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GÖTTERDÄMMERUNG.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. Third edition. Part iii., "The Dying God." Pp. xii+305. (London: Macmillan and Co., Ltd., 1911.) Price 10*s.* net.

THE third part of "The Golden Bough" is an expansion of a portion of the third chapter of the second edition. Its title, "The Dying God," indicates the chief concern of the whole work, for it might well apply to four of the six parts. To the other three, "Adonis, Attis, Osiris," "The Man of Sorrows," and "Balder the Beautiful," it is related as genus to species.

Prof. Frazer is to be congratulated on having discovered the missing link, which he has long desiderated, in the chain of evidence required for his explanation of the fantastic rule of the priesthood of Nemi, which forms the text of his encyclopædic work. This discovery is one of the two chief portions of new matter introduced. Dr. C. G. Seligmann has discovered among the Shilluk of the White Nile a "coronation ceremony" which, in Prof. Frazer's cautious phrase,

"appears to be intended to convey to the new monarch the divine spirit of Nyakang, which has been transmitted from the founder of the dynasty to all his successors on the throne."

The practice of killing divine kings had been previously made out by the author, but the fact of succession to the soul of the slain monarch, though strongly suggested by many analogies, was still lacking. The Shilluk apparently supplied the omission.

The point calls for something more than mere mention, since it is of vital importance not only for the explanation of the Nemi priesthood, but for the general principles of the whole practice of superstitious regicide. A few extracts from Prof. Frazer's account will serve to make the point clear.

"The reverence which the Shilluk pay to their king appears to arise chiefly from the conviction that he is a reincarnation of the spirit of Nyakang, the semi-divine hero who founded the dynasty and settled the tribe in their present territory."

The religion of the Shilluk consists mainly of the worship paid to Nyakang. One of his most famous shrines is at Fashoda. Every shrine is called a grave of Nyakang, "though it is well known that nobody is buried there." Nyakang is the rain-giver of the country. Being incarnate in the reigning king, it is believed with "conviction" that the latter

"must not be allowed to become ill or senile, lest with his diminishing vigour the cattle should sicken and fail to bear their increase, the crops should rot in the fields, and man, stricken with disease, should die in ever-increasing numbers."

To prevent all this "it used to be the regular custom with the Shilluk to put the king to death whenever he showed signs of ill-health or failing strength." The old custom is said to have been the walling-up of the king in a specially built hut, where he died of hunger and suffocation. This custom "was abolished some five generations ago," and the Shilluk have adopted

"a quicker and more merciful mode. . . . What the exact form of execution has been in later times Dr. Seligmann found it very difficult to ascertain, though with regard to the fact of the execution he tells us that there is not the least doubt. It is said that the chiefs announce his fate to the king, and that afterwards he is strangled in a hut which has been specially built for the occasion."

Moreover, even while enjoying health and strength, the king might be attacked at any time by a rival.

"According to the common Shilluk tradition any son of a king had the right thus to fight the king in possession, and, if he succeeded in killing him, to reign in his stead."

In a note Dr. Seligmann is quoted as saying:—

"The assumption of the throne as the result of victory in single combat doubtless occurred once; at the present day and perhaps for the whole of the historic period it has been superseded by the ceremonial killing of the king, but I regard these stories as folk-lore indicating what once really happened."

At the investiture of the new king, a mysterious object called Nyakang is used. It

"is said to be of cylindrical shape. . . . The chief of Akurwa informed Dr. Seligmann that the object in question is a rude wooden figure of a man. . . . We may suppose that it represents the divine king himself, and that it is, or was formerly, supposed to house his spirit, though the chief of Akurwa denied to Dr. Seligmann that it does so now."

The object is placed on the royal stool, a leg of which is held by the king.

There is a lack of absolute certainty about the whole account. Dr. Seligmann has not seen the "Nyakang" nor a coronation. As for the residence of "the holy spirit of Nyakang" in the object bearing his name, all we have is the remark, "as Dr. Seligmann with great probability conjectures."

This method of crystallising dogmas out of the fluid ideas of barbarous thought is very characteristic of the inductive processes of the author. It may be said to constitute both his weakness and his strength. The rationalist may observe that the actuality of the Shilluk customs is mechanical common sense guided by the principle that might is right. The king must be a strong man both for his own and his people's sake. When a stronger man comes, he is liable to the incidence of this principle. When he himself decays, he is "relieved" of his duties, in the most effective way. Everything else is superstitious accretion, *ex post facto*, and of no practical importance. But when, as may happen in organised religions, such accretions crystallise into form, and are used as social or political levers upon the popular will, their importance may be far-reaching. Probably no one is better aware of this distinction than the author, but he has his own characteristic method of painting the social dangers of unscientific beliefs.

The other new subject in the volume has a similar aspect. This, put baldly, is the suggestion that the victors in the great Greek games were originally

"divine kings" and "dying gods." Victory in the race meant reigning for a term of years as an embodiment of the sun. Defeat at the end, a mark of senile decay, meant the death of the old, and the ascension of the new, god-man.

One may doubt whether early thought so welded together in actual practice the notions of god, king, priest, and man; but the ideas were a mixture, if not a compound.

The new matter thus, by emphasising the form of the inquiry, considerably increases its value, if we accept its form. This is the artistic side of the book, such as every scientific theory must possess.

The new edition of "The Golden Bough" is addressed to a new generation which has succeeded to the soul of a former generation impregnated with the teaching of the earlier editions. Its influence is certain to be proportionally cumulative and far-reaching.

A. E. CRAWLEY.

THE SCOURGE OF TROPICAL AFRICA.

A Handbook of the Tsetse-flies [*Genus Glossina*]. By E. E. Austen. Pp. x+110+x plates. (London: Printed by order of the Trustees of the British Museum. Sold by Longmans and Co., B. Quaritch, Dulau and Co., Ltd., and at the British Museum (Natural History), 1911.) Price 5*s.* 6*d.*

THE increasing attention which has been paid during the last few years to the collection and observation of tsetse-flies (Glossina) has led to the discovery of so many new species that the exhaustive monograph of this genus, published by Mr. E. E. Austen eight years ago, is now much out of date. The concise revision of the species by the same author now issued by the Trustees of the British Museum will therefore be most welcome to all who are concerned with the study of these formidable pests. In the original monograph only seven species were described, whereas now no fewer than fifteen are enumerated (excluding *Glossina maculata*, Newst., and *G. submorsitans*, Newst., to which the author does not accord specific rank), and two of these are described for the first time.

As a result of his examination of the male genital armature of all the known species, except *G. maculata*, Newst., and *G. fuscipleuris*, Aust., Prof. R. Newstead has shown that these structures present three markedly different types, which appear to afford a useful indication as to the mutual interrelationships of the species, especially as they coincide with the more important external distinctions. These sections he called respectively the *palpalis*-group, the *morsitans*-group, and the *fusca*-group. Mr. Austen has departed from this arrangement by dividing the last-named group into two, the only constant character given for separating these divisions being a difference in the tint of the wings. Wing-colour, however, has clearly no value as a group-character in this genus, and the proposed subdivision is open to the serious objection that it obscures the existence of important structural affinities, without any compensating advantage.

Apart from this, the synoptic tables for the determination of the groups and the species leave little to be desired. The preparation of a really accurate and workable key for a genus which presents but few salient and stable specific characters is by no means so simple a matter as it may appear, but with these tables any intelligent field worker should be able to determine his species without much difficulty.

Each species is fully dealt with under the following headings:—description, distribution, bionomics, and affinities and distinctive characters. The information given with regard to habits and life-histories indicates how very little we yet know of the bionomics of these insects, except in the case of two or three species. The puparia of six different species are now known, and these have all been figured (pp. 5 and 7). It is interesting to note that these structures exhibit distinctive specific characters, so that the discovery of even empty puparia may serve to throw some light upon the breeding habits of the various species.

From the point of view of a field worker this excellent handbook has only one drawback, namely, that no information whatever is given concerning the bionomics of the most important species, *G. palpalis*, the carrier of sleeping sickness; the reason adduced being lack of space. In these circumstances much of the unduly elaborate and highly technical description of the generic characters might well have been eliminated, while several pages have been wasted by the needless repetition of the synoptic tables.

The genus Glossina appears to attain its maximum development in the humid region of equatorial West Africa. From Southern Nigeria no fewer than nine different species have already been recorded, the Gold Coast coming next with eight. From Northern Nigeria five species are known, the remaining British colonies each having only four or less.

We may reasonably assume that all these insects are potentially capable of conveying serious diseases to men or domesticated animals, yet it must be admitted that so far no method has been devised for compassing their destruction in an effective manner. It is true that in certain places the clearing of forests has caused tsetses to withdraw, but this is a measure which is capable of only limited application, and might even defeat its object if done on too large a scale. As a rule, insect pests are most easily destroyed during the larval stage, but such a course is rendered impossible in the case of Glossina owing to the fact that the larva completes its development in the body of the mother. Thus we have to undertake the much more difficult task of destroying the perfect insect; and it is to be regretted that no serious attempts appear to have been made in the British colonies to test the method of trapping the flies with birdlime, which has been attended with considerable success in the Portuguese island of Principe.

The remedial measure most generally suggested is to cut off the food supply of the insects by killing all the larger mammals. But advocates of this course are apt to forget that unless the flies are absolutely dependent for their existence upon these large mammals only, the remedy cannot be really effective. The writer has had occasion recently to examine a number of reports bearing upon this question, and the statements made are often highly conflicting; but still,

there appears to be some trustworthy evidence that tsetse-flies, including even *G. morsitans*, can exist in numbers where big game is negligible as a food supply.

These wider questions are beyond the scope of Mr. Austen's handbook, which, however, contains a store of information which will be invaluable to those who are seeking to free Africa from the tyranny of these dangerous pests. G. A. K. M.

THE PSYCHOLOGIST AND THE TEACHER.

The Psychology of Education. By Prof. J. Welton. Pp. xxi+507. (London: Macmillan and Co., Ltd., 1911.) Price 7*s.* 6*d.* net.

WHATEVER criticism Prof. Welton's book may excite, it is undeniably interesting—the most interesting book dealing with its particular problems that has been produced in recent years. With great ability and clearness, the author has drawn a map of life, not as the adult lives it, but as it develops in form and complexity from infancy to manhood. The teacher and the situations with which he deals are in his mind all through. His book is therefore not a treatise on psychology, yet the psychologist's point of view is so dominant that neither does it set forth a theory of education. This Prof. Welton makes clear in his preface. His concern is with the connections between the two—psychology and education—and especially to give a psychological explanation of educational procedure.

The book will surely make a very strong appeal to experienced teachers, for its style is attractive and conspicuously free from abstruse technicalities of expression. Indeed, one is tempted to think that the author has been over-anxious to conciliate the teacher. His opening chapter is particularly addressed to the practical man, who will not fail to note that the psychology which "alone is of worth to the educator" is that "which comes from constant and sympathetic intercourse with children." Although careful reading makes it clear that Prof. Welton means less than he seems to say, it is a mistake, we think, even to seem to imply that all good teachers are willy-nilly good psychologists. There is a distinction between psychological knowledge and a practical acquaintance with psychical relations which comes from experience. The child who uses a brick differently from a ball is not a physicist, nor does social tact constitute a claim to knowledge of psychology. "Every true educator is always making use of real psychology." Is then every true farmer always making use of real chemistry?

The restrictions which the author laid upon himself have led to some difficulties. He very rightly protests against the implicit view of so many child psychologists that children are different from men by reason of their incompleteness.

"Progress is not from a mutilated and incomplete mind to one which possesses all its organs. At every stage of his development, a child's experience is as full and satisfying to him as is that of a philosophical psychologist to himself."

Instead of the serial appearance of new powers to determine the order of which is the main task of the genetic psychologist, his aim should be to show how such development is brought about. All this is admirably put, and as admirably describes the author's object.

In his effort to avoid technical language, however, Prof. Welton has not always been able to achieve satisfying analyses of the processes he describes. In his discussion of the nature of imitation, he restricts the use of the word to what most psychologists call deliberate imitation. This is, of course, giving the word a technical sense, for we call monkeys imitative, though we may deny their intention to imitate. It is no doubt to the writings of M. Tarde that Prof. Welton's protest is due. M. Tarde would find an element of imitation in all that we do, and a term which includes so much tends to obscure rather than to clarify thought. Our author has a second objection to the current use of the word in psychology. To call an action imitative when there is no intention to imitate is to describe its external rather than its psychical attributes. There is a certain justification for this criticism, but it is doubtful whether Prof. Welton's way out of the difficulty helps very much. He would avoid confusion by including all the non-volitional forms of imitation under the term assimilation—the general tendency of man to assimilate his mental life to that of his fellows. But how does such a term suit a case like that of Preyer's tiny infant who pursed his lips as he watched his father doing so? Surely this is distinguishable in analysis from catching the enthusiasm of a crowd.

These all-embracing words—assimilation, apperception, &c.—are a great difficulty in teaching psychology, and for that reason a precise technical terminology cannot be dispensed with. It is as necessary in this subject as in botany, if it is to justify its claim to rank as a science. The whole chapter on the nature of experience is the least convincing in a book which is otherwise extremely readable, and sane to the point of conservatism. No teacher can fail to find much that is helpful in its pages, though he must not expect to get from it an introduction to the methods and results of recent pedagogical inquiry. This Prof. Welton has deliberately left out, except for a gentle gibe at those who use chronoscopes, ergographs, and other terrible machines.

The book is admirably printed, and altogether a valuable addition to English educational literature.

J. A. GREEN.

TIMBER AND PAPER.

Wood Pulp and its Uses. By C. F. Cross, E. J. Bevan, and R. W. Sindall. With the collaboration of W. N. Bacon. Pp. xi+270. (London: Constable and Co., Ltd., 1911.) Price 6*s.* net.

"THE present is a Cellulose Age," remark the authors of the book before us. Their statement is not made *ad captandum*: it will, they urge, survive critical examination.

Perhaps in their epigram there is just a tinge of the spirit which makes every mother's goose a swan; but be that as it may, there is no doubt that cellulose plays a very important part in modern life. In the

clothing of men's bodies, as in the nurture of their minds, the difference between our own times and those of, say, the Stone age is obviously enormous; and—though this may be less obvious—the difference largely depends upon cellulose. For, not to mention high explosives and celluloid articles, if paper and papyrus, if cotton, flax, and similar textile materials are taken from us, we are back in the days of potsherd writing-tablets, woad, and fig-leaves—back, in fact, to an early stage of civilisation.

Typically cellulose is the purified fibre substance of cotton. Wood-pulp is a special combination of cellulose. In the fibres of wood, the cellulose is associated with substances which have the essential chemical characters of the di-ketones, and hence are designated "lignones." These are chemically much more reactive than the cellulose. Lignones, for example, are very susceptible to oxidation, even by the oxygen of the air, in this respect differing notably from cellulose. Hence paper such as modern "news" paper, which contains ligno-celluloses from wood-pulp as a constituent, on exposure to air and light becomes readily discoloured, and loses its tenacity. The ligno-celluloses are the essential fibrous components of "mechanical" pulp, which is merely wood disintegrated into its constituent fibres by grinding. On the other hand, since lignone is attacked by chlorine, by alkalis, and by alkali bisulphites, it can be separated with these reagents more or less readily from the cellulose with which it is associated, leaving the latter substance in a tolerably pure condition. This product is "chemical" wood-pulp ("soda" or "sulphite" pulp); it differs materially from, and is superior to, the fibre obtained by the mechanical process. Common "news" paper contains about 80 to 90 per cent. of mechanical wood-fibre, and 10 to 20 per cent. of wood-fibre which has been treated chemically; in high-class "news" paper these proportions are reversed. Naturally, "mechanical" wood-pulp is excluded from paper intended for permanent documents. It serves a useful purpose, however, in enabling the demand for cheap publications to be met.

Since cellulose in a more or less pure form can be separated from wood as "chemical" wood-pulp, the question naturally arises whether such pulp cannot be used as a source of cellulose for the production of textile fabrics, high explosives, and celluloid articles. Its relatively low price would seem to give it a considerable advantage. In fact, some success has been met with in respect of the first-named group; for example, in the manufacture of wood-pulp yarn ("silvalin") and of artificial silk (from "viscose"). But the shortness of the fibres is a serious limitation to the use of wood-celluloses for textile purposes. As regards the other groups, wood-cellulose when nitrated has been found to be less stable than cotton-cellulose nitrated to the same degree, and is therefore less suitable for these industrial uses.

The chief woods employed for the manufacture of "sulphite" and "mechanical" pulps are spruce, fir, and pine. For the production of "soda" pulp, aspen, conifers, poplar, and other deciduous trees are utilised; whilst hemlock wood is much used in the making of wrappers and "fibre" papers. After two introductory chapters, the authors discuss the sources of supply of such woods, and then proceed to describe the various operations involved in the manufacture of the several kinds of pulp. The rest of the book deals chiefly with the conversion of the pulp into paper and cardboard, and with its relation to the textile industries.

Professedly the work is written for the general reader, but there is much in it that would be appreciated by the young chemist beginning to specialise in cellulose products. Occasionally the style is heavy and not too clear; but the volume as a whole gives a good general idea of the wood-pulp industry, and the authors' names are a guarantee of its trustworthiness.

C. SIMMONDS.

DR LUNGE AND THE LEBLANC PROCESS OF ALKALI MANUFACTURE.

The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches: a Theoretical and Practical Treatise. By Prof. G. Lunge. Third edition. Vol. iii., Ammonia-Soda, Various Processes of Alkali-making, and the Chlorine Industry. Pp. xix+764. (London: Gurney and Jackson, 1911.) Price 30*s.* net.

THESE handsome volumes, which we owe to the tireless industry of the emeritus professor of technical chemistry in the Federal Polytechnicum of Zürich, bring the history of the development of alkali manufacture and of its associated industries down to its latest phase. During the dozen or more years which have elapsed since the appearance of the last edition of Dr. Lunge's monumental work, considerable changes have occurred in this department of chemical technology which bid fair, in the fulness of time, completely to revolutionise its methods. A significant feature of modern manufacturing industry is the ever-growing application of electrical energy to its processes, and in no field of production has this application been more fruitful in consequences than in that of industrial chemistry. Although there is, even now, scarcely a single section of applied chemistry which has not felt the influence, directly or indirectly, of this form of energy, it is almost a truism to assert that we are only at the threshold of the new departure.

Dr. Lunge's books bring the story as far as the parting of the ways. He is the faithful chronicler of contemporary achievements, the historian *temporis acti*. He is concerned mainly in giving as full and as accurate a picture of the state of alkali manufacture at the end of the first decade of the twentieth century as is possible to him. As a faithful reflex of the present state of this manufacture the volumes before us suffer from the limitation that they deal only with what have grown to be subordinate processes—that is, processes which are dependent upon the conversion of common salt into alkali through the instrumentality of oil of vitriol, or, in other words, the Leblanc method of manufacture and its associated industries. The supremacy of this method has long since passed away by reason of the elaboration and development of the ammonia-

soda process of Dyar and Hemming. The Leblanc process lives mainly on account of the commercial value of its by-products, but its continued existence even from this cause is seriously threatened by the rapid extension of the methods of producing electrolytic chlorine. Dr. Lunge, no doubt, has it in contemplation to complete his picture by the republication, revised and enlarged, of the third volume of the former edition of his work, in which he dealt with what was then publicly known of the methods of carrying out the ammonia-soda process, as developed by the Solvays, their coadjutors and successors. The appearance of this volume will be awaited with great interest.

In its essential features this edition differs in no material particular from its predecessors. The plan of the original work is substantially unchanged. During a large portion of his long career as a technologist, Dr. Lunge was intimately associated with the practical conduct of the Leblanc process—a process which was nowhere more successfully worked than in England, which constituted, indeed, the chief of our chemical industries, and brought in the aggregate great wealth to those concerned in it. The quondam head of the chemical department of the famous school of technology at Zürich long ago constituted himself the historian of this time-honoured process, which, whatever the future may have in store for it, will always be accounted as one of the most considerable and important of the manufacturing methods of which chemical technology has any record. It occasionally happens that threatened processes, like threatened men, live long. We may express the hope, then, that the days of the Leblanc process are not numbered, and that Dr. Lunge may still long be with us to note and chronicle the changes which may come over it.

GEOMETRY AND ALGEBRA.

(1) *A New Geometry.* By W. M. Baker and A. A. Bourne. Pp. xxii+246+vi. (London: G. Bell and Sons, Ltd., 1911.) Price 2*s.* 6*d.*

(2) *Algebra. Part II., for the Use of Students preparing for the Intermediate and Previous Examinations of Indian Universities.* By Prof. K. P. Chottoraj. Pp. iv+486. (Simla, Calcutta: A. K. Chottoraj, 1910.) Price 1.12 rupees.

(3) *Parametric Coefficients in the Differential Geometry of Curves.* By Dr. S. Mukhopadhyaya. Pp. 31. (Calcutta: The University, 1910.)

(1) THIS text-book is an abbreviated and condensed form of the well-known work by the same authors published eight years ago, and therefore requires little comment. The suggestion made in the Board of Education circular on the teaching of geometry that propositions should so far as possible be taken in groups has been adopted. Thus theorems on parallels form the first, properties of a single triangle the second, tests for congruence the third, and constructions the concluding section of book i. The authors have throughout included considerably more material than is required by the Cambridge schedule, particularly in reference to proportion and areas. The last fifty pages of the book are devoted to solid geometry. The properties of line and planes are treated in a fashion very similar to Euclid XI.; this is followed by a number of properties of the tetrahedron, pyramid, cylinder, cone, and sphere. An excellent collection of examples on the mensuration of solid figures is included.

(2) The subject-matter of this volume ranges from quadratic equations to the exponential and logarithmic series, and in doing so covers more than four hundred closely printed pages. It is therefore evident that the treatment is very thorough. There is indeed far too much detail; all sorts of special and artificial cases are dealt with, apparently in order to fortify the student against every possible difficulty he may be likely to encounter. For those whose sole object is to pass examinations this may be advantageous, but on general grounds it is highly undesirable. The author has a lucid style, and has evidently arranged both the text and the examples with the greatest care. His book should be most useful to the teacher, but we are inclined to think it will be rather oppressive for the student.

(3) This pamphlet is the result of a series of investigations the author has made in differential geometry. The method of parametric coefficients was evolved from an attempt to obtain by elementary means expressions for the radius of curvature and aberrancy in terms of the arc. The first part of the paper deals with the properties of parametric coefficients of n-dimensions, and then applications are made to plane curves; these include the deduction of the equation of the osculating cubic and the general differential equation of the cubic. It is stated that additional applications will be found in a further paper by the author which will be published shortly.

MECHANICS AND TESTING OF MATERIALS.

(1) *Elements of Mechanics, with Numerous Examples for the Use of Schools and Colleges.* By G. W. Parker. Pp. ix+245. (London: Longmans, Green, and Co., 1911.) Price 4*s.* 6*d.*

(2) *A Handbook of Testing.* By Prof. C. A. M. Smith. Materials. Pp. xii+284. (London: Constable and Co., Ltd., 1911.) Price 6*s.* net.

(1) THIS book is intended for the use of students having only a comparatively elementary knowledge of mathematics; great care has been taken to ensure that the student should acquire thoroughly clear ideas of the first principles which form the groundwork of the subject, and this has been borne in mind in working out the numerical examples illustrating the various laws. The first part of the book is devoted to statics, the branch of the subject of perhaps the greatest importance to the engineer; composition and resolution of forces in one plane, moments of forces, parallel forces, couples and their composition, centres of gravity, and conditions of equilibrium are successively dealt with, and then the application of the laws, which have been deduced, to

the case of the so-called simple machines, all of them considered as frictionless, is taken up.

The last chapter of this section is devoted to an elementary treatment of the laws of friction, the rough inclined plane being used as an illustration. As a frictionless machine is a mere mathematical fiction, adopted probably with the idea of smoothing the path of the student, it is a pity that the author did not in the chapter on friction take one of the simple machines, say the screw, and show how materially such a formula as that deduced in the previous chapter for the relation of power to weight is modified directly friction is taken into account, and the problem changed from a mere exercise in applied mathematics to the practical question a young engineer is constantly called upon to face. It is doubtful if it is beneficial to students to set them to work out problems on frictionless machines.

In part ii. dynamics is taken up—velocity and acceleration; the laws of motion and their application to motion on rough planes, Attwood's machine, &c.; composition of velocities and accelerations are fully discussed. The last three chapters treat of uniform motion in a circle, work, and simple harmonic motion.

The author is to be congratulated on the excellent series of examples given at the end of each chapter.

(2) Laboratory work on the testing of materials forms an important part of the training given in engineering colleges at the present day, and many teachers and students have felt the need of a good text-book on the subject. Mr. Smith has done excellent research work on the effect of combined stress, and has devised ingenious strain-measuring apparatus for use in his researches, and he is now to be congratulated on having written a book which will be welcomed by all those who are engaged in the branch of experimental work known as the testing of materials, whether they are students just beginning to feel that they are entering upon a new field of fascinating work, practical men engaged in the daily task of commercial tests, or advanced students busy with research work upon one or other of the difficult problems which still require elucidation. The book is well illustrated, and the illustrations are so drawn that they show the essential principles of the machine or apparatus, a matter of great importance to the student who wishes to design similar appliances in connection with his own experimental work; the chapters on strain-measuring instruments and on alternating stress tests deserve special praise in this respect.

