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Anthropology and Empire.

ANTHROPOLOGY has been slow to secure recognition as having a practical bearing on the affairs of life. The Royal Anthropological Institute, which has just completed the fiftieth year of its existence, while steadily pursuing its main object of promoting the study of man, has constantly insisted upon the importance of this science as a fundamental element in certain departments of legislation and administration, particularly in relation to the native peoples of our Colonies and Dependencies. Until comparatively recently it has obtained a sympathetic hearing more often than a tangible result.

It is unnecessary to enumerate here the many occasions on which this subject has been brought to the notice of the Government at home and of the authorities in our Dependencies. The latest attempt to secure official recognition of the place of anthropological studies in the training of administrative officials was initiated by Sir Richard Temple at the Birmingham meeting of the British Association in 1913. He advocated the establishment of an Imperial School of Anthropology attached to one of the universities. Unfortunately, the outbreak of war interrupted a movement which had secured wide and influential support.

It is important to note that the conception of the vital importance of "applied anthropology" as an essential part of the training of an administrator is not academic in origin. Its strongest advocates are, or have been, men like Sir Herbert Risley, Sir Bampfylde Fuller, Sir Richard Temple, Sir Everard im Thurn, and Sir Reginald Wingate, to name a few only, who have themselves had a prolonged administrative experience, and have found a knowledge of native manners and customs essential to the successful performance of their duties. Sir Reginald Wingate, in particular, as Governor-General of the Sudan, asked the Universities of Oxford and Cambridge to provide instruction in anthropology to probationers for the Sudan Service, and it was at his special request that Prof. and Mrs. Seligman were sent to the Sudan to collect information which might be available for this purpose.

It is a matter of common experience that sympathy based upon knowledge is a first essential for both administrator and trader. Habits, customs, beliefs, and, particularly, etiquette must be intimately known and thoroughly understood. Ignorance of etiquette has been responsible for more than one punitive expedition, costly in both life and money. During the war, when comparatively large numbers of British officers had to be drafted to Indian battalions, it was found essential that they should receive instruction, not merely in the language, but also in the social grades, customs, and beliefs of their troops. Knowledge of native manners, customs, and beliefs has proved a bond of sympathy between governors and governed. Successful administrators have acquired this knowledge painfully and as a result of many mistakes. As one observer of considerable experience has said, the knowledge which had taken years to gain could have been acquired by a trained anthropologist in a few weeks.

If sympathetic knowledge is a factor of such importance in the relations between individuals, it is a paramount consideration in determining the character of administrative regulations and legislative measures which deal with the native in the mass. Success in maintaining law and order depends, in the long run, on the avoidance of any infringement of the customary rights of individuals and social units, as well as of any offence to the modes of thought and beliefs of the subject population. Further, when European culture comes intimately and extensively into touch with a lower culture, it is inevitable that many customs and beliefs of the less highly advanced must seem repugnant and even intolerable when judged by the standard of the more civilised race. Cannibalism and the practice of *sati* in India are cases in point. It is a matter of experience, however, that any modification or restriction of custom should be attempted only after very careful consideration of its place in the life of the people and of the possible consequence of any change. The suppression of the *lobola*, or "bride-price," in South Africa, under the mistaken impression that it was a sale, led to a great deal of ill-feeling and injustice; during the period in which it was interdicted, no marriage was regarded by the natives as legal, and, more important, one of the main factors in their social organisation had disappeared. A little knowledge of anthropology and anthropological method would have averted action which led to much distrust of British rule.

At the present moment the government of our subject races is beset with difficulties. How deep-rooted these difficulties are possibly only anthropologists and administrators in intimate touch with native feeling are fully aware. Native races tend to die out after contact with a civilisation which brings European diseases and European vices in its train; but this is not invariably the case. In some areas the removal of the checks on over-population, such as female infanticide and inter-tribal warfare, has brought about an increase, as in South Africa. In the case of the dying races the excellent system of segregation in reservations, even with an assured food supply and medical attention, appears merely to delay the inevitable. The possibility of preserving these peoples offers a vast field for anthropological research. The problem is not merely humanitarian. The exploitation of the tropics, which is inevitable as the world's needs increase under the pressure of population, depends on labour which will have to be drawn from native races, as, owing to climatic and other causes, white labour will not be available. This, however, is no argument in favour of compulsory or indentured labour. Primitive peoples, though often called lazy, do not differ materially from civilised peoples in their attitude towards labour; they work according to their needs and desires. The labour problem can be solved only by a careful study of primitive economics and industry. Such study should serve as a basis for a system of education and development which will foster native arts and handicrafts. The gradual improvement of native methods of agriculture will have an important bearing on the food supply of the future. But here, again, there is need for knowledge and sympathy before any change is introduced, as native methods are hedged round by custom and belief.

In cases where the native population is numerous and on the increase, the social and political question has been forced into prominence. During and after the war political agitators penetrated to the remotest parts of the Empire. The cases of India and South Africa are singular only in being widely known. Can anthropology assist the State in solving the difficult problem of converting what is now a danger into a useful section of the community? The far-sighted proposals introduced into the Parliament of the Union of South Africa last year by General Smuts suggest an answer. Study of native institutions will indicate such as may be utilised to develop the political sense of the native through local self-government, and at the same time suggest lines of development along which he may be led until he reaches a stage at which he will be fitted to take such a part in the political organism as time and experience may suggest to be desirable in the interests of himself and of the community at large.

The greater amount of attention which has been paid to primitive races has tended to obscure the fact that the study of the peoples of these islands has a bearing on practical affairs of an equal, if not greater, importance. Sir Francis Galton, when president of the Anthropological Institute in the late eighties of last century, insisted upon the importance of the study of our own population. He himself had then for many years been collecting data bearing upon the distribution of intelligence among the different classes of the population and upon the problems of heredity. The report of the Inter-Departmental Committee on Physical Deterioration, published in 1904, furnished evidence of the utterly inadequate extent of our knowledge of the physical characters of the population of these islands. Medical inspection of schools, which includes certain physical measurements, and is now extended permissively to observations of a specifically anthropological character, as well as the institution of a Ministry of Health, has done something to remedy this defect in certain directions. Anthropologists, however, are well aware how far the results have been, or are likely to be, vitiated by an imperfect knowledge of the distribution of racial characters. The institution of an anthropological survey presents many difficulties not entirely confined to expense. There can, however, be little doubt as to its practical value, not only in connection with the health and physique of the population, but also because of its bearing upon the study of mental character, the influence of heredity and environment, the relation of race and disease, the incidence of insanity and crime, and a number of other questions intimately bound up with and affecting the character of future social legislation.

The Determination of Sex.

Mechanismus und Physiologie der Geschlechtsbestimmung. By Prof. Richard Goldschmidt. Pp. viii+251. (Berlin: Gebrüder Borntraeger, 1920.) Price 32 marks.

THOUGH Prof. Goldschmidt's treatise on sex-determination is in scope similar to the text-books published by Doncaster and by Morgan in 1912, knowledge has increased so rapidly since then that there is plenty of room for a new statement. Moreover, as the author has himself devoted several years to the study of a special case which departs from the ordinary rules, his views will be of interest to geneticists. Up to a point, the mechanism of sex-determination is clear. On the one hand, we know that in several birds and some Lepidoptera the female is heterozygous in sex, but we have equally sound proof that in man and in several insects other than Lepidoptera the condition is reversed, the female being homozygous and the male heterozygous in respect of the sex-factor. The evidence for these conclusions is mainly either genetical or cytological. With the exception of Drosophila, which, after some doubt, observers have agreed to regard as having the male XY and the female XX, there is no specific form in which positive evidence of both kinds, genetical as well as cytological, can yet be produced. The absence, however, of such convergent testimony need not trouble us at this stage, for each class of proof is by itself adequate so far as it goes. On the whole, also, though difficulties are met with in special examples, the evidence from operative and other collateral observations agrees well with the conclusions deduced from genetical and cytological sources.

