associated so closely with new developments as was that of Sir William Huggins, whose death on May 13, at eighty-six years of age, we regret to record. It may almost be said that he was present at the birth of celestial spectroscopy; when he commenced his work nearly fifty years ago, he had a virgin field of study before him, so that "nearly every observation revealed a new fact, and almost every night's work was red-lettered by some discovery." It was inevitable that some lines laid down in this early survey required modification as more exact instruments and methods became available, but the observations served their purpose in showing that new regions awaited exploration, and Sir William Huggins lived to lead investigators into the realm thus gained for science, and to stimulate a new generation to study it in detail.

In 1901, a year after Sir William Huggins had been elected president of the Royal Society, an appreciative account of his work was given by Prof. Kayser in these columns as a contribution to our series of "Scientific Worthies." He was then seventy-seven years of age, and had crowned the edifice of his scientific publications by the production of a sumptuous "Atlas of Representative Stellar Spectra." In 1902 his achievements received the highest official recognition by the bestowal upon him of the Order of Merit. While president of the Royal Society from 1900 to 1905, he delivered four addresses in the course of which he described some of the work which the society has done, and is doing, for the nation. Selections from these addresses, with a short history of the Royal Society, were published in volume form in 1906, and the subjects with which they deal were thus brought under the attention of a wider public than that present at the anniversary meetings at which they were delivered. Two of the addresses were concerned mainly with scientific education, and the public interest excited by one of them led the Royal Society to appoint a committee to consider the subject and prepare a report, which was afterwards sent to the existing universities of the United Kingdom, with a resolution adopted by the president and council asking that steps be taken to "ensure that a knowledge of science is recognised in schools and elsewhere as an essential part of general education." It is a matter for regret that this manifesto, which was a sequel to Sir William Huggins's advocacy of the claims of science in modern life, led to no definite result. A fuller knowledge of the conditions at the public schools and universities, and greater precision in the recommendations of the committee, might have gained for him a place among educational reformers who see their causes triumphant.

There is no need now to refer in much detail to Sir William Huggins's activities in the domain of astrophysics, for his work was surveyed in the "Scientific Worthies" article mentioned already. He began his spectroscopic studies with Prof. W. A. Miller in 1864, by the examination of the spectra of a few stars, with particular reference to the identification of their chemical constituents. Nine or ten terrestrial elements were found to exist in the atmospheres of Betelgeuse and Aldebaran, and other elements were suspected. While carrying on these investigations, he submitted a planetary nebula in Draco, close to the pole of the ecliptic, to a spectroscopic examination, and found the spectrum to consist of three bright lines, the brightest of which—the characteristic nebular line—he believed to be coincident with a line due to nitrogen. This identification was afterwards disproved, but there remains to his credit the fact that he was the first to observe the bright-line radiation of some nebulæ.

Sir William Huggins was also the first to apply the Doppler-Fizeau principle to the measurement of radial velocities. He showed in 1867 that motion in the line of sight could be determined by measuring the displacement of spectrum lines in a star or other heavenly body; but though his work, and that to which it gave rise at the Royal Observatory, Greenwich, demonstrated the feasibility of the method, the results were too discordant to be of substantial service to science. Not until Vogel applied photography to the subject, about twenty years later, was real success achieved, and the value of the principle in astrophysical investigations realised.

Photography had been used by Sir William Huggins in cooperation with spectroscopy long before Vogel showed the precision with which radial velocities could be determined by its aid. He was probably the first to obtain a spectrograph of Sirius, in 1863, using a wet plate, though he failed to secure any impressions of lines in the record. After the invention of the gelatin dry plate, several years later, the attempt to secure photographs of stellar spectra was renewed, and success was attained. Using instruments placed at his disposal by the Royal Society, he photographed the ultra-violet series of hydrogen lines in the spectra of six "white stars," this being the first time the series had been revealed, either in terrestrial or celestial chemistry. It is a little surprising, therefore, that he did not anticipate Vogel in the application of photography to the determinations of radial velocities which have led to such valuable additions to our knowledge of binary systems and the gregarious movements of stars.

Not so much is known, perhaps, of Sir William Huggins's work in other astronomical directions as of that in celestial spectroscopy. With Prof. Stone, about 1870, he made some investigations with the object of measuring the heat received from stars, using a thermopile, and concluded that distinct indications of thermal effects due to stellar radiations were obtained; but the results are now known not to be trustworthy. Twenty years later, Prof. Boys, using his far more sensitive radiometer, was unable to find any definite effects from the brightest stars, and only when a more delicate radiometer was used by Prof. Nichols in conjunction with the great telescope at the Yerkes Observatory was it possible to secure distinct deflections due to radiation from stars like Vega and Arcturus.

Such revision as this of early observations is, we take it, a concomitant of scientific progress. However well an investigator may build, the iconoclast, with superior equipment and deeper knowledge of causes of weakness of conclusions, overthrows the edifice and erects his own pillar in its place. There is frequently little left of the original foundation, yet each structure represents an advance upon that which it supersedes. Sir William Huggins recorded in 1867 that he had detected the presence of water vapour in the atmosphere of Mars, and re-affirmed his observation later at his observatory at Tulse Hill, but critical inquiry afterwards showed that the conclusions had been drawn too hastily. While, however, those observations must be discarded, we have the recent investigations at Prof. Lowell's Flagstaff Observatory giving clear evidence of the presence of aqueous vapour in the Martian atmosphere. So, like a coral on its base, rises the living body of science upon the monument of past effort. Cemented upon the rock of nature, Sir William Huggins stretched out his hands toward the stars, and if a succeeding generation is able to examine the secrets of the heavens more closely than was possible in earlier days, let it remember the patient pioneer work required to form the base of the pinnacle from which observations can now be made. R. A. G.

PROF. STANISLAO CANNIZZARO.

BY the death of Cannizzaro, another link between the chemistry of to-day and that of the mid-Victorian era has been broken—a link which perhaps more than any other served to connect two well-defined and sharply differentiated epochs in the history of nineteenth-century chemistry. Cannizzaro was not a great discoverer in the ordinary sense of that word; the number of his published researches is few, and the field of inquiry he cultivated comparatively restricted. His greatest discovery, indeed, was his own countryman, Amedeo Avogadro. The fundamental conception of Avogadro that the gaseous laws of chemical combination—the laws associated with the names of Dalton and Gay-Lussac—could be explained by the simple hypothesis that equal volumes of gases, under identical conditions of temperature and pressure, contain the same number of molecules was as the seed which fell upon stony ground. Even the efforts of Ampère—a man of far more influence in his generation—to cause it to fructify had no immediate effect. Berzelius, for a time, dimly apprehended the potentiality of the supposition, but he eventually lost his way under the blind guidance of dualism, and led Europe wrong for a quarter of a century. The German school, it is true, mainly under the direction of Gmelin, gradually shook itself free from dualism, but it wandered still further from the true faith, and by the middle of the nineteenth century chemical theory was utterly befogged, and its doctrine bristled with inconsistencies, contradictions, and anomalies.

Cannizzaro appeared at the psychological moment, as the phrase goes. In its effect, the publication, in 1858, of his "Summary of a Course of Chemical Philosophy" created a revolution in chemical thought hardly less momentous than that which followed the appearance of Dalton's "New System." The publication of a syllabus of a lecture course is a simple enough occurrence, and perhaps never before marked an epoch. But its effect in this case was instantaneous and profound. Cannizzaro demonstrated that the hypothesis of his forgotten countryman constituted the means of placing the most important of all chemical constants on a definable basis; it rendered our conceptions of atoms and molecules, atomic weights and equivalents, gaseous volumes and valency, and all that is associated with or consequent upon these conceptions, logical and consistent.

It is not too much to say that Cannizzaro's intervention at this time saved the position of the atomic theory. The early 'sixties of the last century were a period of much perturbation; there was then a sort of parting of the ways. Williamson laboured to stem the tide of infidelity, but many were unconverted, and some even hardened their hearts. We hear little or nothing to-day of the scepticism which was fashionable among the young bloods of fifty years ago. It is largely due to Cannizzaro that our faith has been strengthened and purified.

There is something dramatic in the circumstance that Cannizzaro should have passed away at the time that all Italy is celebrating the achievements of Garibaldi and his never-to-be-forgotten Thousand in effecting the establishment of Italian unity, a cause in which Cannizzaro had himself struggled and suffered, and in which he was destined to take a share in shaping to a successful issue.

Cannizzaro was born at Palermo in 1826, where his father was president of the High Court of Chancery. He was originally intended for medicine, but under the influence of Melloni he began the study of natural science, more particularly chemistry, under Piria, in whose laboratory he became *préparateur.* The revolution of 1848 found Cannizzaro in Messina, and the youth of twenty-two an officer of artillery and a member of the Sicilian Parliament. For nearly nine months the revolutionaries held out against Ferdinand's army, but Messina was eventually bombarded and sacked, and Cannizzaro and what remained of his band were driven to Taormina. With the disaster of Novara and the abdication of Charles Albert, the Sicilian movement collapsed; the insurgents retreated to Catania, and thence by Castrogiovanni to Palermo, where Cannizzaro succeeded in getting on board a Sicilian frigate, and in escaping to Marseilles. He was now almost destitute, but friends helped him to Paris, and, thanks to Cahours, he found a place in Chevreul's laboratory in the Jardin des Plantes, and began the study of the amines in conjunction with Cloëz. In 1851 he became professor of physical chemistry at Alessandria, in Piedmont, where he discovered benzyl alcohol and worked with Bertagnini on anisic alcohol. In 1855 he was elected to the chair of chemistry at Genoa, where he drew up the famous "Summary" of which mention has been made.

At this time the cause of Italian unity was in the ascendant, and by 1860, thanks to the affairs of Magenta and Solferino, the consolidation of Central Italy was complete. Sicily was once more ablaze, and before the middle of May Garibaldi and the "Mille" had effected its liberation. Cannizzaro immediately returned to Palermo, and threw himself into the work of organising the political future of the island and its relation to Italian unity. He then resumed his academic work at Genoa, but in the following year he was invited to the chair of chemistry at Palermo, where he remained ten years, taking an active share in the management of the University and serving for a time as rector.

In 1871 he was called to the University of Rome, and made a senator of the kingdom. As director of the Chemical Institute at Panisperma he gave, session after session, for nearly forty years, systematic courses of lectures on general and organic chemistry, and practically every Italian chemist of note now living passed through his laboratories and worked under his inspiration and direction.

Cannizzaro was a foreign member of many learned societies, and of nearly every academy in Europe. At the time of his death he was the oldest foreign member of the Chemical Society of London, having been elected in 1862. In 1872 he delivered the Faraday lecture to the society, giving a charming and graceful exposition of the genesis of the doctrine with which his name will for ever be associated. In 1889 he was made a foreign member of the Royal Society, and two years later was awarded the Copley medal for his services to chemical theory. On the occasion of his seventieth birthday, NATURE published an appreciation of his labours, in the series of its "Scientific Worthies," accompanied by a portrait (No. xxx., 1897). From this account it may be permitted to give the following extract:—

"Cannizzaro, when compared with such men as Berthelot and certain of the leaders of the German schools of chemistry, or even with some of the younger generation of Italian chemists, cannot be called a voluminous writer. In all, about eighty memoirs have proceeded from his laboratory. It is on the special quality and character of his published work, rather than on its extent, or on the range and variety of its subject-matter, that his fame depends. In this respect he resembles the late August Kekulé. The names of both men will for ever be associated in the history of chemistry with the promulgation of generalisations which mark epochs in the development of chemical science." T. E. T.

PROF. E. VAN BENEDEN.

EDOUARD VAN BENEDEN, who died on April 28, adds another to the already long list of illustrious zoologists who have left us since last summer. He belongs essentially to the epoch which brought forth Anton Dohrn and Alexander Agassiz, whose loss we have so recently mourned, and, like them, he participated in the triumphs of biological achievement which mark the 'sixties, 'seventies, and 'eighties of last century. If Dohrn may be called the founder of marine laboratories, and Agassiz one of the originators of modern oceanic research, van Beneden may surely be styled the father of modern cytology. For it was he who discovered the exact similarity of the male and female nuclei in fertilisation, and the halving of the number of chromosomes in gametogenesis.

Born at Louvain on March 5, 1846, he was the son of that distinguished zoologist Prof. P. J. van Beneden, of the Catholic University of Louvain. He was educated at Louvain in the university, and later he studied in Germany, especially at Würzburg under Kölliker. He succeeded the zoologist Lacordaire at Liége, and was put in charge of the course of zoology in the faculty of sciences in 1871, at the age of twenty-five. In 1872 he was appointed professeur extraordinaire, and in 1874 professeur ordinaire. This position he held until his death, and made full use of the opportunities it afforded him of advancing the interests of his favourite science. Though his principal achievements were in the domain of mammalian embryology and cytology, his work covered a wide field. He was the first to give an accurate account of the structure and life-history of those strange parasites of the Cephalopoda, the Dicyemida (1876 and 1882), and he founded the conception of a group between the Protozoa and the Metazoa, to which he gave the name of Mesozoa, a conception which has largely influenced speculative zoology. In conjunction with his pupil Julin, he carried out some interesting researches on the development of the Tunicata, and one of the last of his zoological works was an important memoir on the Anthozoa of the Plankton expedition. He is also the author of researches on Gregarines, Crustacea, Limulus, Cetacea, and other groups.

His work on mammalian embryology, to which he was apparently led by his researches on the ovum, chiefly concerns the rabbit and the bat. His first papers on this subject, "La Maturation de l'Œuf, la Fécondation et les Premières Phases du Développement embryonaire des Mammifères" (1875), and "Recherches sur l'Embryologie des Mammifères" (1880), were noteworthy for his description of the cleavage and for the comparison he instituted between the fully segmented ovum and the gastrula. Though these speculative views proved untenable, and were eventually given up by him, they had a considerable influence in stimulating interest in the subject, and so leading to further researches. Later (1884) he gave, in conjunction with Julin, the first complete elucidation of the fœtal membranes of the rabbit and certain other types, and he was the first to name the pro-amnion and to explain its significance. He was, further, successful in making out the early stages of bats, and as far back as 1875 he directed attention, we believe for the first time, to the remarkable method of impregnation in these animals. His paper on the development of bats, published in the *Anatomischer Anzeiger* for 1899, contains the results of many years' observations, and is regarded by embryologists as the most far-reaching of all his mammalian work.

But although van Beneden's name will always hold a prominent position in the history of embryology, it is by his researches on the minute structure of living matter that he will be chiefly remembered. Of cytology, as this branch of science is now called, he will always be hailed as one of the fathers. He early directed his attention to the subject, and his first important published work, "Recherches sur la Composition et la Signification de l'Œuf, Mémoire couronné de l'Académie royale des Sciences de Belgique," published in 1870, dealt with it. This was followed in 1875 by his memoir, already referred to, on the maturation and fecundation of the ovum of the rabbit, and in 1883 by his greatest work, "Recherches sur la Maturation de l'Œuf, la Fécondation et la Division cellulaire." Then follows a lull in his activity, caused, no doubt, by the terrible accident which happened to him about this time on the Eiger, and as a result of which he was unconscious for three weeks and incapacitated from work for two years, and it was not until 1887 that he published, in conjunction with A. Neyt, his "Nouvelles Recherches sur la Fécondation et la Division mitosique chez l'Ascaride mégalocéphale." All his great achievements in cytological research are recorded in this series of remarkable papers. They prove, beyond all possibility of doubt, the right of Edouard van Beneden to take his place in that select band of great original observers to whom science owes her progress.