In the last chapter the author has given valuable advice and suggestions as to the best lines on which experimental work can be carried out in college laboratories, and a table of suitable experiments with notes as to the necessary apparatus. The book concludes with four appendixes, a bibliography, and a table of constants; the third appendix is devoted to a discussion on all the recent researches on combined stress, including the author's own work, and forms one of the best summaries which have yet appeared of the present state of knowledge on this important question. T. H. B.

OUR BOOK SHELF.

General Index to the Monthly Notices of the Royal Astronomical Society, volumes liii. to lxx., 1892–1910, together with the General Index to Illustrations in the Memoirs, volumes i. to lix., and the Monthly Notices, volumes i. to lxx., 1822–1910; appendix, List of Comets, 1892–1910. Pp. viii+198. (London: Royal Astronomical Society, 1911.) Price 5*s*.

THIS index is one of fundamental importance to all workers in astronomy, and is a sequel to those previously published for vols. i. to xxix. and vols. xxx. to lii. respectively; it is hoped in future to publish general indices covering successive even periods of twenty years. The arrangement of the present volume from the annual indices prepared by Mr. Wesley has been carried out by Mr. Levander, under the general direction of the secretaries, and he is to be congratulated on the success attained.

Many of the headings have, by reason of the progress in astronomical work during the past twenty years, had to be rearranged or modified, and the changes are carefully explained in the preface. The present section dealing with the "Monthly Notices" takes up 168 pages, with something like forty references on each page, a tribute to the energy displayed by the authors of papers as well as to the completeness of the index.

Mr. Knobel has prepared the index to the illustrations, and this should prove exceedingly useful, as the items are arranged under subject headings, *e.g.* moon, planets, instruments, &c., the authors' names being given in approximately the chronological order of the papers.

Dr. Crommelin's appendix gives particulars of all the comets observed during the period 1892–1910, commencing with an apparition of Barnard's periodical comet in 1892, and ending with Brooks's second periodical comet 1910*d*. In view of the plenitude of comets during the present year it is interesting to note that the average number per annum, for 1893–1910 inclusive, works out at 4·7, the greatest number being 10 in 1898.

Many copies of the previous general indices remain in stock, and will be presented to such institutions and observatories as receive the "Monthly Notices," but have not the indices; application should be addressed to the assistant secretary.

Evolution, Life, and Religion: a Study. By the Rev. E. B. Kirk. Pp. 321. (Glasgow: John Smith and Son, Ltd.; London: James Clarke and Co., n.d.) Price 5*s*. net.

THE author of this book states his personal interpretation of cosmic and human evolution, which he considers from a philosophical and theological point of view. There has been material and spiritual progress from the simplest forms towards those of ever-increasing complexity, and the author interprets this as a continued expression of the Logos. He illustrates this by a fundamental diagram which he calls the "Logos-mirror." He has hold of the sound idea that scientific and intuitive interpretations must be regarded as complementary, not as antithetic, but his own personal equation bulks so large that it is difficult for the reader to get alongside of him. As it seems to us, Mr. Kirk intermingles different "universes of discourse" in a manner which is always unprofitable, as when he seeks to show that various fundamental doctrines of theology are expressions of fundamental laws of nature.

We have great sympathy with the proposition that "the mental continuity of creation in our world is as marked as the physical, and the lower

creatures are one family with the higher throughout," but we do not follow the author's theory of "spiritual inheritance" as opposed to "physical inheritance." Perhaps the right of making pronouncements regarding the scope of physical inheritance in garnering the past has not been earned by an author who tells us that "the human bowel is a worm." We do not mean, however, that this quaint sentence is in any way essential to the author's argument.

The Wanderings of Peoples. By Dr. A. C. Haddon, F.R.S. Pp. vii+12+5 maps. (Cambridge University Press, 1911.) Price 1*s.* net.

In this little volume, one of the handy manuals issued by the Cambridge University Press, Dr. Haddon deals with the movements of the world's population from those times "when mortals knew no shores beyond their own" down to the modern movements in quest of political, social, or religious freedom.

The introduction deals with the general factors which determine the impulse and direction of migrations. The author also summarises the evidences for racial or cultural drift which are to be found in the physical characters of peoples, and in their artifacts, customs, folklore, and speech.

The main body of the work is a marvel of condensation. Into little more than one hundred pages Dr. Haddon has contrived to pack in terse and vivid phrases a whole history of the world so far as that history is correlative with ethnology and geography. Asiatic migrations and their sequence in Oceania are described in one chapter. Europe and Africa have each a chapter to themselves. The American peoples —North, Central and South—require for the history of their wanderings a space equal to two-thirds of that of the rest of the world together. One value of the book consists in the fact of its being an index to a more detailed examination of its subject. Each chapter is accompanied by its bibliography, and each paragraph is referred to its authority. For reference purposes the book is thoroughly up to date, and works appear in the bibliography which have appeared since its own chapters were in print. The five maps, owing to their small size, only show the more important migrations, but nevertheless they give a good general idea of the movements which have taken place on each continent. S. H. R.

The King to His People: Being the Speeches and Messages of his Majesty George V. as Prince and Sovereign. Pp. xviii+452. (London: Williams and Norgate, 1911.) Price 5*s.* net.

One of the most impressive characteristics of these speeches and messages is the remarkable manner in which the British Royal Family has been able to sympathise with, and be interested in, every aspect of the lives and enterprises of British subjects in all parts of the Empire. Whether addressing the Royal Society, speaking to school children, presiding at philanthropic meetings, officiating at military and other functions, his Majesty has shown a genius for speaking the right words at the opportune moment. The messages, "Wake up, England!" "Have Courage, Be Thorough," "The Rule of Science," and others, have served as an inspiration to workers throughout the Empire.

Probleme der Protistenkunde. By Prof. F. Doflein. II., Die Natur der Spirochaeten. Pp. vi+36. (Jena: G. Fischer, 1911.) Price 1.20 marks.

The first of Prof. Doflein's studies, that on the Trypanosomata, was noticed in Nature of June 24, 1909, p. 489. The present work deals with the Spirochaetæ, spirillar micro-organisms met with in ditch water and also in connection with many diseases, such as the relapsing fevers and syphilis, and as commensal parasites in the fresh-water mussel, &c. Some are doubtless vegetable in nature, but many must probably be regarded as belonging to the protozoa. From a critical survey of the minute structure of several species the author divides the spirochaetes into three groups: (1) Spirochaeta, with a central staining filament; (2) Cristispira, with a marginal staining filament; and (3) spirochaetes with a flattened band or lamella. He does not consider that sexually differentiated individuals have been proved to occur. The pathogenic forms, like many trypanosomes, are transmitted by blood-sucking arthropods, principally ticks. The essay is illustrated with many figures, and is a useful contribution to this important subject. R. T. H.

Arbeiten aus dem Gebiet der experimentellen Physiologie. Edited by Dr. Hans Friedenthal. Teil ii., 1909–10. Pp. viii+286+5 plates. (Jena: Gustav Fischer, 1911.) Price 5 marks.

This is a collection of twenty-seven papers which have previously been published in various German journals, or in the proceedings of scientific bodies. They have been carried out in Dr. Hans Friedenthal's private laboratory near Berlin, by Dr. Friedenthal himself and his colleagues. They represent a large amount of fruitful and painstaking labour, and relate to a great variety of subjects. The publication of collected papers from individual laboratories is often a great convenience to other workers, and Dr. Friedenthal is to be congratulated on his valuable output of the last few years. W. D. H.

The Process of the Year. Notes on the Succession of Plant and Animal Life. By H. H. Brown. Pp. 180. (London: Society for Promoting Christian Knowledge, 1911.) Price 2*s.* 6*d.*

Though it does not appear to be his primary object, Mr. Brown has condensed much useful reading on nature-study into his volume. His "leading purpose is to show that the world is beautiful and happy." The year is divided into seven periods corresponding with the seven ages of man, and in each division a series of typical plants and animals is considered.

Philosophy. By Nicholas Murray Butler, president of Columbia University. Pp. vii+51 (London: Henry Frowde, 1911.) Price 4*s.* 6*d.* net.

The third thousand has now been issued of President Butler's lecture, delivered on March 4, 1908, in the series on science, philosophy, and art, at Columbia University. The purpose of the lecture was, the preface points out, clearly to differentiate philosophy from science and "to cut away the odd and unfitting scientific garments in which some contemporary writers have sought to clothe philosophy."

Bergson. By Joseph Solomon. Pp. 128. (Philosophies Ancient and Modern.) (London: Constable and Co., Ltd., 1911.) Price 1*s.* net.

The series to which this little volume has been added already included sketches of some fourteen systems of philosophy, but none of them formulated by a contemporary thinker. M. Bergson has been so much in the public eye recently that many readers will be glad to acquaint themselves with the teaching of this twentieth-century philosopher.

Confessions of a Robin. By Lieut.-Colonel A. F. Mockler-Ferryman. Pp. 192. (London: Society for Promoting Christian Knowledge, n.d.) Price 2*s.*

This story of incidents in the life of a robin will appeal to young children, who will not regard talking robins, with a well-developed power of consecutive thought, as incongruous. The tale reveals the author as a sympathetic observer of bird-life.

LETTERS TO THE EDITOR.

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

The Relation of Big Game to Sleeping Sickness.

THE article by Sir Harry Johnston in NATURE of December 7 on "The Preservation of the African Fauna and its Relation to Tropical Diseases" gives a most admirable and sympathetic review of the subject; but there is one statement to which I must venture to take exception as not conveying, in my opinion, an accurate impression of the known facts of the case, namely, the following sentence:—"But within the last twelve months or so it has been proved conclusively by the biologists at work in Uganda that the large antelopes of that country are the hosts of dangerous trypanosomes, amongst others of the trypanosome which causes sleeping sickness."

So far as I am aware, this statement is based on the experiments reported by Bruce, Hamerton, and Bateman (Proc. Roy. Soc., B, 83, pp. 311–27), in which it was shown "that antelopes can be readily infected with sleeping sickness by the bites of artificially infected tsetse-flies" (p. 317), and that "the flies (*Glossina palpalis*) when infected by the virus of sleeping sickness obtained from the blood of infected antelopes are capable of transmitting the virus to susceptible animals" (p. 319). These results are based entirely on experiments conducted in the laboratory, and the authors state expressly that "positive evidence" is required "to complete the chain of evidence that antelope living in the fly-areas may act as a reservoir of the virus of sleeping sickness. *So far it has only been proved that they are 'potential' hosts*" (p. 325; the italics are mine).

The only instances known to me in which *Trypanosoma gambiense*, the trypanosome of sleeping sickness, has been identified as occurring in the blood of wild animals, naturally infected, are two in number, and in each case the animal was a monkey, and the locality Uganda; one such case is reported by Koch, Beck and Kleine (*Arbeiten k. Gesundheitsamte*, xxxi., p. 18); the second is reported by Bruce and his collaborators (Sleeping Sickness Reports, xi., p. 102). If there are other known instances of *T. gambiense* occurring naturally in wild animals, I should be glad to be informed of them; if there are not, however, it seems to me premature to state that antelopes have been proved to be the hosts of the trypanosome of sleeping sickness. If laboratory experiments have shown them to be the *potential* hosts of *T. gambiense*, the same can be said of many other animals which can be inoculated with this trypanosome in the laboratory. The following list of animals susceptible to *T. gambiense* is taken from Laveran and Mesnil, "Trypanosomes and Trypanosomiases," p. 382 (translated by Nabarro; Baillière, Tindall and Cox, 1907):—monkey (several species), lemur, dog, jackal, cat, rabbit, guinea-pig, rat, mouse, jerboa, hedgehog, marmot, horse, donkey, cow, goat, and sheep. This list is based chiefly on experiments performed in Europe, using European mammals or exotic animals in captivity, and there is no doubt it could be greatly extended by anyone experimenting systematically in the tropics on tropical animals; but as it stands it is sufficiently extensive, and indicates that a great many species of wild animals, small or large, might be incriminated as potential hosts of *T. gambiense* equally with the antelopes, and that the destruction of the "big game" alone would be likely to produce very little amelioration, if any, in the conditions.

The whole history of sleeping sickness in Uganda indicates that the disease has been imported from the west by human agency (compare Laveran and Mesnil, *op. cit.*, pp. 359–66), and that man is the primary host of the trypanosome, at least in Uganda. If, however, the parasite has now been transmitted from man to other susceptible animals by the tsetse-flies, there is no reason to regard the antelopes or other big game as having monopolised the functions of being "reservoir" hosts of the virus. From the point of view of preventing the infection from spreading from animals to man, domestic animals would seem to be a much greater danger as a reservoir of the virus than antelopes and creatures the natural instincts of which impel them to keep at a distance from the haunts of human beings.

If, therefore, it is desired to extirpate the potential hosts of *T. gambiense* in regions where sleeping sickness is rife, it would not be sufficient to destroy the big game; it would be necessary to convert the whole country into an uninhabited and lifeless desert. In my humble opinion this method of preventing the spread of sleeping sickness is a futile one, and not likely to yield useful results. I believe that there is only one practicable method of interrupting the transmission of the trypanosome, and that is by measures calculated to destroy or keep down the tsetse-flies. At the present time the most urgent need is more knowledge of the bionomics of the species of Glossina and of their natural enemies. Some years ago I made the suggestion in NATURE (November 8, 1906) that fowls, wild or domesticated, would be likely to be efficient in keeping down the flies by scratching up their pupæ and eating them, but, so far as I am aware, no experiments have ever been carried out to put this notion to the test. So long as sleeping sickness cannot be made amenable to treatment, attention must be concentrated on prevention, the central problem of which, in my opinion, is the destruction of the insects concerned in the transmission of the disease.

E. A. MINCHIN.

Lister Institute of Preventive Medicine, Chelsea Gardens, S.W., December 9.

The Inheritance of Mental Characters.

THE reply of Dr. C. Walker to Dr. Archdall Reid in your issue of last week seems to me somewhat quibbling, and suggests that he is not intimately acquainted with Prof. Pearson's Huxley lecture. The particular part of this lecture quoted by Dr. Reid, and referred to by Dr. Walker, reads actually as follows, the italics being Prof. Pearson's own:—". . . We have found the *same* degree of resemblance between physical and psychical characters. That *sameness* surely involves something additional. *It involves a like heritage from parents.* The degree of resemblance between children and parents for the physical characters in man may be applied to the degree of resemblance between children and parents for psychical characters. We inherit our parents' tempers, our parents' conscientiousness" (not *consciousness*, as printed in Dr. Reid's quotation), "shyness, and ability, even as we inherit their stature, fore-arm, and span."

Now surely Dr. Walker cannot justly charge Dr. Reid with misinterpreting Prof. Pearson's statement in this instance, where Dr. Reid apparently infers from the words "*a like heritage*" that Prof. Pearson meant "*inherited in the same way*"; and that the words "*a like heritage*" implicitly connote in this context an actual identity of the modes of *transmission* and *reproduction* of a parent's "conscientiousness" with those of the transmission and reproduction of a parent's fore-arm. Nor, it seems, would it be unfair to impute, on this ground, to Prof. Pearson the doctrine that external influences brought to bear on the child, such as experience of the world, training, example, &c., could not have any greater effect on his ultimate "conscientiousness" than any external influences could exert on the ultimate length of his fore-arm.

London, December 10. H. BRYAN DONKIN.

I THINK Dr. Walker is scarcely clear as to the situation. A personal acquaintance with a writer is not necessary when we judge his published opinions. By "character" biologists mean any trait of a living being—a head, a hair, a characteristic of a hair, a characteristic of that characteristic, and so on. Of course, no character of any sort—neither a head nor a scar, for example—can develop in the individual unless the potentiality to develop it under fit conditions is antecedently present. If, then, we think in terms of germinal potentiality, all characters, for example heads and scars, are equally inheritable. But biologists commonly apply the term "acquired" to actual somatic characters which have developed under the influence of use or injury, the term "inborn" to characters which

developed in the absence of these influences, and the term "inheritable" to characters which were present in the parent and tend to be "inborn" in the offspring. Thus they speak of heads as inborn and inheritable, and of use-callosities and scars as acquired and non-inheritable. I am not concerned here with the correctness of these terms. My statement of the manner in which they are used is correct.

Prof. Karl Pearson employs the term "inherit," but not, to my knowledge, the terms "inborn" and "acquired." Instead, he uses "bred" and "created," which apparently are intended to mean the same. He has not, I believe, defined any of his terms. Presumably, therefore, he uses them with their ordinary meanings. If he does not, then not only have I been mistaken, but also almost everyone else, including such a careful thinker as Sir Ray Lankester. In that case, what is the meaning of the expression "bred, *not* created"? Is potentiality meant here? The italics are mine.

Even in the absence of statistical inquiry, it is a common conviction that individuals tend to resemble their progenitors mentally as well as physically. Thus the offspring of a vertebrate is another vertebrate, of a man another man, of a Hottentot another Hottentot, and so on. But individual characters are less certainly inherited than varietal characters, varietal characters than specific characters, and so on. Prof. Pearson's work concerns only individual characters (*i.e.* variations); but he makes—not once but repeatedly, not only in scientific memoirs but also in popular lectures and letters to newspapers—the *unqualified* statement that the mental and physical characters of man are inherited at the same rate. It seems that this rate is "somewhere about 0·46 to 0·50." His estimate, if it led nowhere, would have no more importance than, for example, a calculation concerning the average length of noses. But it leads him somewhere—to the notion that the moral and intellectual qualities are "bred, *not* created," instead of to the notion that they are bred *and* created. It leads him to a false opposition between "nature" and "nurture," instead of to the really quite obvious truth that the nature of man, the educable animal, is such that he is supremely responsive to nurture. It leads him to the notion that the poorer classes in England are, on the average, by nature inferior to their more fortunate compatriots, and thence to dire predictions concerning our future as a nation and to demands that something shall be done. It would lead him, I suppose, to the notion that an English baby, reared by African cannibals, would, when grown, resemble his progenitors and differ from his educators as much mentally as physically. And so on and so forth. No one, I suppose, disputes that individuals vary in capacity. The dispute, in the case of the moral and intellectual traits, is entirely as to whether capacity can become more than mere potentiality unless nurture plays its part as the other blade of the scissors. In other words, the dispute is as to whether these traits are or are not acquirements, that is, products of man's educability *plus* his individual experience.

The biometric plan of ascertaining correlations between variations, and thence surmising a causal connection, is not, as is commonly supposed, a new instrument in the hands of men of science. It is merely a variant of the very old method of concomitant variations which is described in almost every book on logic and in almost every work on the methods of science. There is, however, this difference: according to the method of correlated variations as exemplified by biometricians, if two things vary together *on the average*, there is *invariably* a causal connection between them; according to the method of concomitant variations as described by logicians, if two things *invariably* vary together, there is *probably* a causal connection.

In my letter I stated that Dr. Walker had reproduced some of my opinions in his book almost in my own words. I should have added that he made very full acknowledgment.

G. ARCHDALL REID.

Southsea, December 10.

IN Dr. C. Walker's quotations (NATURE, November 23 and December 7) from Dr. A. Reid's paper, Prof. Karl Pearson is represented as saying: "We inherit our parents' tempers, our parents' consciousness," &c.; this should read: "We inherit our parents' tempers, our parents' *conscientiousness*," &c. (see Journal Royal Anth. Inst., vol. xxxiii., p. 204).

E. LAWRENCE.

"Kama," Sunningdale Avenue, Westcliff-on-Sea, December 11.

Temperature of the Upper Atmosphere.

MESSRS. GOLD AND HARWOOD in their paper on the present state of our knowledge of the upper atmosphere, printed in the British Association's reports for 1909, give a table showing the mean temperatures for the months of the year at heights varying from the surface to 15 kilometres. With regard to it they say the principal feature is the very marked minimum in March and the small, though less marked, effect in September. The table is based upon about 5800 readings taken at Strassburg during five years. With the aid of this table I have plotted on the accompanying diagram the temperatures at various

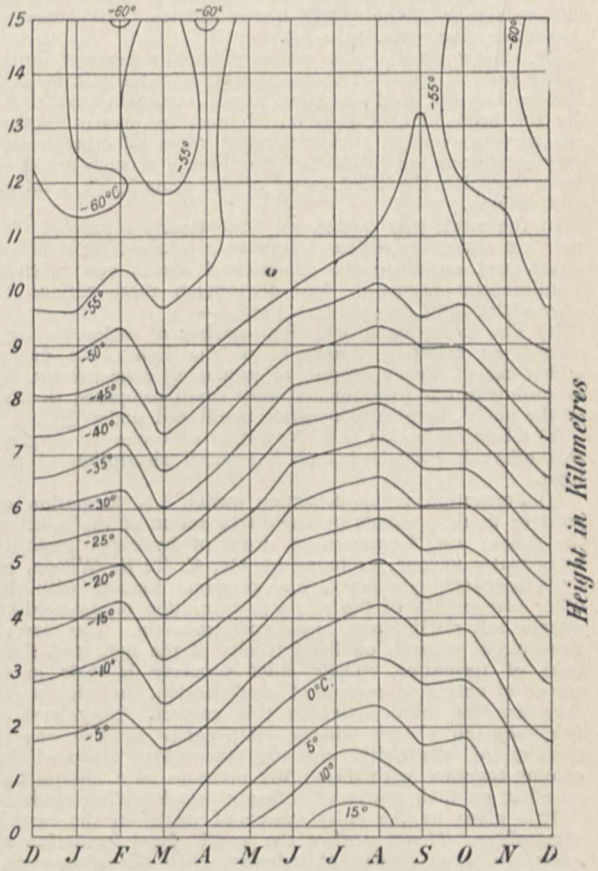

FIG. 1.—Temperature variations throughout the year at different heights.

heights (isotherms). Plotted in this manner, a result is obtained which shows clearly that a check in the fall of temperature takes place between September and October. The principal feature, however, is the rise of temperature between December and February, and the small gradient of temperature below 2000 metres during those months.

The tracing of the isotherms in the advective layer presents some difficulties, owing to the abnormal conditions prevailing in it. It would appear that during December a low temperature condition prevails, and appears to die away from the top downwards, disappearing at a height of about 12,000 metres in February. In March there is a marked inversion of temperature between 12,000 and 15,000 metres which does not seem to continue into April.

Between April and May, however, the isotherm of −55° passes into the upper atmosphere, where, comparatively speaking, warm conditions prevail in the advective layer from May to September. As this method of plotting the results shows clearly the temperature variations throughout the year at high levels, I thought the diagram might be interesting to your readers. R. M. DEELEY.

Inglewood, Longcroft Avenue, Harpenden.

The Weather of 1911 and the Ultra-violet Radiations of the Sun.

IN connection with Dr. Shaw's attempt to explain the remarkable weather of this summer (NATURE, November 30), I should like to direct attention to a point of view which in general, but especially in the past summer, deserves the attention of meteorologists. My remarks are based on a series of experiments which I carried out, together with Prof. Lenard (P. Lenard and C. Ramsauer, "Über die Wirkung sehr kurzwelligen ultravioletten Lichtes auf Gase und eine sehr reiche Quelle dieses Lichtes," Heidelberger Akademie, five parts, 1910–11).

Dr. Shaw states that all conditions necessary for a heavy rainfall appeared to be present, without rain falling. But he has not paid attention to an important condition: for the production of rain nuclei must be present, which can serve as centres of condensation when all other necessary conditions are fulfilled. The absence of such nuclei is in my opinion the chief cause of the remarkable weather of this year.

In the work just quoted we have clearly separated, for the first time, the different actions of ultra-violet light on gases, and explained the complicated effects due to their simultaneous existence. We distinguish three actions of ultra-violet light on dust-free gases:—

(1) The formation of electrical carriers of molecular size, caused by selective absorption of the light; the power which these carriers possess of producing condensation is, according to our experiments, very small compared to that of the nuclei, originally neutral, mentioned under (3).

(2) Chemical action, *e.g.* formation of ozone in oxygen; this effect is connected with but small absorption of the light.

(3) Formation of condensation nuclei, *i.e.* formation of solid or liquid products by the direct action of the light on the gases; *e.g.* formation of drops of hydrogen peroxide from water vapour, as found by Mr. C. T. R. Wilson, or by subsequent reaction of the products formed with the other components of the air, *e.g.* formation of ammonium nitrate and nitrite from ozone and ammonia. The size of these nuclei depends on the intensity of the light and their time of formation. Their chief property is their great power of acting as centres of condensation, and the larger they are the more active in this respect. They possess *originally* no electric charge, but easily acquire one if carriers of electricity are simultaneously produced by coming together with these; the presence of a charge has no effect on their power of acting as condensation nuclei.

This gives us the chief source of nuclei in the earth's atmosphere. If we neglect the purely local formation of nuclei in large centres of industry, then the ultra-violet, and to a minor degree the kathode, radiation of the sun is chiefly responsible for the nuclei which are meteorologically so important. This production of nuclei extends from the uppermost down to fairly low-lying layers of the air, as the active rays are only absorbed to a small extent, and is chiefly conditioned by the amount of oxygen and ammonia present.