Sex being, then, decided by the contribution which one or other of the gametes makes to the offspring, how shall we account for cases in which these seemingly predetermined consequences can by interferences of various kinds be disturbed? Evidence of this description falls into several classes, and its consideration forms a chief purpose of the present book. Hitherto the most famous is that provided by R. Hertwig's experiments on frogs. By delaying fertilisation, he found that the proportion of males could be greatly increased. The suggestion that the females had died off was shown to be inapplicable, and there seemed to be no escape from the conclusion that eggs which in the ordinary course would have become females did after, and presumably because of the delay in fertilisation, become males. The fact, however, that the maturation-divisions in the case of the frog occur after the eggs are laid offered, as Hertwig pointed out, a possible, if rather unlikely, solution; for the artificial delay might have some influence in deciding which elements should be extruded in the polar bodies, and thus the sex-ratio might be disturbed. Quite recently Seiler, a colleague of Prof. Goldschmidt's, claims to have actually witnessed consequences of this kind following upon the introduction of special conditions in the case of the Psychid moth Talæporia, and to have obtained cytological evidence that a rise of temperature during the reduction-division caused the X-chromosome to stay more often inside the egg, and so increased the proportion of males, whereas a lowering of the temperature had the contrary effect. In the case of the frog, even if the delay does act in the way surmised, various difficulties remain to be elucidated, and before definite conclusions can be reached as to sex-determination in Amphibia, and fishes also, we require strict genetical proof as to which sex in those animals is heterozygous in the sex-factor.

Much more serious difficulty arises from a class of fact to which Standfuss was, I believe, the first to introduce us. He found that in Lepidoptera hybridisation might affect the sexes differentially, producing in certain crosses males only, in others predominantly males (the few females being sterile), and similar phenomena proving that the influence of the cross was not alike for the two sexes. A result obtained by an amateur named Brake led Prof. Goldschmidt to investigate a most remarkable case of such differential influence. *Lymantria dispar,* the gipsy moth, is represented by various races all over the northern temperate regions. The sexes are very different, the male being small and dark, the female large and pale in colour. The original observation was that, whereas crosses in the form Japanese ♀ × European ♂ gave *in* F_1 the two sexes distributed as usual, the reciprocal cross, European ♀ × Japanese ♂, produced normal males, but *females more or less modified in the male direction.* Eggs, therefore, which, if fertilised by the sperm of European males, would have produced females gave rise to "intersexual females," as Prof. Goldschmidt calls them, when the sperm came from these Japanese males. To investigate this curious problem, he proceeded to Japan before the outbreak of the war, and when Japan became involved he went to the United States, where he was interned and encountered other serious difficulties when that nation also joined the Allies. But in the course of his travels he was able to collect and experiment with a long series of species or local races inhabiting various parts of Europe, Japan, and North America, raising something like 50,000 specimens. Obscure as the meaning of the phenomena still is, there can be no question that when the full interpretation is unravelled the work will be admitted to have an importance at least proportionate to the astonishing labour which has gone to its production.

In outline the main result claimed is that the various races can be arranged in a scale ranging from the "strongest" to the "weakest," and, this series once established, the consequences of matings made between races occupying different positions on the scale can be predicted with considerable accuracy. Intersexual females appeared whenever the male of a "stronger" race was mated with the female of a "weaker." The intersexuality in its several degrees might affect all the sexual characters, primary or secondary, and in its higher manifestations the instincts also. Where such a diversity of features is concerned, a quantitative scale must obviously be largely a matter of individual judgment, but it is claimed that the amount to which these females were modified in the male direction was roughly proportional to the interval between the parent races on the scale of strength; and in the extreme case, when the strongest male was mated with the weakest female, the brood generally consisted of males only, which are interpreted as being in part aboriginal, genetically determined males, and in part individuals which would have been females but for the disturbing influence which has transformed them into males.

Other matings led to the production of intersexual *males*. The discrimination between the two kinds of intersexes was not, to judge from the illustrations, so difficult as one would have expected. The intersexual males appeared with some regularity in F_2 from the cross mentioned above (Japanese ♀ × European ♂) as giving all normals in F_1 and in certain other families besides. There were also some considerable families all-female. Throughout the complicated series of matings glimpses of order appear which suggest that a comprehensive solution is not very far off. It has, nevertheless, not yet been attained. One of the most curious features, as yet inexplicable, is the fact that in the matings giving all-male families females occasionally appear which are perfectly normal, though their sisters are supposed to have been wholly transformed into males.

The interpretation which Prof. Goldschmidt proposes cannot be adequately expressed in a brief statement. He is under the influence of the theory that each sex contains the potentialities of the other, a conception to which it is now not easy to attach a precise, still less a factorial, meaning. He is disposed to regard the sex ultimately assumed by a given zygote as decided by a struggle or reaction taking place between two components: (1) the sex-factors brought in by X-chromosomes, and (2) a substratum conceived of as inherent probably in the cytoplasm, and capable by its own development of conferring potentialities opposite to those borne by the factors proper. To these opposing elements numerical values are assigned, arbitrarily as it appears to me, and I have been unable to discover in what way the analysis thus offered differs from a restatement of the empirically observed facts, nor is the representation of the all-male and all-female families as alternative end-products of a balanced reaction at all satisfactory. During the period covered by Prof. Goldschmidt's experiments, phenomena closely analogous have been discovered by J. W. H. Harrison in the Bistoninæ. Evidently we are thus brought into touch with a set of facts, probably abundant in nature, which must be accounted for before the problem of sex-determination is disposed of; but, paradoxical as these occurrences are, they do not justify a return to earlier stages of confusion. The problem created by the existence of intersexes, gynandromorphs, and other sex-monstrosities has always been realised. The case of the free-martin, though its true nature is now settled by the brilliant work of Lillie (well summarised in Prof. Goldschmidt's book), proves that influences as yet little understood may be taking part in these determinations.

An interesting attempt was lately made by Morgan and Bridges to apply the chromosome theory rigorously to a number of mosaic gynandromorphs which have appeared from time to time in the pedigreed work on Drosophila. The parental composition being known, it could be shown from the distribution of the sex-linked factors that in nearly every case these curious patchworks might be represented as resulting from a presumably accidental elimination of a sex-chromosome from the affected parts of the body. The result was certainly a striking one; but this interpretation is not readily applicable to intersexual forms which are not mosaics. Admitting, however, that in mosaics *something* may have been eliminated from the affected patches, the suggestion that this something is the sex-chromosome raises the questions: Why do not the miscellaneous variations, to which the chromosomes of somatic tissues are conspicuously liable, more frequently show their consequences as somatic patchworks? and, conversely, Why are the chromosomes of normally dissimilar tissues not themselves dissimilar? But, apart from difficulties to which that line of argument must immediately lead, the occurrence of the intersexes among Prof. Goldschmidt's moths can scarcely be a consequence of accidental elimination, inasmuch as they came with extraordinary regularity. Appeals to the action of "hormones," from which he hopes a good deal, are a mere veiling of the difficulty. No one will dispute that these products are part of the proximate mechanism by which the effects of sexual differentiation are produced; but the problem of sex-determination is to discover the influence which primarily causes that differentiation to proceed in one direction rather than in the other; and herein, where the evidence of gametic differentiation is insufficient, we are left without any plausible conjecture. In considering the characteristics of partly or wholly sterile forms, it may be worth remembering that in proportion as a zygote is sterile, it *may* be retaining elements which, if it were fertile, would be extruded in its gametes. May not this retention influence the characters of the zygote?