By his use of *Ascaris megalocephala* as the material of his investigation, he introduced a means of research which, in his own hands and those of his followers, led to the most important results. He was the first to show, for the ovum, that the chromatic threads are a portion of the network existing in the nucleus. He laid special stress upon the fact that the two daughter chromosomes were alike to the smallest detail, and he first pointed out that they pass to opposite poles of the spindle. He discovered the *corpuscule centrale* in 1876 (first seen, it is true, by Flemming in 1875), and first demonstrated its importance in cell division. He was also the first to show that it is in many cases, if not in all, a permanent organ of the cell (1885 and 1887). He also discovered the *sphère attractive.* Both these structures later received other names, the former being known as centrosome and the latter as centrosphere; but whatever names be applied to them—a matter of no importance—the fact remains that they were discovered, and their importance appreciated, by van Beneden.

Finally, and this, perhaps, is the greatest discovery associated with his name, he showed, in 1883, that in the last gametogenic divisions by which the ovum is produced, the number of chromosomes of the nucleus becomes reduced to one-half the original number, and the like fact for the spermatozoon was discovered in 1884 by him, working in conjunction with C. Julin. Though it cannot be asserted that he was the first to give a complete account of the morphology of fertilisation, yet it may fairly be said that he went as near to that as any other worker, and that he was one of the three zoologists whose discoveries led to the complete elucidation of that phenomenon. Lastly, we must not forget to mention that he founded and edited the *Archives de Biologie*, in which some of his most important work was published.

Van Beneden was a strikingly handsome and distinguished-looking man. His splendid figure will not readily be forgotten by those who were present at the Darwin centenary celebration at Cambridge last year. He was a keen and active sportsman, and his proclivities in this direction often led him far afield—to Sweden for reindeer and, as we have seen, to Switzerland for climbing. He was a lauréat and correspondant of the Institut de France, correspondant of the Acadamies of Berlin, Vienna, and St. Petersburg, foreign member of the Academy "Dei Lincei" of Rome, and an honorary member of many other similar institutions in different parts of the world. He was an honorary doctor of many universities, including those of Oxford and Cambridge, and had many other titles and honours.

A. S.

NOTES.

THE next meeting of the Royal Society will be held on Thursday, May 26, when the Croonian lecture will be delivered by Prof. G. Klebs on "Alterations of the Development and Forms of Plants as a Result of Environment."

OWING to the lamented death of King Edward, the Chemical Society's banquet to the past-presidents who have completed their jubilee as fellows has been postponed from May 26 to the autumn. We are also asked to announce that the conversazione of the Entomological Society of London, fixed for Friday, May 27, is postponed indefinitely.

THE annual May lecture of the Institute of Metals will this year be delivered by Prof. Gowland, F.R.S., vice-president of the institute, who will take as his subject "The Art of Working Metals in Japan." The lecture will be given on Tuesday, May 24, at 8.30 p.m., at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. Tickets admitting visitors may be had gratuitously on application to the secretary of the institute, Mr. G. Shaw Scott, Caxton House, Westminster, S.W., to whom applications should be made not later than Saturday next.

Two meetings—the first with Lord Verulam in the chair—were held on Friday in St. Albans to support the scheme of the society for excavating the site of Verulam during the ensuing summer and autumn. The site covers close on 200 acres, and although the Roman walls and other buildings were used as a quarry in obtaining materials with which to construct St. Albans Abbey, the greater part of Verulam is unique in that it has never been built upon. The beheading of the proto-martyr Alban, together with other circumstances, suggests that remains of early Christian churches may be discovered; and, in any case, the theatre and forum are known to have been larger than any other similar buildings in England.

ON Tuesday, May 24, Prof. Love will begin at the Royal Institution a course of two lectures on "Earth Tides," the second to be delivered on Monday, May 30, and on Thursday, May 26, Dr. W. Rosenhain will deliver the first, and on Wednesday, June 1, the second, of two lectures on "Alloys"; on Friday afternoons May 27 and June 3 Dr. D. H. Scott will deliver the remaining two of his course of three lectures on "The World of Plants before the Appearance of Flowers." The Friday evening discourse on May 27 will be delivered by Captain R. F. Scott on "The Forthcoming Antarctic Expedition," and on June 10 by Dr. H. Deslandres on "The Progressive Disclosure of the Entire Atmosphere of the Sun" (in French).

FRANCE seems inclined to follow the example of Prussia in forming a Government Department for the Preservation of Natural Monuments. Last October an International Congress for the Protection of Landscape was held in Paris, the German Ambassador being one of the vice-presidents. The Prussian organisation for the preservation of nature—the term "Natural Monuments" referring to natural scenery and indigenous fauna and flora—was highly praised by French men of science, and it was proposed to take steps for the institution of a similar system in France. Prof. Miyoshi, of Tokyo, in a brochure laid before the conference, speaks highly of the Prussian movement, and invites Japan to take a similar precaution. Prof. Kumm, of Danzig, illustrated the working of the statute against disfiguration of scenery. Of particular interest was Dr. Hermann's paper on natural parks for the protection of animal and plant life, which have long been a German institution. The second Conference for the Preservation of Natural Monuments in Prussia has also just been held at Berlin. It is worth remark that the German Press and public take a keen interest in this useful work. There is, we may add, plenty of scope for such work in the United Kingdom; but it must be done soon, before the building speculator and the municipal engineer have quite exterminated nature in these islands.

THE number of *L'Anthropologie* for March-April, under the title of "Les Sofs chez les Abadhites," of North Africa, contains the first portion of an important study of tribal sociology by Dr. J. Huguet. The vague term Sof is defined by the writer as "the reunion of all those individuals who, by reason of community of origin, needs, and political interests, have been forced to associate for purposes of attack and defence." The political influence of associations such as these has recently attracted much attention from the officers responsible for the control of these often unruly tribes.

IN the May issue of *Travel and Exploration* Miss E. C. M. Browne describes an adventurous journey by two ladies to the famous sacred lake Manasarowar, in Tibet, which has been hitherto visited only by a comparatively small number of Europeans. Evidently recent British action in Lhasa has borne fruit so far west as Manasarowar. The head Lama of the local Gomba was very friendly, and went so far as to allow the Bhotiya coolies following the camp to shoot birds in the holy waters, an unusual concession on the part of a Tibetan Buddhist, who, in theory at least, is much opposed to taking animal life.

In *L'Anthropologie* for March-April MM. E. Cartailac and l'Abbé H. Breuil continue their survey of the paintings and engravings found in the caves of the Pyrenees. The caves described in this article are those of Gargas, not far from Montrejeau, and Bédailhac and Pradières, near Tarascon. The first of these contains a remarkable series of paintings and engravings, depicting hand-marks, animals such as the elephant, bison, horse, and what seems to be a rude human figure, resembling other European specimens of Palæolithic art, as well as that of the natives of Australia and the South African Bushmen. A similar collection of examples of primitive art from caves once occupied by Bushmen on Mt. Silozwana is described by Messrs. Mennell and Chubb under the title of "Some Aspects of the Matopos" in the first part of vol. viii. (1908) of the Proceedings of the Rhodesia Scientific Association, just received. The figures of the giraffe, guinea-fowls, and flying ants are particularly realistic, and supply excellent examples of primitive native art.

The Choctaw of St. Tammany Parish, in Louisiana, the now scanty remnants of a once famous tribe, are described by Mr. D. I. Bushnell, jun., in the forty-fifth Bulletin of the Smithsonian Institution. They have now forgotten most of their characteristic industries—pottery and basket-making—and have lost the art of fishing, most of their needs being supplied from the nearest store; but though they have been for a long period subjected to Christian influences, they retain many of their primitive beliefs. Thus a solar eclipse occurs when the sun is resting and cleaning himself from the accumulated smoke of his fires. Thunder and lightning are produced by two great birds, and when the female is laying an egg in her nest in the sky there is a thunderclap. The good spirit, Aba, takes to his heaven the spirits of all tribesmen save those dying by effusion of blood and murderers. The evil spirit, Nanapolo, wanders in the recesses of the forest, and though he is feared, he never succeeds in gaining possession of the soul of a Choctaw. They have practically lost their belief in witchcraft, and have never assimilated the practices of Voodooism, so popular among the negroes around them. Mr. Bushnell has excavated a series of mounds which throw some light upon their primitive culture.

The great flights of crossbills which visited this country and the Continent last summer and autumn have, in our islands at any rate, remained in many places to breed. In the May issue of Witherby's *British Birds* a large number of instances of such nesting are recorded, and it is confidently expected that many more will follow. The localities include the Southampton district, Wickham, the New Forest, Kent, Staffordshire, Suffolk, Surrey, and Sussex. The nests were mostly, or invariably, built in Scots firs, those near Burley, in the New Forest, being placed in the forks of horizontal boughs at a height of some 30 feet from the ground and a dozen feet from the stem. It is suggested that an unusual abundance of Scots-fir seeds may have led to the visitation.

Dr. K. Deninger, in vol. xviii., part i., of the *Berichte d. Naturfor. Gesellschaft zu Freiberg*, has done good service in demonstrating the marked distinction between the babirusa of Boru and its relative of Celebes. The original *Sus babirussa* of Linnæus came, it appears, from Boru, but the *Babirussa alfurus* of Lesson's "Mammalogie," which was supposed by its describer to come from the same island, and to be identical with the Linnean species, is based on Celebes specimens. For the Boru species Dr. Deninger takes the name *Babirusa babirusa*, while for its Celebes representative he proposes the new title *B. celebensis*, although in our opinion he ought to have retained Lesson's *B. alfurus*. Until the author brought home specimens, the Boru babirusa seems to have been represented in European museums only by a few skulls, the distinctive peculiarities of which were not recognised. It is distinguished by its nearly smooth hide, of which the colour in adult males is greyish-brown above and light brown below, and also by the thick coat of short bristly hairs, which becomes thickest at the root of the tail. The general colour is whitish-grey, tinged, especially on the head, with yellow. Females and young males are darker. The Celebes species, on the other hand, has the well-known rugged and furrowed hide almost naked, and brownish-grey in colour. The skull of the Boru babirusa is short and wide, with the extremities of the nasals not narrowing to a sharp point between the sheaths of the upper canines in the manner characteristic of its relative in Celebes, and there are also differences between the tusks of the two species. Dr. Deninger, who adopts Stehlin's theory that the bunodont dentition of the Suidæ is derived by degeneration from a selenodont type, concludes by expressing the opinion that Babirusa is nearly related to the Siwalik Merycopotamus, both genera agreeing in the parallel direction of the two lines of cheek-teeth, the general form and small size of the crowns of these teeth, the shape and direction of the tusks, and certain other features.

The Board of Agriculture has taken advantage of the powers conferred upon it by the Destructive Insects and Pests Acts, and has issued an order affecting the following:—The vine louse (*Phylloxera vastatrix*, Planchon), the San José scale (*Aspidiotus perniciosus*, Comstock), the Mediterranean fruit fly (*Ceratitis capitata*, Wiedemann), the Colorado beetle (*Doryphora decemlineata*, Say), the large larch sawfly (*Nematus erichsonii*, Hartig), the potato moth (*Lila solanella*, Boisduval), the gipsy moth (*Liparis [ocneria] dispar*, Linné), the brown tail moth (*Euproctis chrysorrhoea*, Linné), the nun moth (*Liparis monacha*, Linné), the cherry fly (*Rhagoletis cerasi*, Linné), the narcissus fly (*Merodon equestris*, Fabricius), black knot (*Plowrightia morbosa*, Saccardo), wart disease or black scab of potatoes (*Synchitrium endobioticum*, Percival), tomato-leaf spot (*Septoria lycopersici*, Spegazzini), melon or cucumber canker (*Mycosphoerella citrullina*, Grossenbacher), and American pear blight (*Micrococcus amylovorus*, Burrell). Under the provisions of the Act any person selling or planting any seed, cutting, plant, &c., attacked by any of these pests is liable to a penalty of 10*l*. A like penalty is incurred if anyone fails to notify the proper inspectors when any of the pests appear in his garden, or if he omits to carry out the measures specified by the Board for the prevention of the spread of the pest. The inspector may enter any premises where he has reason to suppose one of these pests occurs and examine any plants. He may go further, and order the destruction of the plants affected if the local authority consents to pay compensation. This is the part of the Act that has been most criticised, and it still remains to be seen how much good is done when the most effective, if also the most drastic, method of treatment may be excluded. But the order shows that the Board is alive to the necessity for action, and it will no doubt discover a way of getting over this particular difficulty. If the order constitutes a new terror for amateur gardeners and careless nurserymen it also emphasises the necessity for horticultural instruction in the schools, and justifies the evening classes held in many of the counties.

A curious manna-like incrustation or wax collected on twigs and leaves of *Elaeodendron glaucum* is described by

Dr. D. Hooper in the Journal of the Asiatic Society of Bengal (vol. v., No. 9). It has been identified as the secretion of *Phromnia marginella*, an insect passing in India under the name of the ghost bug. The substance contains sugar in the form of dulcitol, which the author refers to a special secretion in the plant.

AN article in Engler's *Botanische Jahrbücher* (vol. xliv., part i.) by Dr. R. Knuth, on the formation of hybrids in the genus Pelargonium, should be interesting to horticulturists and botanists alike. The large number of Pelargonium hybrids contrasts greatly with the three hybrids known for Geranium and two for Erodium. It is strange to find that five sections of the genus furnish no hybrids, while crosses between species in different sections are not uncommon. The author remarks that, as a rule, there is no fusing of parental characters, but more often one supplies the leaf and the other the flower characters in the hybrid. The "English" pelargoniums, known in this country as decorative or fancy, are attributed to crosses between *grandiflorum* of the section Polyactium, and the species *cucullatum*, *cordatum*, and *angulosum* of the section Pelargium. Dr. Knuth recognises the excellent work of English horticulturists, and places a high value on the classic work of Sweet on the Geraniaceæ, published in 1815.

THE composition of Indian rice has been investigated by Mr. David Hooper, and the results are published as No. 5 of the *Agricultural Ledger*. Rice cultivation is the most important of the agricultural industries of India, more than seventy million acres being annually under this crop. There are a number of varieties of grain differing in size, shape, colour, and other properties, not all being equally suitable for culinary purposes. Thus a variety known as *kauk-nyin* is so glutinous that it will not stand the boiling required by ordinary rice, but is made into various kinds of puddings and sweetmeats. It is frequently boiled in bamboo tubes, to be eaten cold by travellers; when required, the bamboo is peeled off, and a long roll of rice appears which forms a palatable substitute for bread. Taking the 159 samples as a whole, the percentage of carbohydrate varied between 92·2 and 82·2, of protein between 11·4 and 6·06, of fat between 3·6 and 0·11. The fibre rarely exceeded 1 per cent., and was usually round about 0·5 per cent.; the ash usually fluctuated between 0·5 and 2 per cent. This series of analyses of rice is probably the most complete that has yet been executed.