Thus the lack of nuclei, and the consequent fine weather of this year, can be attributed to a much diminished ultra-violet radiation of the sun. This is in accord with the now existing minimum of general activity of the sun, as characterised by the minimum of sun-spots and northern lights. This view is not contradicted, but confirmed, by the high temperature on the surface of the earth, as this is principally conditioned by the increased clearness, *i.e.* transparency to heat radiations, of the atmosphere.

CARL RAMSAUER.

Radiologisch-Physikalisches Institut, Heidelberg, December 9.

"Draysonia."

IN NATURE of November 16 you have done me the honour of inserting a review of my book "Draysonia." As the reviewer appears to have been under some misapprehension, I beg you will in justice do me the favour of inserting a few words of explanation.

I am well aware of my inability to do full justice to the late General Drayson in attempting to bring his theory under public notice. But it is evident that your reviewer, after perhaps a hasty glance at "Draysonia," has not considered it worthy of close perusal; otherwise he would scarcely have assumed that a naval officer who has had the "Nautical Almanac" in use for more than seventy-one years (and has made nautical astronomy an occupation and recreation) "confuses precession with aberration," and is therefore "scarcely fitted" to deal with the subject.

Your reviewer may possibly be a professional astronomer (who perhaps dislikes anything unorthodox and not in accordance with the text-books), and, if so, he will be aware that in the later "Nautical Almanacs" the word "precession" in the catalogue of stars has been substituted for the old and better term "annual variation," which was used in the "Nautical Almanac" and by our old astronomers for as many years as I can remember up to 1894 or 1895, when the change was made. Previous to this the word precession had been mainly confined to precession of the equinoxes (dealt with in section 6 of "Draysonia"), which at present is about 50″ and is totally distinct from what astronomers term aberration, but which I prefer to call annual motion of the pole.

Your reviewer further states that I have computed the precession of many stars by Drayson's method, and that, if this proves anything, it proves the correctness of the "Nautical Almanac." This is a mistake and is an inversion of my process. Instead of having, as he stated, calculated the so-called precession of many stars, I have used the precessions, so accurately given in the "Nautical Almanac," in order to find therefrom the amount of the annual motion of the pole; and I have shown that the so-called annual precessions of the stars, all varying in amount and direction, both in right ascension and declination, are exactly accounted for by one single movement of the pole of about 20″, which produces the apparent annual precession as obtained by observation and recorded in the "Nautical Almanac," the accuracy of which I have never impugned.

I am unable to understand why your reviewer questions my statement that Mr. Stone, the late Radcliffe observer at Oxford, made the error of sidereal time erroneous to the extent of 41·51s. in 1892. A reference to the Royal Astronomical Society's notes of March, 1894, will show that I am correct. ALGERNON DE HORSEY.

Melcombe House, Cowes, November 19.

I AM quite willing to admit that I have misunderstood the gallant Admiral, and accept unreservedly his statement that he does understand the difference between precession and aberration. In my own defence you will perhaps permit me to quote the passage which misled me.

"Possibly I shall be told that I have found a mare's nest, and that it has been known all along that the right ascension of a star and its annual precession in declination are functions of the annual motion of the pole, and that such motion can be found in the 'Nautical Almanac,' *and is properly termed aberration.*"

The italics are mine. To my mind this sentence admits of only one construction; and, if I have been so unfortunate as to misconstrue it, I have no doubt I have not correctly apprehended the author's meaning in other places, and therefore it is of little use to discuss the several points raised. THE REVIEWER.

Dust Explosions.

PROF. GALLOWAY'S brief article on dust explosions in NATURE of November 30 is very timely; but readers of it would receive the impression that the true cause of the explosion at the Tradeston Flour Mills, Glasgow, in 1872, was first made known in the report of Profs. Rankine and Macadam. This is not the case: the fact that flour-mill ex-

plosions are actually dust explosions was first stated in England by Mr. Watson Smith, editor of the Journal of the Society of Chemical Industry, in a letter which appeared in *The Glasgow Herald* on July 12, 1872, immediately after the Tradeston disaster. The priority of Mr. Watson Smith was recognised at the time by the Royal Society of Edinburgh, and later (in 1882) by Sir Frederick Abel in a lecture at the Royal Institution.

It is interesting to know that nearly six years ago Mr. Watson Smith read a paper at Liverpool (the scene of the latest dust explosion) in which stress was laid on the fact that any kind of carbonaceous dust might, under certain conditions, become a source of danger (see Journ. Soc. Chem. Ind., January 31, 1906).

ALBERT SHONK.

10 Dartmouth Road, Hendon, December 5.

I MUCH regret that I had entirely forgotten the fact, stated in Mr. Shonk's letter, that Mr. Watson Smith had attributed the disaster at the Tradeston Flour Mills to an explosion of dust in a letter to *The Glasgow Herald*, published before the report of Profs. Rankine and Macadam appeared, or I would certainly have mentioned it in the article referred to. W. G.

The Feeding Habits of Crepidula.

WITH reference to the note on Crepidula in NATURE of December 7 (No. 2197, p. 187) it may be of interest to your readers to know that during some recent researches on this animal I have been able to confirm the necessity for investigating how far the presence of the slipper-limpet (*Crepidula fornicata*) is a menace to successful oyster-culture on the Kent and Essex coasts. It has been believed by various naturalists that Crepidula takes the same kind of food as the oyster, but on this point there exists no definite information. During an investigation of this matter I discovered the manner in which the animal feeds, from which there can be no doubt whatever as to the nature of its food. The mode of feeding in Crepidula is the same in principle as that of the oyster, that is, there is an ingoing and an outgoing current of water kept up in the mantle-cavity, while between the two currents the gill acts as a strainer, retaining even very fine particles of suspended matter, which eventually—by one of two ways—reach the mouth.[1]

Thus it is established beyond doubt that Crepidula feeds on the same material as the oyster, that is, on the food-material found on or floating near the sea-bottom, and the danger apprehended from this intruder is confirmed: Crepidula is competing successfully with the oyster for food and space. Whether there is enough food and space for both Crepidula and oysters is another matter which must be determined by local researches. Thus the problems for the Kent and Essex oyster-farmers are to keep up the food supply of oysters and to reduce the numbers of Crepidula and the many other animals which take the same food as oysters. J. H. ORTON.

Marine Biological Laboratory, Plymouth,
December 10.

Tadpole of Frog.

AT the beginning of April last I collected some frog ova for the purpose of making observations on development. Tadpoles appeared about April 9, and from time to time from that date until July 17, when young frogs were developed, I took batches away for preservation and sectioning. On July 17 only one tadpole was left of the original stock, and that one, though in water out of doors and with a supply of waterweed, has not developed farther, but is a tadpole still and is still alive. Some years ago I had a similar case with a frog tadpole. Can any of your readers suggest the reason of this phenomenon?

T. PLOWMAN.

Nystuen, Bycullah Park, Enfield, December 8.

[1] It is proposed to publish a full account of how Crepidula feeds in the next number of the Journal of the Marine Biological Association.

MICROKINEMATOGRAPHY.

WITHIN the last few months we have been shown a new appplication of the kinematograph, which indicates yet another stage of technical attainment, and another field in which it may supplement our knowledge. Its range has been extended to the representation of objects as seen through high powers of the microscope. Apart from any positive increase to knowledge which may be obtained by its means, this is a technical achievement of a very high order. In the usual microscopic preparation it is impossible to obtain a high degree of illumination, and the greater the magnification the less the illumination becomes. It is only by artificially increasing the contrast by means of stains and so forth that we can obtain a clear differentiation of even a motionless object. To take in one minute some thousands of successive photographs of a living, unstained object, magnified six hundred or a thousand times, an object, moreover, which is moving rapidly, and therefore continually altering its focal plane, is a task which might easily seem impossible.

M. Comandon, however, has succeeded in this extremely difficult problem. The illumination-difficulty he avoided by using what is known as the ultra-microscope or dark-ground illumination, in which the object is seen against a black background, being lit itself by rays of light striking it from the side, and thence deflected upwards towards the lens of the microscope. This method gives an extremely brilliant contrast-illumination of the outlines of the object against a black ground and makes it possible to take on a properly sensitised film photographs of exceedingly short exposure. The resulting picture naturally shows comparatively little of the internal structure of the object under examination; the bulk of the rays of light are deflected from its surface. But it is surprising how much does appear. The nucleus of a cell, for example, is frequently quite distinct, and some structures, such as the kineto-nucleus of a trypanosome, can sometimes be seen perfectly clearly and be followed as the organism moves from place to place. A large number of films prepared under the direction of M. Comandon has been exhibited during the present year by Messrs. Pathé Frères, and the realism and vitality of these kinematograph pictures can scarcely be imagined by anyone who has not seen them thrown on the screen.

An interesting film is one which displays the blood actually circulating in the vessels of the living body. The preparation, which is from the tail of the tadpole, shows a number of tiny blood-vessels, which measure about one-hundredth part of a millimetre in diameter. Crowded together in the larger of these, the individual corpuscles of the blood can be seen to pass out one by one into minute branches, for which they seem almost too large, and within which they make their way here and there through the surrounding tissue, not apparently without occasional difficulty. Even in the larger vessels, along which the bulk of the corpuscles are hurrying, the rate of progress varies considerably, and the direction may actually be reversed for a time and the blood apparently flow backwards. The coloured corpuscles of the blood, from which it derives its red tint, have, of course, no independent motion of their own, and are simply carried along by the stream in which they are suspended. But the colourless cells or leucocytes have such independent motion, and in another film we are shown a white cell gradually altering its shape, throwing out a long filament into which the rest of the corpuscle slowly flows, until the whole cell has altered its posi-

tion and moved from one place to another. By aid of this motion these leucocytes are able to fulfil one of their best-known functions, which is to act as scavengers of the vascular ways of the body, and to take up into themselves abnormal substances with which they come in contact, whether microbes, diseased cells, or granules of inert matter; and this process is illustrated for us by a series showing the gradual surrounding and ingestion of a red corpuscle by a white cell. This is the phenomenon of phagocytosis, which has of late been brought so prominently before the public in its relation to the cure of infectious disease.

That such abnormal substances may occur in the blood is shown in a beautiful series of pictures of its condition in relapsing fever. After we have been made familiar with the appearance of normal blood, in which the red corpuscles appear as brilliant rings and the larger white cells as cloudy masses with shadowy nucleus and brightly shining granules, we see the blood as it may appear at the height of an attack of the disease. It is now full of foreign organisms, long, slender spiral threads, which dart hither and thither upon the screen, now hooking themselves together and again disentangling themselves, impinging on the red cells and recoiling in amazing numbers and activity. The whole blood history of an attack is shown on these films, from the interval between the crises when no organisms are present, through the period of multiplication to the termination of the attack with the tendency of the spirals to aggregate together and eventually disappear. Several such blood-pictures may be seen, including a most beautiful preparation of an infection with a trypanosome, a close ally of the organism which produces sleeping sickness. Here the parasite is seen in quite perfect distinctness, swarming in enormous numbers in a drop of blood with an incredible activity and energy of motion.

Technically perhaps the greatest triumph of these microkinematograph pictures are the films which show us the *Spirochaeta pallida*, the causal organism of syphilis. This delicate thread, with its many tiny spirals, is so exceedingly minute that even when motionless and stained it is difficult to see with the best of ordinary microscopes. But here it appears alive and moving, with its coils all clear and sharp, a perfectly distinct picture. Only those who know the careful pains, which are necessary to obtain a satisfactory demonstration of this tiny object, can fully appreciate the skill which has gone to the making of such photographic films as these.

We have dwelt chiefly upon the microscopic preparations which Messrs. Pathé Frères have exhibited, because they seem to us the most remarkable of those which we have seen. But there are many other applications of kinematography to biological subjects

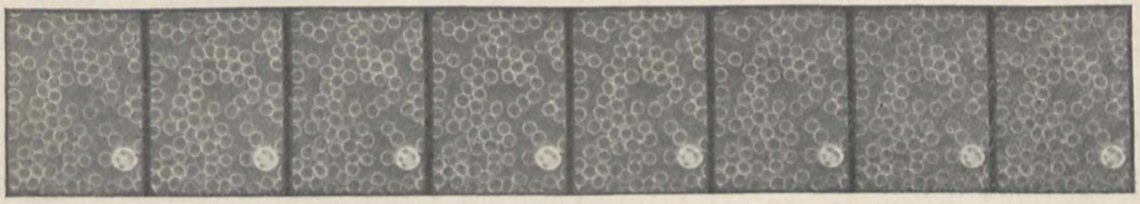

FIG. 1.—Series of pictures of normal human blood. From a kinematograph film.

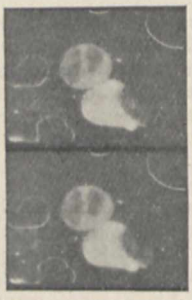

FIG. 2.—Amœboid movement of leucocytes.

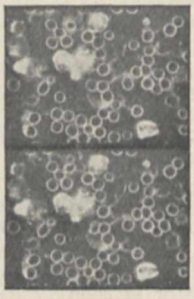

FIG. 3.—Trypanosomes in the blood.

FIG. 4.—Spirillosis of fowls.

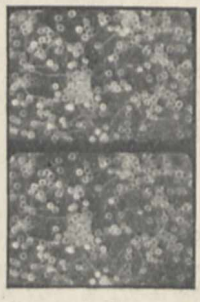

FIG. 5.—Relapsing fever.

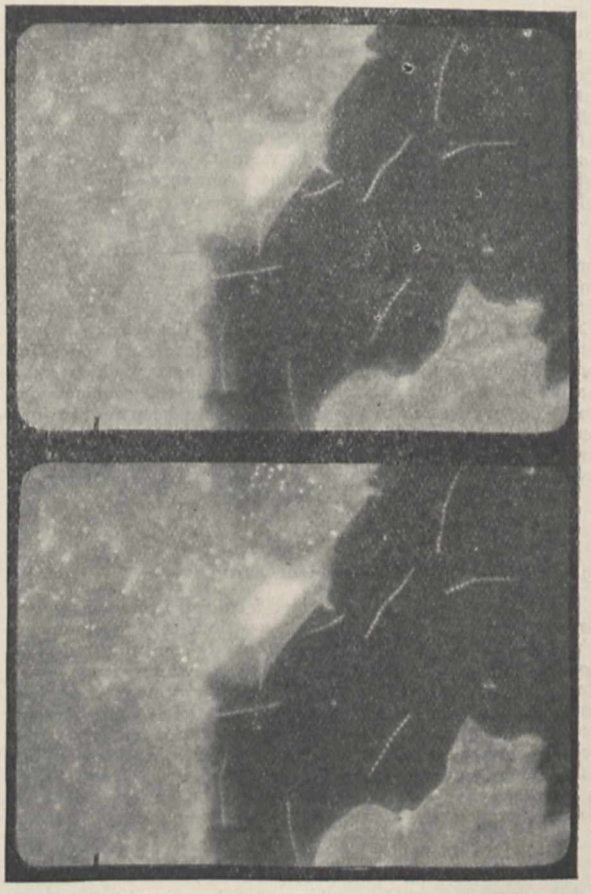

FIG. 6.—Spirochæta of Syphilis (from the cornea of the eye) enlarged.

which are of great interest and value. Many movements in nature proceed at a rate such that we cannot successfully follow them with the eye and brain. The slow movements of a leucocyte, the gradual unfolding of a flower-bud or upward growth of a plant advance so leisurely that we cannot readily follow the change—it is only by observing them from time to time that we can appreciate that alteration is occurring. A succession of photographs, however, taken at considerable intervals, and passed rapidly in review before us, shows us as occurring in a few minutes the whole process which may take hours or days in reality, and we are better able to appreciate the nature of the phenomena because the sequence becomes more obvious. Conversely, many motions occur too fast for us to analyse them. The fact that our retina can clearly distinguish only impressions which reach it at a comparatively slow rate makes it impossible for our unaided eye to follow the sequence of many natural phenomena. By reproducing at a slower pace the changes which do occur, the kinematograph can assist us to attain a clearer perception of the nature of the alteration which is taking place, or, even if we are still unable to grasp the successive phases, a study of the film itself will enable us to follow the sequence and analyse the motion with a greater detail and a greater accuracy than any number of examinations of the natural phenomenon can possibly supply. The kinematograph therefore can give us a positive addition to the sum of our knowledge, as well as diffuse through wider circles knowledge already gained.

This latter, while perhaps the most obvious, is not the least of the functions which such moving pictures can fulfil. There are thousands of people in this country who are intimately acquainted with the cellular constituents of the blood, and their various shapes and functions, thousands who have seen the ordinary bacterial preparations or are familiar with the heart-beat and its action on the pulse, but of these thousands not one-tenth have actually seen the amœboid movements of a leucocyte or a spirillum wriggling its way between the corpuscles or the heart itself beating before their eyes. Yet these are things which it concerns them to understand, and no amount of imagination can supply the clearness and comprehension which actual seeing can give. The kinematograph might well become a most efficient aid to the teaching of very many biological, and especially medical, subjects.

The accompanying illustrations have been reproduced from kinematograph films kindly supplied for the purpose by Messrs. Pathé Frères.

THE RUBBER-PRODUCING PLANT OF THE MEXICAN DESERTS.[1]

AMONGST the botanical collections formed in 1852 by Dr. J. M. Bigelow, whilst attached to the Mexican Boundary Survey, were specimens of a shrub known to the Mexicans as "guayule," afterwards described by Prof. Asa Gray as *Parthenium argentatum*. No mention, however, was made of its rubber-bearing qualities. It was not until 1876 that public attention was directed to guayule rubber by an exhibit sent to the Centennial Exposition at Philadelphia in that year. The country peon had, it appeared, for long been in the habit of making playing balls and other articles by the "communal mastication" of the bark of this shrub, and it was by that means sufficient was obtained for the above-mentioned exhibit. Investigation showed that the plant was capable of producing in the neighbourhood of ten per cent. of its weight of dry rubber, and that it grew in vast abundance in the desert country of northern Mexico.

This discovery speedily changed the economic value

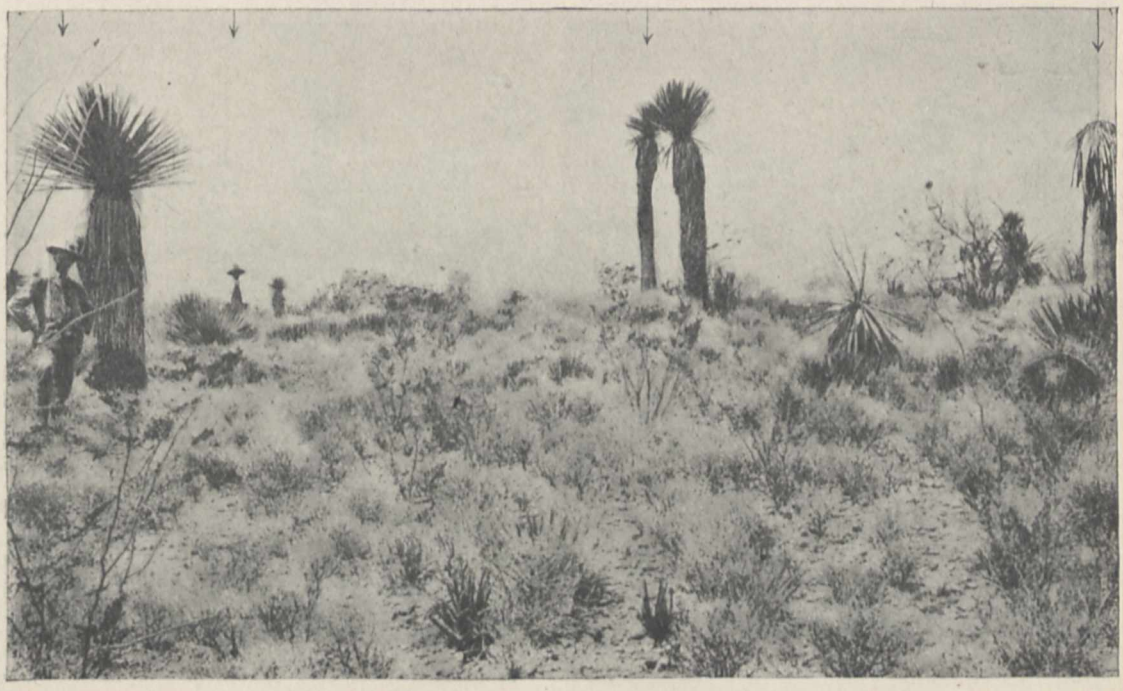

FIG. 1.—Foot-slope of Sierra Zuluaga.

1 "Guayule (*Parthenium argentatum*, Gray), a Rubber-plant of the Chihuahuan Desert." By Prof. F. E. Lloyd. Pp. viii+213+46 plates. (Washington: Carnegie Institution, 1911.) Publication No. 139.

of these deserts, and set in motion business operations involving millions of capital based upon the amount of raw material in sight. In 1902 chemical and mechanical extraction plants were set up, and guayule rubber, though an inferior article containing a high percentage of resinous substance, soon became a very important item in the imports of the United States. At the present day the outlay of American capital in Mexico alone is said to amount to 30,000,000 dollars.

A good deal has already been written dealing with guayule, but the monograph by Prof. F. E. Lloyd is a most welcome addition to special rubber literature. Its contents are the outcome, Prof. Lloyd states in his preface, of an investigation carried out by others and himself at the instigation of certain Mexican rubber companies towards the elucidation of the question of the profitable cultivation of guayule in the desert with a view to future maintenance of supplies.

In addition to the physiology of the plant under varied conditions, the main subjects dealt with are questions of climate and soil, seed germination, methods of reproduction, results of cropping, environment of the plant, its rate of growth, methods of extraction, the possibility of maintaining the supply by irrigation, and the effects of this upon the yield of rubber. In the course of the investigation attempts are made to throw light upon many interesting problems in connection with the physiology of desert vegetation.

Much attention has been given to the formation of resin and rubber, and the close connection between the two. There appears to be no tube-like laticiferous system as in other rubber-yielding plants, the rubber being formed apparently in the cells of the resin-canals, whilst the resin itself is found only in the canals and not in the cells.

The guayule shrub is a very slow grower, a fifteen-year-old plant being no more than 15 inches in height, and Prof. Lloyd estimates that existing supplies will be exhausted in a few years' time. Seed can be germinated and plants easily raised by giving a small amount of shade and subsurface irrigation. On p. 121 the author remarks that "the most fundamental economic question for which an answer will be sought in these pages is that relating to the production of rubber under irrigation." In searching for a reply one has to be content with the statement that "The less the water the thicker the bark (cortex) and *vice-versa*." Irrigated plants naturally grow more vigorously but produce wood at the expense of cortical tissues, and it is largely the latter from which the rubber is extracted.

The book is evidence of a vast amount of labour undertaken in the spirit of enthusiasm, but its utility for the general reader is curtailed by the want of condensation in dealing with experiments and tabular results, and the absence of definite statements or deductive conclusions. It is elaborately illustrated by photo-litho plates, containing a large number of photographs and line-drawings of the minute histological structure of the different parts of the plant, as well as by some fine photographs of desert surroundings.

FIG. 2.—Guayule in a very dense growth.

THE AËRONAUTICAL BLUE-BOOK FOR 1910–11.[1]

THE specific questions which form the subject of the experiments and observations described in this report may be briefly described as follows :—

The deviation of air resistances from the law of proportionality to the square of the velocity and the effects of friction in this connection—discussed theoretically by Lord Rayleigh and experimentally by Messrs. Bairstow, Booth, Dr. Stanton, and Mr. Pannell.

[1] Technical Reports of the Advisory Committee for Aëronautics for the Year 1910–11 (with Appendices). Pp. 134. (Published by his Majesty's Stationery Office. London: Wyman and Sons; Edinburgh: Oliver and Boyd; Dublin: E. Ponsonby, Ltd., 1911). Price 6*s*.

Theorems on stresses in envelopes by Mr. Booth.

Forces and couples on a model dirigible placed obliquely to the current by Mr. Bairstow.

Air resistances of wires and ropes, both stationary and vibrating, by Mr. Melvill Jones and Dr. Stanton.

Air pressures on the honeycombed radiator and Paulhan girder.

Methods of observing flow of water past an obstacle by Mr. Eden.

Propeller experiments by Mr. Bairstow.

Tests of balloon fabrics.

Meteorological apparatus by Mr. J. S. Dines.

The present report is characterised by greater definiteness of purpose than was noticeable in its predecessor for 1909–10. Many of the papers have a direct bearing on aërial navigation, and we do not exclude Mr. Bairstow's experiments on square plates altogether from this category, since if it is required to test the deviations from the law of proportion of pressure to square of velocity, the first tests may as well be made on square plates as on any other kind of surface. The experiments on obliquely placed model dirigibles also have an important bearing on the problems of stability and steering as applied to airships, and the necessity for such investigations is fairly evident. At the same time, the superfluity of diagrammatic details which was referred to in the review of the preceding year's report is also to some extent a conspicuous feature of the present volume, and it again appears desirable to direct attention to the fact that some of these are wholly unnecessary and only occupy space that could be with greater advantage devoted to broad and general discussions by the members of the committee on the principles of mechanical flight, considered in relation to the experiments here described. The three and one-third pages of description of Mr. Dines's theodolite would probably be just as useful without the three folded diagrams, one taken at Pyrton Hill in a clear sky, and one showing the observations by Cary at station A, and Bosch at station B, up to the point where a certain pilot balloon was lost sight of.