Like its predecessors, this book expressly abstains from the attempt to deal with the problem of sex-determination in plants. We cannot quarrel with the wisdom of that decision, for the truth is that we are very far from any workable scheme which can be applied to them; but it is unfortunate that the diagram put forward by Correns as a representation of his views on sex in Bryonia should be chosen as the model of a "digametic" system of sex-determination. The author does imply that he has misgivings about that illustration, which, as I have elsewhere shown, is quite inconclusive. The incautious reader could scarcely avoid the inference that the scheme of sex-determination applied to animals is one which had been proved to hold in the case of a flowering plant—a very misleading conclusion.

Another region of the subject still altogether obscure is the genetical relation of the unisexual to the functionally hermaphrodite forms in animals. Prof. Goldschmidt's book contains all that can yet be said on that difficult question. There are, of course, various sorts of monœcism, and for scarcely any of them have we yet even an acceptable cytological scheme, still less any genetical evidence.

The book, as a whole, is very well done, and may be recommended to all students who wish to have the latest presentation of the facts in a clear and readable form. As I have implied, there is a want of lucidity in the discussion of the problem of the intersexes, and trouble would be saved to the reader if he were at once told that he will not be presented with a real solution. If he reads the book carefully he will discover that for himself; but the series of facts is exceptionally interesting and, at the present stage of genetical theory, of such vital importance that the effort will not be wasted. W. BATESON.

Anæsthetics.

Anaesthetics: Their Uses and Administration. By Dr. Dudley Wilmot Buxton. Sixth edition. (Lewis's Practical Series.) Pp. xiv+548+viii plates. (London: H. K. Lewis and Co., Ltd., 1920.) Price 21*s.* net.

THE appearance of this new edition is to be welcomed because great advances have been made during the past few years, and also several other text-books on this subject have been for some time out of date and even out of print.

Although the size of the new volume is not much increased, Dr. Buxton has found means to add much fresh material and to re-write a great deal of the old. The chapter on the history of anæsthetics remains one of the most readable in the book, and will repay perusal by anyone not otherwise interested in the subject.

Within the past few years, and especially during the war, many new methods of anæsthesia have been devised or perfected, and many new problems attacked with more or less success. It is naturally to the chapters dealing with these methods and difficulties that one turns with the greatest curiosity. Nothing appears to have been forgotten, and each subject is discussed clearly and as fully as the space of one volume allows. The advantages of the administration of warm anæsthetic vapours are dealt with and the apparatus is described. Perhaps the section devoted to the use in major surgery of nitrous oxide with oxygen is one of the most important to the student of to-day. The advantages of this method of anæsthesia are shown to be real, although it has no doubt suffered from the too hearty advocacy of enthusiasts. In cases of severe shock, in both military and civil practice, its merits are so great as to make its use almost obligatory. On the other hand, many anæsthetists, and certainly most surgeons, will agree that as a routine method for abdominal sections it is not suitable. Dr. Buxton wisely points out that on the count of safety alone its advantages have so far been assumed rather than proved, and he agrees with Page that in cases of marked arterial degeneration, emphysema, or obstructed air passages its use is contra-indicated.

The subject of intratracheal insufflation of ether is fully dealt with, and perhaps that of intravenous ether infusion receives more space than it deserves, as some of its leading exponents seem now to use it but little. This may be due to the more extended use of rectal etherisation combined with oil, which, although a little troublesome, has proved very useful in plastic surgery about the head, and especially in bad cases of Graves' disease.

Many subjects concerning which it has been difficult to obtain a connected account without reference to the original papers are clearly and sufficiently summarised in this edition. Among these, one notices the sections dealing with acapnia, anoci-association, acidosis, and shock with its allied conditions. Dr. Buxton is certainly to be congratulated on having not only modernised, but also improved what was already one of the very best text-books on the subject.

Mathematical Text-books.

(1) *An Elementary Treatise on Differential Equations and their Applications.* By Prof. H. T. H. Piaggio. (Bell's Mathematical Series. Advanced Section.) Pp. xvi+216+xxv. (London: G. Bell and Sons, Ltd., 1920.) Price 12*s.* net.

(2) *Elementary Algebra.* Part i. By C. V. Durell and G. W. Palmer. (Cambridge Mathematical Series.) Pp. viii+256+xlvi. (Answers.) (London: G. Bell and Sons, Ltd., 1920.) With introduction, price 4*s.* 6*d.*; without introduction, price 3*s.* 6*d.*

(3) *A Short Course in College Mathematics: Comprising Thirty-six Lessons on Algebra, Coordinate Methods, and Plane Trigonometry.* By Prof. R. E. Moritz. Pp. ix+236. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) Price 10*s.* 6*d.* net.

(4) *Arithmetic.* Part ii. By F. W. Dobbs and H. K. Marsden. (Bell's Mathematical Series.) Pp. xii+163+xi. (Answers.) (London: G. Bell and Sons, Ltd., 1920.) Price 3*s.* 6*d.*

(1) OF the two volumes that head the list it is difficult to speak too highly. The scope of that on differential equations is stated most succinctly to teachers by the mere statement that it covers the course for the London B.Sc. Honours, Schedule A of the second part of the Tripos, and some of the work for the London M.Sc. and for the Tripos, part ii. The author has clear views of the equipment of the students who are likely to use the book—an elementary knowledge of the differential and integral calculus, and a little co-ordinate geometry. In the old days it was quite possible for a respectable mathematician to become, with comparatively little effort, also a respectable mathematical physicist. Owing to the remarkable extension of specialisation in both subjects, this is no longer the case. It is perhaps all the more essential that the living interest of such a branch of the subject as this should be maintained at every stage, and it is here that the crucial test is made of the powers of the mathematician who also aspires to be a great teacher. He is not content merely to "give an account of the central parts of the subject in as simple a form as possible." He is careful that the various stages of the journey shall lead to Pisgah heights from which may be viewed the Promised Land to which the adventurous may make their way, and some province or other of which, according to taste or opportunity, they may some day make their own. Nor are the names and records of the older guides forgotten, and as each fresh height is scaled historical notes give just enough to fix the chronology and to whet the appetite for further information about those who first made their own the notable peaks and crags around the young climber.

In the first chapter we are glad to see the influence of the remarkable chapters published by Dr. Brodetsky last year in the *Mathematical Gazette,* and of Prof. Wada's paper on graphical solution. Chap. iv., on simple partial differential equations, with their genesis, the construction of simple particular solutions, and the procedure from simple to complex solutions with the help of Fourier's series, is a welcome innovation at so early a stage.

Chap. vi., on singular solutions, abandons any attempt at an analytical treatment at this stage of the student's development, and appeals to geometrical intuition. Chap. ix. deals with solution in series, following the method of Frobenius. Here we find among the examples the equations associated with the names of Bessel, Legendre, and Riccati, with a sketch of the hypergeometric equation and its twenty-four solutions. The nature of an existence theorem is explained in chap. x. The methods of Picard and Cauchy are followed by a discussion of the method of Frobenius, and here plentiful references are given for the benefit of those whose knowledge of the theory of series is inadequate. The references, indeed, are plentiful throughout. We may note one that is of little use to many of us—Stodola's "Steam Turbine," which has been unobtainable for some time past. In the miscellaneous examples the author, in a large number of cases, adds to the theorems to be solved the physical applications.

An appendix contains useful references for further reading.