PROF. R. MAREK contributes an important paper on the position of the upper limit of the forest growth in the eastern Alps, and its relation to the elements of climate, to Petermann's *Mitteilungen* (p. 63). The general conclusion arrived at is that the importance of mean atmospheric temperature has hitherto been greatly overestimated, and that such factors as rainfall and direction and force of wind are essential causes determining the altitude of the forest line.

THE Proceedings of the Royal Society of Edinburgh (vol. xxx., p. 183) contain a paper by Dr. W. A. Caspari, of the *Challenger* Office, on the composition and character of oceanic Red Clay. Dr. Caspari gives the results of analyses of thirteen samples of Red Clay obtained from the different oceans in depths varying from 1900 to 3100 fathoms, and discusses the peculiarities of each. It is established, generally, that Red Clays originate, in the main, from the degradation of acid and basic volcanic glasses, and that the chemical processes involved cannot differ in essence from those associated with the subaërial weathering of silicates. A feature of deep-sea "weathering" is that it takes place under conditions which admit of finality; in the Red Clay areas there is a temperature of 1° C. to 3° C., a pressure of 400 to 600 atmospheres, and a uniform medium, sea-water, which have scarcely changed for millions of years. As a result, a degradation product of much the same composition is found all over the globe, and it is to be observed that it is a more acid silicate than the corresponding continental material.

THE Bulletin of the Philippine Weather Bureau for August, 1909 (recently received), contains an interesting note on the frequency of local earthquakes in relation with atmospheric pressure in Manila in 1902–8. As "local earthquakes" are designated the so-called instrumental earthquakes the records of which traced by the microseismograph show that their point of origin was in the locality, or very close to it. During the years under consideration 796 such disturbances were recorded at the observatory, and a table showing graphically their mean hourly frequency exhibits clearly two principal maxima and minima, and one secondary maximum and minimum. When this curve is smoothed by showing the frequency for three-hour periods, its parallelism with that of the double daily oscillation of atmospheric pressure shows that "at Manila the highest pressures are more favourable to the occurrence of instrumental earthquakes than low pressures." Prof. F. Omori, the eminent seismologist, has attributed the reason of such parallelism to the fact that in all probability these local earthquakes have their origin at very shallow depths, and may be closely connected with daily changes of pressure exerted by the atmosphere on the earth's crust (see Bulletin of the Imperial Earthquake Investigation Committee, Japan, vol. ii., p. 105).

"THE CAUSE OF THE VERTICAL MOVEMENTS IN THE ATMOSPHERE" is the title of an interesting paper by Prof. W. Trabert in the *Sitzungsberichte* of the Vienna Academy of Sciences of December 2, 1909. The inquiry is based upon the observations of the upper air made at Lindenberg during the month of January, 1909. The diagrams, which exhibit, *inter alia*, the isotherms and lines of equal potential temperature up to an altitude of 5000 metres, show that at times tongues of low temperature extend downwards from the upper regions, and that others of higher temperature extend from below upwards, so that areas of high and low temperatures become intermingled. Among the results arrived at we may mention the following:—In a warm column of air the movement is upwards, and *vice versa*. The ascending movement causes the air-pressure to fall, and conversely. If cyclones and anti-cyclones are thus caused, the air already cooled is dynamically carried higher up, or the warmed air transferred further downwards, causing fresh vertical motion; the origin of cyclones and anti-cyclones is therefore thermic and dynamic. The pendulum-like upward and downward movement of the air is due to aqueous vapour, and the latent heat set free by its condensation furnishes the energy for the maintenance of the vertical circulation.

THE importance of the coherer as a detector in radiotelegraphy amply justifies the large amount of attention which has been paid to it by experimenters during the last few years. Attention has been directed in these columns to the work of Mr. G. W. Pierce (*Physical Review*, vol. xxix., and references there) and of Mr. L. W. Austin (Bulletin of the Bureau of Standards, vol. v.). In the *résumé* of communications made to the Société française de Physique on March 18 there are abstracts of two further papers by M. Tissot and M. Blein respectively. Both direct attention to the influences of the thermoelectric properties and the variation of the resistance with temperature of the materials used on their behaviour as coherers, but Dr. W. H. Eccles, in a paper read before the Physical Society of London on March 11, showed that the whole of the properties of coherers could be explained, both qualitatively and quantitatively, by the Joule and Peltier heat generated at the junction, and its effect on the resistances of the materials forming the contact.

Vol. vi. of the "Collected Researches of the National Physical Laboratory" contains 200 pages quarto, and consists of reprints of fourteen papers by members of the staff which have appeared in the pages of the technical Press or the proceedings of scientific societies, most of them during the year 1909. Several of these papers have already been noticed in these columns, but we should like to direct attention to the report of the committee appointed by the Institution of Naval Architects to carry out the scheme for establishing a tank at the laboratory in which the experiments necessary for the advance of British shipbuilding might be carried out. Ten experimental tanks are already in use throughout the world, Japan possessing one, but most of them are owned by private firms. An advisory committee of naval architects has been appointed, which will draw up a scheme of work to be done in connection with the problems now awaiting solution.

A specimen bottle of a concentrated combined toning and fixing bath, issued under the name of "Combino," has been sent for examination by Mr. P. F. Visick, 30 Finland Road, Brockley. It gives good colours, and as it is only necessary to place the print as taken from the frame into the solution until the desired colour is obtained, it makes the use of ordinary silver printing-out paper as simple as the self-toning papers now so common. It is a gold-toning solution, and the maker claims that it is stable when either concentrated or diluted for use, and that double-toning, that is, a variation of colour according to the depth of the printing, is impossible. It is issued in 4-oz. bottles at one shilling, and is diluted to five times its bulk for use.

The changes undergone by stored coal are of considerable importance, both from the point of view of liability to spontaneous combustion and loss in calorific value. A recent Bulletin (No. 38, Series 1909) from the University of Illinois Engineering Experiment Station, by Messrs. S. W. Parr and W. F. Wheeler, is devoted to the consideration of this subject. A critical abstract of all the earlier work on the weathering of coal is given. This is followed by a detailed account of experiments made to determine the amount of disintegration and the changes in weight and calorific value occurring in the grades of coal found in Illinois and in the neighbouring States under different conditions of storage. The losses in calorific value for coal stored under water were found to be less than with the usual storage in air, but the differences were not great enough to warrant any changes in present storage methods from this point of view alone. Storage under water gives protection against spontaneously ignited fires, and also lessens breakage losses, and hence may be worth while resorting to in certain cases.

Messrs. Reynolds and Branson, Ltd., have just issued a comprehensive catalogue of photographic requisites containing particulars of many new cameras and accessories.

A work on the birds of Dumfriesshire, by Mr. H. S. Gladstone, will shortly be published by Messrs. Witherby and Co. The book will give an exhaustive account of the present-day status and past history of all the birds of the county, and will be illustrated by photographic plates and a map. It will be published by subscription, and in a strictly limited edition.

An Aviation Association of Ireland has been formed, with Mr. J. B. Dunlop as president, Dr. W. E. Lilly and Mr. J. C. Peary as vice-presidents, and Mr. D. O'B. Gill, 19 Herbert Street, Dublin, as honorary secretary. A lecture was delivered before the association on February 8 by Dr. Lilly, and has now been reprinted by the *Motor News*, of Dublin.

Messrs. J. and A. Churchill have a new edition of vol. ii. of "Allen's Commercial Organic Analysis" just ready for publication. This volume has been re-written under the editorship of Dr. H. Leffmann and Mr. W. A. Davis. The subjects are:—fixed oils, fats and waxes, special characters and methods, butter fat, lard, linseed oil, higher fatty acids, soap, glycerol, cholesterols, wool fat and cloth oils.

A new catalogue of lenses has just been issued by Messrs. J. H. Dallmeyer, Ltd. Among the new types of lenses of which particulars are given are a new series of Dallmeyer stigmatics, the single components of which are dissimilar and may be used separately; improved forms of the well-known "Adon" lens, which gives, for the same camera extension, a much larger picture than an ordinary lens; and a new telephoto combination working at *f*/10, and giving variable magnification. The capabilities of the various lenses and combinations are illustrated by some striking pictures.

OUR ASTRONOMICAL COLUMN.

Halley's Comet.—The observations of Halley's comet during the present month have shown that, in brightness, it has at least come up to general expectation. Numerous amateur observers report having seen it as a fairly conspicuous object before dawn.

If Dr. Ristenpart's calculated time for perihelion is correct, the comet transitted the sun between 3h. 4m. and 4h. 4m. this morning (May 19), and any special phenomena which could be caused by the passage should be fully reported to some competent authority. From Dr. Holetschek's results it appears likely that the brightest part of the tail would not extend so far as the earth, but meteors from the outlying, and possibly curved, extremity should be looked for, carefully noted, and reported. Recent observations indicate, however, that the tail is quite long enough to extend past the earth.

Mr. G. Gillman reports that he has continued his observations at Aguilas, Spain, on each successive morning, and found that at 3h. 20m. on May 13 the tail was particularly well defined. It was visible to the naked eye almost to a line joining θ Pegasi and α Aquarii, which means that the apparent length was some 43°. This is the greatest length yet recorded by him.

Mr. C. Leach also sends another sketch showing the extent of the tail as he saw it with the naked eye at 3h. 45m. a.m. on May 8. This shows the head of the comet in line with α Andromedæ, γ Pegasi, and Venus, with the tail extending, nearly parallel to the south side of the Great Square, to a greater length than the distance between γ and α Pegasi; the tail was perfectly straight. Mr. Leach also sends a sketch and note, taken from a local paper, describing the comet as seen by Prof. Attilio Sesta, at Palermo, at 3h. 25m. on May 8. This corroborates Mr. Leach's own observation, and adds that the nucleus was very bright (visible until 5 a.m.), and that the diaphanous tail exhibited rectilinear margins which formed a small angle at the head.

A number of positions of the comet during November-February are published by Dr. Rambaut in the Monthly Notices (lxx., 6). The places were determined from photographs, taking astrographic stars for reference points.

In *Astronomische Nachrichten*, No. 4408, Herr J. Franz considers the passage of the earth through the tail and the possibilities of meteor showers at the time. For different values of $1-\mu$ he finds that possible collisions may occur at May 19·442, 19·115, and 18·892. The corresponding radiants of possible small showers are near η Piscium, ρ Piscium, and β Arietis.

In the supplement to No. 4407 of the same journal a telegram from Prof. Pickering announces that Dr. Wright, at Lick, photographed the spectrum on April 29, and found the sodium D lines bright; this is announced as a recent development. An observation by Prof. Frost and Dr. Slocum on April 14 showed a distinct continuous spectrum for the nucleus, with no trace of bright lines or bands.

THE SPECTRA OF COMETS.—Further laboratory results bearing on the nature of cometary spectra are published by Prof. Fowler in a paper appearing in No. 6, vol. lxx., of the Monthly Notices.

Among other things, it is now shown more definitely that the tail spectrum is produced by an oxide of carbon, probably the monoxide. With sufficient density this compound gives the "Swan" spectrum, the most common feature of cometary spectra, whilst at very low pressures —0·01 to 0·005 mm.—the "tail spectrum" is developed. The addition of a trace of nitrogen introduces the cyanogen bands into the high-pressure spectrum, and the kathode bands of nitrogen, such as were found in the spectrum of the tail of Morehouse's comet, at the lower pressures. Hydrocarbons are regarded as variable constituents of comets because the characteristic band at λ 431 is only an occasional feature of their spectra.

The anomalous spectrum of Brorsen's comet, as observed by the late Sir William Huggins in 1868, is explained by supposing that it resembled the "tail spectrum," the differences of wave-length not being beyond the probable limits of error. If this is the true explanation, it appears that the heads of comets vary considerably in density, that of Brorsen's being about the same density as the tail of Morehouse's.

A new high-pressure (100 mm.) spectrum of carbon monoxide was discovered during the research, and it is suggested that the presence of this in cometary spectra is indicated by the anomalous positions of the carbon bands observed. Thus the blue carbon band in cometary spectra often occurs at λ 468 instead of at λ 473, the position of the brightest head; the superposition of the brightest band of the new spectrum, at λ 4679, would account for this.

Some interesting deductions as to the nature and the illumination of comets' tails are made on the assumption that the actual conditions are comparable with those obtained in the laboratory experiments. For example, it is shown that to come within permissible limits of mass the tails must be hollow, or must be made up of attenuated sheets or streams. The illumination is probably of electrical origin, but whether the negatively charged particles producing it proceed from the head of the comet or from the sun is still an open question.

OBSERVATIONS OF SOUTHERN NEBULÆ.—The positions and brief descriptions of five southern nebulæ are published by Mr. Innes in No. 2 of the Transvaal Observatory Circulars. One of these objects, in R.A. 16h. 49m., dec. $-40°$ 36′ (1875), is very diffuse, and covers 10′ in declination and 3m. of R.A.: its position was determined from a plate taken with the Franklin Adams star camera. Cometary, planetary, and ring nebulæ are also included.

OBSERVATIONS OF THE AURORA.—In No. 3, vol. xxxi., of the *Astrophysical Journal* Prof. Barnard gives the details of all the observations of auroræ made by him during the period 1902–9. There are many points of interest too numerous to mention here, but it is evident that such carefully recorded data will prove extremely useful in discussing the probable relation of auroræ with solar outbursts, &c. Prof. Barnard outlines a scheme for systematic observations by observers some miles apart which would result in determinations of the height, &c., of specific auroræ. A tabulated statement of his results shows September and February to be months of prolific auroræ, but, as he points out, September is the month of clear skies, and the prominence of February depends largely upon the year 1907. July and December are especially low. There are indications of a maximum during 1907–8–9.

BRITISH SCIENCE GUILD.

FIRST ANNUAL BANQUET.

THE Right Hon. Lord Strathcona and Mount Royal presided at the first annual banquet of the British Science Guild, which was held at the Royal Institute of Painters in Water Colours, Piccadilly, W., on the evening of Friday, May 6. Amongst those present were the Right Hon. Lord Blyth, Col. Lord Kesteven, Sir Thomas Barlow, K.C.V.O., F.R.S., and Lady Barlow, Sir David Gill, K.C.B., F.R.S., Sir Norman Lockyer, K.C.B., F.R.S., and Lady Lockyer, Sir Alfred Keogh, K.C.B., and Lady Keogh, Sir Frederick Pollock, Bart., Sir William Ramsay, K.C.B., F.R.S., Sir Boverton Redwood and Lady Redwood, Sir Philip Watts, Sir Aston Webb, C.B., R.A., and Lady Webb, Sir William White, K.C.B., F.R.S., and Lady White, Colonel Sir John Young, C.V.O., Sir Henry Trueman Wood, Prof. Perry, F.R.S., Dr. W. N. Shaw, F.R.S., Prof. W. D. Halliburton, F.R.S., and Mrs. Halliburton, Mr. and Mrs. Carmichael Thomas, Mr. Roger W. Wallace, K.C., and Mrs. Wallace, Dr. A. D. Waller, F.R.S., and Mrs. Waller, Mr. A. Bruce Joy, Mr. Dugald Clerk, F.R.S., and Dr. F. Mollwo Perkin (honorary secretary).