The article on propellers, while accompanied by six bulky folding plates, only occupies four pages of letterpress. One of these is devoted to "improvements in apparatus"—not improvements in propellers, but in the dynamometers and other instruments for testing them, while the remainder are principally devoted to determining the constants and coefficients of a Vickers and Maxim, and three Ratmanoff propellers. Certain conclusions are stated, referring in particular to the effects of cutting down the blade area, and the extent to which the principle of similarity can be applied to models. But surely there is a great deal more to be said about the general problem of propeller action, even in connection with the interpretation of the results of these experiments, and it is desirable that the investigation should be extended to other types of propeller than the two here discussed. Perhaps this will be done another year.

In making these criticisms it is necessary to guard against one serious mistake which is commonly made, and does much to retard scientific progress and development. It is frequently said of certain physical investigations that they are of no use because they do not take into account all the disturbing factors which exist in nature. As applied to aviation, we are told by some people that it is no use to investigate the efficiency of planes and propellers by laboratory experiments, as the investigations fail to take account of the atmospheric disturbances which affect the motion of an actual aëroplane. This, however, is equivalent to saying that we require to know less about the efficiency of our apparatus under the complex conditions prevailing in nature than we should if the conditions were simpler. In reality we ought to know *more*, and experiments made under ideal conditions instead of being condemned as "unnecessary," should be described as "insufficient," and should therefore be pushed on with all possible haste as a preliminary step to investigations of a more general character.

In view of the desirability of using experiments with models for all they are worth, and the success which has attended such experiments in naval architecture, it is satisfactory to find that the principle of dynamical similarity is receiving considerable attention. At the same time, one has rather an idea that the atmospheric conditions under which aëroplanes and dirigibles are navigated are rather different from those existing in the National Physical Laboratory, and the idea suggests itself that, instead of trying to produce a current of air that shall be as nearly uniform as possible, results equally interesting would be obtained if it were attempted to do the very opposite thing. When so many physical data are unknown even to within 100 per cent., it surely is rather unnecessary to trouble about whether a velocity of 1·6 or 2·1 miles an hour is set up in the air when a rotating arm is travelling through it at thirty-five miles an hour. A study of the "wash" or interference effects caused by planes or propellers on other planes or propellers following in their wake would be more useful. For example, the lift and drift of the isolated Paulhan girder determined on p. 36 may for this reason be different from the values which they would have when the girder occupied its proper place in an actual flying-machine.

There are two possible alternatives. One is (following the usual custom) to disparage such researches as those last-named; the other is to ask for something more. The latter alternative certainly appears from every point of view to be the better.

The collection of abstracts of papers on aëronautics, compiled from various English and foreign journals, extends from p. 92 to p. 124, and is an exceedingly valuable feature of this, as it was of last year's report. The preparation of such abstracts involves an expenditure of time and thought, on the part of the abstractors, which, as a rule, receives but scanty recognition. The idea suggests itself whether some working arrangement could be arrived at between the Government Committee and the Aëronautical Society to enable the abstracts to be reprinted in the Journal of the latter, and thus circulated among its members at regular intervals. Perhaps this question may be deferred until the Aëronautical Society has had time to settle down after the arduous work of reorganisation on which its council has recently been engaged.

SIGHT TESTS IN THE MERCANTILE MARINE.

THE Board of Trade has published the annual return of the sight tests used in the mercantile marine for the year ending December 31, 1910 (Parliamentary Paper, Cd. 5876), a return which includes the examinations in both form and colour vision. In the course of the year 7502 candidates were examined, including fishermen who sought to obtain certificates as skipper or second hand of fishing boats, and of this total 109 (1·46 per cent.) failed in form vision, and one of them, who was re-examined, failed again. One hundred and forty-one failed in colour vision, but of these 69 were re-examined on appeal, and 29 of them passed, leaving 112 (1·56 per cent.) as ultimate failures.

The colour examination, since November, 1909, has been conducted with five skeins of wool, a purple and

a yellow, in addition to the green, pink, and red originally used by Holmgren; and a coloured plate gives the colours which were selected as matches by the rejected candidates, and are distinguished by letters of reference in a schedule showing the performances of all the candidates who were ultimately rejected, and are therein described as completely or incompletely red or green blind. This information, however, is withheld in the very cases in which it is most required, that is, in the cases of candidates who, having originally been rejected, were passed on appeal. With regard to these, we are only told that they "failed in the colour vision tests," and, in another column, that they "appealed and passed." It would be highly interesting to know both on what grounds they were originally rejected and on what grounds they were ultimately passed, because these are the very cases in which the sufficiency of the methods of examination employed may possibly be called in question at some future time. The matter is perhaps of less importance, as we read in the report that "the whole question of sight tests is now being carefully considered by a Departmental Committee appointed for the purpose," and it is therefore possible that changes both of procedure and of record may be suggested.

Of the 112 men rejected for defective colour vision, 42 were completely and 21 incompletely green blind, and 32 were completely and 17 incompletely red blind, no instances of the rarer varieties of failure being recorded. The rejections are somewhat in excess of those of many previous years, and the explanation seems to be that the fishermen seeking certificates, as mentioned above, have only been required to pass the same sight tests as candidates for certificates as masters or mates in the mercantile marine since November, 1909, and that they have increased the proportion of defectives. As compared with the amount of defective colour-sense in the population generally, the proportion of rejections does not seem large, and it is highly probable that many colour-blind persons are prevented, by a knowledge of their condition, from attempting to enter the sea service.

WIND IN THE ADRIATIC AND IN HOLLAND.[1]

THERE has been in recent years a re-awakened interest in the problem of the periodic variations of the wind, but there remains much to be done to complete that thorough harmonic analysis of the motion of the air which Kelvin emphasised as one of the most important lines of meteorological research so long ago as 1876. Hitherto attention has been devoted mainly to a consideration of the semi-diurnal variation, and the results have shown conclusively that the regular semi-diurnal wave of pressure can, as indeed it must, be connected through the hydrodynamical equations with a similar regular variation of the wind-vector. In the discussion of the record for individual places, the question of the local variations from the general law and their explanation rightly find a place, but they ought not to be allowed to exclude the consideration of other possible periods.

In the first chapter before us, Dr. Mazelle, Director of the Observatory at Trieste, analyses five years' records from the Beckley anemograph erected in 1902 on a lighthouse in the Adriatic, the Klipper Porer, which lies a mile and a half W.S.W. of Cape Promontore, the most southerly point of Istria. The results have been very fully discussed, and the records are arranged and tabulated in many different ways to exhibit the different features inherent in them. A table giving the frequency of the wind for sixteen directions for the four seasons of the year shows that at all times the E.N.E. wind is most frequent, and that all easterly winds have their maximum frequency in winter and spring, while westerly winds are more frequent in summer and autumn. Another table, giving the diurnal variation of the frequency of the wind for the eight principal directions, shows that N.E. winds are most frequent about 3 a.m., and W. winds about 3 p.m., a result which may arise from land and sea breezes.

Diagrams are drawn to show the diurnal variation of the wind-vector for the four seasons and for the whole year. In general the vector rotates in a clockwise direction in the course of the day, but in winter the curve is looped and the rotation is counter-clockwise from 3 p.m. to 3 a.m. The variation is greatest during summer, and is greater in spring than in autumn. It would have been an advantage if the results had been analysed for the four principal directions, instead of for N.E., S.E., N.W., S.W., in order to permit of direct comparison with results from other places and with theory.

A considerable part of the paper is devoted to a discussion of strong winds or gales, especially gales from the N.E. quadrant, Bora, and from the S.E. quadrant, Scirocco. Dr. Mazelle takes a stormy day to be one on which the mean velocity of the wind is at least 50 kilometres per hour. There were 149 such days in the five years, or, roughly, one day in twelve. January had 33 such days, or rather more than one in five. June, on the other hand, had only one such day in the whole period. A curious and suggestive peculiarity is the secondary maximum in October, which had 18 stormy days, compared with 11 in September and November. The diurnal variation on a stormy day is about the same in summer as in winter, the maximum occurring at or slightly before noon in both seasons. For days of stormy Bora and Scirocco the definition is extended to include days on which the maximum velocity exceeded 50 kilometres per hour. There were 233 days of stormy Bora and 71 of Scirocco during the five years, a result which does not altogether support Horace's description of Scirocco or Notus as "arbiter Hadriae," "that tumultuous ruler of the restless Adriatic." Bora is most frequent in winter, the worst month being January, with an average of eight days; Scirocco is most frequent in autumn, with a maximum monthly average of 2·6 days in October. In every month the average number of days of Bora is greater than that of Scirocco.

Perhaps the best idea of the character of Bora and Scirocco is given by tables showing the length of the periods during which the mean velocity exceeded 50 kilometres per hour, and of periods during which the velocity never fell below 50 kilometres per hour. It is seen from these that on one occasion of Bora the wind blew uninterruptedly with a velocity exceeding 50 kilometres per hour for 144 hours, and that on the same occasion the mean velocity did not fall below 50 kilometres per hour for 7 days. The corresponding maximum periods of duration for Scirocco are 36 hours and 3 days. The absolute maximum velocity recorded during the five years was 128 kilometres per hour for Bora, 102 for Scirocco, 98 for S.W. gales, and 80 for N.W. gales. Unfortunately, the factor of reduction is not stated, so that it is not possible to compare these values with records for this country.

The second paper is a discussion contributed by

[1] "Die tägliche Periode der Windrichtung und Windstärke nach den anemometrischen Aufzeichnungen auf der Klippe Porer." By E. Mazelle. Besonders Abgedruckt aus dem lxxxvii. Bande der Denkschriften der Mathematisch-Naturwissenschaftlichen Klasse der Kaiserlichen Akademie der Wissenschaften. Pp. 65. (Wien: Alfred Hölder, 1911.)

"On the Diurnal Variation of the Wind and the Atmospheric Pressure and their Relation to the Variation of the Gradient." By Dr. J. P. van der Stok. Pp. 14. Koninklijke Akademie van Wetenschappen te Amsterdam. Reprinted from Proceedings of the Meeting of May 27, 1911.

Dr. J. P. van der Stok to the Proceedings of the Royal Academy at Amsterdam, "On the diurnal variation of the wind and the atmospheric pressure and their relation to the variation of the gradient." He criticises the method, adopted in previous investigations, of attempting to determine the variation of the wind from the variation of the gradient of pressure, and, regarding it as too laborious and affected with uncertain errors, attempts to determine the gradient from the observed variation of the wind. It would be interesting to institute a comparison between this method, that of utilising hourly observations of pressure at three stations, adopted by Tsuiji, and the general method based upon the regularity of the semi-diurnal wave of pressure.

Dr. van der Stok finds it convenient to assume that the semi-diurnal variation of the wind has the same phase angle as would be indicated by the theoretical application of the general method, and deduces the value of the coefficient of friction, k, which will ensure agreement between observation and theory in this respect. He then utilises this value of the coefficient to deduce the diurnal variation of the gradient of pressure from the observed diurnal variation of the wind. It seems desirable to consider in this application the difference, emphasised in a recent paper by Sandström, between friction due to motion over the rough surface of the earth and sea and the frictional effect which arises from the difference in direction and velocity between the wind at the surface and that at some distance above it. The results used in the investigation are the hourly observations, presumably estimates and not instrumental records, at de Bilt for five years 1903–1908, and the four-hourly observations at the Terschellingerbank Lightship for 25 years 1884–1908. The values found for k show a general agreement with those found by van Everdingen from the incurvature of the wind at de Bilt, but the value for Terschellingerbank is 50 per cent. larger. The coefficient shows a regular annual variation, with the maximum during autumn and winter, the minimum during spring and summer, an interesting result which ought to be compared with the values for inland stations. The author criticises the results of the analysis at St. Helena, on the ground that the wind-vector turns in a clockwise instead of in a counter-clockwise direction, but a reference to Dines's discussion of these results shows that, except for certain small irregularities in the night, the vector rotates in a counter-clockwise direction throughout the year. The vector of the variation of the horizontal magnetic force at St. Helena rotates in a clockwise direction except in July. E. GOLD.

REPORT OF THE GOVERNMENT CHEMIST.

IN his report upon the work of the Government Laboratory for the year ended March 31, 1911, the principal chemist notes that the laboratory has now been constituted a distinct establishment under the Treasury. This is certainly a more appropriate arrangement than the previous one, under which the control was vested in the revenue authorities, for since the laboratory now serves many other State departments besides the fiscal ones, the control in question had become somewhat of an anachronism.

Last year the total number of samples dealt with was 186,044, as compared with 170,033 in the preceding year. The report describes the nature of these, with explanatory notes and statistics. As usual, they included the most diverse kinds of articles, from "standard" bread to poisoned salmon. From among the items of more or less general interest mentioned in the report we extract the following.

Beer and brewing materials are regularly tested for the presence of arsenic, and 41 out of 638 samples were found to contain arsenic in excess of the prescribed limit. Steps were taken in these cases to prevent the contaminated article being sent into consumption, and to trace the source of the arsenic. Usually this was found in the fuel used for drying the malt.

Two interesting cases of fish-poisoning are noted. In one instance dead trout were found (Kensey Brook, Tamar and Plym District), and analysis of the water showed that the brook had been contaminated with ammonia from a gas works. In the other case, dead salmon had been found in the Conway district, and as there are lead mines near it was thought that the fish might have been poisoned by drainage containing lead. On analysis, however, zinc, and not lead, was discovered in the salmon, as also in the river water; this served to indicate the source of the pollution and explain the destruction of the fish.

One curious question referred to the laboratory was whether the composition of a particular clay was such as to distinguish it from the exempted "common clay" of the Finance Act of 1909–10; the report is silent as to the conclusion arrived at. Questions connected with the pigments, paper, and gum used in making postage and other fiscal stamps were also investigated. At the house of a coiner, it is stated, a plate and apparatus were found, all ready for the production of illegal stamps. "His productions were somewhat crude," the principal chemist remarks; "but were sufficiently good to deceive an unobservant person, especially in a poor light."

In connection with dangerous trades a number of pottery glazes were examined. They included a series of forty-eight taken from works where lead-poisoning had occurred, and it is a significant fact that except in two or three cases, practically the whole of the lead in these samples was "soluble" lead. Large proportions of lead were also found in dust collected from various factories, other than potteries.

Space allows mention of only one more of the many interesting matters to be found in the report. A question arose respecting the authenticity of a portion of an "Account Book of Revels" of the years 1604–5, preserved in the Public Record Office. This document is a manuscript containing details of expenses incurred in producing certain plays, including *Othello*, respecting the production of which at so early a date there has been much controversy. Suspicion had been cast upon the manuscript, the suggestion being that the entries in question had been made about forty years ago, just before the book had passed into the custody of the Record Office. "After a searching microscopical and chemical examination of the ink and paper in different parts of the document," the principal chemist was able to report that in the character of the ink, the depth to which it had penetrated, or the degree of fading, there was no evidence whatever of any difference between the impugned writing and that in other parts of the document. C. S.

PRINCE BONAPARTE'S AIDS TO SCIENTIFIC WORK.

THE announcement of the gift of 250,000 francs to the Paris Academy of Sciences by Prince Roland Bonaparte has already been made in these columns. The issue of the *Comptes rendus* of the Academy for November 27 includes a copy of the letter from Prince Bonaparte to the president of the Academy, M. Armand Gautier, announcing his intention, and also the remarks of the president after reading this letter to the meeting of the Academy. A free translation of both is subjoined.

In accordance with a feeling expressed many times, I have arrived at the conclusion that it is not by the institution of new prizes with the conditions of award fixed beforehand that the cause of scientific progress can be served most effectively. Undoubtedly it is an excellent thing to reward good work, but it is of greater importance to encourage the growth of original investigation by removing those obstacles which are apt to paralyse the peace of mind of men engaged in research work, of which the principal is generally the question of ways and means.

Impelled by this idea, I created in 1908 the Fonds Bonaparte. Anxious to continue this work, I am placing at the disposal of the academy a further sum of 250,000 francs, not as a capital sum, but in the form of five annuities, intended to be used at once in the spirit I have indicated; that is to say, putting aside all idea of recompense for work accomplished already, whatever its merit may be, my wish is that this sum may be used to stimulate discoveries by rendering easier the researches of workers in science who, having already given proof of their ability to undertake original work, and not belonging to our academy, lack sufficient resources to undertake or to follow out their investigations.

I therefore ask the academy to allocate in 1912, 1913, 1914, 1915, and 1916 these new annuities in the same manner that it has already, in previous years, dealt with the earlier annuities of the Fonds Bonaparte.

Devoted as I am to all scientific studies, I shall be happy, and my object will be gained, if I can in this way help to increase the amount of positive knowledge.

The president said :—

I do not think I need ask the academy to give its approval to this further liberality that Prince Roland Bonaparte offers us to-day. The academy accepts the gift with gratitude.

Not satisfied with continuing to help, as he has done for the last four years, young men of science who might have been stopped in their researches by material difficulties, our colleague doubles the amount which he places at their disposal by making it 50,000 francs a year for five more years. The number and value of the researches which his gifts have made possible during the four years which are almost at an end lead us to hope that the results will be still better for the new period which begins in 1912.

With its president, the academy and French science thank Prince Roland Bonaparte very heartily for his generosity and invaluable initiative.

NOTES.

We notice with deep regret the announcement of the death, on Sunday, December 10, at ninety-four years of age, of Sir Joseph D. Hooker, O.M., F.R.S. In the scientific world he occupied a place in the front rank, and his name and work will be permanently prominent in the history of scientific progress in modern times. Thirty-four years ago, on October 25, 1877, an appreciative article on his services to science was contributed to our columns by Prof. Asa Gray in the eleventh article of our series of Scientific Worthies. We need only refer to that article now as an indication of the high esteem in which Sir Joseph's unusual gifts and energies have long been held by those most competent to estimate their value. We hope in our next issue to supplement this article with another, and here only remark that his botanical knowledge was unrivalled, and his work has won the gratitude of the whole civilised world. The announcement was made on Tuesday that the Dean of Westminster had, with the full concurrence of the Chapter, offered to the family to permit the interment of Sir Joseph Hooker's ashes in the Abbey, on the condition that his remains were previously cremated. It would have been appropriate for his remains to rest in the north aisle of Westminster Abbey among those of Newton, Sir John Herschel, Darwin, and Kelvin, and near the memorials of Adams, Stokes, and Joule. The family has, however, felt obliged to decline the offer of burial in the Abbey, as it was Sir Joseph's express wish that he should be buried by the side of his father at Kew. The funeral will therefore take place at Kew Parish Church to-morrow (Friday) at two o'clock. It is specially requested that no flowers be sent.

The list of honours conferred by the King on the occasion of his Majesty's visit to India, and in commemoration of the Coronation, is published in a supplement to *The London Gazette* of December 8. Among the names in the list are those of several people concerned with scientific work. We notice the following in a long list of appointments and promotions :—*K.C.S.I.* : Surgeon-General C. P. Lukis, Director-General, Indian Medical Service. *C.S.I.* : Colonel S. G. Burrard, F.R.S., Officiating Surveyor-General of India; Mr. F. B. Bryant, Inspector-General of Forests to the Government of India; Dr. G. T. Walker, F.R.S., Director-General of Indian Observatories; Prof. J. C. Bose, Presidency College, Calcutta. *K.C.I.E.* : Mr. Eardley-Wilmot, lately Inspector-General of Forests to the Government of India. *C.I.E.* : Major Leonard Rogers, professor of pathology, Medical College, Calcutta, and bacteriologist to the Government of India; Mr. H. H. Hayden, Director of the Geological Survey of India. *Knights Bachelor* : Mr. R. P. Ashton, president of the Mining and Geological Institute, Calcutta; Lieut.-Colonel C. H. Bedford, Chemical Examiner, Bengal.

The Nobel prizes were distributed by the King of Sweden on December 10. Three of the prize-winners—Mme. Curie (chemistry), Prof. W. Wien (physics), and Prof. A. Gullstrand (medicine)—were present personally to receive their prizes.

We regret to announce the death, on December 11, after a very short illness, of Mr. William Thynne Lynn. The son of a physician in Westminster Hospital, he was born at Chelsea in 1835. He was for a short time assistant in the Cambridge Observatory, and was assistant at the Royal Observatory, Greenwich, from 1856 to 1880, when he retired from official duties. He was elected a fellow of the Royal Astronomical Society in 1862, and contributed several papers to the Monthly Notices. In 1900 he became a member of the British Astronomical Association, was the author of many papers in its Journal, and was a member of the council at the time of his death. He was associated with Prof. D. P. Todd in the authorship of "Stars and Telescopes," and, among other works, wrote the popular little treatises "Celestial Motions," "Remarkable Comets," and "Remarkable Eclipses," each of which ran through several editions. He was a constant contributor to *The Athenaeum*, *Observatory*, and other journals, principally on subjects connected with the history of astronomy and the calendar, and occasionally contributed to our pages. His knowledge of astronomy generally, and especially of its history, was unusually extensive. On subjects connected with chronology he was also extremely well informed, and was always ready to place his knowledge at the service of others.

We regret to learn of the death of Mr. H. Snowden Ward, which took place in New York about a week ago, after an exceedingly short illness. Mr. Snowden Ward was a journalist and publisher who was well known in this country as being energetically interested in all branches of photography, but especially in the progress of methods of photomechanical reproduction, and, later, in the advance of pictorial photography. His endeavour to get the word photograph, when used as a substantive, replaced by "photogram," which he maintained was more correct, was always kept to the front by the name of his monthly

journal *The Photogram* and his annual "Photograms of the Year." Of late years Mr. Snowden Ward, while continuing his journalistic work, studied the life and writings of Charles Dickens, with special reference to the actual places and circumstances referred to by the novelist. He was giving lectures on this subject in the United States when he was taken ill. He was only forty-six years of age.

THE death is announced, at fifty-two years of age, of Dr. E. F. Trevelyan, formerly professor of therapeutics at the University of Leeds, and professor of pathology at the Yorkshire College, then a constituent of the Victoria University.

PROF. G. ELLIOT SMITH, F.R.S., professor of anatomy in the University of Manchester, has been awarded by the Paris Anthropological Society the Prix Fauvelle, of one thousand francs, for his researches in the anatomy and physiology of the nervous system.

PROF. F. B. LOOMIS, who left Amherst College, Mass., in July at the head of an exploring expedition to Patagonia, has written to a colleague an outline of his progress up to the beginning of October. He had not been able to secure many fossils, but could already see that the expedition would be able to revise the geology of the country traversed. Many of the beds previously described as land deposits were, in his judgment, marine.

THE death is announced, on December 5 at Gloucester, in his seventy-eighth year, of Dr. Francis T. Bond, for thirty-eight years medical officer to the Gloucestershire combined sanitary district. Dr. Bond was formerly professor of clinical medicine at Queen's Hospital, Birmingham. From 1862 to 1873 he was principal of the Hartley Institute, Southampton. He translated Radicke's work on "Medical Statistics," and was a frequent contributor to medical and sanitary journals. Dr. Bond was an early worker in bacteriological research and was interested in scientific agriculture; he elaborated a method of cheese manufacture, and invented a filter and other hygienic devices.

THE presentation of the testimonial to Mr. Henry Keeping on his retirement from the post of curator of the Geological Museum, Cambridge, took place in the Sedgwick Museum on Saturday, December 2, when Prof. T. McKenny Hughes handed him a purse subscribed by old friends and students in recognition of his long and valuable services. Mr. Keeping entered upon his duties as curator fifty years ago under Prof. Sedgwick in the old Woodwardian Museum, where the geological department was located until its removal into the Sedgwick Museum in 1904. In collecting fossils in the field Mr. Keeping has displayed exceptional ability and skill; and amongst the mass of specimens which he has thus added to the museum special mention should be made of the remarkably rich series of Tertiary fossils from the Hampshire basin which his keen eye and intimate knowledge of the beds of that area have enabled him to obtain.

AN interesting discovery is reported from Western Canada. During the summer Mr. Andrew Gordon French discovered what is claimed to be one of the largest mines of reef platinum metals in the world in the dyke rocks of the Nelson district, British Columbia. He has now announced the discovery therein of a new element, to which he has given the name Canadium. The element is described as a new member of the family of noble metals, with a melting point somewhat lower than that of silver and gold, possessing a brilliant white lustre, easily soluble in hydrochloric and in nitric acids, not tarnished by damp air, sulphuretted hydrogen, alkaline sulphides, or tincture of iodine, and not precipitated from its solutions by chlorides or iodides. Continued heating in the oxidising flame does not oxidise the molten metal, though some specimens, when first heated, give off dense fumes, which may be due to osmium, or possibly to something also new. It is electronegative to silver, is precipitated from its solutions by zinc, and, when alloyed with lead, may be separated by cupellation. The metal occurs pure as semi-crystalline grains, and in short rods about 0·5 mm. long and 0·1 mm. thick, and also alloyed with the other platinum metals. Quantities up to 3 oz. per ton have been found in the rock. It is more brilliant and lustrous than palladium, and softer than platinum, ruthenium, and osmium. The new metal is thus well characterised and clearly differentiated in properties from all known substances, and the confirmation of the discovery will be awaited with interest. Mr. French has had wide practical experience in the extraction and separation of the platinum metals with various bullion-smelting firms in this country, and is a native of Glasgow.