By a strange oversight, chap. v. begins with types of equations "solvable for *p*," where not only has *p* not been defined, but the letter has also been repeatedly used on previous pages in different senses. Of course, the third line in ex. i. of paras. 52 and 53 will reveal the new signification to a smart reader, though the private student, as a rule, will be completely at sea for a time. There are other minor points, which will, no doubt, be attended to in the second edition; but space forbids us to say more than that, in this most interesting volume, Prof. Piaggio has proved himself to be a teacher of remarkable insight and skill.

(2) We know of no better introduction to the elements of algebra than that by Mr. Durell, of Winchester, and the late Mr. Palmer, of Christ's Hospital. The authors have contrived a course in which there is scarcely a page without ample evidence of intimate care controlled by a profound knowledge of youthful psychology. To many, the greatest attraction in the book is the fact that so large a proportion of it is adapted for *viva voce* work, and in accordance with modern ideas the material is throughout selected so as to bring the pupil as soon as possible within sight of the applications of the subject to the affairs of everyday life, and to such elementary scientific work as may be fairly expected to have come within his experience. The usual explanatory matter, which few boys and girls ever read, is reduced to a minimum, and placed in an "introduction" of about twenty pages. Useful extensions of various sections for the benefit of the few irrepressibles who cannot be kept back, and for the budding engineers and future specialists, are added in a final chapter. The writer of this notice can speak with personal experience of the successful manner in which a training on these lines copes with the inertia which lies at the base of most, if not, indeed, of all, of the difficulties that confront the beginner. In the hands of a sound teacher the pupil's rate of progress will be as rapid as he chooses, and the book may be placed with confidence in the hands of the private student. The collection of sixty odd pages of well-graded revision papers of various stages of difficulty adds considerably to the general value of the book.

(3) The short course of college mathematics by Prof. Moritz, professor of mathematics in Washington University, was originally devised to meet the demand during the war for short courses. So far as it goes, the treatment is thorough; the sixty pages on graphic methods are well and plentifully illustrated, and the student who has mastered the book should have a sound grasp of the essentials of trigonometry.

(4) The second part of Messrs. Dobbs and Marsden's "Arithmetic" consists of collections of papers, with the minimum of explanatory text, covering easy mensuration, financial subjects, graphs, and applications of elementary arithmetical notions to such problems as specific gravity, map-reading, etc. About half the book is given to revision papers. There is considerable variety in the carefully selected sets of questions.

Our Bookshelf.

Heredity and Evolution in Plants. By C. Stuart Gager. Pp. xv+265. (Philadelphia: P. Blakiston's Son and Co., 1920.)

THIS little book is an expansion of several chapters of the author's "Fundamentals of Botany." It is intended for beginners and general readers, and presents in a fresh way a very readable and well-illustrated account of the phenomena of heredity and evolution from the strictly botanical point of view. The author begins quite unexpectedly with two chapters on the life-history of a fern, and this concise account, followed by a chapter on fundamental principles, forms a background for the treatment of the subject proper. The definition of heredity as "the genetic relationship that exists between successive generations of organisms" omits to recognise the fact that the conception of heredity is fundamentally concerned with resemblances and differences as they occur in genetically related organisms. Later chapters deal with Mendelism, evolution, Darwinism, and experimental evolution. A very good balance is preserved between the historical and the descriptive methods, with a sprinkling of illustrations, the majority of which are new to text-books.

A chapter on the evolution of plants touches upon such problems as alternation of generations, evolution of the sporophyte, and the evidence from comparative anatomy, and ends with a hypothetical ancestral tree of relationships. One of the subjects best treated is that of geographical distribution, which discusses the means of dispersal, peculiarities of distribution, effects of glaciation and cultivation on distribution, endemism, the "age and area" hypothesis of Willis, etc., with numerous illustrative cases from the recent literature. The final chapters deal with the fossil record and the various hypothetical relationships of the groups of vascular plants.

The book is well produced and relatively free from typographical errors. We notice a slip (p. 42) in the statement regarding the multiplication of the offspring from a mustard plant. Many general readers will find enjoyment and information in a perusal of this little book.

R. R. G.

Practical Chemistry: Fundamental Facts and Applications to Modern Life. By N. H. Black and Dr. J. Bryant Conant. Pp. xi + 474. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1920.) Price 11*s.* net.

THE title of "Practical Chemistry" might lead to the impression that the book, written by two American teachers, was a laboratory manual. That is not the case. The text-book is an admirably clear and interesting introduction to chemistry, in which, it is true, the practical applications of the subject are not neglected. The attitude of the authors is completely modern, and the appearance of the book is greatly improved by numerous well-executed illustrations, and reproductions of photographs of actual plant and apparatus used in industry. Portraits of famous chemists, brief historical details, and numerous experiments are given. At the end of each chapter is a list of "Topics for Further Study," which often contain interesting suggestions. Any attempt to stimulate thought is welcome in a text-book, and the present volume is rich in such efforts.

In addition to a careful and accurate account of the familiar topics, many recent discoveries are included in a very readable manner. For instance, accessory factors in diet, the purification of water by chlorine, the hydrogenation of oils, the cleansing power of soap, and the really practical processes used in the fixation of nitrogen are all discussed in sufficient detail to make them intelligible. A useful summary is added to each chapter, together with a list of interesting questions. The authors are to be congratulated on producing a really interesting book; clear and accurate, with a freshness of treatment which is grateful to the hardened reader of elementary text-books. As an introductory text-book for elementary students, and for use in the higher forms of schools, this may with confidence be recommended.

J. R. P.

Physiology. By Dr. Ffrangcon Roberts. (Students' Synopsis Series.) Pp. viii + 389. (London: J. and A. Churchill, 1920.) Price 15*s.* net.

THE student of physiology has such a wide choice of text-books dealing more or less exhaustively with the subject that the entry of a new volume into the list might be regarded as unnecessary. This book, however, is intended to meet a special need incurred by the growth of the science. The application of physical and chemical methods to the elucidation of the problems of the body, the war-time accumulation of new facts and ideas, and the advances in the sister sciences have so altered the material and increased the size of the new editions of the standard text-books that an orderly arrangement is in danger of being obscured by the mass of detail. This is a real difficulty to the student, and furnishes a valid reason for the issue of this volume of the Students' Synopsis Series. The book is definitely intended to supplement, and not to supplant, the larger text-books. It assumes that the student has already an acquaintance with the elements of physiology and has had some experience of practical work. It also assumes that he has a considerable knowledge of physics and chemistry, without which its treatment of such a topic as the reaction of the blood, though ably presented, would by its brevity fail to convey the necessary instruction. The book admirably fulfils its purpose, and Dr. Roberts is to be congratulated upon his success in accomplishing the difficult task of compiling a summary of the salient facts of physiology which is readable, clear, concise, and up to date. The volume is well edited and its illustrations are apposite.

P. T. HERRING.

Landscape Architecture. By Prof. H. V. Hubbard and Theodora Kimball. Pp. 132. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1920.) Price 6*s.* 6*d.* net.

THIS work sets out to provide a comprehensive classification of the field of landscape architecture, and attempts to show in detail both the "subjects making up the field, and the relation of the field itself to tangent fields." The scheme resolves itself into a series of some thirteen to fourteen hundred headings, under which published literature, notes and other manuscript material, maps, plans, photographs, and other pictorial matter may be arranged. These headings are placed in groups according to their relationship with each other, and the groups themselves are classified. Landscape art must be much more highly organised in the United States than it is here to justify the publication of such an elaborate scheme as this, the chief *raison d'être* of which is the convenient docketing of papers in one form or another. We doubt if there are half a dozen firms of landscape gardeners in this country whose accumulation of material is so extensive as to need extraneous assistance in arranging it, but to any such this work is no doubt capable of affording valuable suggestions. It shows, at any rate, how extensive is the area covered by landscape art, and how far-reaching are its ramifications when followed out to their full extent. W. J. B.