After the Royal toasts, proposed by the chairman, "The Peace Organisation of the Empire" was proposed by Sir William Ramsay. He regarded it as a great honour to propose that toast—a toast given there for the first time. All he could do, perhaps, was to put before them some platitudes. He knew how little he knew, and he thought he knew a great deal when he had found that out. If he talked, therefore, in platitudes, he would be no striking exception to the rule. It was, he continued, generally supposed that science was something abstruse and abstract. It was not so. It was common sense, and common sense, as they all knew, was one of the rarest of commodities. What one learnt as one grew older was how little one knew about anything. How complex the simplest things were! His attention, he continued, had been turned to physical problems where the things he dealt with were comparatively simple. He had been working on the questions of liquids and gases—things more simple than social or economic problems; and yet those ideas, simple as they were, did not often find simple expression. He instanced the case of "the square of a temperature," which, like many other such phrases, conveyed no definite idea to anybody. If that was so in simple physical science, how much more complex were the problems that faced the social reformer. In this complex world of ours he (Sir William) had the utmost difficulty in making up his mind which of two political candidates was the one to vote for. He wished that Mr. Haldane, their president, had been there to illuminate that subject. It might even be desirable, continued Sir William, to get an elector like himself to vote against both candidates—to say that neither deserved his confidence; and if they could only get a sufficient number to vote like that, then no one at all would be returned to Parliament. Men of science, continued Sir William, had a uniform mode of procedure. They had a problem suggested to them which they thought worth investigating. They ascertained what had been done before on the subject, and then proceeded to try an experiment on a very small scale. The next stage was to try the experiment on a larger scale, and if that also promised well they might be encouraged to erect a large plant and increase it to the maximum of its production. Now, he asked, did they do that in politics? He thought not. The analogy was a close one. The problems which confronted the manufacturer were very much the same as the problem which confronted the Government. They both wanted to produce an article in demand. They had a permanent staff in both cases, and they wanted to provide an article that would meet with public approval. Men were constantly improving —at least if they were not progressing they were retrogressing, as it was impossible to stand still. In chemical manufacture what was chiefly wanted was—brains. A well-known manufacturer declared that brains were indigenous to Cambridge, and that he only wished he could get a number of Cambridge men to work on the lines he would suggest. That was exactly the Government's difficulty too. Mr. Haldane recently stated he had made the discovery that not only in Parliament, but in other places, there were brains, and that there were persons who, if they would, could solve those complex problems which were so costly, and yet for which one had to find some immediate solution. Now the intelligent manufacturer—just as a Government does—provides himself with a permanent staff to keep things going; but, further than this, he brings in other people in order to consult with them if anything goes wrong, or if he has reasonable grounds for believing he can make an improvement. The person thus consulted receives a retainer, perhaps—gets so much a year and so much a job. "It is suggested," continued Sir William, "and I think it is an admirable notion, that the same plan which has proved itself successful in helping our manufacturers should be applied by the Government. There is an enormous number of people in this country who could be got by a very small retainer indeed, or perhaps feel honoured by being chosen, and when required they would be at hand to help with their advice."

The question of dirigible balloons threatened our naval supremacy, continued Sir William. What was the best way to destroy them? The natural way was to project a shell at them; but our mechanical art had not grown so perfect as to enable us to time the explosion of a shell to the thousandth part of a second, while, on the other hand, the substance of the balloon would be too soft to explode the shell by concussion on contact with the balloon itself. "I was asked," Sir William proceeded, "what was the best way to destroy those balloons, and I made several suggestions. I am perfectly willing to put any suggestions I have at the disposal of the Government for the benefit of my country, and I am sure there are hundreds of thousands in the same position who are able and willing to do something for the benefit of this country without pay." Concluding, Sir William said that the practical solution of that problem was that there should be consultative committees formed in all branches of inquiry appertaining to the national welfare, and he saw no reason even why such parties called in for consultation should not be paid just as the ordinary consultee was paid by the manufacturer when called in to tender advice. The appointment of a large number of such consultative bodies, call them what they wished, would be of inestimable advantage to the nation in solving many of the complex problems which were so baffling to the ordinary advisory resources of a Government dependent practically altogether upon its permanent staff.

Mr. Frederick Verney, M.P., responding in the absence of Sir William Mather, said it was most interesting to hear a man of science speaking on politics. He heartily agreed with Sir William Ramsay in his main contention that the Government would be immensely helped and rendered far more efficient if they had at their disposal and took advantage of the enormous amount of latent wisdom which only required to be called forth to be put at the service of the country. If England could boast of one thing more than any other nation, there was one thing which we might safely say, and that was that in no other country was so much and so good unpaid work done to-day as was done in England. It was not so desirable to increase that work as to render it more efficient for the Empire at large, and he did not believe any member of the House of Lords or House of Commons would be against that proposal. Certainly no one in England would have welcomed more warmly Sir William Ramsay's proposal than Mr. Haldane himself, as there was no statesman who had shown himself more eager to avail himself of all the science put at his disposal than the Secretary of State for War. In any case, if there was any consolation for people to be killed scientifically, they would have abundance of chance of it in due time, and in the next great war he was afraid they would have too much of it. There was one essential difference between politics and science. In politics they had nothing but uncertainties to deal with, but in science they had perhaps something tolerably certain to deal with. In politics one had to deal with human nature—with character—and thus the uncertainties of political life were the hardest to foresee and the most difficult to deal with; and the man who could fight his way through the uncertainties of politics, and could do something for the good of the nation at large, deserved well of his country, and merited the name of British statesman.

Sir Alfred Keogh, K.C.B., also responded to the toast. As to the application of science to methods of government, he was glad to hear allusion made to their distinguished president, who was the great exponent of that idea. Regarding the possibility of war with Germany, we were at present engaged in real warfare with her, but that war was being waged in the laboratories of the two countries. The German nation deserved scientifically all the admiration we could give to it. It had recognised the relation of science, not only to industries, but to methods of government and the general education of the community. The great disadvantages in this country were that our rulers and governors did not appear to be acquainted with the fact that they had at their elbow men who, over and over again, would help them in all the problems they had to solve.

Sir William White, K.C.B., F.R.S., in giving the toast "The Armed Forces of the Empire," said that that toast was not a novelty, but although he had known it by many titles, it always meant the same thing—namely, that, as British citizens, they desired to honour and remember those who gave or were ready to give their lives for the service of the country and of the empire. Behind "the armed forces of the empire," he reminded them, lay the principle of personal service, and whatever else we could give, there was one thing we could all give to our country and empire, and that was personal service. In modern times war was a very complex thing. The day had passed when personal courage alone and readiness to do or die were an assurance of victory, because nowadays so much depended upon the equipment of war, in the perfecting of which every branch almost of art and science was laid under tribute; but although the material was important, it required the man and mind to utilise it; and when the man and mind were employed in competition with others struggling for victory, it was in the highest degree important that those who served in our armed forces should be equipped mentally, scientifically, and in every way possible so as to give the fighting unit an honest chance. Those were matters, however, which depended upon the central administration, and if it was not conducted on scientific lines, then there was little hope of that object being fulfilled.

Col. Sir John Young, in responding, concurred with the proposer of the toast in regard to the importance of science to the efficiency of the naval and military forces. He was glad to say that in Mr. Haldane, at any rate, true scientific principles have had a friend who understood thoroughly the job he had to accomplish.

Sir Boverton Redwood proposed the toast of "The British Science Guild in Greater Britain." Some misconception, he said, existed still as to what the guild really was. Many people thought it was only an addition to previous learned societies. He reminded them that the British Science Guild was not a scientific society in the ordinary acceptation of the term, but was an organisation intended primarily to bring about the adoption of scientific methods in all matters of daily life, and incidentally to promote and foster the study of science by people who were not what might be called "scientific people." The term "science," however, frightened and repelled many, although it had been defined over and over again as the organised application of common sense. He cordially endorsed Sir William Ramsay's opinion that the attention given to that organised application of common sense was lamentably lacking in many quarters, from the Government downwards. Now, that state of things must not continue if the British nation was to hold its dominant position amongst the nations of the world. The British Science Guild had shown them already what ought to be done, and how to do it, and it was not only in this country that there was scope for its work. From its inception there had been a gradually increasing number of members in Greater Britain beyond the seas, and that was an exceptionally good feature of the movement. Already some action had been taken in the direction of organising those members, and branches or committees had been formed with that object in Canada and Australasia. The effect of that was to stimulate the interest they took in the guild and to bind them to the common body, and generally they had evidences that there was the opportunity for great benefit from the work of those branches in the empire beyond the seas.

The chairman, in responding, gave an interesting account of the remarkable progress of Canada since the visit of the British Association in 1884. Lord Rayleigh had, in allusion to that visit, described Winnipeg as the only city he knew where they ploughed up their streets to make them level. To-day Winnipeg had streets as good as those in London, and was thoroughly equipped in up-to-date institutions and modern conveniences of every kind. It was perfectly useless, he continued, for the unemployable, who could not or would not work, to go to Canada. There they would be absolutely lost, because everyone in Canada was a worker, but they gladly welcomed the genuine and willing worker in Canada, which was really as much England as was the Mother-country.

Sir David Gill, K.C.B., F.R.S., also responded, and said that in dealing with science and its application to practical affairs, there was not the least doubt that the temperament of men of science had been somewhat of a drawback in forcing scientific facts and principles upon the attention of mankind generally, as the man of science was apt to think he had done all he could do when he had found out scientific truths. He seemed to require something to aid him in forcing upon unwilling Governments that information which they were too ignorant to apply to national needs.

"The Guests" was proposed by Sir Frederick Pollock, Bart., and responded to by Mr. Roger W. Wallace, K.C., after which Sir Aston Webb, C.B., R.A., gave the toast of "The Chairman," to which the latter gracefully responded, thus concluding the proceedings.

CLIMATOLOGICAL REPORTS.

THE director of Chemulpo Observatory (Dr. Y. Wada) has issued the mean annual results of the valuable meteorological observations made at the Japanese stations in Corea in 1906–7 (see NATURE, April 1, 1909). The following are some of the results of air-temperature and rainfall for 1907:—

Station.	Chemulpo	Fusan	Wonsan	Mokpo	Song-chin	Yongamp
Latitude, N. ...	37° 29′	35° 6′	39° 9′	34° 47′	40° 40′	39° 56′
Longitude, E. ...	126° 32′	129° 3′	127° 26′	126° 22′	129° 11′	124° 22′
Mean max.... ...	15·1°	17·5°	16·8°	17·7°	13·2°	13·4°
Absolute max. ...	34·6	32·5	37·5	32·7	32·0	32·9
Month	VIII	VIII	V	VIII	VI	VII
Mean min. ...	7·2	9·8	6·0	9·8	4·1	4·3
Absolute min. ...	−14·5	−8·4	−18·1	−8·2	−21·4	−24·3
Month	XII	II	II	II	II	XII
Adopted mean ...	10·8°	13·6°	10·3°	13·1°	8·2°	8·6°
Total Rainfall ...	667·3	1021·2	1576·5	811·6	627·3	1029·6

The instruments and method of observation are the same as those at meteorological stations in Japan; temperatures are given in centigrade degrees and rainfall in millimetres. The mean temperature was practically normal, but the rainfall fluctuated considerably; the data for the normals for these stations only go back to March, 1904.

The report of the Mauritius Observatory for 1908 shows that the mean annual temperature, 73·6°, was practically normal; the absolute maximum was 89·1°, minimum 53·8°, maximum in the sun's rays 166·2°, on November 12. The rainfall, 62·43 inches, was 14·5 inches above the average of 1875–1908, but for the whole of the island, obtained from reports from sixty-five stations, the mean was 90 inches, being 7¾ inches above the average. Six cyclones occurred over the South Indian Ocean; during one, between February 28 and March 4, very heavy rainfall occurred over the whole island, ranging from above 45 inches at Curepipe to 9 inches at Port Louis; the tracks of three of the cyclones have been determined. Ninety-four photographs of the sun were sent to the Solar Physics Committee, and particulars of fifty-four earthquakes were sent to the seismological committee of the British Association.

The report by Mr. Iyengar of meteorology in Mysore for 1908 embodies the daily and monthly means for the second-order stations at Bangalore and Mysore, and the 8h. a.m. observations, with their monthly means, at the third-class stations at Hassan and Chitaldrug. Over the province, as a whole, the temperature of the year was practically normal; April was the warmest, and December the coldest, month. The absolute maxima and minima were 102·1° at Chitaldrug (in May) and 50·1° at Hassan (in December). The rainfall was deficient and very unequally distributed, the defect varying from 13 to 43 per cent.; in November and December there was practically no rainfall.

The report issued by the Egyptian Survey Department on the rains of the Nile Basin and the Nile flood of 1908 states that during that year rainfall was measured at eighty-eight stations in the Nile Basin, while that recorded at 118 other stations in neighbouring regions was studied in connection with the meteorological conditions of north-eastern Africa. On the whole, rainfall was deficient to the south of the equator, and the country between the Victoria and Albert lakes seems also to have received less rain than usual. On the Bahr el Jebel the annual fall was usually in excess, and in the plains of the Blue Nile some months were wetter than usual. The tables show the monthly and annual rainfall for 1908, and the means for other years so far as data are available. We have previously referred to the flood of 1908, which again reached its normal value after a series of nine low floods. An interesting chapter on earth movements at Lake Victoria is added to the report.

The report of the chief of the U.S. Weather Bureau for the fiscal year ended June 30, 1908, shows that the important work of that department has been carried on with great activity. The tables, which extend over some 390 pages, include, *inter alia*, observations made twice daily during 1907 at twenty-nine stations selected to cover as nearly as possible all sections of the United States showing distinctive climatic features, monthly and annual summaries at 188 stations, and records of excessive rainfall in short periods at stations furnished with self-registering gauges. In our issue of October 21, 1909, we directed attention to several matters referred to in the administrative report, from an advance copy published in the annual summary of the *Monthly Weather Review* for 1908. We may add that this report states that the officials of the Bureau are encouraged in giving popular lectures with the view of eradicating superstitions prevailing with regard to the weather, and that instruments and charts are now exposed in kiosks at various suitable places. The instruments comprise special forms of maximum and minimum thermometers, air thermometer, hair hygrometer, thermograph, and a special type of rain-gauge with dial indicator.