MR. J. C. ROBERTSON, of 119 Victoria Road, Kirkcaldy, has sent us a communication relating to recent proposals for the reform of the calendar. For the most part his remarks add little to the information conveyed in our articles of April 27 and October 26. But he also takes occasion to advocate the setting back of the year by ten days in order that its beginning may coincide with the winter solstice. This suggestion cannot be supported on the ground of any advantage in commercial affairs, and the chief interest which it has for us lies in the light which it throws on the mental attitude of the prominent reformers. In criticism of the provisions of the Fixed Calendar Bill, we suggested the case of a servant engaged on March 32, and wished to know the date of the first monthly payment and the rule for calculating its amount. On the first point Mr. Robertson confirms our surmise that the due date is April 28. This, it may be observed, implies that in practice a month may be any period from twenty-eight to thirty-five days—a truly great improvement on our present system! He then suggests that the payment will be by special agreement one-twelfth of the annual wage. But again it is difficult to appreciate the simplicity of a calendar which needs to be supplemented by special agreements. Alternatively, he states that the Bill provides that the payment shall be in proportion to the length of service. We believe that according to the Bill payment should be in proportion to the number of weeks in the month. When, as in the case suggested, a fraction of a week is involved, we were at a loss for a rule, and Mr. Robertson has not convinced us that the Bill is explicit on the point. We have no wish to press this simple example too far, but we do think that the reformers have altogether underrated the practical difficulties of the problem and undervalued the legitimate objections which can be brought against their solution of it.

MR. HERON-ALLEN informs us that the violent gales at the end of November have enabled him to make two very remarkable finds at Selsey, near Chichester. One is a series of Proteoliths in the seldom exposed Pleistocene mud bed on the west coast, which Sir Ray Lankester pronounces to be of the rostro-carinate eagles's-beak form, similar in shape and date to the sub-Crag Proteoliths of which frequent mention has been made in these pages. Mr. Heron-Allen is handing them all over, together with the Selsey Palæoliths and Mesoliths, to Sir Ray Lankester,

who is at work on this subject. The other "find" is a British gold stater, dished and plain on one side, and bearing on the other the impress of a die not to be found in Willett's or Evans's works, and which, until Mr. Heron-Allen deposited his coin at the British Museum, was unknown and unrepresented in the national collection.

In describing (*Archaeologia Æliana*, ser. 3, vol. vii.) the animal remains obtained during the excavations on the site of the Roman city of Corstopitum, near Newcastle-upon-Tyne, in 1910, Messrs. A. Meek and R. A. H. Gray state that the bones and skulls of many of the oxen agree very closely with those of the white cattle of Chillingham and other British parks. A peculiarity said to characterise both is the absence or early shedding of the antepenultimate lower premolar. On this ground both the Chillingham and the Roman cattle are declared to represent a new wild species, for which the name *Bos sylvestris* is proposed; but whether this is typified by the former or the latter the reader is left to decide for himself. They ignore the fact that park-cattle already possess a scientific name —*Urus scoticus* of Hamilton Smith—and likewise that the colour of these cattle is decisive as to their domesticated origin. Most naturalists would likewise regard the alleged absence of the anterior premolar as a feature due to domestication.

In a study of the Pacific Ocean in its relation to ethnography, contributed by Dr. J. M. Brown, regent of the University of New Zealand, to part i., vol. ii., of *The Journal of Race Development*, the writer lays special stress on the region of subsidence. This he believes to account for one of the most singular phenomena in human culture. "These central groups are occupied by a people, the Polynesians, who in some of their arts, the masculine, those of war, navigation, architecture, and carving, rise to the highest levels of the barbaric stage. And yet they have adhered to arts that are purely Palæolithic: these are the art of thread-making, that of fire-making, and the fictile art; they have never had a spindle: they have a pump-drill, but they have never applied it to the production of fire; and though they have plenty of clay, they have never made pottery. In early stages of culture these belong to the women's department, and woman, guided as she is by emotion oftener than by reason, is more conservative than man. This Palæolithic element in the household culture seems to indicate that man has been in Polynesia since Palæolithic times, and that woman came into those regions only in those times, when there were still only short canoe voyages to make to land that could be seen on the horizon."

Nos. 46 and 47 of the Scientific Memoirs of the Government of India deal respectively with "Malaria in the Punjab," by Major Christophers, and "Dysentery and Liver Abscess in Bombay," by Major Greig and Captain Wells. Malaria in the Punjab is manifested in two ways, as "endemic malaria" and as "autumnal epidemic or fulminant malaria," the latter—the more important—being associated with a high mortality. The determining causes of epidemics are excessive rainfall and scarcity, though the epidemic areas are not necessarily coincident with those of heaviest rainfall. The determining factor of epidemic and fulminant malaria is found to be flooding, and the villages are attacked almost exactly in proportion as they have been flooded. Experiments with sparrows and the Proteosoma, a parasite analogous to the malaria parasite of man, and similarly conveyed by mosquitoes, show that severity of infection is largely dependent on the dose inoculated, and the latter depends not merely on the number of mosquitoes biting, but on the number of sporozoites injected at each bite, and this, again, depends on the richness in parasites of the blood of the individual from whom the mosquito derives the infection. The memoir contains a number of plans and illustrative charts. As regards Memoir 47, on dysentery, though bacillary dysentery occurs in Bombay, it is infrequent, and the form associated with amœbæ is more prevalent. The prevalence of amœbæ shows a marked seasonal variation, which follows the humidity, and not the temperature, curve in Bombay. The amœbæ can be cultivated, and are not *Ent. histolytica* or *coli*, but are probably the same form as that observed by Noc in Cochin China. Apparently the same amœbæ can be cultivated from tap water in the districts, and the evidence at present available indicates that water is probably the channel by which this form of dysentery is disseminated.

To vol. iv., part iii., of the Transactions of the Hull Scientific and Field Naturalists' Club, Mr. T. Sheppard contributes notes on the post-glacial, glacial, and pre-glacial faunas of East Yorkshire. The glacial beds have yielded remains of mammoth, straight-tusked elephant, elk, reindeer, red deer, Pleistocene bison, aurochs, rhinoceros, and walrus.

The question of the nature of the diet of the extinct giant phalanger (*Thylacoleo carnifex*) has been incidentally revived by Messrs. Baldwin Spencer and R. H. Walcott in a discussion as to the origin of cuts on bones of extinct Australian marsupials (Proc. R. Soc. Victoria, vol. xxiv., pp. 92–123). Such incised bones occur at considerable depths—sometimes beneath beds of tufa—and the authors consider that the cuts were probably made by the teeth of Thylacoleo. The name given to the giant phalanger by Owen indicated his opinion as to its carnivorous habits; but this view was disputed in 1868 by Sir W. H. Flower, who thought that its diet was probably vegetarian, although it might have included flesh. Thirty years later Dr. R. Broom argued that Owen was right; and if Messrs. Spencer and Walcott are correct in their view as to the origin of the aforesaid cuts, the carnivorous habits of the giant phalanger are definitely proved.

In the volume on mammals in the "Fauna of British India," the late Dr. W. T. Blanford stated that the blackbuck (*Antilope cervicapra*) living on a spit of sand between the Chilka Salt Lake, in Orissa, and the sea, never drank, as there is no water on the spit except in deep wells. The statement has been strongly controverted by various writers, one at least of whom has suggested that the antelopes obtain water from sheep-troughs. Of late years it has, however, been conclusively shown that giraffes, kudu, and gemsbok live for a considerable portion of the year in the Kalahari Desert without drinking, obtaining such moisture as they require from the succulent roots of certain plants. In a letter published in *The Field* of November 25 Dr. Drake-Brockman records a very similar instance in the case of the maritime gazelle (*Gazella pelzelni*) in Somaliland. In July, 1910, five of these gazelles were placed on the island of Saad-ud-din, which is absolutely waterless save on the rare occasions when showers fall. There is, however, a succulent Schweinfurthia, of which the gazelles are fond, and a lily with a large onion-like root, which is scraped out of the sand and eaten by the gazelles. These are absolutely the only sources of moisture obtainable by the antelopes, which have now lived on the island for about eighteen months, since it has been clearly proved, by the absence of their tracks from the shore, that they do not drink sea water. The case of the Chilka black-

buck accordingly requires reinvestigation in order to ascertain whether they too may be able to obtain moisture from plants.

THE sponge fauna of the Kola-Fjord forms the subject of a paper (with a summary in German) by Mr. L. L. Breitfuss in *Trav. (Comptes rendus) Soc. Imp. Nat. St. Petersbourg*, vol. xlii., part i. In the second fasciculus of the same part Dr. Weltner describes (as the seventh instalment of the account of the fauna of Turkestan) the sponges of the Issyk Kul (Lake Issyk) and the neighbouring rivers of the district north of the Tian Shan. These belong to the almost cosmopolitan *Ephydatia fluviatilis*, and from the fact of its occurrence in the Issyk Kul, which is about 5300 feet above sea-level, at a depth of as much as 40 metres, the species is regarded by the author as a member of the high-mountain and deep-lake fauna. At depths between 15 and 30 metres there was found from the middle of July to the end of August a form which produces sexual buds. Since, however, only a few unripe gemmules with misformed amphidiscs were then found, it is considered that the development of normal sexual gemmules must occur at some other season.

A CATALOGUE of the periodicals, Transactions of societies, and similar publications contained in the library of the Royal Botanic Garden, Edinburgh, has been compiled and published as Nos. xxvi. and xxvii. of "Notes" from the garden. With a view to the utilisation of the separate items as index slips for public or private use, the printing is limited to one side of the page.

A CONTINUATION of garden notes on new trees and shrubs, prepared by Mr. W. J. Bean, appears in *The Kew Bulletin* (No. 8). Chinese introductions include a distinct rough-stemmed bush, *Berberis verruculosa*; a beautiful hornbean, *Carpinus polyneura*; and the new conifer, *Fokienia Hodginsii*. Another interesting and rare Chinese conifer, represented at Kew by several specimens, is the lace-bark pine, *Pinus Bungeana*; a peculiarity of this tree is the white bark, but it is noted that this is a very late development, and has not yet been attained by the Kew specimens. Noteworthy, also, is the small American tree *Leitneria floridana* that by itself constitutes the family Leitneriaceæ; the wood produced is perhaps the lightest known, having a specific gravity about 0·2.

THE original homes of our cultivated plants is a matter of considerable interest to gardeners, so that Mr. A. W. Hill found an appropriate subject in the relation of South America to horticulture for a lecture before the members of the Royal Horticultural Society, that is published in the Journal (vol. xxxvii., part i.). The "monkey puzzle," *Araucaria imbricata*, emanates from Chile, and from that State or Peru have come many hardy or half-hardy shrubs, including *Berberis Darwinii*, *Azara macrophylla*, and *Drimys Winteri*. Less hardy, and therefore requiring greenhouse cultivation, are the climbers Stigmaphyllon and Tacsonia, and the wall plants *Streptosolen Jamesoni* and *Lapageria rosea*. Species of Begonia from South America have contributed materially to the development of modern garden varieties, while no less interesting are the species of Calceolaria and Fuchsia that are strongly represented on that continent, and several brilliant species of Tropæolum.

PROF. D. H CAMPBELL is well known to botanists as the author of many valuable and important memoirs on the morphology of vascular cryptogams. A recent number (No. 140) of the Publications of the Carnegie Institution of Washington embodies a connected account of the eusporangiate ferns, in which he has brought together in a very complete form the result of his researches on the comparative morphology of the Ophioglossaceæ and Marattiaceæ. The memoir, which contains 224 pages of text, and is amply illustrated by text figures and plates, is fully worthy of the high reputation of Prof. Campbell, and it will be indispensable to all students of this interesting group of plants. After an extensive account of the structure and development of a considerable number of species the author draws certain general conclusions as to the phylogenetic significance of the structures he describes. Thus, as a result of a discussion of the evolution of the vascular structure, he regards the vascular system of the stem of, *e.g.*, Marattiaceæ as a collocation of leaf bundles, and discards the "stelar" view, as it is generally held, on the ground that it obscures a right interpretation of the facts. As might have been anticipated, the author deals with the supposed origin of the eusporangiate ferns (which he regards as a primitive group) from a bryophyte stock, and the analogies and comparisons he draws between the embryo of species of Ophioglossum and of Anthoceros are striking. Naturally he does not suggest a derivation of the ferns from Anthoceros as it now exists, but he points out very cogently the remarkable features of resemblance that actually exist. All who are interested in the evidence on which the speculations respecting the ancestry of the higher plants are founded will find matter of great interest in Prof. Campbell's memoir, whilst as a repository of facts which, whatever be the fate of theories and hypotheses, will always retain their face values, the memoir forms a considerable contribution to the permanent literature of botany.

THAT branch of the United States Department of Agriculture concerned with the introduction of foreign seeds and plants has achieved success largely owing to the systematised methods of procedure and the activities of the explorers in charge. One of the latter, Mr. D. G. Fairchild, contributes to *The National Geographic Magazine* (October) a popular illustrated article in which a few of the important introductions are noted. Probably the greatest undertaking has been the importation of date-palm suckers, which have been planted in the States of Arizona and California. From India, mangoes have been imported in large variety, and are being grown in Florida, Porto Rico, and Hawaii. The production of Oriental persimmons and the cultivation of bamboos on a commercial scale are also notable enterprises, as well as the introduction of a new vegetable, "udo," *Aralia cordata*, from Japan, comparable to and said to rival asparagus.

THE report on the permanent experiment field of the Roseworthy Agricultural College, published in *The Journal of the Department of Agriculture of South Australia*, contains some very interesting results. Perhaps the most remarkable is the great increase in the wheat crop obtained by applying small dressings of superphosphates, the grain rising from twenty-one to twenty-six bushels, and the straw also showing a marked increase. Nitrate of soda did not produce anything like the effect that would be looked for in this country, a result probably to be attributed to the lack of moisture, which would operate as a limiting factor. In the same Journal it is also stated that the broom millet (*Sorghum vulgare*, var. *technicum*) can be grown profitably in certain parts of the State. Stress is rightly laid on the value of any new crop likely to widen the basis of the local agriculture. Mention is also made of the fact that varieties of wheat which have proved admirably suited to Australia were wholly unsatisfactory in Great Britain.

THE third volume of results published by the Geological and Natural History Survey of Connecticut contains three bulletins, "The Lithology of Connecticut," by Prof. Barrell and Mr. G. F. Loughlin; "Catalogue of Flowering Plants and Ferns of Connecticut Growing without Cultivation," by the Committee of the Connecticut Botanical Society; and "Second Report on the Hymeniales of Connecticut," by Prof. E. A. White. One object of the Survey's publications is to enlist the interest of the general community, in which connection Prof. Barrell's "Introduction to Lithology" is noteworthy for its luminous thoroughness. The economic value of all soils is carefully investigated by Mr. Loughlin. On the same principle, the useful or deleterious properties of flowering plants and fungi receive full notice. Prof. White has made considerable experiments with mushrooms, and the number of edible and wholesome Agaricaceæ is surprisingly large. His descriptions of fungi, illustrated by some excellent photographs, are very complete. The catalogue of flowering plants and ferns comprises 2228 species; nothing that has not been authenticated is included. Distribution is uneven; Connecticut soils, being formed from transported material, often differ from the underlying rock. In the south-eastern portion of the State there is a small group belonging to the flora of the Atlantic coast plain of the middle and southern States, probably a remnant of a larger colony. Among interesting species are the dwarf mistletoe, parasitic on the black spruce; and the numerous representatives of Rhododendron and Cypripedium. In 1907 an Act of the General Assembly was put into force, by which "The Mountain Laurel, *Kalmia latifolia*, is hereby made, constituted, and declared to be the State Flower of the State of Connecticut." The prevailing difficulties of nomenclature are well illustrated in this careful list. It will, in connection with the full geological knowledge of the State, enable some investigations to be made of considerable ecological interest.

HEFT 3 of the current volume of the *Mitteilungen aus den Deutschen Schutzgebieten* is mainly devoted to the final portion of an account of the Cameroon Mountains, by Dr. K. Hassert. The hydrography is fully treated, and the distribution of water, with its remarkable inequality, is brought out. The coastal slopes have as high a rainfall as any part of the earth's surface, while the south-eastern, eastern, and northern regions are but imperfectly supplied. The fauna and vegetation are shortly described, and the inhabitants are discussed. A section on the economic products of the region, and two appendices dealing with the observations of altitude and the determination of geological specimens complete the article.

MR. V. N. LEBEDEF investigated the hydrology of the Kamchatka River in 1908–9, and has given a preliminary account in the *Izvestiya* of the Russ. Geogr. Soc., Nos. i.–v., 1911. The river is a mighty stream, being more voluminous in its lower course than the Dnieper, and discharging when low fully 42,380 cubic feet of water per second. A greater aggregate of low temperatures is required to bring it to the freezing point than any other river of Siberia, probably owing to the high temperature of the springs that feed it. It receives tribute also from the melting of the snow and ice in the mountains, while rain is of secondary importance. The lakes of eastern Kamchatka are in summer not colder than similar lakes in Europe, notwithstanding the great difference in climate, while in winter they are even warmer, because they are frozen over earlier. The stream that drains the Nerpichye Lake is, unlike most lake outlets, warmer than the air soon after the thawing of the ice. A map of the delta of the Kamchatka River with its numerous islands, channels, and creeks accompanies the article.

MR. I. KARK, who has studied the Murgab River in relation to a project for storing the surplus water in spring to be used for irrigation in summer has published the results in the *Izvestiya* of the Russ. Geogr. Soc., Nos. viii.–x., 1910. At Tashkepri the minimum discharge of the river in September is 1330 cubic feet a second, and the maximum, in March, 5608 cubic feet, while the annual flow of water is more than 694 thousand million cubic feet. The solid matter carried down by the stream, which silted up a reservoir constructed some years ago at Yolatan, is derived principally from the sand and clay of the löss deposits below Takhtabazar. Below Sultanbent and Yolatan, where the delta may be considered to begin, the load is deposited, and, raising the general level of the country, forces the river to seek a lower course westwards. Hence it is that the town of Merv has moved in the same direction. Mr. Kark suggests that borings should be executed to ascertain the practicability of obtaining water by artesian wells. These borings would also yield information regarding the depth of the solid rocks and their age.

THE meteorological chart of the North Atlantic Ocean for December, issued by the Deutsche Seewarte, gives some news received from the German Antarctic Expedition. The ship *Deutschland* left Buenos Ayres on October 7 for a position near latitude 48° S., longitude 30° W., in order to determine by soundings whether a shoal exists there, as surmised by several shipmasters. The vessel would then visit the South Sandwich Islands to explore the floor of the ocean in their vicinity, and afterwards repair to South Georgia to take in stores, &c., this month. From there it would take a direct south-east course to the neighbourhood of Coats' Land, and make the eastern part of Weddell Sea, where less pack-ice is likely to be found than in the south-western corner. If land is reached a station will be established, and the ship will endeavour to get free of the ice by March next. In the southern summer of 1912–13 it will return for the removal of the members of the expedition. Particulars of successful landing on the Antarctic shore may be looked for about April next.

IT is impossible to read the monthly issues of the Bulletin of the American Mathematical Society without realising that American mathematicians are a much more powerful and well-organised body than their fellow-workers in this country. In an article on "American Mathematics" in *The Popular Science Monthly*, Prof. G. A. Miller shows that much still remains to be done before America can occupy a position of equality with the leading mathematical centres of the world, and his remarks certainly appear to apply with even greater force to England. It may perhaps be rather doubted whether the imperfect definitions of such words as "matrix" or "algebra" given in ordinary dictionaries can be regarded as affording much conclusive evidence, since it is probable that similar defects might be found in their treatment of other branches of science; but Prof. Miller is on firmer ground when he directs attention to the absence of any popular encyclopædic works of general reference in the English language dealing with the developments and history of higher mathematics. "As the result of this lack of intermediate mathematical literature, comparatively few of our people know what constitutes a mathematician of high order."

THE Journal of the Washington Academy of Sciences for November 19 contains a short account of the results obtained by Messrs. Rosa, Dorsey, and Miller in a deter-

mination of the ampere in absolute measure at the Bureau of Standards. A current balance of the Rayleigh type was used, a coil being suspended from one pan of a balance so that it hung horizontally between two horizontal fixed coils of double its diameter, the three coils being coaxial. The change of weight in one pan of the balance necessary to maintain equilibrium when the current in the fixed coils was reversed was determined. The absolute value of the chemical equivalent of silver obtained by means of the balance is 1·11804 milligrams per coulomb. The value adopted at the London Conference in 1908 was 1·11800. The electromotive force of the Weston normal cell at 20° C., obtained by sending one absolute ampere through an international ohm, was found to be 1·01822 volts.

AT the recent Karlsruhe meeting of the Naturforscher-versammlung Prof. von Kowalski, of Freiburg (Switzerland), gave a summary of our present knowledge of the phosphorescence of organic substances at low temperatures, a knowledge which we owe largely to the observations made by him and his pupils. Many organic substances which exhibit no signs of phosphorescence at ordinary temperatures become phosphorescent in liquid air, and the intensity of the effect is increased if the substance is in solution in water or in alcohol to a concentration of about one-twentieth normal. Subjected to ultra-violet light for an instant, the solid solution gives a continuous phosphorescent spectrum, which gradually fades away, the longer waves disappearing first. If the exposure to the light is continued for a second or more the phosphorescent spectrum shows, in addition, a number of bright bands which persist longer than the continuous spectrum, and in fading away appear to spread themselves over the whole spectrum. These bands are intimately connected with the chemical structure and with the ordinary absorption spectrum of the substance investigated. Their positions can be obtained by displacing the absorption bands through a fixed interval towards the red end of the spectrum.

SEVERAL new models of microscopes, particularly the type known as the "Handle Model," are described in a catalogue received from Messrs. R. and J. Beck, Ltd. It is a matter of no small importance to the student to be able to lift his instrument without fear of straining any of its parts or of dislocating the objective in relation to the object. Many cheap microscopes are so designed that it is necessary when moving them to grasp the base; otherwise considerable strain is thrown on the fine adjustment. The models referred to are made in different patterns to suit either the student or the advanced worker, and in either case the price is moderate. The cheapest of the series is an example of what can be done in this country when modern methods of production are adopted. It is probably the least expensive microscope, for the adjustments provided, at present to be obtained of either English or Continental manufacture. The fine adjustment is of the lever type, so that the chance of it getting out of order or of becoming less accurate as the result of wear is reduced to a minimum. The stand is supported on a foot of the horseshoe type, and the objections to this design are to some extent obviated by lengthening the point of support towards the observer, with the result that increased stability is secured.

STUDENTS and teachers of applied mechanics in search of new examples as test exercises will find the set prepared by Mr. C. E. Inglis (Cambridge University Press, price 2*s*. 6*d*. net) to be of service. There are, in all, 160 exercises, divided into twenty papers; these are chiefly drawn from examination papers set at the Cambridge Engineering Laboratory, and the standard of most of the problems is that of the "A" papers in the Engineering Tripos examinations. Answers to the problems are included, but no hints for solution are given; hence the questions fulfil the purpose of the author, which is to provide material for the student who has learned many principles, but must also gain self-reliance in the application of the knowledge he has acquired. The problems given cover a wide range, and include exercises in structures, machines, strength of materials, and higher applied mechanics generally. The diagrams are well drawn and are clearly dimensioned. Many of the problems bear the stamp of novelty, and are suggestive of others on the same lines. Students preparing for the final engineering examinations of any of the universities should find the book useful.

Engineering for December 8 contains an account of a peat-gas plant which has been working at Portadown, in Ireland, since September last with results which are reported to be quite satisfactory. The plant works with air-dried peat, and consists of two producers of 200 brake-horse-power capacity each, together with coke-scrubber, tar-extractor, sawdust scrubber, exhauster, and expansion box. The peat is fed in block form into a hopper above the producer, whence it falls into the producer itself as combustion proceeds. The gas is drawn off through the coke-scrubber and washer to the tar-extractor, where the tar is extracted under centrifugal action. It then passes on to the sawdust scrubber, and is delivered to the gas-holder by a high-speed fan, which draws it through the plant. The heating value is about 140 British thermal units. This plant has replaced a Mond-gas plant by which power was formerly provided, and figures are given in comparison of the cost of the two methods of power-gas production. The net expense for fuel in the peat-gas plant is 4*l*. 5*s*. per week. The anthracite used in the Mond-gas plant cost 13*l*. 16*s*. 3*d*. per week. The plant has not been running sufficiently long to ascertain definitely whether a slight increase in labour may be necessary; but, allowing 40*l*. per annum for such a contingency, under these conditions at a factory of 500 looms, employing 500 to 600 hands, a saving in the fuel bill of about 438*l*. would result. The plant was constructed by Messrs. Crossley Brothers, Ltd., of Manchester.