Nucleic Acids: Their Chemical Properties and Physiological Conduct. By Prof. W. Jones. Second edition. (Monographs on Biochemistry.) Pp. viii + 150. (London: Longmans, Green, and Co., 1920.) Price 9*s.* net.

SINCE the first edition of this monograph was reviewed in NATURE for April 1, 1915, our knowledge of physiological chemistry has been considerably extended. The four hypothetical nucleotides required by the nucleotide theory of the structure of plant nucleic acid have now been prepared, and new facts regarding the purine fermentation in various animals have been brought to light. The work concludes with a bibliography of no fewer than twenty pages.

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 Arrangement of Atoms in Crystals.

IN NATURE for January 6, p. 609, was published a note in which some figures given in my paper on "The Arrangement of Atoms in Crystals" (*Phil. Mag.*, vol. xl., August, 1920) were contrasted with similar figures given by Wyckoff (*Amer. Journ. Sci.*, [iv], vol. l., pp. 317–60, November, 1920). These figures were estimates of the distances between atoms of metal, carbon, and oxygen in the crystals calcite, $CaCO_3$, rhodochrosite, $MnCO_3$, and siderite, $FeCO_3$. In this note it is stated that our data differ considerably, "the deviations rising to 0·6 Å. in the distance from carbon to metal."

There are no discrepancies of this magnitude between Wyckoff's results and mine. The large differences to which the note directs attention are due to errors in quoting the results given in my paper, owing, I think, to a misconception of the structure which Wyckoff and I agree in assigning to these crystals.

I give the correct figures, the distances being expressed in Ångstrom units:

		Wyckoff.		Bragg.	
		I.	II.	Experimental	Sum of radii
Ca-O	...	2·30	2·42	2·30	2·35
C -O	...	1·21	1·28	1·42	1·47
Ca-C	...	3·04	*3·206*	*3·206*	
Mn-O	...	1·96	2·13	2·10	2·11
C -O	...	1·22	1·32	1·42	1·47
Mn-C	...	2·83	*3·072*	*3·072*	

If I understand Wyckoff's results rightly, we are in agreement as to the type of structure in the case of these carbonates, and the symmetry of the crystal alone suffices to fix the positions of the calcium and carbon atoms. The distance between them can be calculated from the molecular volume of calcite, Avogadro's number N, and the crystal axial ratios. The dimensions of the calcite structure have been made the subject of careful investigation (Uhler, *Phys. Rev.*, July, 1918), as it has been used for standard X-ray wave-length determinations. Taking the value $d_{(100)}=3{\cdot}028$ Å. given by Uhler, it follows that this distance from calcium to carbon atoms is 3·206 Å. Wyckoff gives the value 3·04 Å., and so ascribes to the whole structure a smaller scale. If, as I believe, his scale is too small, all his figures should be increased in the ratio 3·206 to 3·04. A similar increase of scale holds for rhodochrosite. Under I. are given Wyckoff's values, and under II. those values increased in what I believe to be the correct ratio.

Wyckoff gives figures which differ from mine for the distance between carbon and oxygen atoms. He has made a very careful determination of a certain parameter (denoted by "u" in his paper), and I believe his value for it, 0·25, to be much more trustworthy than my approximate value 0·30. Wyckoff's value confirms a determination 0·25–0·27 by W. H. Bragg (Trans. Roy. Soc., A, vol. ccxv., pp. 253–74) in 1915—a determination which I did not know when I published my figures. If the figures in column II. are accepted, this would mean that my estimate of the "diameter" of carbon in compounds is too high, and that a better value would be nearer that of fluorine, 1·35 Å. This is the only serious discrepancy between our results, and it does not seem to me that it affects in any way the general conclusions which I drew in my paper.

The figure 2·47 Å., quoted as being given by me for the distance Ca–C, has presumably been arrived at by the author of the note by adding the radii for these atoms. As they are partially separated by the oxygen atoms which surround the calcium atom, there is no direct connection between the sum of the radii and the distance between them. I used in my calculations the theoretical value obtained as above.

May I take this opportunity to correct another error in the note? The figures given for the "diameters" of the electro-negative elements are quoted correctly from my paper, but those given for the metals are one-half the value which I gave under this head.

W. L. BRAGG.

Manchester University, January 22.

A Case of Coloured Thinking with Thought-forms and Linked Sensations.

COLOURED thinking is such a peculiar condition that those interested in it will welcome the details of a well-marked case of it. It must be distinguished from linked sensations such as coloured hearing—one of the synæsthesiæ—in which heard sounds call up colours, as when the low notes of the organ suggest violet or the high notes white or yellow, etc.

Coloured thinking or chromatic mentation (psychochromæsthesia) is the visualising of concepts as coloured, the ability to think of a letter of the alphabet, a number, a date, a month, or a name as associated with some colour or other—white, black, red, green, etc. To those who have never experienced this sort of thing it is unintelligible.

One coloured thinker thus expressed himself: "When I think at all definitely about the word January the name appears to me reddish, whereas April is white and May yellow; the vowel 'i' is always black, the letter 'o' white, and 'w' indigo-blue. Only by a determined effort can I think of 'b' as green or blue, for to me it has always been and must be black; to imagine August as anything but white seems to me an impossibility, an altering of the inherent nature of things."

Of course, the same person who has coloured hearing—the commonest of the linked sensations—may likewise have coloured thinking, although most coloured thinkers do not also have linked sensations. The case the interest of which I think sufficiently great to report on now is one both of linked sensations and of coloured thinking. But there is also a third element of interest in it, namely, that of thought-forms. A thought-form or psychogram is the visualising of, say, the numerals or letters of the alphabet or months of the year in such a way that they seem to form some definite figure in space—for instance, an arc of a circle or a ladder sloping up to the right or left, and so forth. A psychogram is the uncoloured form of a concept or a series of them; the psychochrome is the concept itself exteriorised in colour.

The case the coloured thoughts, linked sensations, and thought-forms of which I subjoin is that of a student of this University (Miss A. M.), who has all the features characteristic of these cases. She has been a coloured thinker ever since she can remember; the colours have not altered with lapse of time, they are exceedingly definite, they do not agree with the colours seen by other thinkers for any one given concept, and, finally, the "seer" cannot account for them in any way.

The only feature in the present case not quite typical is that it is not so clearly hereditary as is usually observed. Miss A. M. says that neither of her parents is a coloured thinker, though her "mother associates colours with the characters of people." This has been called "individuation," and is not so uncommon as might be imagined.

The classic discussion of this sort of thing is to be found in Sir Francis Galton's "Inquiries into Human Faculty and its Development" (London, Macmillan, 1883). This has been reprinted in Everyman's Library. Since that time very little has been written in English on the subject. With the exception of a letter in NATURE (vol. xliv., p. 223, 1891) and two papers by Miss M. A. Calkins in the *American Journal of Psychology* (1892), there has been nothing published on the subject until my articles in 1905 and 1908 respectively appeared in the *Edinburgh Medical Journal* and in the *Journal of Abnormal Psychology* (Boston, U.S.A.). The *British Review* of April, 1913, published a popular account of colour-hearing by C. C. Martindale.

D. FRASER HARRIS.

Dalhousie University, Halifax, Nova Scotia,
December, 1920.

APPENDIX.