The "Meteorological Year-book" of the Deutsche Seewarte for 1908, which has recently been published, contains the results of observations at ten stations of the second order, hourly observations at Hamburg, Wustrow, Memel, and Borkum, and storm statistics at fifty-seven signal stations in the North Sea and Baltic whenever a gale was experienced over a considerable area, embracing not fewer than three of the stations. The appendices include the hourly means of wind velocity at Pillau (a seaport in eastern Prussia) for the period 1899–1908. The mean monthly values exhibit a minimum in July (4·09 m.p.s.), rising gradually to a maximum (6·29 m.p.s.) in December, and gradually decreasing again to the minimum.

From an excerpt from the "Bavarian Meteorological Year-book" for 1909 we learn that registering balloon ascents made at Munich in connection with the international scheme for the investigation of the upper air were not so successful as in some previous years, owing to unfavourable weather conditions and loss of the instruments used. Nevertheless, eighteen successful ascents were made, and the results have been very carefully discussed. Among the several interesting features shown by a preliminary summary of the results for the years 1906–9 we may refer to the mean altitude and temperature at the beginning of the upper inversion, arranged according to seasons, which were found to be as follows:—winter, 10,650 metres, −61·5° C.; spring, 9870 m., −54·9°; summer, 11,770 m., −57·2°; autumn, 11,790 m., −58·2°. The mean monthly tables show that the lowest altitude of the "stratosphere" was in March and the highest in August. An extraordinary increase in altitude, practically without change of temperature, occurs from April to May, viz. from 9470 to 11,050 metres; but owing to the few and unequal number of cases available, the results deduced can only be accepted with caution.

The first part of a series of valuable contributions to the climatology of South Germany appears in the "Bavarian Meteorological Year-book" for 1909, viz. investigations by MM. E. Alt and L. Weickmann on thunderstorms and hail, from observations made in Bavaria, Württemberg, and Baden during 1893–1907 at carefully selected stations. The discussion is carried out in great detail, with tables for geographical districts, isopleths for thunderstorm frequency in W.-E. and N.-S. directions, and by charts, but we can only refer to some of the more general results. The mean daily period of thunderstorm frequency for the whole of South Germany shows that the principal maximum occurs between 2h. and 5h. p.m., 39 per cent. of storms taking place about 3h. p.m. In the annual period the storms occur most frequently between April and September, the maxima being in June and July. With regard to hailstorm frequency, 70 per cent. of the storms occur between noon and 6h. p.m., the maxima being from 3h. to 5h. p.m. In the yearly period they occur most frequently between May and July, the maximum being in June, and, compared with the number of thunderstorms, hailstorms were comparatively rare. It may be mentioned that investigations as to a possible connection of thunderstorm frequency with the sun-spot period led to no result.

The results of the meteorological and magnetical observations for 1909 at Stonyhurst College Observatory, Lancashire, have been received. The tables are, as usual, plainly arranged, and the departures from very long averages being given render the data exceedingly valuable. The weather of the year was generally mild and quiet; the temperature of June was 3·2° below the average, and July and December were very wet, each having more than 4 inches above the average rainfall. The mean of the highest daily temperatures was 52·1°, of the lowest 40·6°; adopted yearly mean, 46·2° (0·6° below the average for the last sixty-two years). The highest reading was 75·1° (August 15), the lowest 15·1° (December 21). The total rainfall was 48·77 inches (1·84 inches above the normal). The mean disc area of sun-spots (in units of 1/5000th of the visible surface) appears at 3·8, and the mean daily range of magnetic declination at 13·5′; the mean for the year was 17° 28·5′ W. Photographic copies of noteworthy seismographs were supplied to various authorities, and would be sent to any observing station on application.

THE PROGRESS OF AGRICULTURE IN INDIA.[1]

IT would be difficult to conceive a harder task than that set before the members of the staff of the Agricultural Department of India when they first set to work to improve Indian agriculture. The native methods of working were often primitive, their seeds were impure and their crops uncertain; the ryots were uneducated, poor, and without that ambition to rise that would have gone so far to lighten the work of the newcomers; but, in spite of all this, the Department has, in the space of a comparatively few years, done a vast amount of work; it has to chronicle failures as well as successes, but the successes have largely preponderated, and we can see some of the results in the various reports that have recently been issued.

The research institute for the Indian Empire is at Pusa, an estate of more than 1300 acres bounded on three sides by a loop of the little Gundak River. It is situated in the heart of a district where intensive cultivation prevails in consequence of the favourable climatic and soil conditions, which are also indicated by the density of the population—900 to 1100 per square mile. As, moreover, the district is largely controlled by a community of indigo planters, there is little fear that cultural improvements suggested by the staff should be unnoticed. The Phipps laboratory is said to be admirably suited for its purpose; it is provided with water-power and electricity, while the soil of the experimental grounds can be made to grow practically all the important crops of the plains. The scientific staff comprises an agriculturist, a botanist, a chemist, two entomologists and a mycologist, with their supernumeraries and assistants.

In the botanical department Mr. Howard's work on wheat promises results of considerable importance both to India and to Great Britain. He has completed the classification of the Punjab wheats and has isolated some twenty-five pure types, the best of which will in time be available for general distribution. A survey on similar lines of the varieties grown in the Central Provinces, Bengal, Bombay, the United Provinces and Burma is in hand. This work is being followed by hybridisation to evolve new varieties possessing strength of straw, good cropping power, and resistance to rust. Some of the pure types which are being used as parents were found to be a great improvement on the mixed sorts previously grown, and we are not surprised to read that "large numbers of colonists came to see the plots and arranged for small supplies of seed for trial on their holdings." Not only is there the likelihood of an increased yield, but it appears that India can grow "strong" wheats such as are required in the English market, the common impression that Indian wheats are necessarily weak being erroneous. The economic results of a notable increase in wheat production of high quality can hardly be overestimated. An interesting physiological problem is also under investigation. It was found in 1908 that the same sample of Muzaffernaggar wheat sown at Lyallpur, Muzaffernaggar and Pusa gave rise to grain varying markedly in appearance, composition, milling and baking qualities. Mr. Shutt has observed similar variations in Canada. The cause can hardly lie in the amount of plant food in the soil, since no such variation is observed in going from plot to plot on the Broadbolk wheat field at Rothamsted; it must lie in some other of the factors constituting the general environment. Further investigations will be awaited with much interest.

Dr. Butler has continued the mycological work on the lines of previous years, very wisely concentrating attention on a few diseases, and carefully working out the life-history and general biology of the organisms involved. Of these, the chief are "red rot" in sugar-cane, the palm diseases, the wilt diseases of various crops, "white rust" and other diseases of citrus, the mulberry disease of Kashmir, and others. So successful has Dr. Butler been in combating the palm disease in the Godavari delta that he is considered on this work alone to have paid the cost of his department for many years to come! He has in preparation a book on Indian plant diseases that may be expected to help Indian planters considerably.

Dr. Leather was away on leave for part of the time, his place being taken by Mr. Annett. Work was continued on the losses of water from the soil, and the water requirements of plants, subjects that are obviously of fundamental importance in India. It was found also, in the first instance by pot experiments, and later by field trials, that certain soils benefitted notably by manuring with phosphates.

The task of controlling the insect pests falls to the lot of Mr. Maxwell-Lefroy, the Imperial entomologist, and Mr. Mason, with assistants for special work, but the staff is small for the work it has to do. The life-histories and habits of a number of injurious insects have been investigated, and also the influence of climatic changes on insect life and the problem of utilising beneficial insects. Attention has been devoted to seri-culture and to lac. The second entomologist, Mr. Howlett, investigates Diptera. He has ascertained the life-histories of nearly all the mosquitoes occurring at Pusa, and has, in addition, found two species of fish capable of destroying large numbers of Anopheles larvæ. The number of Diptera injurious to crops and animals is very considerable, and fully justifies the appointment of an entomologist to deal especially with them.

The improvement of the livestock and poultry of India is undertaken by the Agricultural Department under the direction of Mr. Shearer. A large and remunerative export trade in Indian cattle has recently arisen, for which the Montgomery appears especially suitable. Careful attention is therefore being devoted to this breed.

Such is a brief outline of the main lines of work at

[1] Report on the Progress of Agriculture in India for 1907–9. (Calcutta: Superintendent Government Printing, India.)
Report on the Introduction of Improvements into Indian Agriculture by the Work of the Agricultural Departments.
Report of the Agricultural Research Institute and College, Pusa, 1907–9.
Agricultural Statistics of India for the Years 1903–4 to 1907–8. 2 vols.
Report on the Operations of the Department of Agriculture, Madras Presidency, for the Official Year 1908–9.
Madras Agricultural Calendar, 1910.

Pusa. The various provinces have also agricultural departments, with scientific staffs investigating problems of local importance and methods suitable for their own districts; an example of the kind of work they do is afforded by a study of the Madras report. The methods of bringing the scientific work to the notice of the cultivators were discussed by a committee of the Board of Agriculture and collected in their report—the second on our list. Whilst they vary somewhat in the different provinces, they may be classed roughly as (1) agricultural associations; (2) local demonstrations; (3) village agencies which hire out improved implements and demonstrate their use; (4) vernacular journals controlled by the Department, those run by private enterprise not being always satisfactory; (5) leaflets, circulars, and *communiques* to the Press; (6) shows; (7) itinerant assistants, who, under suitable conditions and when working on one definite problem, have been found of considerable service; (8) seed farms and depots to do the work which seed merchants do here; (9) schools to train the sons of cultivators; (10) colonisation with expert cultivators. Like the cultivator of the soil in all countries, the ryot is conservative but not unwilling to take up a new thing that is clearly going to be of advantage; he suffers, however, sorely from lack of funds, and we are told that he often has to pay so much as 24 per cent. interest or more per annum for the money which he must borrow if he is to effect improvements. He must therefore get more than 24 per cent. return or he loses on the transaction, and so it may happen that an improvement which would be profitable elsewhere is of no advantage to him. This state of affairs can only slowly be remedied, and must for long remain a bar to the general improvement of Indian agriculture.

But when we turn to the large cultivators there is no such hindrance, and it may reasonably be expected that they will gain considerable benefit from the scientific work that is being done. To give only one instance, Mr. Bergtheil is investigating the problems of the indigo planters, and has already obtained results of value, a number of improvements having been effected of notable aggregate value. It has been shown, further, that the yield per acre can be increased very considerably by substituting the Java for the more common Sumatrana variety. By selection and hybridisation it may be possible to get even better results. The belief is expressed in the report that the natural indigo will yet compete successfully with the synthetic product.

Such large works as irrigation are outside the scope of the present reports, although of great importance to the advancement of agriculture. Work is, however, in hand on the reclamation of *reh* or alkali land, a condition that may accompany irrigation unless drainage is also attended to. Mr. Henderson is making satisfactory progress in reclaiming the very salt soils of Sind. Other important improvements are going on, and we may in the near future look for great returns for the work that is now being done.

E. J. R.

THE MESSINA EARTHQUAKE AND ITS PREDECESSORS.

ITALIAN Government Commissions have recently issued two valuable reports on the earthquakes of Calabria and Messina. One of them deals with the earthquake of November 16, 1894, a shock of great interest, but overshadowed by the disasters of 1905 and 1908. The greater part of this report, of 350 quarto pages, consists of a detailed account of the earthquake by Prof. A. Riccò. Sig. E. Camerana considers the nature and distribution of the damage to property, and suggests methods of construction that should be employed in future; Dr. M. Baratta investigates the relations of the earthquake with its predecessors; and Dr. G. di-Stefano describes the geological structure of the district. The epicentral area includes the villages of San Procopio, Santa Eufemia, and Seminara, which lie near the west coast of Calabria and about twenty miles from Messina and Reggio. The number of persons killed at these and other places was 101, and the number of wounded about a thousand, the highest death-rate, of about 5 per cent., occurring at San Procopio. The epicentre coincides nearly with that of the well-known Calabrian earthquake of February 5, 1783. The isoseismal lines of the two earthquakes were similar in form, both being flattened and compressed towards the east, and expanding in the opposite direction. The earthquake of 1783 was, however, much the stronger, the loss of life far greater (the death-rate at one place rising to 75 per cent.), and the after-shocks were five times as numerous as in 1894, were of greater intensity, and were spread over a longer interval of time. The earthquake of 1894 was, in fact, a replica, on a much smaller scale, of the greatest of all Calabrian earthquakes.

The Messina earthquake of 1908 is of far greater interest and importance than its predecessor of 1894, and it is satisfactory to find that the reports on it are being issued without undue loss of time. A Royal Commission, under the presidency of Prof. Blaserna, was appointed to investigate the sites best adapted for the re-building of the ruined towns. The report of the commission is of more than local value. As regards Messina, while recognising the unsatisfactory nature of the subsoil, it is realised that, for commercial and other reasons, the city must be re-built on its former site. It is recommended, however, that the building regulations adopted for districts of high seismicity should be rigorously enforced, and that no buildings intended as permanent dwellings should be erected on loose sands and gravels on sloping ground or within a hundred metres of the sea, and the commission also points out certain suburban districts in which the city might be allowed to expand.

Two or three of the appendices to the report are of considerable interest. In one, Sig. P. Marzolo, director of the Hydrographic Institute, compares the results of the soundings recently made in the Straits of Messina with those made in 1876–7. There are, he finds, no abrupt changes of level, but outside the Straits, to the north, the bathymetric curves of 200 and 300 metres are now much farther from both the Sicilian and Calabrian shores than they were in 1877, while the curve of 400 metres near the Calabrian coast no longer exists. Sig. Marzolo, however, refers the change to deposits from ocean currents rather than to elevation of the sea-bed. In the harbour of Messina, the bathymetric curves for the years 1903 and 1909 are practically coincident, and this is also nearly the case with the curves for 1908 and 1909 for the harbour of Reggio.

In another appendix Sig. A. Loperfido describes the results of new series of levellings, former series having been made along the same lines in 1907–8. In each case the new levellings were begun at points so distant that their altitude may be regarded as unchanged by the earthquake. In Calabria they started at Gioia Tauro (9 km. north of Palmi), and were continued round the south coast over a length of 87 km. The changes of level, at first inconspicuous, begin to exceed a tenth of a metre at Favazzina, and from this place to Saline they indicate a continuous lowering of the coast, amounting to 42 cm. at Villa S. Giovanni and 54 cm. at Reggio, with a maximum of 58 cm. about a kilometre south of Reggio. In Sicily three shorter lines of levelling were carried out, one from Capo Peloro to Messina, and the others inland from the latter city. They show a lowering of 65 cm. at the mareograph of Messina, a maximum of 71 cm. being attained about 3 kilometres farther north.

A paper by Sig. F. Eredia on Messinese earthquakes has appeared in the *Bollettino* of the Italian Seismological Society (vol. xiii., pp. 481–96). In this he describes a series of earthquakes which occurred in August, 1898, the centres of which were near Rometta, which lies seven miles south-west of Messina. Two of these shocks (on August 6 and 12) were strong enough to cause slight damage to buildings at Rometta, and before the end of the month they were followed by at least eighty slighter tremors. The centres of both shocks were beneath the Peloritan mountains. Comparing the areas most strongly shaken by them with others disturbed in April, 1893, and February, 1904, it would seem that, during the eleven years, there has been a continual northerly migration of the epicentres.