A SECOND French edition of the first part of vol. i. of Prof. O. D. Chwolson's "Treatise on Physics" has been published by MM. A. Hermann et Fils, of Paris, at the price of 17 francs. As was the case with the first edition, the translation is the work of M. E. Davaux, and is based on the Russian and German editions. In this case, too, additions and notes have been made by MM. E. and F. Cosserat. The previous edition was reviewed in the issue of NATURE for February 15, 1906 (vol. lxxiii., p. 362), to which reference may be made.

OUR ASTRONOMICAL COLUMN.

SCHAUMASSE'S COMET, 1911*h*.—From the Nice and the Arcetri observations of comet 1911*h*, on November 30, December 1 and 2, M. Fayet has calculated a set of elements, which is published in a supplement to No. 4541 of the *Astronomische Nachrichten*. The elements give February 5, 1912, as the date of perihelion passage, and, as will be seen from the extract from the ephemeris, given below, the comet is now getting nearer to both the earth and the sun.

Ephemeris 12*h*. (*M.T. Paris*).

1911	α (true) h. m.	δ (true) ° ′	log *r*	log Δ	$1/r^2\Delta^2$
Dec. 12 ...	13 55·6 ...	+ 3 6 ...	0·1611 ...	0·2459 ...	0·15
,, 16 ...	14 11·2 ...	+ 2 8 ...	0·1506 ...	0·2352 ...	0·17
,, 18 ...	14 27·2 ...	+ 1 9 ...	0·1403 ...	0·2252 ...	0·19
,, 22 ...	14 35·4 ...	+ 0 39			

The comet is travelling south-east through Virgo, and rises about three o'clock in the morning.

OBSERVATIONS OF COMETS.—In No. 4538 of the *Astronomische Nachrichten* Prof. Barnard publishes the results of his observations of Wolf's periodic comet (1911*a*) during the present return. The observations were made with the Yerkes 40-inch refractor, and show that the magnitude was about 14–15, the diameter from 5″ to 10″, and that the comet was a small and indefinite, although not diffused, object.

Positions of comet 1911*b* (Kiess), determined during July 13 to August 10 at Leipzig, are given by Dr. H. Naumann, who found the comet to be very diffuse and changeable in appearance.

In No. 4539 of the same journal Dr. Backlund discusses the observed and calculated places of Encke's comet (1911*d*) during the present apparition, with special reference to the question of acceleration and the mass of Mercury adopted in calculating the perturbing forces. Prof. Konkoly records the wave-lengths and intensities of the four bands 560, 546, 516, and 472 observed in Brooks's and Beljawsky's comets, showing that the second and fourth of these were relatively faint in Beljawsky's comet at the time of observation. Only the first, third, and fourth of these bands were recorded in the spectrum of Quénisset's comet on October 14.

In the *Gazette Astronomique* (Nos. 47–48) are reproduced drawings, made by M. Biesbroeck at Uccle, of comets 1911*c*, 1911*f*, and 1911*g* on October 17; the differences in form are very striking. That of Brooks's comet (1911*c*) is of the Morehouse type, with long envelopes developed in front of the nucleus sweeping out into a long, fairly narrow tail. The form of comet 1911*f* (Quénisset) is very different, the tail being emitted as a narrow straight jet from a point at the centre of the rear of the head. In Beljawsky's (1911*g*) we recognise the type of envelope seen in the case of comet 1910*a*, where the nucleus was located slightly within the front surface of a broad parabolic envelope.

THE DISTRIBUTION OF STARS OF DIFFERENT SPECTRAL TYPES.—Dr. Karl-Gustav Hagström publishes the results of an interesting investigation concerning the distribution of stars in space, from the point of view of their spectra, in No. 7, vol. xlvi., of the *Kungl. Svenska Vetenskaps-akademiens Handlingar*. He finds that his class α (fifth-type stars) shows a marked concentration about the equator of the Milky Way, and that his β type (Orion stars) are more numerous and more concentrated in the southern than in the northern hemisphere; but for solar and first-type stars, also for the later types, he can find no preferential grouping. Accepting Herschel's idea that the visible stars form a single system, and admitting that the non-concentrated types are inside the ring of such a system, it would appear from this investigation that the system is lenticular in form, the cooler redder stars being situated in the neighbourhood of the sun, and the hotter stars in the edge of the lens form. As the hotter stars also appear to be in the southern hemisphere, it would seem that the sun is located in the northern part of this stellar system.

DETERMINATION OF RADIAL VELOCITIES.—An important contribution to the study of stellar radial velocities appears in vol. x. of the Annals of the Cape Observatory—Spectroscopic Researches. It contains the results of the measurement and discussion of radial-velocity plates taken between November 7, 1903, and May 4, 1908, and deals with thirty-one stars of the third magnitude and brighter. The measurements of each line on each plate, and the wave-lengths of the comparison spectra, are very fully discussed, and it is shown that there is apparently a distinct variation of wave-length with spectral type, the thirty-one stars, for this purpose, being arranged in six successive groups. A comparison of the Cape results with those published, for the same stars, by other observatories is reassuring concerning the general trustworthiness of radial-velocity results; thus eleven out of the thirteen results given for α Tauri, determined at six different observatories, all lie between 51·7 and 55·9 km. per sec.

EARLY METHODS OF DETERMINING LATITUDE.—Among the publications of the Deutsche Seewarte of the Kaiserliche Marine at Hamburg has recently appeared a memoir entitled "Die Geschichtliche Entwicklung der Polhöhenbestimmungen bei den älteren Völkern," by Carl Schoy. It contains a history of the various methods of determining geographical latitude employed by the early astronomers to about the date 1250. The author makes no original contribution to our sources of knowledge; but he has made a careful survey of the existing sources and the work of modern scholars, and his explanatory comment, with numerous references, should be useful to those who are interested in the archæological side of the subject.

The memoir consists of five chapters, of which the first deals briefly with the earliest attempts at a solution of the problem, especially among the Chinese. The second chapter relates to the Greek astronomers, from Eudoxus to Ptolemy; in this period we find the earliest recognition of the change of latitude with locality. The contribution of Indian astronomers, which is next described, does not seem to have advanced the methods of observation, but was of the greatest importance in the development of trigonometry.

The last two chapters treat of the work of the Arab astronomers Al-Battâni, Ibn Jûnis, and Abul Hassan, of Morocco. The mediæval Arabs inherited the knowledge acquired by the Greeks and the Hindus, and are known to have possessed translations of the works of Euclid, Ptolemy, and Brahmagupta. But they also made notable progress on their own account. Abul Hassan, in particular, shows the greatest fertility of resource in inventing new methods, and succeeded in solving the most complicated problems in dialling. This, at least, would appear from his work; but, naturally, it is impossible to estimate the debt which he owed to his predecessors.

STARS HAVING PECULIAR SPECTRA.—While examining the photographs of the Henry Draper Memorial, the late Mrs. Fleming discovered an immense number of variable stars and other objects having peculiar spectra, and the finds have been from time to time recorded in the Harvard College Observatory Circulars. No. 167 of these probably completes the record of Mrs. Fleming's discoveries, and contains a list of thirty-one new variables, of which thirteen were found by her. It also gives a list of seven stars having peculiar spectra, of which Mrs. Fleming discovered five; in three cases Hβ is bright, three others contain bright lines, one being a gaseous nebula, and the other has a normal fourth-type spectrum.

THE EVOLUTION OF MULTIPLE STARS.—The question of the evolution of double and multiple star systems is discussed, in the light of recent discoveries, by Dr. See in No. 4539 of the *Astronomische Nachrichten*. *Inter alia*, he states that such systems, having developed from spiral nebulæ of vast extent and slow motion of revolution, should show but little relative motion, and suggests that in such cases as β Cygni, α Tauri, &c., an effort be made to photograph the extremely faint residual nebulosity which, according to the hypothesis, may still surround the members of such systems.

MATHEMATICS IN ENGLISH SCHOOLS.

THE powerful and vigorous article on "Mathematics in English Schools" contributed to *Science Progress* for October by Mr. Charles Godfrey, headmaster of the Royal Naval College, Osborne, opens up a subject deserving the most attentive study on the part of everyone who is interested in the future progress of our race. As the author points out, modern civilisation stands on a foundation of applied mathematics; without mathematics the earth could not support its present population. But in England we have a ruling class whose interests are sporting, athletic, and literary; consequently not only is mathematics not a bread-and-butter subject except for those who are satisfied with this simple diet, but the work of the mathematician is ignored and even treated with contempt. And this in spite of the fact stated by Mr. Godfrey, that mathematics occupies a larger share of time in our school curricula than in those of other countries. The remedy proposed by Mr. Godfrey is that our teaching in schools should be based on the "outlook" value of mathematics, and should train our boys to appreciate the tremendous potentialities of the subject of which they are mastering the elements. At

present our teaching involves a large amount of disciplinary drill in subjects like algebra, which affords no outlook beyond that afforded by the examination value of the subject.

Mr. Godfrey finds that, whatever may be the real educational value of this training, we have no definite proof that it confers advantages which could not be at least equally efficiently derived from other studies. On the other hand, we have certainly failed in one thing: broadly speaking, we have failed to make mathematical thought enter as a main element into the life of the educated classes. More and more the affairs of life are being made amenable to mathematical treatment, and as it has turned out the development has been on lines divergent from the lines of schoolwork. In these developments, the study of the calculus has been the fundamental form in which mathematics is applied to the affairs of modern life. This study, however, does not grow out of the summit of school mathematics, but branches off low down the stem, and it is independent of formal geometry; a vigorous pruning of school algebra and arithmetic would in no wise prejudice the growth we want to encourage.

Mr. Godfrey, referring to the requirements of the non-mathematical schoolboy, compares the drudgery and drill of multiplying and dividing long algebraic expressions to the technique of piano-playing, which may be useful for the professional musician, but conspicuously fails to stimulate a taste for music in the average pupil. He finds that the time saved from this drill would amply suffice not only for the teaching of the calculus when its fundamental principles are divested of the unnecessary complications introduced by the consideration of transcendental functions, but that a stimulating course in mechanics can quite well be fitted into the curriculum which the mathematical as distinct from the science master can provide for the non-specialist schoolboy.

As regards statics the position is clear, provided that experimental methods receive due prominence. The case for dynamics is not so clear, and Mr. Godfrey's difficulties may perhaps receive confirmation from the disagreement which still exists among teachers regarding mass and weight, poundals and slugs. He would therefore propose to restrict the study to kinematics, which, as he points out, is really nothing more than geometry with the introduction of a time element. Many of Mr. Godfrey's suggestions have been under the consideration of the committees appointed by the Mathematical Association to inquire into the teaching of school mathematics, and the feasibility of the proposals to which he directs attention is proved by the fact that, in the French *lycées* for classical specialists, the proposed training in analysis is reached with a far shorter number of hours of schoolwork than is given to mathematics in England.

The views indicated very imperfectly in this abstract will doubtless be read with regret by disciples of the old school. But England's neglect of mathematics requires us to face many hard and unpleasant truths, and it is probably no exaggeration to say that at the present time a plea for the study of classics, even Latin and Greek grammar, would receive a favourable reception at the hands of a large section of the British public which would turn a deaf ear to any corresponding claim of the mathematician.

G. H. B.

THE HEALTH OF THE NATION.

THE sixth annual meeting of the National League for Physical Education and Improvement was held at the Mansion House on December 8, the Lord Mayor presiding. Letters of regret were read from the Archbishop of York, Lord Haldane, the Lord Chief Justice, and others. The first speaker was Sir Archibald Geikie, president of the Royal Society. He greatly approved of the objects of the league, which are to stimulate public interest in the physical improvement of the people, to lessen waste by coordinating agencies already established for this purpose, and starting them where none at present exist, to make better known the local powers already possessed by public authorities, and to promote fresh legislation where necessary. In a short, telling speech he pointed out that while the league was to be congratulated on the very rapid and excellent progress it had made during the six years in which it has been in existence, it has been, and still is, hampered by want of funds, a want which it is to be hoped will be remedied in the coming year by the aid of all those who have the health of the nation at heart.

Bishop Boyd Carpenter described more in detail the work of the league during the past year. The three subjects on which it had been particularly engaged were the need for a clean milk supply, organised physical recreation, and the dangers arising from the use of inflammable makes of flannelette. He showed that the league's work was not of a purely philanthropic nature—it was an effort at self-protection on the part of a great nation. It tried to protect children in their upgrowth and to prevent them, in various ways, from becoming a source of weakness to the community.

Prof. Bostock Hill, medical officer of health for Warwickshire, suggested that a national health week be instituted, culminating in a Health Sunday, when the churches might bring home to the nation the gospel of hygiene. Communal sanitation has resulted in a very considerable reduction in the death-rate of this country; but he pointed out that more than communal effort was now required, and that this could only be brought about by giving to the people individually a knowledge of what hygiene could do for them, and at the same time co-ordinating the services of all societies, private and public, towards this end. People must be brought to understand that hygiene consists in the spread of cleanliness, applied to air, food, earth, and the dwelling.

Lady St. Davids brought forward several practical suggestions, such as the formation of tooth clubs for toothless people, instead of boot clubs for bootless children, since the former were in more danger of injuring their constitution than the latter. She also pleaded for the closer cooperation of the nursing profession with all who were concerned in the promotion of the health of the nation.

THE ANALYSIS OF SPECIES.[1]

THE author of the paper referred to below has made an important pioneer contribution to the study of heredity in crosses between plants of widely divergent phylogeny, viz. reputed species of Linum, and has compared the results obtained from such species-hybrids with those obtained from the simpler varietal crosses. Statistical methods have been utilised for the expression of the characters examined, as in the work of Johanssen.

The general trend of the results is to show that even in cases where the composition of F_2 appears to present perfectly smooth variation between the two parental extremes, the behaviour in F_3 shows that the inheritance is in reality factorial, and can be most easily explained on Mendelian principles. The frequency with which the parental forms reappear is least in crosses of reputed species, and becomes more common with closer crosses until simple mono-hybrids are reached. The methods by which the data were obtained appear to have been above suspicion, both experimentally and statistically, while the important error from vicinism is said to have been excluded.

One possibility has perhaps been overlooked, namely, that while the inheritance of such a character as length of seed is probably determined by several allelomorphic pairs, yet the ultimate dimensions of the seed of any given plant, fluctuation having been evaluated, may be influenced through correlation with other similarly inherited characters, notably the dimensions of the fruit. The position of any plant in the frequency curve for a family is thus, apart from fluctuation, firstly determined by the factors which it carries, and secondarily by a deflection of the expression of those factors from the normal by somatic correlation.

The characters studied were the length and breadth of the seed, the length and breadth of the petals, and the

[1] "Das Verhalten fluktuierend variiender Merkmale bei der Bastardierung." Von Tine Tammes, aus dem Botanischen Laboratorium der Universität Groningen. Extrait du Recueil des Travaux botaniques Néerlandais, vol. viii., Livr. 3, 1911.

petal colour, all of which received quantitative measurement, together with qualitative studies of the dehiscence of the fruit and the hairiness of the ovary walls. The article is illustrated by two photographs, and by ten diagrams which include nearly a hundred frequency polygons. W. L. B.

AMPHIBIAN FAUNAS OF SOUTH AFRICA AND MADAGASCAR.

IN discussing the relationships between the amphibian faunas of South Africa and Madagascar in the Annals of the Transvaal Museum for April, Mr. J. Hewitt accepts the theory of an early land connection between Australia, India, Madagascar, the Seychelles, and South Africa, which was sundered between Australia and Africa after the Lower Cretaceous, and was elsewhere broken up into islands in the early Tertiary. The connection between Madagascar and India persisted until the Eocene, or perhaps later, as an archipelago, and Africa may have been connected by swamps with Madagascar until the early Pliocene. Another land-bridge connecting South Africa and South America by way of the Atlantic is likewise accepted. The fauna of the whole area is considered to have had many features in common; but after the separation of Madagascar and the formation of the African continent the latter area was invaded by a Palæarctic fauna, which could not reach Madagascar. The fauna of that island accordingly seems to represent in a modernised form —with a few additions—the one originally common to the southern Ethiopian area.

The author then proceeds to discuss how the relations of the amphibian faunas of Africa, Madagascar, South America, and Australia can be explained on these suppositions. To follow him in detail would take too much space; but it may be mentioned that he is disinclined to accept the generic identity of the Malagasy boa-like snakes with South American types, and that he regards true frogs (Rana) as of African, and tree-frogs (Hylidæ) as of South American, origin. The two latter are stated to have attained their present distribution by crossing what is now Bering Strait, in opposite directions, after the sundering of the connection between Africa and South America (p. 37), Rana having thus reached South America from the north (p. 35). On the other hand, it is stated later (p. 38) that the Ranidæ are an Old World group "which crossed over to the Neotropical region at a time when the land-bridge was just beginning to give way, and when eventually they had travelled northwards as far as the Antillean bridge this was no longer complete." The discrepancy in the two statements requires explanation.

WATER SUPPLY IN AUSTRALIA.

THE great drawback to settlement in some parts of Australia is the frequent droughts that have to be dealt with. So far back as 1884 the New South Wales Government appointed a commission to consider the question of irrigation, and, as a result, a water conservation department was organised, and an experienced Indian irrigation engineer appointed to advise. As one result of this the construction of a dam across the Murrumbidgee River was decided on. This dam, known as the Burrinjack Dam, rivals in size and quantity of water impounded the famous Assouan Barrage across the Nile. The Murrumbidgee River for 200 miles above the dam runs its course principally amongst mountains, the higher peaks of which are covered with snow in winter. The catchment area at this point amounts to 5000 square miles, the rainfall varying from 20 to 70 inches a year. At the place where the dam has been constructed the whole of the river water passes through a narrow granite gorge, and consequently the minimum cost of construction, combined with the maximum stability, has been secured. For about 200 miles below the dam no irrigation works are needed, as the district through which the river flows is undulating and has a sufficient rainfall. Below this the river enters a flat country, with a diminished flow of water. Like some other rivers in Australia, the Murrumbidgee, instead of increasing in volume as it proceeds on its downward course to the ocean, actually diminishes, and becomes a small stream. This is due to the diversion of its water into shallow lagoons, where the evaporation caused by the fierce sun and percolation disposes of the greater part of the water. The dam is of concrete, 240 feet high and 784 feet long. It will back up the water in the main stream for 41 miles, and of two of its tributaries for 15 and 25 miles. Although the water supply is to be brought into operation at once, the dam has only been built up to 110 feet; the remaining 130 feet, it is expected, will take two years more to complete. For carrying on the works and providing for the staff employed a temporary township has been created provided with complete sanitary arrangements and medical attendance. An electric installation has also been set up for working the cranes and other machinery. A light railway 28 miles long has been constructed connecting the temporary township with the main line of railway from Sydney to Melbourne. The estimated cost of this work is 758,000*l*.

THE DIVINING ROD.

DR. L. WEBER, professor of physics in the University of Kiel, has published in the *Journal für Gasbeleuchtung und Verwandte Beleuchtungsarten sowie für Wasserversorgung* a copy of an address on the divining rod read by him at Flensburg in September last. Dr. Weber regards belief in the powers of water diviners as a form of antiquated superstition and gross error; he is of opinion that there is no evidence that the movements of the rod are due to any cause outside the diviner, who is the subject of self-deception. He bases this view on the results of careful investigation, but, in so far as the paper in question is concerned, only one instance of actual experiment is given (see below).

Dr. Weber mentions the results obtained by Herr von Uslar in the German African colonies, and thinks that the divining rod was, in this case, simply a magic staff which animated von Uslar's expedition to extraordinary exertions, and, more particularly, to deep boring with excellent results.

The experiment mentioned in the *Journal* is one performed at Flensburg before the Association of Gas and Water Specialists of Lower Saxony. Herr Léon, a well-known water diviner from Kiel, submitted himself to the blindfold test tried so frequently; he indicated two places in a room, in one of which his rod acted strongly, and in the other of which there was little or no action. He was then carefully blindfolded, turned round, and taken to the two places in irregular turns, when his rod gave corresponding indications to those obtained at first (when not blindfolded) in only two cases out of the six. The present writer has performed similar experiments, and always with similar results to those which Dr. Weber obtained with Herr Léon; he is, however, of opinion that they cannot be regarded as conclusive, since it is quite possible that, if the movements of the diviner's rod are due to an objective cause, the blindfolding may influence the nervous condition of the water diviner in such a way as to render him a less efficient "water indicator" than he would be in ordinary circumstances. On the other hand, it must be remembered that Herr Léon accepted the conditions of the experiment, and when a scientific man undertakes to investigate an apparently mystic process, such as water finding, he cannot be expected to do more than lay down conditions which appear to him reasonable and are accepted by the diviner.

J. W.

NEW MECHANICAL ENGINEERING LABORATORY OF THE MUNICIPAL TECHNICAL INSTITUTE, BELFAST.

ABOUT eighteen months ago the Corporation of Belfast authorised the preparation of plans and the installation of a teaching equipment suitable for the scientific training of mechanical engineers. The plans for this work were at once put in hand, and the installation has been carried out to the designs and under the direction and superintendence of Prof. J. H. Smith, head of the mechanical engineering department of the institute.

The laboratory was opened by Prof. J. Perry, F.R.S., on November 24 in the presence of a large company, including members of the Corporation, prominent manufacturers, and business men. The dimensions of the laboratory are 141 feet by 42 feet, with a mean height of 20 feet. The building is fitted with two travelling cranes. It has an upper floor and a lower floor, between which are placed the lines of shafting, the piping for engines, and all similar accessories.

The installation includes steam-driven machines, electric generating plant, oil engine, gas engine, petrol engine, centrifugal pumps, turbines, and refrigerating machine. There is also a full range of smaller testing appliances necessary for the complete training of an engineer.

The detailed list of appliances is a very lengthy one. The steam generating section includes a Lancashire boiler measuring 30 feet by 8 feet, and a marine-type boiler measuring 14 feet by 11 feet, together with pumps, meters, economiser, superheater, feed-water heater, induced draught fan, pressure and temperature indicators, &c.

The steam section comprises a steam engine of the horizontal cross-compound type of 60 horse-power, built by Messrs. Combe Barbour, of Belfast; a 20 horse-power high-speed generating set built by Messrs. W. H. Allen and Co., of Bedford; a 15 kilowatt Parsons steam turbo-alternator; a De Laval turbine of 20 horse-power; a steam pump and a condensing plant.

The hydraulic section is exceptionally well designed and equipped, and includes a motor-driven high-lift turbo-pump, cast-iron channels, tank, tumbling bay, venturi meter, pitot tubes, Thomson turbine, Girard turbine, Pelton turbine, and an apparatus for experiments on pipe friction.

The testing of materials section contains a Riehlé testing machine of 68 tons capacity, on which experiments may be made in tension, compression, bending, and torsion; an Adie machine for cement testing; a fatigue testing machine, designed by the professor of mechanical engineering (Dr. Smith); appliances for the microscopical examination of metals; a "hardness of metals" tester; and various other appliances.

The section of internal-combustion machines includes a gas engine, a suction-gas plant, an oil engine, and a petrol engine. Additional fittings are a main switchboard of special design, an air-compression plant, a refrigerating plant, and an electrical direct-driven fan of "Sirocco" pattern. There are, in addition, all the necessary subsidiary appliances, such as calorimeters, micrometer, and other gauges, indicators, anemometer, &c.

The workshop adjoining the mechanical engineering laboratory is exceptionally well fitted with up-to-date machines, amongst which are a universal milling machine, a high-speed planer, a high-speed screw-cutting lathe, a boring and surfacing lathe, a Hendy-Norton screw-cutting lathe, a vertical automatic drilling machine, a shaping machine, together with grinding machines, brazing apparatus, vices, and other adjuncts found in a well-equipped machine shop. Adjoining the machine shop is a pattern shop, which contains a hand-turning lathe, circular saw, band saw, universal wood-cutter, and the requisite supply of benches.

The Plenum ventilating and heating plant also forms part of the mechanical engineering equipment of the institute, and from time to time it is used in the instruction of students and for experimental purposes.