Coloured Concepts or Psychochromes of Miss A. M.

a, creamy-white; b, shade clearer than "d"; c, pink; d, indigo, dirty (gritty) blue; e, black (wet); f, dry brown; g, black on white; h, darkish fawn, like chocolate blancmange; i, black; j, dirty, pearly, bluish-white; k, clear brown, edged with mustard-yellow; l, yellow; m, jade-green; n, pea-green; o, black; p, darker green, bluer; q, black, with red tinge; r, dry red; s, crimson, scarlet; t, deep black-red; u, dark grey, almost black; v, very dark navy, blue and green; w, not so dark, green and navy; x, brownish-mustard-yellow, very ugly; y, almost neutral bluish-green; z, like "x," but a little yellower.

Sunday, golden-yellow, with a fleck of green in the middle; Monday, pretty light green; Tuesday, dark blue with red flecks; Wednesday, soft, deeper green; Thursday, like Tuesday, with more red; Friday, brown, soft like suède gloves; Saturday, bright scarlet.

January, clear, intense pale green, like ice; February, dirty light reddish-brown; March, green and red at end; April, fresh, pale yellow; May, very pale green, almost white; June, green; July, yellow and royal blue; August, golden-yellow; September, red and brown (autumn); October, navy blue; November, brown with yellow edges; December, dirty, almost colourless, made up of black, navy blue, and dark green.

Christmas, pink (Christ), red and green (mas); Easter, creamy-white.

1, black; 2, creamy-yellow; 3, red, pale; 4, brown; 5, bright, wet red; 6, dull indigo; 7, ugly yellow; 8, white; 9, green; 10, black; 11, black and yellow; 12, creamy-yellow.

The twenties, yellow; the thirties, reddish; the forties, brown; etc. The hundreds are the same.

Synaesthesiae.

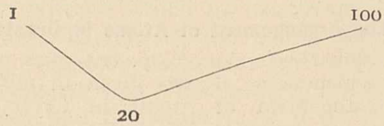
Pains have colours, but following the colours of the names, *i.e.* sore, red; ache, opaque-whitish; sprain, greenish-red; cut, blue and red; bruise, blue and red.

Tastes are only slightly coloured: acid are sharp, penetrating yellow; sweet, soft yellow. Odours, only slightly, either grey or yellow: a musty smell is grey and red; acrid, yellowish-grey. Touch, not at all: heat is yellow, and different degrees different shades up to a pure white, which is cold.

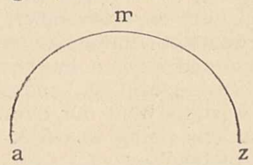
Music is the only thing that makes Miss A. M. see purple and violet. Deep organ notes blend from blue to purple, but only music. Even the names "purple" and "violet" she sees only by the letters which make them up. If "violet" had not a "t" at the end it would be merely dark blue, and the same with the "r" in purple. The lowest organ notes are, to her, deep purple, like a bruise, while the very high notes are yellow and pink.

Psychograms.

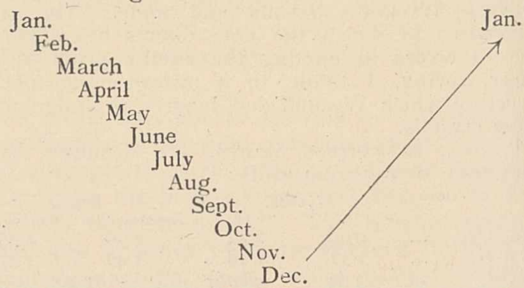
Numerals go like this:



The alphabet goes like this:



The months go like this:



The week between Christmas and New Year's Day stretches back to January.

Days of the week go like this:

Sat. Sun. Mon. Tues. Wed. Thurs. Fri. Sat.

Heredity and Acquired Characters.

MR. J. T. CUNNINGHAM remarks (NATURE, January 13, p. 630): "Provided that biologists understand one another, it is, perhaps, not an insuperable barrier to the progress of biology that Sir Archdall Reid is unable to understand their terminology." Prof. MacBride declares (*ibid.*): "I have attended many congresses of biologists, and I have never found evidence of confusion in their minds as to what was meant by an 'acquired character.'" I feel humbled, but not enlightened.

As far as I am able to understand Mr. Cunningham's letter, he regards as "acquired" everything which develops in response to use, and everything else as "innate." Herein he agrees with Lamarck and Sir Ray Lankester, but differs from a host of other writers, including Spencer, Wallace, Romanes, and Weismann, all of whom regarded the effects of injuries as "acquired" characters. He differs even from himself, for he has, when arguing in favour of the transmission of acquirements, attributed the evolution of antlers to the effects of irritation (injury). He differs in the same issue of NATURE from Prof. MacBride, according to whom "'acquired character' is a technical term; by it is meant a quality, *i.e.* the degree of development of an organ, which is produced as a response to function, altered from the normal in response to an alteration of the environment from the normal." Whence it follows that, while Mr. Cunningham would term the muscular development of the ordinary man "acquired," Prof. MacBride would call it "innate," and would limit the term "acquired" to such developments as the blacksmith displays. If everyone worked as blacksmiths, Prof. MacBride would differ still more from Mr. Cunningham, for the whole of development would then be termed by the former "innate" and by the latter "acquired." To Mr. Cunningham the English language is always an acquirement; to Prof. MacBride it is innate if learned in England, but acquired if learned in France.

Formal definitions of the meanings of the terms "innate" and "acquired" when applied to characters are extremely rare in biological literature—unless such terms as "germinal" and "somatic" be attempts at definition. However, Romanes made the attempt. This is what he says ("An Examination of Weismannism," p. 5): "By a congenital character is meant any individual peculiarity, whether structural or mental, with which the individual is born. By an acquired character is meant any peculiarity which the individual may subsequently develop in consequence of its own individual experience." Elsewhere (p. 214) he defines congenital (plasmogenetic) characters as "variations due to admixtures of germ-plasm in acts of sexual fertilization (and, therefore, present at birth), as distinguished from somatogenetic characters—variations which have been acquired independently of germ-plasm." Somatic characters he defines as "characters acquired by the soma (*i.e.* variations acquired after birth by the action of the environment), as distinguished from characters produced and potentially present from the first by a union of two masses of germ-plasm—plasmogenetic characters." Romanes's language may be lacking in precision, but evidently he supposed that there is something peculiarly "innate" about a "germinal" character and something peculiarly "acquired" about a "somatic" character. Unlike Prof. MacBride, he gives all these terms their ordinary or dictionary meanings—and so, I believe, do most biologists.

Dr. Ruggles Gates (NATURE, January 20, p. 663) believes I contradict myself. It is possible he has not grasped my meaning. An illustration may help. Before me are two pencils. Comparing these individuals, I find that their differences as regards length are great, but as regards colour small. Dr. Gates will agree that I am not entitled to transfer the terms by which I described the differences between the individuals to the characters wherein they differ—*i.e.* I am not entitled to call the lengths of the pencils great and their colours small. That way lies confusion of thought. Now consider two living individuals, the one an Englishman and the other a scarred negro. They differ in colour innately—they are in this respect by nature different; their germ-plasms are unlike; even if reared under exactly similar conditions of nurture they would be unlike. They differ in scars by acquirement; here they have had not unlike natures, but unlike nurtures; if reared under similar conditions they would be like. In brief, the colour difference is blastogenic, while the difference in scars is somatogenic. All this is intelligible; the words are used correctly. They are given their ordinary meanings; they are not in the least technical. But are we now entitled to transfer our descriptive terms from the differences between individuals to the characters in which they differ? Are we entitled to call skin-coloration "innate" and scars "acquired"? We are now comparing, not separate individuals, but the characters wherein they differ. In effect, we are comparing the characters of the same individual. How is skin-colour more innate and less acquired than a scar? They are both ancient products of evolution, both depend on germinal potentiality, both develop in response to some form of nurture, and both are situated in the soma.