C. D.

MAGNETIC STORMS.[1]

THE magnetic needle has been described with poetic licence as "true to the pole," and few, I suspect, are aware how little it deserves this reputation. The earliest known information on this point in England dates from 1580, when Boroughs, observing at Limehouse, found the needle to point 11¼° to the east of geographical north. During the next 2½ centuries it kept moving to the west, reaching its extreme position of 24½° to west of north in 1818. It has since retraced its path, and now at Kew points only a little more than 16° to west of north.

Besides this slow secular change, there are daily changes, which are continuously recorded at a number of observatories. At a complete station there are three magnetographs, recording, respectively, declination, horizontal force, and vertical force changes. In the Kew pattern instrument each magnetograph has a separate drum and a separate sheet of paper, but the three drums are driven by a single clock, and two days' traces are usually taken on the same sheet.

In some foreign types of magnetograph, *e.g.* the Eschenhagen, which was used in the National Antarctic Expedition of 1901–4, the three elements are recorded on one drum, but only one day's record is taken on each sheet.

In my subsequent remarks I am obliged to employ a term having more than one meaning. It will be simplest to explain these by reference to the familiar daily variations of temperature. Suppose that in March we record the temperature at Kew at every hour and take a mean value for each hour of the twenty-four from all days of the month. We shall then find a regular rise from a minimum, probably at 6 a.m., to a maximum, probably at 3 p.m., and then a gradual fall to the minimum. The difference between this maximum and minimum is known as the *range* of the regular diurnal inequality for the month. On individual days, however, the hours at which the highest and lowest temperatures occur will vary, and if we take the mean of the differences between the highest and lowest temperatures of each individual day, irrespective of the hour at which they occur, we get a totally distinct range, which I shall call the mean *absolute* range.

The absolute range in any element cannot be less, and must usually be considerably greater, than the range of the regular diurnal inequality. At Kew, for instance, the mean absolute daily range of declination derived from the eleven years 1890 to 1900 was 13·6′, while the corresponding range of the regular diurnal inequality was only 8·0′.

The range of the regular diurnal inequality varies with the season of the year. Table I. shows its amplitude in the case of the declination at Kew, Batavia, and the *Discovery's* winter quarters.

TABLE I.

Range of Regular Diurnal Inequality (Declination).

Station	Lat.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	° ′	′	′	′	′	′	′	′	′	′	′	′	′	′
Kew ...	51 28 N	4·9	6·1	9·1	10·9	10·7	10·9	10·6	**11·0**	9·5	7·7	5·4	**4·5**	8·0
Batavia..	6 11 S	4·2	**4·6**	3·6	2·9	2·4	**2·0**	2·3	3·2	3·8	4·5	4·5	4·2	3·0
Antarctic	77 51 S	58·6	69·6	47·4	35·4	**27·3**	28·1	29·2	35·8	52·6	45·5	60·1	**85·2**	45·5

Remembering that in the southern hemisphere June represents mid-winter, it will be seen that the range is in all cases larger in summer than in winter.

Allowance must be made for the fact that the disturbing force required to displace the needle 1′ out of the magnetic meridian is proportional to the horizontal component H of the local magnetic force. Now the values of H in C.G.S. measure, at the epochs to which the data refer, were 0·183 at Kew, 0·367 at Batavia, and only 0·065 at the Antarctic station. Thus the disturbing force required to produce a range of 1′ at Batavia would produce a range of 2′ at Kew and of nearly 6′ at the *Discovery's* winter quarters; but, even allowing for this, the Antarctic range is much the largest of the three.

[1] From a discourse delivered at the Royal Institution on Friday, March 4, by Dr. C. Chree, F.R.S., Superintendent Observatory Department, National Physical Laboratory.

The great increase apparent as we pass from temperate to Arctic or Antarctic latitudes is even more conspicuous in the irregular movements, which, when sufficiently pronounced, are known as magnetic storms. This is illustrated by Table II.

TABLE II.

Absolute Ranges of Declination.

At Kew from 11 years				Antarctic (77° 51′ S.) from 2 years			
Percentage of Days when Range				Percentage of Days when Range			
0′–10′	10′–20′	20′–40′	over 40′	0′–30′	30′–60′	60′–120′	over 120′
31	57	11	1	7	22	32	39

As already explained, the forces required to displace the needle 1′ out of the magnetic meridian at Kew and 3′ out of the magnetic meridian at the Antarctic station are approximately equal. If, then, the disturbing forces at the two places were of similar magnitude, we should expect ranges of less than 30′ in the Antarctic to be as common as ranges of less than 10′ at Kew, and ranges above 40′ at Kew to be as common as ranges above 120′ in the Antarctic. This, it will be seen, is exceedingly wide of the mark. A single year's records in the Arctic or Antarctic is likely to supply as many large disturbances as the records of a generation in the south of England. This is one reason why so much importance attaches to continuous magnetic observations in high latitudes.

The daily amplitude of irregular magnetic changes, like that of the regular diurnal inequality, is variable throughout the year, but the seasonal variation is usually different in the two cases. This is shown by Table III.

TABLE III.

Annual Variation in Inequality and Absolute Declination Ranges at Kew, omitting Highly Disturbed Days (1890–1900).

	Winter	Equinox	Summer
	′	′	′
Inequality range	5·25	9·30	10·80
Absolute range	10·35	13·81	13·56

Each of the three seasons contains four months, March, April, September, and October being included under "Equinox."

If the days of large disturbance, averaging nineteen a year, had been included in Table III., the preeminence of the equinoctial value of the absolute range would have been greater. Kew, it should be added, is fairly representative of all stations in temperate latitudes.

When we pass to days of large disturbance, the prominence of the equinoctial season in temperate latitudes becomes accentuated. This is shown by Table IV., which gives the seasonal distribution of the 721 magnetic storms recorded at Greenwich from 1848 to 1903, as calculated from the lists drawn up by Mr. W. Ellis and Mr. E. W. Maunder, with corresponding results for Batavia from 1883 to 1899, obtained by Dr. Van Bemmelen.

TABLE IV.

Seasonal Distribution of Magnetic Storms.

Place	Epoch	Percentage of all Recorded		
		Winter	Equinox	Summer
Greenwich	1848–1903	32	42	26
Batavia	1883–1899	33	35	32

Out of every 100 storms recorded at Greenwich, forty-two occurred in the four equinoctial months.

The seasonal variation seems to diminish as we approach the magnetic equator, and but little remains of it at Batavia.

When we pass to high latitudes the preeminence of the equinox as a season for magnetic storms seems to disappear entirely. This is shown by Table V., which compares declination results at Kew and at the *Discovery's* winter quarters.

TABLE V.

Percentage of Days having Range above 20′ at Kew, and above 120′ at the "Discovery's" Winter Quarters (77° 51′ S.).

Station	Mid-Winter	Equinox	Midsummer
Kew	12	16	9
77° 51′ S.	24	31	81

At Kew, out of every 100 days at midsummer (May to July), only nine had an absolute range above 20′, the corresponding figure for the four equinoctial months being sixteen, or nearly double; but in the Antarctic eighty-one out of every 100 days at midsummer had a range exceeding 120′, while the corresponding figure for the equinoctial months was only thirty-one.

The phenomena of magnetic storms appear, at least at some stations, to be largely influenced by the hour of the day. Table VI. gives some figures for Greenwich derived from the hours of beginning and ending in Mr. Maunder's lists for the years 1848 to 1903, as well as some figures which Dr. Van Bemmelen has given for Batavia.

TABLE VI.

Diurnal Variation in Magnetic Storms.

Station	Local time	Percentage of Total Occurrences		
		1-8 p.m.	9 p.m.-4 a.m	5 a.m.-noon
Greenwich ...	Beginning	60	22	18
	End...	9	45	46
Batavia ...	Beginning	30	25	45
	End...	18	55	27
	Maximum intensity	33	43	24

At Greenwich no less than 60 per cent. of the storms commenced during the eight hours 1 to 8 p.m., while only 9 per cent. then ended.

There is yet another influence on magnetic changes which requires to be considered, viz. sun-spots.

TABLE VII.

Connection between Sun-spot Frequency and Declination Ranges.

Year	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
Sun-spot frequency (Wolfer)...	7·1	35·6	73·0	**84·9**	78·0	64·0	41·8	26·2	26·7	12·1	5·5
Diurnal inequality range—											
At Kew	7′·3	8′·5	9′·8	**10·7**	9′·8	9′·5	8′·5	7′·8	7′·6	7′·3	6′·8
At Pavlovsk ...	6·3	7·3	8·7	**9·6**	8·6	8·2	7·4	6·8	6·3	6·0	6·2
Absolute daily range—											
At Kew	10·7	13·7	**17·7**	15·6	16·5	15·6	14·5	12·1	12·3	11·3	9·2
At Pavlovsk ...	12·1	16·0	**21·0**	17·8	20·4	18·1	17·5	14·6	14·7	13·1	10·5
At Pavlovsk—											
Mean range in month	28·2	46·3	**93·6**	48·3	84·1	47·4	52·4	43·8	46·6	38·3	32·8
Total range in year	42·1	92·3	**194·0**	87·1	145·6	73·9	88·7	101·1	118·9	63·8	94·2

While Prof. Wolfer's figures are given in Table VII. as a measure of sun-spot activity, it may be added that closely parallel results would be derived from the Astronomer Royal's figures for sun-spot areas. There was a well-marked maximum in 1893. The remarkable parallelism between the changes in sun-spot frequency and in the diurnal inequality ranges appeals to the eye.

Passing to the absolute daily range, we have a quantity which is considerably influenced by magnetic storms. Here, again, the ranges in the years of many sun-spots are conspicuously the larger, but the parallelism with sun-spot frequencies is less close. 1893, the year of sun-spot maximum, shows at both Kew and Pavlovsk a distinctly smaller absolute range than either of the adjacent years, especially 1892. Of the last two lines in Table VII., the first gives the arithmetic mean of the differences observed at Pavlovsk between the extreme positions of the compass needle during each month of the year, while the second gives its total range during the year. In both cases 1892 occupies the premier, and 1894 the second, position. 1893 lags far behind; in the case of the annual range it even follows 1900, which had the smallest sun-spot frequency of the whole eleven years. The close parallelism visible between sun-spot frequency and the regular diurnal inequality becomes more and more obliterated as we pass from the regular to the less regular, and from these to the highly irregular daily changes of terrestrial magnetism.

A general parallelism between sun-spot frequency and the range of the regular diurnal inequality is far from proving any intimate connection between the two phenomena on the same day. Table VIII. gives the results of an attempt to find out whether the parallelism extends to individual days' results.

TABLE VIII.

Relation of Sun-spot Area (Greenwich) to Absolute Declination Range (Kew) on same Day and on Three Subsequent Days.

	Algebraic excess of range over mean from all days							
	10 days (each month) of largest spot area				10 days (each month) of least spot area			
	Same day	1 day after	2 days after	3 days after	Same day	1 day after	2 days after	3 days after
11-year mean	+0′·17	+0′·25	+0′·48	+0′·53	−0′·32	− ′·45	−0′·38	−0′·35
1894	+1·23	+1·55	+1·61	+1·69	−1·44	− ·92	−1·62	−1·36
1895	−0·85	−0·22	+0·c6	−0·17	+1·19	+1·4	+1·29	+0·92

The days of each month were divided into three groups. The first group included the ten days in which the Greenwich sun-spot areas were the largest, the third group the ten days in which they were least. If any close parallelism existed between the solar and magnetic phenomena on the same day, we should expect the mean of the absolute declination ranges from the first group of days to be much larger than the mean for the whole month, and that from the third group to be much less. Taking all the months of the years 1890–1900, there is a difference in the direction indicated, but it is exceedingly small.

To provide for the possibility that the solar influence takes one or more days to travel to the earth, mean declination ranges were formed, not merely for the ten days of largest or smallest sun-spot area, but also for the ten days immediately following these, for the ten days separated by two days, and yet again for the ten days separated by three days, from the days constituting the sun-spot groups. The results appear in Table VIII., and are somewhat more favourable for an association between the magnetic phenomena and the solar phenomena two or three days previously than for an association between the phenomena on the same day. Individual years, however, e.g. 1894 and 1895, give conflicting results.

In the preceding discussion declination has been chiefly referred to, because it is the most familiar element. In some respects, however, declination records during magnetic storms are inferior in interest to those of horizontal force. Fig. 1 shows two successive days' records—November 12–14, 1894—of this element at Kew. The first day's trace, which was quiet, helps to bring out two important features. A little after 2 p.m. on November 13 there is a very small decrease of force (downward movement), followed by a much larger increase. These sudden commencements to storms are not unusual, and seem to occur simultaneously all over the earth. The type at most stations is very similar. The initial slight fall in force is only sometimes seen; the rise is generally substantial. In the Antarctic the oscillatory character is unusually prominent.

By 8 or 10 a.m. of November 14 the disturbance is practically over, but the force shows a marked depression compared to its value at the same time on the previous day. This is a very common after-effect of magnetic storms; the greater part of the depression usually disappears in two or three days. Fig. 1 is a good example of an ordinary disturbance in which the magnetic changes, though considerable, were seldom rapid. It differs conspicuously in this respect from the recent great storm of September 25, 1909. Many of the movements on this occasion were too rapid to be shown clearly in the photographic traces.

Dr. Schmidt, the leading German authority on our subject, assigns to this recent storm the first place of all recorded since the Potsdam Observatory came into existence some twenty years ago. Table IX. gives his estimate, on an arbitrary scale, of the intensity of the seven largest storms recorded at Potsdam.

TABLE IX.

Dr. Ad. Schmidt's Estimate of Intensity of Magnetic Storms.

Date of Storm	Disturbance at Potsdam	Date of Storm	Disturbance at Potsdam
September 25, 1909 ...	3800	September 11, 1908...	1520
October 31, 1903 ...	2860	August 20, 1894 ...	1410
February 14, 1892 ...	over 1800	February 9, 1907 ...	1340
July 20, 1894	1580		

An old question which has received a good deal of recent attention is whether there is a cyclic period approaching a month in the occurrence of magnetic storms. J. A. Broun, an early pioneer of magnetic work, believed his observations to indicate a period of about twenty-six days. From an elaborate study of many years' storms at Greenwich, Mr. E. W. Maunder deduced a period of 27·275 days, and Mr. Arthur Harvey independently, from a study of storms at Toronto, deduced the remarkably similar period of 27·246 days. The latest result of this kind is due to the eminent German magnetician already mentioned, Dr. Schmidt, who believes in a period of 29·97 days. Schmidt found evidence of this period in a number of recent storms, and he declares that it exists in the case of very large storms even when separated by many years. He found that the dates of occurrence of five out of the seven largest storms recorded at Potsdam (see Table IX.) could be deduced to a high degree of accuracy from the expression $2410{,}000+3031{\cdot}0+n\times 29{\cdot}97$, which counts time in days from the commencement of the Julian era.