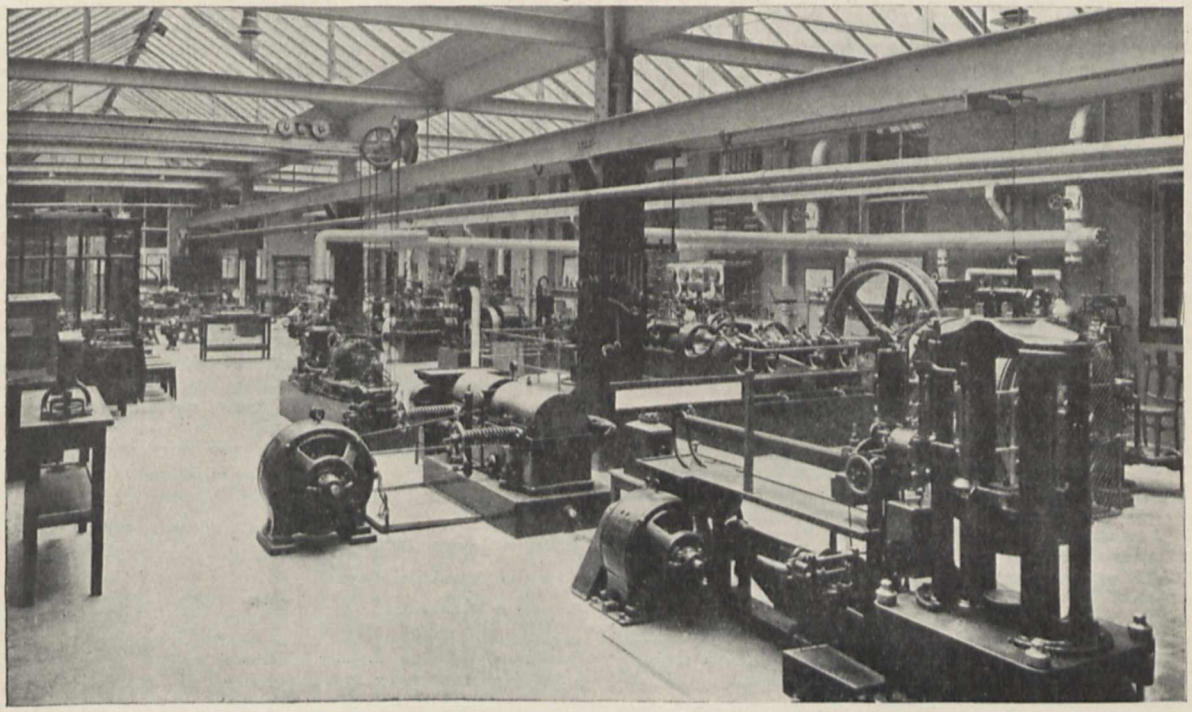

Photo.] New Mechanical Laboratory, Municipal Technical Institute, Belfast. [*A. R. Hogg.*

The city of Belfast can now claim to possess a mechanical engineering equipment as comprehensive as that of any technical institution of the United Kingdom.

SCIENCE EXAMINATIONS AND GROUPED COURSE CERTIFICATES.[1]

CIRCULAR 776 was issued by the Board of Education on June 20, 1911, which date was near the commencement of the long vacation, and made it practically impossible for the governing authorities of technical institutions to introduce any necessary amendments into the schemes of instruction for the present session. In its general arrangements the scheme is, without doubt, excellent, and teachers familiar with certain of the local group course systems will probably at first conclude that it will fit the modern conditions of the group course system very accurately. More careful study, however, reveals the fact that there

[1] From an address delivered before the Association of Teachers in Technical Institutions on November 11 by Mr. Barker North, ex-president of the Association.

are enormous difficulties in the way of its immediate adoption, and the smaller technical institutions in particular will be very hard hit by the condition bringing the scheme into operation during the present session. These difficulties exist with reference to both day and evening work, but it is in connection with the latter that the matter is one of great urgency, and the following remarks will therefore deal only with the principal changes affecting evening instruction.

A. *Changes in Subjects and Stages foreshadowed in the Circular.*—(1) The abolition of all Stage I. and practical examinations; (2) the abandonment of all examinations held by the Board in the following subjects: sound, light, geology, mineralogy, physiology, general biology, zoology, botany, navigation, nautical astronomy, physiography, agricultural science, hygiene, and elementary science of common life; (3) principles of mining becomes coal-mining only; (4) for the purpose of constituting examining boards, to include teachers in technical schools, the subjects retained will be grouped as follows: (*a*) pure and applied mathematics, (*b*) engineering, (*c*) physics, (*d*) chemistry, (*e*) mining and metallurgy; (5) there will be two stages only in each subject, viz. "lower," corresponding to the old Stage II. examinations, and "higher," the standard being intermediate between the old Stage III. and honours examinations; (6) in each grade of each subject, one paper only will be set, with the exception of "higher" pure mathematics, in which two papers will be given.

B. *Conditions of Admission.*—(1) A fee of 3*s.* 6*d.* must be paid by the candidate for each stage in each subject; (2) candidates must be over seventeen years of age on July 31 following the examination; (3) students taking full-time *day* courses will only be admitted under special conditions; (4) in the following subjects: theoretical mechanics (solids), theoretical mechanics (fluids), applied mechanics (materials and structures), applied mechanics (machines and hydraulics), heat engines, heat, magnetism and electricity, inorganic chemistry, organic chemistry, and metallurgy, a candidate for admission to the higher examination must furnish a certificate of having completed a satisfactory amount of laboratory work, and submit laboratory note-books signed and certified by the teacher.

C. *Records of Successes.*—The issue of personal certificates will be discontinued, result lists only being published by the Board, with the following exceptions: (1) certificates for the present will be issued for coal-mining; (2) personal certificates to successful candidates at *higher examinations only*, will be awarded provided (*a*) "that they have previously received appropriate group course certificates" endorsed by the Board, (*b*) "that the examination has not been approved in connection with the course for a certificate"; (3) successes in higher and lower stages, and in other approved external examinations, such as the City and Guilds Institute, may be recorded upon grouped course certificates endorsed by the Board, but successes at internal examinations may not be separately recorded.

After studying the conditions detailed above, most teachers will no doubt come to the conclusion that evening students will not be likely to sit for the Board's new examinations. The institution of the 3*s.* 6*d.* fee will alone act as a sufficient deterrent, especially in the case of a group course student wishing to take several examinations, but this, when combined with the fact that a record of success can only be obtained by complying with certain very difficult conditions, must reduce the number of candidates almost to the vanishing point. The past few years has been a transitional period, and elaborate group courses, suited to the local industries, have been adopted by most schools in place of the system of detached classes suited to the Board's examinations. In most places, however, the syllabuses of instruction are modelled on the syllabuses of the Board's science examinations, no doubt with the view of attracting certain students who still place faith in the certificates awarded by the Board; and this is the case particularly with smaller institutions, where the local certificates have proved so far of little value. This must continue until some means can be devised of giving a definite and fairly uniform value to the certificates awarded by different institutions for corresponding years of a group course.

Undoubtedly the country is ripe for the introduction of a national group course system, and we therefore turn expectantly to the scheme which the Board suggests.

The Scheme of Grouped Courses in the Circular.—For evening students the Board suggests the classification of courses into three grades:—(1) Junior courses (two years), for youths leaving elementary schools at fourteen. (2) Senior courses (three years), for students who have taken either (*a*) a junior course, or (*b*) a three years' course at a secondary or higher elementary school. (3) Advanced courses (two years), for students who have taken the senior course. The Board is prepared to endorse certificates in senior and advanced courses only under the following conditions, amongst others:—(1) The group course system *must previously have been approved* by the Board, who must also be satisfied with the equipment of the school, and the steps taken to admit only properly qualified students to the course. (2) No unendorsed certificates may be issued by the local authority.

The local certificates of a few of the larger institutions in the country have already become of some value to the holders in the local industries, and therefore the question of endorsement is of little immediate importance to these places, but in the case of the smaller institutions, in view of the fact that the local certificates are not of great value, if any, where they are already given, the question of endorsement becomes of prime importance. A cursory glance at calendars of various technical institutions will show that, although each may have many excellent features, such a variety exists in the construction of the courses that the Board cannot conscientiously approve many of these, and thus a grave injustice must be done during the next few years to a great number of students who have been working towards a definite objective. Take the first three years' courses at Manchester, Bradford, Leeds, and Liverpool in chemical industries as examples. The total possible student hours in the three years are, respectively, Manchester, 660 hours; Bradford, 540 hours; Leeds, 697 hours; Liverpool, 630 hours; sufficient variation, one would think, to result in a very different standard of attainment at the end of the Board's senior course scheme, each institution admitting at the age of sixteen years. The division of the time mentioned above is apportioned as follows:—

—	Manchester	Bradford	Leeds	Liverpool
	hours	hours	hours	hours
Theoretical Inorganic Chemistry	60	90	97½	90
Practical ,, ,,	165	150	180	135
Theoretical Organic Chemistry..	60	60	75	nil
Practical ,, ,,	240	60	90	,,
Preliminary Mathematics	60	nil	nil	60
Theoretical Elementary Physics	30	,,	37½	30
Practical ,, ,,	45	,,	37½	45
Principles of Analysis...	nil	45	35	nil
Chemical Calculations	,,	15	60	,,
Tutorial Work	,,	30	nil	,,
Theoretical Heat (Stage II.) ...	,,	30	,,	30 (or Electricity)
Practical ,, ,, ...	,,	60	,,	45
Pure Mathematics, Stage II., or Theoretical Mechanics, Stage I.	,,	nil	,,	120
Theoretical Electricity, Stage I. or II.	,,	,,	,,	30
Practical Electricity, Stage I. or II.	,,	,,	,,	45
Technical Analysis	,,	,,	90	nil

It should be mentioned that at Bradford the student takes preliminary mathematics, elementary physics, and Stage I. inorganic chemistry for two years in the branch technical schools as a preliminary, whereas the other institutions all begin with Stage I. inorganic chemistry in the technical courses mentioned above. Further, in the three years' course above, Bradford completes Stage III. inorganic chemistry, the other institutions completing Stage II.; in organic chemistry, Manchester and Leeds complete Stage II. work, Bradford Stage I., and Liverpool does not include organic chemistry in the three years' course.

An examination of some 200 calendars of institutions throughout the country has shown that the examples given

are typical of the group course system, a feature which is not surprising when we consider the way in which the course system has developed. It illustrates, perhaps, more clearly than any other fact the lack of "guidance from the mind that sees the needs of the country from the greater and national point of view." Cast-iron schemes and syllabuses are not required: the Board's rigid syllabuses have during recent years proved a failure from the teacher's point of view; but surely some greater degree of uniformity can be obtained than is shown above, whilst retaining the necessary pliability to suit local requirements of the industries. Before any uniform system of endorsement of certificates can be introduced, coordination of the courses in different institutions must be secured by the standardisation of the courses, as a guide to the standard to be arrived at in any one year, or at the end of a given course. A very grave injustice will be done to a great number of students, and, further, there will be a danger of the loss of many students, unless the conditions outlined in the circular are modified, either (1) by delay in the operation of the scheme for one or two years, or (2) by modifications of the conditions, such as reduction of the entrance fee, the granting of certificates by the Board, particularly in the lower stage, and the revival of examinations in such subjects as light and natural sciences, during the transitional period that must ensue until institutions can come into line with the new requirements.

The time is opportune, too, for revision of the award of Government grant on the work done by evening students. Local authorities are sufficiently hard pressed at the present time without taking over the burden of the cost of examination systems, and the time has arrived for allocating an increased amount of money in the form of a capitation grant for those taking group courses, somewhat on the lines of the grant made at present for day courses in technical institutions, thus differentiating between group courses and single-subject courses. Teachers are convinced that three nights per week, under present conditions of daily employment, are too much in the cases of youths under eighteen, and up to the end of the second year in the senior course the Board might reasonably make the full grant for two evenings (five hours) per week, extending over a thirty weeks' session, instead of encouraging, as at present, courses which are overburdened, for the local authority cannot afford to reduce the number of hours per week in the institution expected from the student, owing to the loss of grant which this would entail. A better grounding in the elementary branches of the work would at the same time undoubtedly be secured.

As to the best method of carrying out a national system of examinations, which is absolutely independent of centralised examinations such as those of the Board of Education, and City and Guilds Institute, the feeling is growing in some quarters that this will be most successfully accomplished by the cooperation of county education authorities with the local education authorities in county boroughs, to form examination boards of teachers and representatives of the local industries, acting as external examiners or assessors in conjunction with the teachers in the institutions of a given area as internal examiners. Such boards would be more in sympathy with the local requirements than any central board could possibly be, and the Board of Education, through its inspectorate, and a National Examination Board should be able to maintain a moderately constant standard throughout the country once the system is in thorough working order. Such a National Examination Board should contain representatives, who should be teachers, from the local examination boards.

Each year in a student's work marks a distinct stage in his career, and this should be recognised on successful completion of the work of each year by the award of a local certificate or record, to be exchanged at the end of the course for the full endorsed certificate, giving a national stamp, or hall-mark, to the work. At the same time, it is worth consideration whether certain single-subject courses of a highly technical character are not worth the award of a special endorsed certificate, particularly in cases where the student is able to take up the higher work without passing through the preliminary grind of the earlier years, or in cases where the subject-matter does not readily adapt itself to inclusion in a course. There is undoubtedly the need for a national evening course system, so that the smaller institutions may readily and naturally feed the larger, in which the more advanced work will be concentrated, and so that this work may lead up systematically to the day diploma work of our specialised technical institutions.

INDUCED ACTION OF LEUCOCYTES.[1]

SCIENTIFIC workers may like to have a brief account of some recent researches which, I think, are likely to be of both theoretical and practical interest. The researches commenced nearly five years ago in a special study of leucocytes by a method devised by my brother, Mr. H. C. Ross, and myself. This consists in placing liquid blood under a cover-glass, not, as usual, upon another surface of glass, but upon a bed of transparent jelly with which various reagents, including stains, have been mixed. The original object of the method was to try to cultivate human leucocytes *in vitro*. At first careful studies of the rate of absorption of stains by the leucocytes under various chemical conditions of the jelly were made by Mr. Ross. Two years later he found that extract of hæmal gland, extracts of apparently many dead and decomposing tissues, and globin, when mixed with the jelly, force a large proportion of the leucocytes to divide before the eyes. Subsequently, he and his assistant, Dr. J. W. Cropper, ascertained by a series of lengthy studies that many of the substances which possess this property (in different degrees) belong to the amidine grouping. They have found, also, that a second series of substances, though by themselves they cannot produce division of leucocytes, have the power of augmenting very greatly the power of the former group of substances to do so. They give the names *auxetics* and *augmentors* to the two groups respectively. The principal auxetics are extracts of organs, creatine, xanthine, creatinine, guanidine, benzamidine, theobromine, acetamidine, caffeine, theophylline, methylamine, ethylamine, propylamine, &c., and certain aniline dyes. Some of the augmentors are various alkaloids, atropine, choline, cadaverine, neurine, &c.

The technique, though simple, requires considerable care. If a stain such as polychrome methylene blue is added, the cells become coloured progressively as the division advances. All the varieties of the human leucocytes can be made to divide; but the technique is slightly different for each variety. The proportion of cells affected in a given preparation of blood varies according to perfection of technique up to, say, 80 per cent.; but as death occurs rapidly, especially if stain be used, it usually overtakes a large proportion of them before the division has been completed. After about twenty minutes all the cells die, and by that time the process is complete in only a small percentage. Efforts to keep the cells alive longer upon these medicated jellies or in solutions of auxetics have not yet been very successful and would not be easy. After their death the leucocytes give up again most of their stain, and the jelly preparation rapidly spoils; but a method has been found of making (with some difficulty) permanent specimens of such of the blood as adheres to the cover-glass by fixing the whole preparation with osmic acid vapour, and then freezing and picking off the cover-glass from the bed of jelly.

To watch the same cell passing through the whole process requires an accurately adjusted warm stage or microscope-incubator and considerable patience, because the cell which we happen to select for observation will most probably belong to the majority which die before completion of the division; but partial division can be easily witnessed. If, however, the specimen is incubated for ten minutes, and is then surveyed rapidly from field to field, numbers of the leucocytes caught in all stages of the process can be readily seen. The fixed films just referred to show exactly the same objects, but enable us to examine them repeatedly and at leisure. And in both these cases the dividing forms are so numerous and similar that there

[1] From a paper read at the meeting of the Pathological Section of the Royal Society of Medicine on November 7 by Sir Ronald Ross, K.C.B., F.R.S.

can be no question of their being exceptional artefacts or distortions, such as may sometimes simulate almost anything. Division of the mononuclear variety of leucocytes is produced and studied the most easily.

In films in my possession numerous examples of dividing mononuclears fixed at all stages demonstrate (together with observations of the jelly preparations) the following steps in the process. In a few minutes after the blood is drawn from the subject and mounted the round, so-called nucleus becomes oval and then kidney- or bean-shaped, leading on rapidly to the outline of two circles cutting each other, and, lastly, touching each other in a "figure of eight." When the process is about half complete, and if the direction of division is parallel to the surface of the jelly or glass, another phenomenon is seen. About four to eight finger-like processes, radiating from the point midway between the centres of the two circles, are protruded or divided off, giving the whole body roughly the appearance of an ant, of which the head and abdomen are simulated by the two spheres and the legs by the processes just mentioned. Such forms are numerous and characteristic; but, of course, when the direction of division happens to lie at an angle to the surface, they are foreshortened, or may be distorted by the pressure of the jelly. As the division proceeds the processes are retracted into each daughter sphere, until the final figure of eight is produced.

If polychrome methylene blue is put in the jelly the cells become coloured progressively as the division advances. At first, after a few minutes, the so-called cytoplasmic, or Altmann's, granules take a purple tinge; then the so-called nucleus becomes a pale blue, and last of all the so-called nucleolus is stained, after which, apparently, the cell dies. As the so-called nucleus proceeds to take the hour-glass and figure-of-eight forms, strands of coloured substance are seen, especially in the fixed films, passing between the two daughter spheres, and such connections are maintained until complete dissociation occurs. The behaviour of the so-called nucleolus is not easy to follow, because, as just noted, it does not stain until the cell dies and further division is checked. On the other hand, the behaviour of the so-called cytoplasmic granules must be described as very curious. In the middle of the division they are found to number about eight (when they can be easily counted) and to lie, each one, at the end of one of the finger-like processes mentioned above; and appearances suggest that half of each granule is distributed to one daughter cell and the other half to the other daughter cell. No distinct chromosomes are seen at any stage *inside* the so-called nucleus; and there appears to be no sign of astral fibres, though perhaps the finger-like processes may be interpreted as being bunches of these fibres which have not been rendered individually visible by the process of staining employed. On conclusion of the process the so-called cytoplasmic granules appear to be equally distributed between the two daughter cells, and to place themselves on the outer surface of the so-called nucleus of each, that is, in the position in which they were seen in the original parent cell. Apparently asymmetric forms are also frequently seen, but need not be described here.

Such seem to me to be the facts as observed by myself in preparations shown or given to me by Mr. Ross and Dr. Cropper. I will not touch here upon the similar divisions of the so-called polymorphonuclear leucocytes, which have also been already described and figured by Mr. Ross. Nor will I attempt to reconcile the observations with current cytological teaching, even as regards the division of leucocytes. Very probably different methods of staining may bring them, at least partly, into closer conformity. Though engaged for years in the study of blood I have never seen these forms before, nor, indeed, have I ever seen in any ordinary preparation what could certainly be called a dividing leucocyte. I have been shown bodies claimed to be such; but these are admittedly so rare that they are open to the usual logical fallacies connected with very exceptional observations. The observations here referred to are not open to these fallacies. As I have said, the dividing forms are so numerous and characteristic that we can have no doubt that they really are dividing forms—whatever other observations or theories may be on record. It seems to me, therefore, that we are now compelled to admit two new facts:—(1) that large numbers of human leucocytes can be made to divide *in vitro*; and (2) that this division occurs entirely, or at least specially, in the presence of certain chemical substances.

In 1900 J. Loeb showed that parthenogenesis can be induced in the eggs of sea-urchins (Arbacia) by the addition of a definite proportion of MCl_2 to sea water; and since then many workers have studied such phenomena among other animals, while Wassilieff has used hyoscyamine, nicotine, and strychnine for similar researches. The independent observations now recorded would appear to extend cognate principles to body cells by showing that the division of leucocytes may be suddenly forced on at a great rate and in a few minutes by the absorption or presence of appropriate chemical agents, and may perhaps be inhibited by other chemical agents. The author added some remarks on the application of these observations to the genesis of tumours, and a discussion followed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. W. Bateson, F.R.S., honorary fellow of St. John's College, Cambridge, and director of the John Innes Horticultural Institution at Merton, Surrey, has been appointed the next Herbert Spencer lecturer. The subject of the lecture, which is announced to be given on Wednesday, February 28, 1912, will be "Biological Fact and the Structure of Society."

The following courses of lectures and laboratory instruction in mathematics, astronomy, and physical science have been announced for next term, which begins on Monday, January 22, 1912:—Prof. Esson, F.R.S., will lecture on the comparison of analytic and synthetic methods in the geometry of conics; Prof. Love, F.R.S., on rigid dynamics; Prof. Elliott, F.R.S., on elliptic functions and on the theory of numbers; Prof. Clifton, F.R.S., on optics and acoustics; Mr. J. Walker, on double refraction and polarisation of light. Practical instruction in physics will be given by Prof. Clifton, Mr. J. Walker, Mr. I. G. Griffith, Mr. O. F. Brown, and Mr. G. H. Clough. Prof. Townsend, F.R.S., will lecture on electromagnetic induction; Mr. E. S. Craig, on mechanics and physics. Practical instruction in the electrical laboratory will be given by Mr. F. B. Pidduck, Mr. E. S. Craig, Mr. H. T. Tizard, Mr. S. Smith, and Mr. W. B. Gill. Prof. C. F. Jenkin will lecture and give practical instruction on strength of materials and thermodynamics; Mr. D. R. Pye will lecture on drawing, for engineering students; Prof. H. H. Turner, F.R.S., will lecture on elementary mathematical astronomy.

DR. H. BASSETT, demonstrator and assistant lecturer in chemistry at the University of Liverpool, has been appointed professor of chemistry at University College, Reading.

DR. W. R. BOYCE GIBSON, lecturer in philosophy at the University of Liverpool, has been appointed by the council of the University of Melbourne to the chair of mental and moral philosophy.

THE President of the Board of Education has appointed Mr. L. A. Selby-Bigge, C.B., to be permanent secretary of the Board when that post is vacated by Sir Robert Morant, K.C.B., on his appointment to the Insurance Commission. Since 1908 Mr. Selby-Bigge has been principal assistant secretary of the elementary branch of the Board.

THE council of the Royal Horticultural Society has requested the following gentlemen to act as a committee to inquire into the desirability of establishing a National Diploma in Horticulture, and to recommend what steps, if any, should be taken for the purpose:—the Rt. Hon. A. H. Dyke Acland, Prof. W. Bateson, F.R.S., Mr. E. A. Bowles, Mr. F. J. Chittenden, Prof. J. B. Farmer, F.R.S., Mr. C. R. Fielder, Mr. W. Hales, Mr. J. Hudson, Prof. Keeble, Sir Daniel Morris, Lieut.-Colonel D. Prain, F.R.S., Mr. H. J. Veitch, and Mr. W. P. Wright.

THE London County Council has arranged to hold its sixteenth annual Conference of Teachers on three days, Thursday, January 4, Friday, January 5, and Saturday,

January 6, 1912. The meetings will be held at Birkbeck College, Bream's Buildings, Chancery Lane, E.C. There will be addresses and discussions under the heads of specialisation in schools; chalk, brush, and pencil work in elementary schools; the doctrine of formal training (mental discipline); the treatment of backward children; and educational experiments in schools. No charge will be made for admission to the conference. Application for tickets of admission should be made to the Chief Inspector, London County Council, Education Offices, Victoria Embankment, W.C.

IT is announced in the issue of *The London University Gazette* for November 29 that a donation of 1000*l.* has been made by Mr. and Mrs. Walter Baily, in celebration of their golden wedding, for the purpose of rearranging and decorating the interior of a portion of University College. From the same source we learn that the Galton Laboratory Appeal Fund now amounts to 2629*l.* 15*s.* 6*d.* The list of donations, many of which are conditional on the buildings being commenced within two years, includes gifts of 500*l.* from Mr. W. E. Darwin, and Prof. Karl Pearson, F.R.S., and Mrs. Pearson; 250*l.* each from Prof. Arthur Schuster, F.R.S., and Mr. E. G. Wheler; and 100*l.* each from the Earl of Rosebery, Viscount Iveagh, Mr. A. F. Butler, Major Leonard Darwin, the Hon. Rupert Guinness, and Major E. H. Hills, F.R.S.

AN interesting experiment is being tried by the local education authority of Plymouth with the view of arousing an interest in the study of science among the children in its schools. On December 8 Mr. C. Carus-Wilson lectured to five thousand children in the Plymouth Guildhall, taking "Volcanic Outbursts" as his subject. Each child paid one penny for admission to the lecture, and it is expected that no contribution from the rates will be necessary to meet the expenditure incurred. The children seem to have been thoroughly interested, and the education authority is likely to arrange a series of similar lectures in the future. Descriptive accounts of natural phenomena, when judiciously illustrated, appeal to most children, and many men of science trace their first enthusiasm for their subject to a good lecture, supplemented by telling experiments. The Plymouth experiment deserves to be copied in other large towns.