Dr. Ruggles Gates writes: "I pointed out (NATURE, December 2, p. 440) that if his contention that all characters are both innate and acquired in exactly the same sense and degree is true, then it would follow that all variations are also of one type, while experimental biologists are universally agreed that this is not the case. At least two categories of variations are postulated . . . blastogenic and somatogenic. . . . Yet Sir Archdall Reid's only attempt to answer my criticism that the universally admitted existence of two types of variations undermines his whole position is the very weak one of quoting Darwin's tentative theory of pangenesis." But I did not quote the theory of pangenesis *against* Dr. Gates; I was merely trying to make my meaning clear. And surely the word "variation" indicates, not a character as such, but a difference between individuals. Resemblances do not necessarily exclude differences. A cleft lip is always a character in both man and rabbit; but it is a variation in the former, but not in the latter. A sixth digit resembles all other digits in that it is a product of nature and nurture; and yet (if the parent has it not) it is none the less a variation. So also a sixth digit resembles a scar in that it is a product of potentiality and stimulus; and yet it differs from the latter in that the unlikeness from the parent is innate, whereas it is acquired in the case of the scar. The resemblances between the two do not necessarily eliminate their differences. How, then, is my whole position undermined?

G. ARCHDALL REID.
9 Victoria Road South, Southsea.

Man and the Scottish Fauna.

I AM grateful to your reviewer (NATURE, December 30, 1920, p. 568) for his appreciation and for pointing out slips and misprints in my "Influence of Man on Animal Life in Scotland," but on some points of fact I would venture to disagree with other of his remarks.

Geologists will not be perturbed by his difficulty in believing in the persistence of evidence of man's presence in Scotland from times earlier than the formation of the 25-ft. beach. Sections of many places have shown that the 25-ft. beach, of estuarine material, *rests upon* the boulder clay, so that it is certainly not "clear that the land ice was grinding over all after the elevation which formed the younger 25-ft. beach." On the contrary, the evidence is that the 25-ft. beach was formed subsequent to the disappearance of the ice-fields. The relations of the 50-ft. beach are not so clear, but facts have to be explained on reasonable suppositions. And the occurrence of kitchen-middens of molluscan shells along the ridge of the 50-ft. beach in the Forth Valley is more easily accounted for on the supposition I have advocated—that they were collected while the 50-ft. beach was still a sea-margin—than on that of your reviewer, who would have the kitchen-middeners collect their shell-fish on the sea-side, now a great distance away, and thereafter scale first the 25-ft., and afterwards the 50-ft., beach before sitting down to their simple meals.

On the strength of a reference by Thomas the Rhymer, your reviewer suggests that I have erroneously omitted the green woodpecker from the list of banished Scottish animals. But both ornithologists (such as Yarrell and Newton) and etymologists (as in Wright's "Dialect Dictionary") are agreed that the word "wodewale," on which the whole value of the citation hangs, is a general word for a woodpecker, and applied to the great spotted as well as to the green woodpecker. The word has no specific significance. There seems to be, indeed, no evidence, past or present, that the green woodpecker has been a native of Scotland.

In naming the brown trout *Salmo trutta,* I followed the considered opinion of such an expert in fish nomenclature as Mr. C. T. Regan, of the British Museum (Natural History); my statement regarding the success of the introduction of Loch Leven trout to New Zealand did not pretend to record any *first* achieved success, and as it stands is correct; and the two "caricatures, and poor at that," specified by your reviewer happen to be reproduced from photographs of specimens mounted by skilled taxidermists, and now exhibited in the Royal Scottish Museum.

JAMES RITCHIE.

I SHOULD be sorry indeed if, in reviewing his book, I had given Dr. Ritchie the impression that I undervalued it as a contribution to prehistoric research. I did no more than express difficulty in accompanying Dr. Ritchie to the full extent of his conclusions, and surprise that, from first to last, he takes no notice of the 25-ft. beach.

I admit that I expressed myself too positively in saying that it was "*clear* that the land ice was grinding over all after the elevation which formed the younger 25-ft. beach." But many years of personal examination of the features of the Scottish seaboard have left on my mind a strong impression that some agent more powerful than sub-aerial denudation has masked or obliterated by far the greater extent of the 50-ft. beach. Such an agent may have been subsidence, glacial action, or "trail" (earth thawing and flowing after prolonged freezing, as in the "earth-glaciers" of the Rockies).

Some support to this view may be found in the late Prof. James Geikie's Munro lectures, "Antiquity of Man in Europe," 1914: "At the head of Loch Torridon well-formed terminal moraines rest directly upon the 45-50-ft. beach" (p. 273).

Prof. Geikie considered (p. 279) that the formation of that beach was followed by "partial subsidence," and continued:

"We cannot actually demonstrate that snowfields and glaciers reappeared at this stage. . . . Nevertheless, we are not without evidence suggestive of the appearance at this time of inconsiderable glaciers amongst our highest mountains. These glaciers undoubtedly existed at a later date than the glaciers that dropped their moraines on the 45-50-ft. beach. It is therefore only reasonable to infer that the high-level corrie glaciers in question were probably contemporaneous with the formation of the 25-ft. to 30-ft. beach."

The occurrence of kitchen-middens on the 50-ft. beach can scarcely be taken to prove the presence of man when the sea stood at that level. On the summit of the Fell of Barhullion in Wigtownshire, 450 ft. above the present sea-level and 1½ miles distant from the nearest beach, are the remains of a fortified enclosure. The refuse-heap of this encampment contains a large quantity of limpet-shells. Loch Spouts, in Ayrshire, is on high ground two or three miles from the sea. Dr. Munro has recorded that when the crannog in that swamp was explored, in the midden were found "large quantities of the shells of whelks, limpets, and hazel-nuts" ("Lake-dwellings of Europe," p. 420).

Prof. Geikie cited the discovery of a canoe near Perth as evidence that Neolithic man was in occupation when the sea washed the 50-ft. beach. I have been unable to find any detailed record of the finding of this canoe, and if, as Prof. Geikie says, it was made of pine, I should hold that to be incompatible with very high antiquity. Having taken part in the excavation of many crannogs, I have never seen any submerged timber, except oak and yew, that retained a firmer consistency than cheese.

Dr. Ritchie expresses the opinion that "there seems to be . . . no evidence, past or present, that the green woodpecker has been a native of Scotland." In Wallis's "History of Northumberland," 1769, vol. i., p. 319, it is stated that this species "has been observed in some of our vale-woods, but is not common. It was frequent in Dilston Park before the wood was cut down." Two instances of its occurrence in the valley of the Tweed are recorded in Mr. Evans's "Fauna of the Tweed Area," p. 109. Dr. Ritchie seems to be in error in attributing to Newton and Yarrell the use of the name "woodwall" as a generic term for all three British species of woodpecker. Yarrell strictly confines it to the green woodpecker, though he admits that Willughby and Ray use the term in a looser sense ("British Birds," third edition, vol. ii., p. 149), while Newton merely mentions it among the popular names for woodpeckers in general. The great and lesser spotted woodpeckers do not utter any song or bell-like note, and it seems fairly clear that it is the green woodpecker that figures in the ballad of Robin Hood (*cura* Ritson):

> The Woodwele sang and would not cease,
> Sitting upon a spray,
> So loud he wakened Robin Hood
> In the Greenwood where he lay.

It is probable that the green woodpecker, yaffle, or woodwale disappeared from Scotland with the forest that sheltered it.

THE REVIEWER.

Literature for Men of Letters and Science in Russia.