Fig. 2, which serves as a chronicle of magnetic history at Kew from August 20 to November 16, 1909, will illustrate some of the difficulties in the way when one attempts either to prove or disprove the existence of a period in magnetic storms.

The upper curve shows the value each day of the absolute declination range at Kew, the lower the value at each midnight of the horizontal force. We see incessant variations from day to day, and the number of days in which the declination range conspicuously overtops the average is considerable. During these days there is usually a distinct fall in the horizontal force, a circumstance also indicative of magnetic disturbance. The following days were considerably disturbed:—August 29, 30, September 21, 25, 30, and October 18, 19, 23, 24; while a variety of other days, *e.g.* August 31 and October 2, 8, and 9, were decidedly more disturbed than the average. If we associate August 30 and September 25 we get a twenty-six-day period; if we associate August 29 and September 25, or September 21 and October 18, we get a twenty-seven-day period; if we associate August 31 and September 30 we get a thirty-day period; and we have any number of other possible combinations left. Disturbed conditions are seldom limited to a few hours of a particular day, and often extend over two or more days. Thus there is usually a good deal that is arbitrary in the value deduced by observation for the interval between two specified storms.

The disturbances of September 21, 25, and 30 led to a fall in the horizontal force, from which it is doubtful whether the element had entirely recovered even by the middle of November.

Mr. Maunder and Dr. Schmidt both associate their periods with that of the revolution of the sun relative to a point on the earth. This period exceeds the true period of the sun's rotation—which varies considerably with solar latitude—because the earth is travelling round the sun in the direction in which the sun rotates.

The view most in favour at the present time is that magnetic storms are due to some solar discharge, probably from sun-spot areas, and of an electrical nature. We may suppose a solar discharge to traverse space like a jet of water; when it overtakes the earth a magnetic storm begins, which continues until the full width of the jet has passed over. If the solar discharge continues long enough, it may sweep over the earth during several successive revolutions of the sun, and so give rise to a series of magnetic storms at nearly equal intervals.

Theories accepting a solar origin for magnetic storms differ as to the nature of the solar discharge.

Nordmann has suggested Röntgen rays, Birkeland kathode rays, and Arrhenius negatively charged particles. On Nordmann's hypothesis the terrestrial phenomena should follow the solar in a few minutes, on Birkeland's hypothesis in a few hours, while according to Arrhenius the interval might be two days or more.

The most elaborate investigation hitherto made into the supposed solar origin of magnetic storms is due to Prof. Kr. Birkeland, of Christiania, who believes kathode or analogous rays to be the vehicle by which the solar disturbance is propagated to the earth. He has made numerous experiments with kathode rays in a vacuum tube which contains a miniature earth or "terrella." By means of electric currents in wires wound on the terrella, a magnetic field is produced similar in type to the earth's field. It was apparently his experiments that suggested his explanation of a certain type of magnetic storm which he terms the "equatorial." These "equatorial" disturbances are,

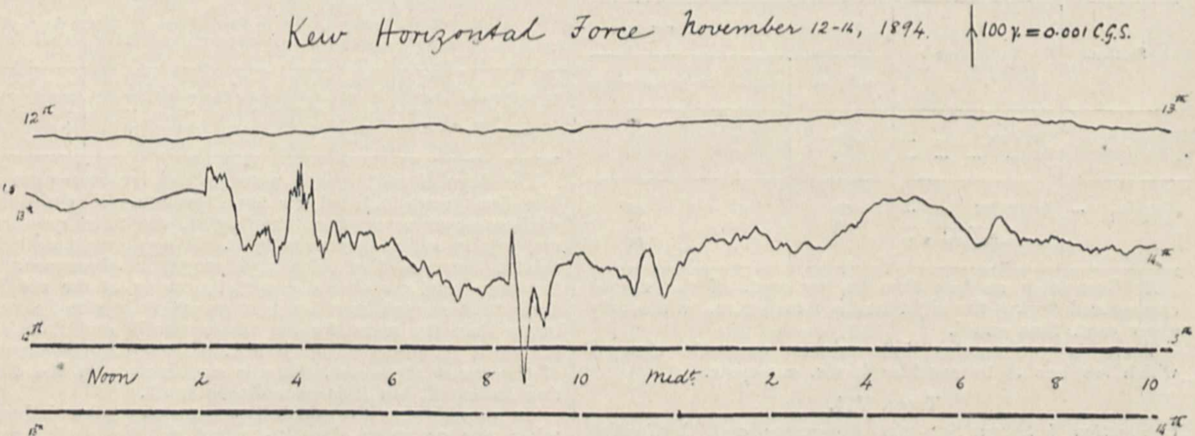

FIG. 1.

he says, normally largest in the earth's equatorial regions, where they consist mainly of a change in the horizontal force, but they are also well marked in temperate latitudes. The cause postulated by Birkeland is a circular electric current in the plane of the earth's magnetic equator, at a

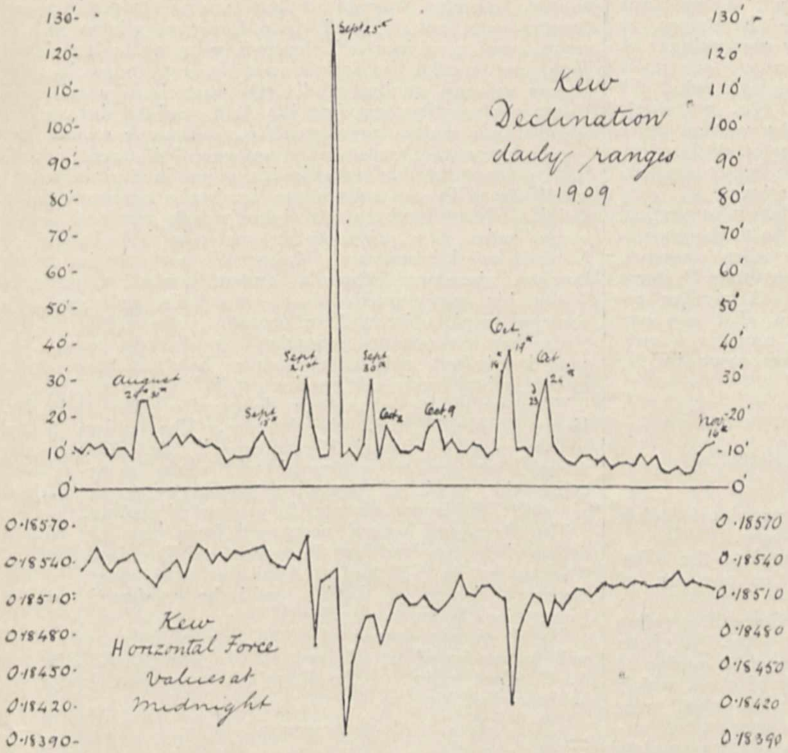

FIG. 2.

height of several thousand miles. An objection to this explanation is that, according to Prof. Carl Störmer's[1] analysis, it is impossible for kathode rays emanating from the sun to reach the earth's atmosphere at all, except in a narrow band round each magnetic pole. The larger the mass and the greater the velocity of the particle for a given electrical charge, the nearer can it approach the earth in the equatorial plane, and the larger is the radius of the zone surrounding each magnetic pole within which the particle can actually reach the earth. The β particles of radium, from their higher velocity, have more penetrating power than ordinary kathode rays, and are, in their turn, eclipsed by the α rays, the lesser velocity of which is more than compensated by their larger mass. According to Störmer, the greatest angular distance from a magnetic pole at which average kathode rays emanating from the sun can reach the earth is only 2·4°, while the corresponding angular distances for β and α rays are respectively 4·1° and 12·7°.

Undeterred by these mathematical results, Birkeland assumes that a type of magnetic disturbance, which he calls the "polar elementary" storm, is due to kathode rays from the sun which get within a few hundred kilometres of the earth's surface at considerable distances from a magnetic pole. The paths of approach and retreat are supposed to be radial, and the connecting part horizontal. These "polar elementary" storms were observed on a good many occasions at four temporary Arctic observatories provided with magnetographs, which Birkeland was able to keep in action during the winter 1902–3. The characteristics of "polar elementary" storms are their comparatively simple character and short duration, and the fact that their amplitude—unlike that of Birkeland's "equatorial" storms—is much larger in the Arctic than elsewhere. These storms have at least a general resemblance to a special type of disturbance[1] of which I found numerous examples in the records of the National Antarctic Expedition of 1901–4.

Birkeland found that frequently, after an "equatorial" storm had been in progress for some hours, one or a series of "polar elementary" storms intervened. He obtained copies of the curves taken at a number of observatories on the days of the disturbances recorded by his Arctic stations, and he has reproduced these with his own records in a most valuable series of plates published in his recent monumental work, "The Norwegian Aurora Polaris Expedition, 1902–3," vol. i.

Whilst recognising to the full the devotion with which Prof. Birkeland has prosecuted his investigations into magnetic storms for more than a decade of years, and while admiring the beauty of his experiments, I have to admit that I do not find his explanations convincing. If "equatorial" storms are due, as he believes, to electric currents at great heights above the earth in the magnetic equator, the disturbing force, while approximately horizontal and in the magnetic meridian at places near the magnetic equator, should, even in temperate latitudes, have a considerable vertical component, and near the magnetic poles the vertical component should largely predominate. I am unable to see these phenomena in the curves of Birkeland's own plates. Further, during the time of Birkeland's Arctic expedition the *Discovery* was at work in the Antarctic, and the simultaneous results obtained there do not seem capable of explanation on his hypothesis.

Fig. 3 affords one out of a number of examples of this.

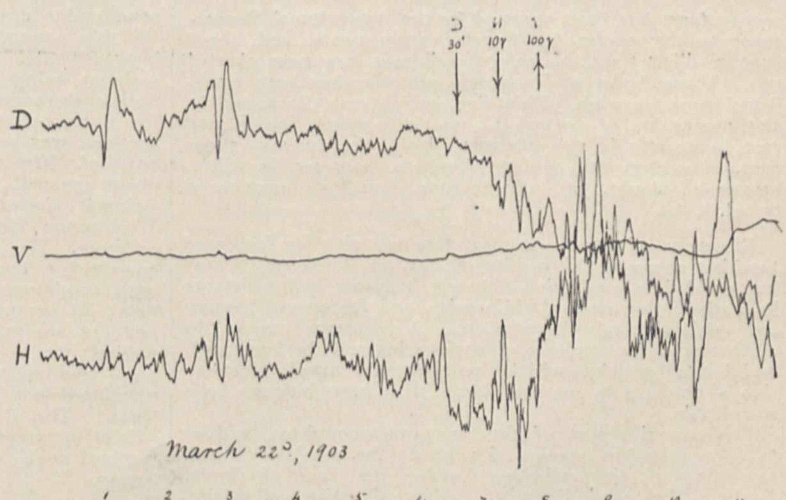

FIG. 3.—Magnetic Storm in Antarctic.

It shows the declination (D), vertical force (V), and horizontal force (H) traces at the *Discovery's* winter quarters on March 22, 1903, during a magnetic storm which forms

[1] *Archives des Sciences physiques et naturelles*, Geneva, 1907.

[1] "National Antarctic Expedition, 1901–4." Magnetic Observations, p. 186.

the subject of Birkeland's Plate xx. Birkeland's curves, representing stations from 77° 41′ N. to 43° 32′ S. lat., all show two small but singularly distinct movements at about 1 p.m. and 2.45 p.m. G.M.T. These he ascribes to an "equatorial" storm. Now if these storms were due, as he supposes, to an overhead current in the plane of the magnetic equator, the vertical force disturbance, as we have seen, ought to have been largely predominant at the Antarctic station, which was only about 400 miles from the south magnetic pole. This is exactly what did not happen. Two movements occur in Fig. 3 exactly synchronous with those elsewhere, but the vertical force movements are much smaller than those in declination, and the disturbance in the horizontal plane is not smaller, but much larger than at the equatorial stations.

Interest also attaches to the large oscillation in vertical force between 9.30 and 11.30 p.m. G.M.T. with the accompanying considerable movements in the other elements. This is precisely the time of a "polar elementary" storm recorded at Birkeland's Arctic stations. A similar coincidence occurred on so many occasions that one can hardly suppose it to be accidental. This suggests a very intimate connection between magnetic phenomena in the Arctic and Antarctic.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. H. Jeans has been appointed Stokes lecturer in mathematics from midsummer, 1910.

Mr. W. B. Alexander has been appointed to the office of assistant to the superintendent of the museum of zoology.

The third annual report of the Forestry Committee refers to the work carried on during the past year. In June last the reader, Mr. A. Henry, commenced a series of experimental sowings of the different kinds of elms, which have yielded interesting results, showing that what were supposed hitherto to be varieties of one species, of unknown origin, are in reality combinations of two species, in which the Mendelian ratios are observed. Incidentally, these experiments have directed attention to the astonishing vigour displayed by certain first-crosses in trees, all of which hitherto had arisen in the wild state. An attempt is being made this year to produce artificially similar hybrids in the case of the more valuable kinds of trees, and for the first time, almost, the production of new breeds of forest trees is being tried. A plot on the University farm has been assigned by the Agricultural Department to the reader for forestry experiments, and about 5300 seedling trees, of known pedigrees, are now planted out. A small plot of *Eucommia ulmoides* has been established near Norwich. This tree, which was discovered in the mountains of central China, is perfectly hardy and fast in growth in this country. Its bark produces 5 per cent. of rubber, the quality of which, however, is still a matter of doubt, as only minute quantities have been tested.

GLASGOW.—In order to meet the necessity for increased teaching power in the faculty of arts, the University Court has decided to establish eight new lecturers and assistants in mathematics, natural philosophy, and the several literary and philosophical departments. A separate course in mathematics for students of engineering will be instituted, and better provision will be made for the tutorial instruction of students in smaller classes than have hitherto been practicable.

The annual report of the museums committee testifies to a considerable amount of work in the cataloguing and arranging of the collections under the care of Profs. Graham Kerr and Gregory. Gifts of entire collections, associated with the names of David Ure, Webb Seymour, and Mackenzie, have enriched the geological museum.