IT is not clear from the reports in the daily papers of a meeting held at Brighton on December 12 whether the intention is to establish a university or a university college in the town. *The Times* reports that the meeting was "in furtherance of the movement to make Brighton a university town," while *The Morning Post* states that at the meeting (over which the Mayor of Brighton presided) "the proposal to establish a college of university rank for the county was unanimously approved." There is, of course, a vast difference between the two proposals, but apparently it is a university college which Brighton has in mind, and not a university. Resolutions approving of the principle of the establishment of a university college for Sussex, and the appointment of general and executive committees, were carried unanimously at Tuesday's meeting. The Mayor of Brighton was elected chairman of the executive committee, and Mr. W. H. B. Fletcher, who has taken a prominent part in the educational affairs of West Sussex, vice-chairman.

AN interesting account of the way in which American agricultural experiment stations come into contact with the farmer is given in Bulletin 208 of the Agricultural Department of the University of Wisconsin. Crop demonstrations are arranged on twenty farms connected with various public institutions throughout the State, making use of seeds bred at the experiment station, and of methods of cultivation and manures that previous experiments had shown to be advantageous. The fields selected for these demonstrations are, so far as possible, chosen alongside of the public highways, where the operations and results can be seen by the farmer throughout the whole season as he drives to and from town. The local papers also contain accounts from time to time of the work done and the appearance of the crop. Some time during the summer, when the crops are at their best, a demonstration picnic is arranged, to which large numbers of farmers are invited, the average attendance last year being 320. These meetings occupy an entire day, and a definite programme is arranged dealing with six to eight subjects centring round the field work. The effective feature is the fact that all the practices suggested to the farmer are illustrated in operation on the farm, and the crops are there to show in concrete form what the results have been. The influence of the work is very great, many farmers putting the new methods into operation at once.

THE December issue of *The Reading University College Review* is one which reflects credit on the college. The most interesting feature to readers in general will be the forty pages of notes on the multifarious activities of the institution. From these we learn that the entry of new students for the present session was very satisfactory. The number of students taking degree courses is 114, of whom 44 belong to the faculty of science and 6 to the Department of Agriculture. During the previous session 80 students received instruction in the dairy institute, in which connection it is interesting to record that at the annual meeting of the Berks. and Oxon. Chamber of Agriculture the following resolution was passed:—"The Board of Agriculture having decided to establish a central research station for dairying, we, the Berks. and Oxon. Chamber of Agriculture, strongly urge that University College, Reading, which is already in close touch with agriculturists and farmers in Berks. and the adjoining counties, should be selected as that centre. Our contention is based on the fact that the college is situated in the centre of a large dairying district, and that in Reading it has the headquarters of this Chamber and of the Berks. and Adjoining Counties Dairy Farmers' Association, where it can readily consult the farmers of the district. Believing that such close relations are essential to any scheme of agricultural development, we are anxious to see advantage taken of the exceptional facilities afforded in Reading."

AT a dinner of the Clothworkers' Company held on December 6, the President of the Board of Education, replying to the toast of the Houses of Parliament, referred to the generous assistance rendered by the great City companies to the promotion of facilities for higher education in this country. The President said he found that the Goldsmiths' Company contributed 50,000*l.* to the new engineering buildings of the Imperial College of Science and Technology. The Drapers' Company contributed 10,000*l.* to the building fund of the new college at Bangor, and this year the Drapers' Company contributed 23,000*l.* to the physiological laboratory at Cambridge and 15,000*l.* to the University of Sheffield. This year the Clothworkers' Company contributed 5000*l.* to the textile industries department at Leeds University. The Merchant Taylors' Company maintain the Merchant Taylors' School, the Mercers' Company are identified with St. Paul's School, the Fishmongers' Company with the Gresham College, the Skinners' Company with Tonbridge School, and the Haberdashers' Company with Aske's Foundation. The Clothworkers' Company are second in the list of donors to the City and Guilds of London Institute. Words failed him, Mr. Pease said in conclusion, to commend sufficiently their liberality and generosity in the interests of education. The Clothworkers' Company has equipped the textile and dyeing department of Leeds University to the extent of 161,000*l.*, and 75 per cent. of its income is contributed to the promotion of education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7.—Sir Archibald Geikie, K.C.B., president, in the chair.—Miss I. B. **Sollas** and Prof. W. J. **Sollas**: Lapworthura: a typical brittlestar of the Silurian age; with suggestions for a new classification of the Ophiuroidea.—Leonard **Hill** and Martin **Flack**: The physiological influence of ozone. Ozone, in concentrations of one part in a million and more, acts as an irritant to the respiratory tract, and diminishes the respiratory metabolism, as shown by the lessened output of carbonic acid and the diminished fall in body weight, which occur both during the period of administration and for some time after. Concentrations of several parts per million cause acute inflammatory congestion of the lungs, and

animals die as the result of this if kept long exposed to the ozone. Concentrations which can just be sensed by smell, *i.e.* far less than one part per million, have no injurious effect, and can be used safely in systems of ventilation. Injurious concentrations of ozone, by producing irritation of the air-passages, cough, and headache, compel anyone exposed to such to remove himself from the influence of ozone before any serious damage is done to the respiratory tract. Very low concentrations of ozone mask disagreeable smells, give a fresh quality to air vitiated by such smells, and vary the depressing monotony of air which is artificially warmed. Ozone may possibly have some use in the treatment of disease of the respiratory tract if used in concentrations which produce a slight irritation, and thus bring more blood and tissue lymph to the part.—H. R. **Dean**: The factors concerned in agglutination. (1) If, to a mixture of sheep corpuscles with antiserum so dilute that no agglutination is visible be added a solution of globulin obtained from normal guinea-pig serum, the corpuscles are markedly agglutinated. By use of suitable controls it can be demonstrated that neither the globulin solution nor the dilution of antiserum employed are of themselves capable of agglutinating the corpuscles. (2) The substance present in the globulin solution which aids agglutination is relatively thermostable, and its presence can be demonstrated in whole heated guinea-pig serum. (3) Corpuscles, sensitised and washed to remove free antibody, can be agglutinated by the globulin solution. If, after agglutination has taken place, the corpuscles be removed with a centrifuge, the supernatant fluid can be shown to have lost its agglutinating property. (4) The agglutinating power of an extremely dilute antityphoid serum can be increased by addition of globulin solution. Adding this to a mixture of emulsion of *B. typhosus* with a dilution of antiserum too weak by itself to agglutinate bacilli, distinct agglutination can be obtained. (5) Formation of a specific precipitate by interaction of serum and homologous antiserum depends on the presence in the mixture of a relatively large amount of antiserum. If to a mixture of serum with antiserum so diluted that it is no longer able to produce a precipitate is added the globulin solution, a definite turbidity is produced. (6) Probably agglutinating serum (antiserum) contains two factors, both of which are necessary to produce agglutination; one of these is the specific antibody, the other is a non-specific substance, possibly serum globulin. The interaction of antigen with antibody produces an aggregation of molecules of non-specific substance, which may ultimately result in formation of definite turbidity. This process of aggregation of the particles of non-specific substance is an essential part of the process of agglutination. It is possible to make a dilution of an antiserum which contains sufficient of specific anti-substance, but not sufficient of non-specific substance. Deficiency in non-specific substance can be made up by addition of globulin solution obtained from normal serum. —Arthur **Harden** and S. G. **Paine**: Action of dissolved substances upon the autofermentation of yeast. All dissolved substances which plasmolyse the yeast-cell also cause a large increase in the rate of autofermentation. Substances such as urea, which even in concentrated solution do not produce plasmolysis, have no accelerating effect. Toluene produces a similar effect to concentrated salt solutions. The effect produced by salts is probably a direct result of the concentration of the cell contents due to plasmolysis, but in the case of toluene it is possible that some other factor (such as disorganisation of the cell, or hormone action) is concerned.—Prof. G. **Dreyer** and W. **Ray**: Further experiments upon the blood volume of mammals and its relation to the surface area of the body. —G. W. **Ellis** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organism. Part viii.—On the cholesterol content of the liver of rabbits under various diets and during inanition. The authors have made analyses of the livers of a number of rabbits fed on the following diets:—cabbage, bran which had been extracted with ether, extracted bran to which cholesterol had been added. In some cases the cholesterol, instead of being given with the food, was injected in olive-oil solution into the peritoneal cavity. For animals fed on extracted bran alone the total liver cholesterol per kilog. of body weight is very constant, but when cholesterol is given with the food or injected into the peritoneal cavity a considerable increase takes place. A similar increase was observed in the liver cholesterol during inanition, when the animal lives on its own tissues. The percentage cholesterol content of the livers of newly-born animals is of the same order as that of normally fed adults. The results afford support to the working hypothesis, with regard to the origin and destiny of cholesterol in the organism, put forward some time ago by the authors, viz. that cholesterol is a constituent constantly present in all cells, and when these cells are broken down in the life process the cholesterol is not excreted as a waste product, but is utilised in the formation of new cells. A function of the liver is to break down dead cells, *e.g.* blood corpuscles, and eliminate their cholesterol in the bile. After the bile has been poured into the intestine in the processes of digestion, the cholesterol is reabsorbed, possibly in the form of esters, and carried in the blood stream to the various centres and tissues for reincorporation into the constitution of new cells.

Physical Society, November 24.—Dr. A. **Russell**: The maximum value of the electric stress between two unequal spherical electrodes. The experiments carried out by F. W. Peek (Journal Am. Inst. of Electrical Engineers, 1911) for the General Electric Company of America prove conclusively the value in practical work of a knowledge of how to compute the maximum value of the electric stress between high-pressure conductors. With equal spherical electrodes the electric stress between them can easily be computed from known tables. When, however, they are unequal the calculation becomes so laborious that it is prohibitive to nearly every experimenter. The author develops formulæ for this case, by means of which, and of the formulæ for the capacity coefficients given in a recent paper to the society, the calculation is very appreciably shortened. When the distance between the spheres is very small compared with the diameter of either, the following approximate formula for $R_{max.}$ (the maximum value of the electric stress) can be used

$$R_{max.}=(V/x)[1+(2b-a)x/(3ab)+\{4(a-b)^2+ab\}x^2/45a^2b^2)].$$

where V is the maximum P.D. between the electrodes, x their distance apart, a the radius of the smaller and b the radius of the larger sphere. In this case a knowledge of the values of the capacity coefficients is not required.—F. J. **Harlow**: The cubical expansion of fused silica. The author describes experiments in which measurements of the cubical coefficient of expansion of fused silica from 0° C. to 100° C., and from 0° C. to 184° C., were made by the weight thermometer method. The values obtained were ${}_0S_{100}=99{\cdot}8\times10^{-8}$ and ${}_0S_{184}=144{\cdot}7\times10^{-8}$. The fundamental coefficient is considerably less than that calculated from previous linear measurements, whereas ${}_0S_{184}$ is only slightly less. A low value of the fundamental coefficient is to be expected, since the coefficient has been shown to change sign at about −80° C. Observations of the ice-point before and after heating showed that no permanent charge in the volume of the bulb occurred through heating, thus confirming the utility of fused silica for thermometric purposes.—B. W. **Clack**: The temperature coefficient of diffusion. The paper describes further experiments carried out by the author with an improved form of the apparatus previously described (Proc. Ph. Soc., xxi., p. 374), by means of which the value of the coefficient of diffusion of salts through water can be found at various temperatures. Special flasks, similar to those already employed, were filled with the solution under investigation, and one was suspended from each arm of the balance in a large bath of distilled water maintained at constant temperatures in a thermostat room. The diffusion tubes of both flasks were of equal length, but their cross-sections differed considerably, and a method of differential weighing was used to compensate for any small changes in temperature. From the rate at which the flasks change in weight the value of the coefficient of diffusion of the salts is deduced. Figures are given for this value in the case of KCl and KNO_3 at various concentrations and at different temperatures, and from these figures the temperature coefficient of diffusion is found.—E. **Marsden** and T. **Barratt**: The α particles emitted by the active deposits of thorium and actinium. In a previous paper (Proc. Phys. Soc., August) the authors showed that if α particles are

counted on a zinc sulphide screen at a mean rate of μ per second, then the probability of occurrence of a time interval, of length between t and $t+\delta t$, is $\mu e^{-\mu t}$. This formula may be applied to test whether two α particles are given off simultaneously from a disintegrating atom or whether in any source of α particles there exist two successive α-ray products, the latter being of short life. In the previous paper uranium and polonium were shown not to give such irregularities, and in the present paper the same result has been found for actinium and thorium active deposits, although experiments of various investigators pointed to the probability of positive results. The experiments further suggest a lateral disintegration in thorium active deposit, and this is proved to be the case by results, which show that the two α-ray products in Thor. Act. Dep. (Th. C_1 and C_2) do not give an equal number of α particles when the active deposit is in equilibrium which is required by the ordinary disintegration theory. Thus it is concluded that of the atoms Th. C, 35 per cent. give rise to α particles of 4·8 cm. range and 65 per cent. to α particles of 8·5 cm. range, with probably the intermediate emission of β particles. Various cognate questions are also discussed in the paper.—S. W. J. **Smith**, W. **White**, and S. G. **Barker**: The magnetic transition temperature of cementite. The temperature at which cementite (carbide of iron) loses its ferromagnetism is determined sufficiently accurately for purposes of thermo magnetic analysis, and examples are given to show the possibility of using the thermomagnetic properties of cementite to determine whether that substance is present in any iron-carbon alloy.

MANCHESTER.

Literary and Philosophical Society, November 28.—Prof. F. E. Weiss in the chair.—Dr. J. N. **Pring** and D. M. **Fairlie**: The synthesis of hydrocarbons and their stability at high temperatures and pressures. The reaction between carbon and hydrogen, which has been found to produce methane at all temperatures up to 1600°, has been examined at various pressures up to 200 atmospheres. In this way it has been possible to evaluate and verify the equilibrium in the formation of methane, arising according to the equation $C+2H_2 \rightleftarrows CH_4$. In accordance with this reaction it follows from the law of mass action that $\frac{p_{CH_4}}{p_{(H_2)^2}}=K$, a constant at any given temperature. This was found to be the case in these experiments when any particular form of carbon was used. The yield of methane was found to increase with the pressure to the extent demanded by the above formula. At atmospheric pressure the equilibrium value with graphite corresponds to 0·24 per cent. at 1200° and 0·06 per cent. at 1575°. Values which were considerably higher were obtained with amorphous carbon, viz. an equilibrium which corresponds to 0·38 per cent. at 1200° and 0·18 per cent. at 1550°. This divergence is due to the fact that amorphous carbon is unstable at these temperatures, and gives temporarily "false" or "metastable" equilibria, which are higher than the true values. The great inertness of methane to decomposition enables this false equilibrium value to persist for some time. The velocity of the reaction between carbon and hydrogen is very much increased at high pressures. No other saturated hydrocarbon is formed or can exist at temperatures above 1100°, and at pressures up to 200 atmospheres. The heat evolved in the transformation of carbon into graphite can be calculated from the data obtained in this work by means of certain deductions of van 't Hoff. The results show that this heat of transformation increases in the range of temperature between 1100° and 1600°. It follows from this, in accordance with the law of Kirchhoff, that the specific heat of carbon increases more rapidly and is higher than that of graphite at these temperatures, whereas the reverse would follow from the accepted values of Kuntz and of Weber, which do not therefore apply at high temperatures.

DUBLIN.

Royal Dublin Society, November 28.—Prof. T. Johnson in the chair.—Sir Howard **Grubb**: Improvements in equatorial telescope mountings. The paper is divided into two parts, one dealing with the anti-friction arrangements of the large equatorials which are at present in course of construction for Johannesburg, Santiago de Chile, and Madrid. This first portion of the paper describes the newly designed apparatus, and reports upon the result of the first trials. The apparatus described is a development of that used in Sir Howard Grubb's large instruments, improved in many ways and adapted for use with the modern ball or cylinder bearings, which have been found to give very satisfactory results. The second portion of the paper deals with a new arrangement for a differential hour circle. There are two designs described, one of which has been suggested by Sir David Gill, and is being adapted to the Johannesburg and Santiago telescopes. In this arrangement the differential hour circle is kept continually moving by a series of electric contacts from the sidereal clock of the observatory. The other form which has been designed by the author of the paper has been adapted to the Madrid equatorial, and in this case the differential hour circle is kept moving *backwards* as respects the polar axis by a small piece of clockwork carried on the axis itself, and this enables actual right ascensions to be read off by this circle from a fixed vernier.—Prof. T. **Johnson**: *Forbesia cancellata*, gen. et sp. nov. This fossil plant was collected by the Geological Survey of Ireland in 1851 from the Lower Carboniferous of co. Cork, and named in 1864 by W. H. Baily "Sphenopteris, sp." The fossil shows marked dichotomy in all its parts, even in the ultimate pinnule segmentation. There is no sign of vascular tissue, but axis and frond are alike honeycombed. The chambers are lined with rows of parenchymatous cells and their septa, apparently strengthened by sclerotic bands connected with submarginal vertical striæ. One specimen shows signs of a fruiting condition comparable with that in Cephalopteris, Nathorst, from the Upper Devonian of Bear Island. On the assumption that Forbesia is evascular, the author considers it to be the most primitive of the *primofilices* yet found. Comparison with *Sphenopteris devonica*, Unger and Richter, is made.

BOOKS RECEIVED.

Traum und Traumdeutung als Medizinisch-Naturwissenschaftliches Problem im Mittelalter. By Dr. P. Diepgen. Pp. 43. (Berlin: J. Springer.) 1.20 marks.

Traité complet d'analyse chimique appliquée aux essais industrielles. By Profs. J. Post and B. Neumann. Deux. édition française by G. Chenu and M. Pellet. Tome troisième—premier fascicule. Pp. 468. (Paris: A. Hermann & Fils.) 15 francs.

Traité de Physique. By Prof. O. D. Chwolson. Ouvrage traduit sur les éditions russe et allemande, E. Davaux. Deux. édition française. Tome premier, by E. Cosserat and F. Cosserat. Pp. xviii+515. (Paris: A. Hermann & Fils.) 17 francs.

Lehrbuch der Physik. By Prof. H. Ebert. Erster Band. Pp. xx+661. (Leipzig: B. G. Teubner.) 14 marks.

Das Leben im Ozean nach Zählungen seiner Bewohner. By Prof. V. Hensen. Pp. v+406+28 Tabellen u. 1 Tafel. (Kiel: Lipsius & Tischer.)

Religion and Modern Psychology. By J. A. Hill. Pp. 200. (London: W. Rider and Son, Ltd.)

A Treatise on Hydrodynamics. Part i. Hydrostatics. By Dr. W. H. Besant and A. S. Ramsey. Seventh edition. Pp. 275. (London: G. Bell and Sons, Ltd.) 7*s*. 6*d*. net.

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Six Years 1900–1905 under the direction of Dr. A. A. Rambaut, F.R.S. Vol. xlix. Pp. xx+304. (Oxford: H. Frowde.)

Aus Natur und Geisteswelt:—Die Milch und ihre Produkte, by Dr. A. Reitz; Die Kinematographie, by Dr. H. Lehmann; Die Sonne, by Dr. A. Krause; Probleme der modernen Astronomie, by Prof. S. Oppenheim; Einführung in die Biochemie, by Prof. W. Löb; Aus der Vorzeit der Erde, by Dr. F. Frech, i. to vi., Zweite Auflage; Das Süsswasser-Plankton, by Prof. O. Zacharias, Zweite Auflage; Moleküle, Atome, Weltäther, by Prof. G. Mie, Dritte Auflage. (Leipzig: B. G. Teubner.) 1.25 marks each.

Wirkungsweise und Gebrauch des Mikroskops und Seiner Hilfsapparate. By Prof. W. Scheffer. Pp. vii+116. (Leipzig: B. G. Teubner.) 2.40 marks.

Vorbereitungsbuch für den Experimentalunterricht in Chemie. By Prof. K. Scheid. Pp. vi+620. (Leipzig: B. G. Teubner.) 13 marks.

The "Wellcome" Photographic Exposure Record and Diary, 1912. Pp. 280. (London: Burroughs, Wellcome and Co.) 1s.

Farm and Garden Rule-book. By L. H. Bailey. Pp. xxiv+587. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

L'œuvre scientifique de Blaise Pascal. Bibliographie critique et analyse de tous les travaux qui s'y rapportent. By A. Maire. Pp. xxxi+184. (Paris: A. Hermann & Fils.) 15 francs.

Recent Methods in the Diagnosis and Treatment of Syphilis. The Wassermann Serum Reaction and Ehrlich's Salvarsan. By Dr. C. H. Browning, I. Mackenzie, and others. Pp. xxvi+303. (London: Constable and Co., Ltd.) 8s. 6d. net.

Tennyson and his Friends. Edited by Hallam, Lord Tennyson. Pp. xiv+503. (London: Macmillan and Co., Ltd.) 10s. net.

Elementary Graphic Statics. By Dr. W. J. Crawford. Pp. viii+131. (London: C. Griffin and Co., Ltd.) 2s. 6d. net.

A Compendium of Aviation and Aërostation: Balloons, Dirigibles, and Flying-machines. By Lieut.-Colonel H. Hoernes. Pp. xi+179. (London: C. Griffin and Co., Ltd.) 2s. 6d. net.

Geological and Topographical Maps: their Interpretation and Use. A Handbook for the Geologist and Civil Engineer. By Dr. A. R. Dwerryhouse. Pp. vii+133. (London: E. Arnold.) 4s. 6d. net.

Die Pflanzenwelt Dalmatiens. By Prof. L. Adamovic. Pp. vi+137+72 plates. (Leipzig: Dr. W. Klinkhardt.) 4.50 marks.

Philips' Comparative Series of Wall Atlases. *Europe.* Edited by J. F. Unstead and E. G. R. Taylor. 21s. Explanatory handbook to ditto, 6d. net. (London: G. Philip and Son, Ltd.)

Ancient Types of Man. By Prof. A. Keith. Pp. xix+151. (London: Harper and Bros.) 2s. 6d. net.

Prehistoric Japan. By Dr. N. G. Munro. Pp. xvii+705+plates. Reprint. (Edinburgh: W. Bryce.) 24s. net.

Mathematical and Physical Papers. By Lord Kelvin. Vol. vi. Voltaic Theory, Radio-activity, Electrions. Navigation and Tides. Miscellaneous. Arranged and revised, with brief annotations, by Sir J. Larmor. Pp. viii+378. (Cambridge: University Press.) 10s.

A Guide to the Fossil Invertebrate Animals in the Department of Geology and Palæontology in the British Museum (Natural History), Cromwell Road, London, S.W. Second edition. Pp. x+183+7 plates. (London: Printed by order of the Trustees.) 1s.

Prinzipien der Atomdynamik. By Prof. J. Stark. II. Teil:—Die elementare Strahlung. Pp. xv+286. (Leipzig: S. Hirzel.) 7.80 marks.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY OF ARTS, at 4.30.—The Fisheries of Bengal: Dr. J. Travis Jenkins.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Residence Tariffs: A. E. Seabrook.

CONCRETE INSTITUTE, at 8.—Some Recent Works in Reinforced Concrete: G. C. Workman.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion:* Double-cutting and High-speed Planing Machines: J. Hartley Wicksteed.—*Probable Paper:* Oil-burning Locomotives on the Tehuantepec National Railway, Mexico: R. Godfrey Aston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests on Reinforced Concrete: E. F. Hunt.

MONDAY, DECEMBER 18.

ROYAL SOCIETY OF ARTS, at 8.—The Carbonisation of Coal: Prof. V. B. Lewes (Lecture IV.).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—American Deserts: Dr. T. McDougall.

INSTITUTE OF ACTUARIES, at 5.—Some Recent Statistical Results: W. Palin Elderton.

TUESDAY, DECEMBER 19.

PHYSICAL SOCIETY.—Annual Exhibition.

ROYAL STATISTICAL SOCIETY, at 5.—The Economic Position of Scotland and her Financial Relations with England and Ireland: E. Crammond.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Some Aspects of Railway Station and Goods Yard Illumination: Haydn T. Harrison.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Experiments on the Strength and Fatigue Properties of Welded Joints in Iron and Steel: Dr. T. E. Stanton and J. R. Pannell.—*Probable Papers:* The Water Supply of the Witwatersrand: D. C. Leitch.—Investigations Relating to the Yield of a Catchment-Area in Cape Colony: E. C. Bartlett.

WEDNESDAY, DECEMBER 20.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Solar Halos and Brocken Spectres: Walter Larden.—The Statical Changes of Pressure and Temperature in a Column of Air that accompany Changes of Pressure at the Bottom: W. H. Dines, F.R.S.

GEOLOGICAL SOCIETY, at 8.—The Glacial Sections at Sudbury (Suffolk): Rev. Edwin Hill.—The Ordovician and Silurian Rocks of the Kilbride Peninusula (Mayo): C. I. Gardiner and Prof. S. H. Reynolds.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Photomicrography of the Electrical Reactions of the Heart: F. Shillington Scales.—British Tubificidæ: Rev. Hilderic Friend.

THURSDAY, DECEMBER 21.

INSTITUTION OF MINING AND METALLURGY, at 8.

LINNEAN SOCIETY, at 8.—Some Annelids of the Thames Valley: Rev. Hilderic Friend.—The Seedling Structure of Leguminosæ: R. C. Compton.—The Internodes of Calamites: Prof. Percy Groom.

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