At the observatory a new house has been erected for the fine Corbett equatorial.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting M. Émile Cartailhac for the degree of D.Sc. *honoris causa* on May 10:—

"Nulli profecto ex eis qui hodie hominum naturae student posthabendus est Aemilius Cartailhac. Qui vir annos viginti quattuor natus commentarios in hoc genere apud Gallos eo tempore maximi habitos, in quibus gentium incultarum mores et vetustatis obsoletae reliquiae tractabantur, edendos suscepit. Quo munere viginti annos functus, cum res ex omni parte terrarum allatas scrutaretur, cum in ea loca ubi eiusmodi monumenta invenienda sunt ipse multas peregrinationes faceret, adeo incendit civium suorum studia ut diversis auctoribus quasi symbolam conferentibus maxima illa Acta conflata sint, quibus edendis ipse multos annos praefuit, quibusque etiam nunc curam impertit. Academiarum quoque Gallicarum rectoribus persuasit ut discipulos in his rebus institui iuberent: ipse Tolosae in sua urbe atque Academia iuniorum studia dirigit. Nihil profecto his diebus magis admirati sumus quam rudes illas picturas in cavernis ubi habitabant homines pristini inventas. Huiusmodi monumentis, quibus maxime abundant Hispania septentrionalis et australis Gallia, hic noster maximam operam dedit, eademque pulcherrime expicta in medium protulit. Iure igitur hic vir tanta doctrina ornatus, scientiae tam deditus, apud cives suos iamdudum nobilis, ubicunque homines haec studia colunt insigni laude celebrandus est."

The first Halley lecture was delivered on May 10 by Dr. Henry Wilde, F.R.S., the founder. The subject of the lecture was "Celestial Ejectamenta." Dr. Wilde maintained that comets originated within the solar system, being the result of explosive discharges from planets, especially the larger planets, in process of cooling.

The Romanes lecture, postponed from May 18, will be delivered by ex-President Roosevelt on Tuesday, June 7. The subject is "Biological Analogies in History." The honorary degree of D.C.L. will be conferred on the lecturer on the same occasion.

The honorary degree of D.Sc., as already announced, will be conferred on Messrs. P. H. Cowell, F.R.S., and A. C. Crommelin, of the Royal Observatory, Greenwich, on Saturday, May 21.

AMONG many other matters of interest dealt with in the second volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1909, special attention may be directed to the gifts and bequests made during the year to promote higher education in America. The total value of all benefactions recorded as having been received by the 606 universities, colleges, and technical institutions reporting to the Washington Bureau in the year under consideration amounted to about 3,561,000*l.* Of this amount, 806,000*l.* was given for buildings and improvements, and 2,244,000*l.* for endowment, the remainder being for current expenses. Thirty-six institutions each received 20,000*l.* or more, and together accounted for 1,972,000*l.* of the above total. Yale University, Connecticut, was helped most generously, having received some 254,600*l.* The University of Virginia was credited with about 157,500*l.*, while the University of Chicago, Illinois, Grinnell College, Iowa, Bowdoin College, Maine, and Washington University, Missouri, each received 100,000*l.* or more. We notice that the 606 institutions referred to employed a teaching force of 26,369, and had an aggregate enrolment of 308,163 students. Of the 606 institutions, 89 are under the control of States or municipalities and 517 are managed by private corporations. It will be noticed that several prominent universities supposed to have received very large gifts during the year are not mentioned in this summary of the official record of benefactions. The Commissioner of Education points out that official statements of the amounts reported to have been received could not be obtained by the Bureau at Washington.

IN the issue of *Science* for April 29 Prof. Guido H. Marx publishes a table showing the attendance of students at American and foreign universities during the session 1906–7. The figures of attendance were furnished to the U.S. Commissioner of Education by the editor of "Minerva." Prof. Marx recognises the probability that the totals he gives may understate, rather than overstate, the attendance in some of the countries which have not published complete official statistics. The United States is placed first on the list with 212,956 students in institutions of higher education, or one such student to 394 of the population. Of the larger European countries France takes first place with 50,935 students, or one to 771 of the population. Germany comes next, where, including "hearers," the numbers are 73,020 and 830 respectively. Then we have in order Austria-Hungary, 51,691 and 909; Italy, 33,174 and 1014; United Kingdom, 41,305 and 1068; Spain, 15,642 and 1204; and the Russian Empire, 54,208 and 2754. Prof. Marx points out that the total in the case of the United Kingdom excludes 22,159 evening students, and that Prof. B. Menschutkin, writing to NATURE, claimed 76,900 students for the year 1908–9 for Russian higher educational institutions, with the surmise that possibly there were 20,000 more in private higher colleges.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 22.—Prof. H. L. Callendar, F.R.S., president, in the chair.—W. A. **Scoble**: Further tests of brittle materials under combined stress. A former paper described tests on cast iron, which is the brittle material which is most commonly employed in engineering practice. The tests described in the present paper were made on hardened cast steel. The specimens were ⅞-inch diameter and 30 inches effective length, and were tested under combined bending and torsion. Neither the maximum shear stress nor the maximum strain was constant at fracture, but the results indicated that the maximum principal stress is the best criterion of strength for a brittle material under combined stress. In general, the hardening did not affect the strength of a bar to resist bending, but it doubled the torque which was required to cause failure.—C. **Cheneveau**, with an appendix by A. C. **Jolley**: The magnetic balance of MM. Curie and C. Cheneveau. This balance is intended for the determination of the coefficient of specific magnetisation, susceptibility, and permeability of feebly paramagnetic and diamagnetic bodies. The body under investigation is suspended from one arm of a torsion balance, which measures the force exerted on the body when it is placed in the non-uniform field of a permanent magnet. The torsion balance is formed by a horizontal rod suspended by a long fine platinum wire, and carrying at one end a hook from which the substance under investigation can be suspended in a small enclosing glass tube. On the other end of the torsion arm a copper sector is fixed which moves between the poles of an auxiliary magnet, and thus provides efficient damping. A second branch arm is also provided, upon which may be placed suitable counterweights to balance the specimen. The suspension carries a mirror, and the movements are read on a translucent scale in the ordinary way.

Zoological Society, May 3.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Dr. H. B. **Fantham**: (1) The morphology and life-history of *Eimeria* (*Coccidium*) *avium*, a sporozoon causing a fatal disease among young grouse. A detailed account of the morphology and life-history of the Coccidium which destroys the epithelial lining of the duodenum and cæca of grouse chicks, causing enteritis accompanied by diarrhœa. (2) Observations on the parasitic protozoa of the red grouse (*Lagopus scoticus*). Observations on some seven other protozoa parasitic in the blood or in the digestive tract of grouse. None of these parasites, however, could be said to be either numerous or very harmful to the birds examined. (3) Experimental studies on avian coccidiosis, especially in relation to young grouse, fowls, and pigeons. The results of many and varied experiments were recorded in this paper, relating to the time of ripening and duration of infectivity of coccidian oöcysts, their dispersal by insect larvæ, &c., and the effects of various reagents on the oöcysts. The distribution of the parasites within the host was given, and the results of the transmission of grouse coccidiosis to young fowls and pigeons were set forth. (4) Observations on the blood of grouse. The various blood-cells were described, and the results of blood counts (both of red cells and of leucocytes differentially) of healthy and diseased birds were set forth. Both coccidiosis and strongylosis produce anæmia, and the presence of various parasites is also associated with numerical differences in the leucocytic elements of the blood.—Prof. G. O. **Sars**: Report on the Ostracoda collected by the third Tanganyika expedition during 1904–5.—Dr. R. **Broom**: Tritylodon, and on the relationships of the Multituberculata. The author had re-examined the type and only known specimen of Tritylodon, and in one or two points came to different conclusions from Owen and Seeley. Gidley's recent paper on Ptilodus was criticised at some length, and an endeavour made to controvert his conclusion that Ptilodus is allied to the diprotodont marsupials. It was held that while the multituberculates are doubtless very unlike the living degenerate monotremes, they are more primitive than the marsupials, and not at all closely allied to them, and that until the evidence of their affinities is much greater than at present they may well be left as an independent order.

Linnean Society, May 5.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—H. **Scott**: Eight months' entomological collecting in the Seychelles.—J. M. **Brown**: Some points in the anatomy of the larva of *Tipula maxima*; a contribution to our knowledge of the respiration and circulation in insects.

DUBLIN.

Royal Dublin Society, April 26.—Dr. J. M. Purser in the chair.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the year 1909. Among the species recorded are the chalcid fly, *Megastigmus strobilobius*, from silver fir-seed, in the county of Wicklow, and the root-knot eelworm, from tomatoes in a greenhouse at Belfast.—W. R. G. **Atkins**: The cryoscopic determination of the osmotic pressure of some plant organs. A number of fruits and underground organs were pressed, and the freezing points of the juices determined with Beckmann's apparatus. The mean molecular weights of the solutes were also obtained. The pressures in the same organs of different samples of the same species were found to be tolerably constant, as were also the mean molecular weights. Pressures ranging from 5·94 to 29·53 atmospheres were met with in fruits, and from 6·47 to 18·67 atmospheres in underground organs, while the mean molecular weights varied from 76 to 304 in the whole series.—Dr. W. E. **Adeney**: Studies of "streaming" of dissolved atmospheric gases in water.

PARIS.

Academy of Sciences, May 9.—M. Armand Gautier in the chair.—Gaston **Darboux**: A particular class of triple orthogonal systems.—M. Jean Bosscha was elected a correspondant in the section of physics in the place of the late M. Crova.—A. **Bernard** and P. **Idrac**: A second series of researches on Halley's comet and its spectrum made at the Observatory of Meudon. Details of observations following the changes in spectrum and structure commencing on January 7, and carried on to May 7.—J. J. **Landerer**: The polarisation of the light from the moon. A reply to criticisms of the method published in 1889.—M. **Coggia**: Observations of Halley's comet made at the Observatory of Marseilles with the 26-cm. Eichens equatorial. Positions of the comet and comparison stars are given for April 16, 17, 18, 21, 23, 26 to 29, and May 2 to 6. The comet could be seen with the naked eye on April 23 as a star of the third magnitude; on April 26 it had increased in brightness to the second magnitude, with a tail of about 1°. By May 5 the tail was about 10° long.—Paul **Pascal**: The magnetic analysis of some chromophoric groups. A double linkage always reduces the diamagnetism. The application of this to the study of some colouring matters appears to show that the existence of a marked coloration is nearly always correlated with a quinonoid structure, at least in bodies containing oxygen. —Daniel **Berthelot** and Henri **Gaudechon**: The chemical effects of the ultra-violet rays on gaseous bodies. Polymerisation reactions. The action of the ultra-violet rays from a quartz mercury arc lamp on acetylene, cyanogen, and ethylene, either alone or mixed with indifferent gases, and contained in a thin quartz tube, has been proved to result in polymers being formed. The residual gas in all cases was pure, the polymers formed depositing on the sides of the tube in liquid or solid form. Oxygen under these conditions was proved definitely to give rise to ozone. —Pablo-Martinez **Strong**: The colloidal nature of the chromopolysulphuric acids. It is shown that these acids possess the properties of true colloids.—V. **Volmar**: Some trialkylacetonaphthones and their decomposition by sodium amide. Ketones of the general type

$$C_{10}H_7—CO—C(R_1R_2R_3)$$

have been prepared. These are all split up by the action of sodium amide, the α isomers giving products corresponding to those obtained from the trialkylacetophenones, whilst with the β products the inverse reaction takes place.—V. **Grignard** and L. **Zorn**: The action of thionyl chloride on mixed organo-magnesium compounds. Aromatic magnesium compounds give rise to sulphinones; fatty compounds give a mixture of sulphinone, sulphide, and alcohol. —P. **Freundler**: The chloranthranilic esters and their condensation with nitroso-benzene.—M. **Tiffeneau**: The action of dehydrating agents on some α-glycols.—L. **Lutz**: The mode of formation of gum in Tragacanthoides.—Raoul **Combes**: The part played by oxygen in the formation and destruction of the anthocyanic red pigments in plants. The experiments described prove that when the anthocyanic pigments are formed the oxygen is retained by the organs in process of reddening, and there is at this time an increase in the activity of the oxidation phenomena in these organs. These results confirm those of Molliard.—Vital **Boulet**: The endotroph mycorhizes of some fruit trees.—Henri **Coupin**: The growth of some moulds in oil. The growth of the moulds used in oil resembled the growth in water more than that in air.—M. **Marage**: The development of the energy of the voice. The energy of the voice is proportional to the volume of air expelled from the lungs and the pressure exerted upon it. Respiratory exercises are described for increasing the capacity of the lungs and for strengthening the muscles of the abdominal wall.—Armand **Dehorne**: The longitudinal division of the chromosomes in the spermatogonia of *Sabellaria spinulosa*.—J. P. **Bounhiol**: The thermic region of the Algerian coast. The distribution of the temperature of the sea off the Algerian coast has been studied with a view to the establishment of the sardine in these waters. —G. **Baudran**: The Koch bacilli. A glycerophosphate medium. Maximum doses of iron and alumina.—C. **Gerber**: The caseification of raw milk by the ferments from boiled milk.

DIARY OF SOCIETIES.

MONDAY, MAY 23.

VICTORIA INSTITUTE, at 4.30.—Heredity and Eugenics: the Rev. Prof A. Caldecott.

TUESDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Earth-tides: Prof. A. E. H. Love, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.—Observations on the Anatomy and General Biology of some Members of the larger Cetacea: D. G. Lillie.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905. Report on the Rotifera: C. F. Rousselet—(1) The Marine Fauna of the Mergui Archipelago, Lower Burma, collected by Jas. J. Simpson and R. N. Rudmose-Brown, University of Aberdeen, February to May, 1907: The Hydroids; (2) Hydroids from Christmas Island, Indian Ocean, collected by Dr. C. W. Andrews, F.R.S., in 1908: J. Ritchie.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

WEDNESDAY, MAY 25.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Daily Rainfall at the Royal Observatory, Greenwich, 1841–1903: W. C. Nash.—Low Temperature Periods during the Winters 1908–9 and 1909–10: L. C. W. Bonacina.—The Rate of Rainfall at Kew in 1908: R. Corless.

GEOLOGICAL SOCIETY, at 8.—Dedolomitization in the Marble of Port Shepstone (Natal): Dr. F. H. Hatch and R. H. Rastall.—Recumbent Folds in the Highland Schists: E. B. Bailey.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

ROYAL SOCIETY OF ARTS, at 8.—Persia and the Regeneration of Islam: Bernard Temple.

THURSDAY, MAY 26.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: Alterations of the Development and Forms of Plants as a Result of Environment: Prof. G. Klebs.

ROYAL INSTITUTION, at 3.—The Constitution and Internal Structure of Alloys: Dr. W. Rosenhain.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The People of Burma: Sir Richard Carnac Temple, Bart., C.I.E.

FRIDAY, MAY 27.

ROYAL INSTITUTION, at 9.—The Forthcoming Antarctic Expedition: Capt. R. F. Scott, R.N., C.V.O.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

PHYSICAL SOCIETY, at 5.—On an Oscillation Detector actuated solely by Temperature Variation of Resistance: Dr. W. H. Eccles.—Exhibition of a Resonance Transformer: A Eagle.—The Limitations of the Weston Cell as a Standard of Electromotive Force: Dr. S. W. J. Smith.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Adjourned discussion* upon Mr. S. N. Brayshaw's Paper on A Research on the Hardening of Carbon and Low-tungsten Tool-steels: Prof. J. O. Arnold.—Comparison of the Tensile, Impact-tensile, and Repeated-bending Methods of Testing Steel: B. Blount, W. G. Kirkaldy, and Capt. H. Riall Sankey.

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