AT the beginning of this year an appeal was issued for funds to enable a certain number of scientific and literary publications to be sent to the House of Science and the House of Literature in Petersburg, where the remnant of the intellectual life of Russia is mostly congregated. The British Committee for Aiding Men of Letters and Science in that country has assured itself that such publications will reach their destination, and has made arrangements for their transmission. There are probably many authors who would be willing to send copies of their works in the form of excerpts or otherwise to Russian workers who have been cut off from the outside world since the revolution. The British Committee will be glad to receive any such books or papers of a non-political type and to send them to Petersburg. It cannot guarantee delivery to individuals, but it can ensure that publications will reach the Houses of Literature and Science. Parcels for transmission should be addressed to the above Committee, care of Messrs. Wm. Dawson and Sons, Ltd., Continental Department, Rolls Buildings, Fetter Lane, E.C.4.

L. F. SCHUSTER.

British Science Guild Offices, 6 John Street, Adelphi, London, W.C.2, January 26.

The Mild Weather.

APROPOS of Mr. Charles Harding's letter (NATURE, January 20), one result of the extraordinary weather in the south of England since the third week of December was that on January 24 I saw forty or fifty plants in flower of the minute Crucifer (*Hutchinsia petraea*) on limestone screes close to Bristol. Some of the seedlings were 2 in. high, with five or six flowering heads and with seed-pods already developed. Last year a few were in flower on February 12, but even this is remarkably early, for March–April is the usual time in the district for this rare plant, and most of the books give March–May. On January 5 I saw a hazel in full blossom between Gunnersbury and Kew.

H STUART THOMPSON.

5 Westbourne Place, Clifton, January 30.

The Forest Resources of India.[1]

MORE than one-fifth of the total area of British India (including the Shan States), comprising some 250,000 square miles, is under the control of the Forest Department. In this vast area the diversity of climate, soil, and vegetation is very great. The forest vegetation ranges from that of the arid, semi-desert tracts of North-west India and the alpine scrub on the higher slopes of the Himalayas to the luxuriant evergreen forests of parts of Assam, Burma, and the west coast of India, while the total number of woody plants comprises approximately 5000 distinct species. The number of valuable timbers and other commercial products available in the forests is very large, and many of them are as yet imperfectly known. Among the best-known timber trees are red cedar (*Cedrela Toona*), deodar (*Cedrus deodara*), satinwood (*Chloroxylon Swietenia*), rosewood (*Dalbergia latifolia*), padauk (*Pterocarpus dalbergioides*), sandal (*Santalum album*), sal (*Shorea robusta*), and teak (*Tectona grandis*). The principal minor products are classified under bamboos, grass, fibres, oil-seeds, tanning materials, essential oils, gums, resins, rubber, drugs, and lac. Minor forest industries which are likely to develop considerably in the near future are the paper-pulp industry, which offers great scope for the utilisation of bamboos and grasses, and the production of turpentine and rosin from the resin of *Pinus longifolia*. During the last twelve years the Indian resin factories have increased their output tenfold.

FIG. 1.—Main building of the Forest Research Institute, Dehra Dun. From "The Work of the Forest Department in India."

Forest crops usually require long periods of time to attain maturity, and the effect on growth and development of any particular method of treatment often only manifests itself after a number of years. The forest officer, therefore, who can himself rarely hope to see the full results of his own work, must possess in an unusual degree the qualities of patience, imagination, and foresight, and must, as a rule, be content with the knowledge that he is working for the good of posterity. The early efforts of forest officers in India to demarcate and protect the forests from destruction, and, by careful treatment, to enable

[1] "The Work of the Forest Department in India." Prepared under the direction of the Inspector-General of Forests to the Government of India, April, 1920. (London: Harrison and Sons.) Price 1*s*.

the forests to produce a regular and increasing supply of timber and other products, met with much bitter opposition from short-sighted commercial interests and from the local population which had been accustomed to regard the forests as the free gift of Nature. The present generation, however, is enjoying the fruits of the labours of devoted pioneers, who in the face of great opposition have built up "a property of constantly increasing value, the future importance of which it is hardly possible to over-estimate." In view of the general apathy regarding scientific forestry which prevailed in Great Britain itself until the vital importance of forest resources was emphasised by the recent war, it is indeed remarkable that during the last seventy years the importance of forestry in India has been steadily kept in view by British administrators. In this respect, indeed, India may well claim to have set a worthy example to the rest of the British Empire.

The most noteworthy event in the early history of scientific forestry in India was the enunciation of a definite and far-sighted forest policy by Lord Dalhousie in 1855, which was followed by the appointment of Dr. Brandis as Superintendent of Forests in Pegu in 1856. In 1874 the superior forest staff consisted of seventy-one officers; in 1918 this number had risen to 257, while schemes now under consideration are expected to raise this figure to 350. It is instructive to compare with these figures the following details of the average annual surplus forest revenue, in lakhs of rupees, during the quinquennial periods mentioned:

Period	Revenue
1864–68	13·6
1869–73	17·0
1874–78	20·8
1904–08	116·0
1909–13	132·3
1914–18	160·2

FIG. 2.—Teak plantation eighteen months old at Kaptai, Chittagong tract. From "The Work of the Forest Department in India."

The value of Indian forest resources, however, must not be judged mainly by financial results. The first duty of the Forest Department is to provide the ordinary domestic and agricultural requirements of the local population in respect of timber, fuel, grass, grazing and other products. Large quantities of such produce are utilised by rightholders and free-grantees, while in times of famine the people are often largely dependent on the forests for their existence. The forests also provide congenial employment for a considerable portion of the population, and it is estimated that some five millions of people in India are directly or indirectly dependent on forestry for their livelihood for the greater part of the year. In many cases, also, the primary object of the forester in establishing and preserving forest vegetation is to prevent injurious erosion and to regulate the storage of rainfall.

The future development of the forest resources of India depends chiefly on three factors:

(1) Creating or increasing the market for individual products. Valuable work in this direction was done at the recent Empire Timber Exhibition by emphasising the uses and handsome appearance of several common Indian timbers, which hitherto were practically unknown in home trade circles. This kind of work necessitates, on one hand close co-operation between forest officers and the commercial world, and on the other co-operation between forest officers and those men of science who are engaged in studying the properties of forest products. With reference to the latter point, recent progress has been made by attaching a cellulose expert (to investigate paper-making materials), a tannin expert, an expert in wood-technology, and others, to the Forest Research Institute at Dehra Dun.

(2) Providing improved transport facilities in the shape of roads and mechanical appliances with the object of lessening the cost of extraction and making it possible to work areas which are at present inaccessible. An important step recently taken in this connection is the addition of a special engineering branch to the Indian Forest Department.

(3) Improved methods of sylvicultural management, the success of which primarily depends on research work carried out by sylviculturists, botanists, zoologists, chemists, and other men of science with the object of increasing available knowledge regarding the requirements of individual species, and the factors which favour or impede their healthy growth and development. Such work is the bed-rock of all truly progressive forestry. It is of little use to build up a market for a product unless a sustained supply of it can be assured and concentrated on those areas where its exploitation can be provided for most efficiently and at a minimum cost. Moreover, until a detailed knowledge of the requirements of individual species has been acquired, the maximum yield of any particular product cannot be obtained. That there is much to be done under this head is evident from the fact that, although the conditions of soil and climate over a large part of the forest area in the Indian Empire are exceptionally favourable to vegetative growth, the present yield from the best of the Indian forests is considerably below that of intensively worked European forests. That the importance of this kind of work is not being overlooked by the Indian forest authorities is indicated by the fact that at the Forest Research Institute, which was established at Dehra Dun in

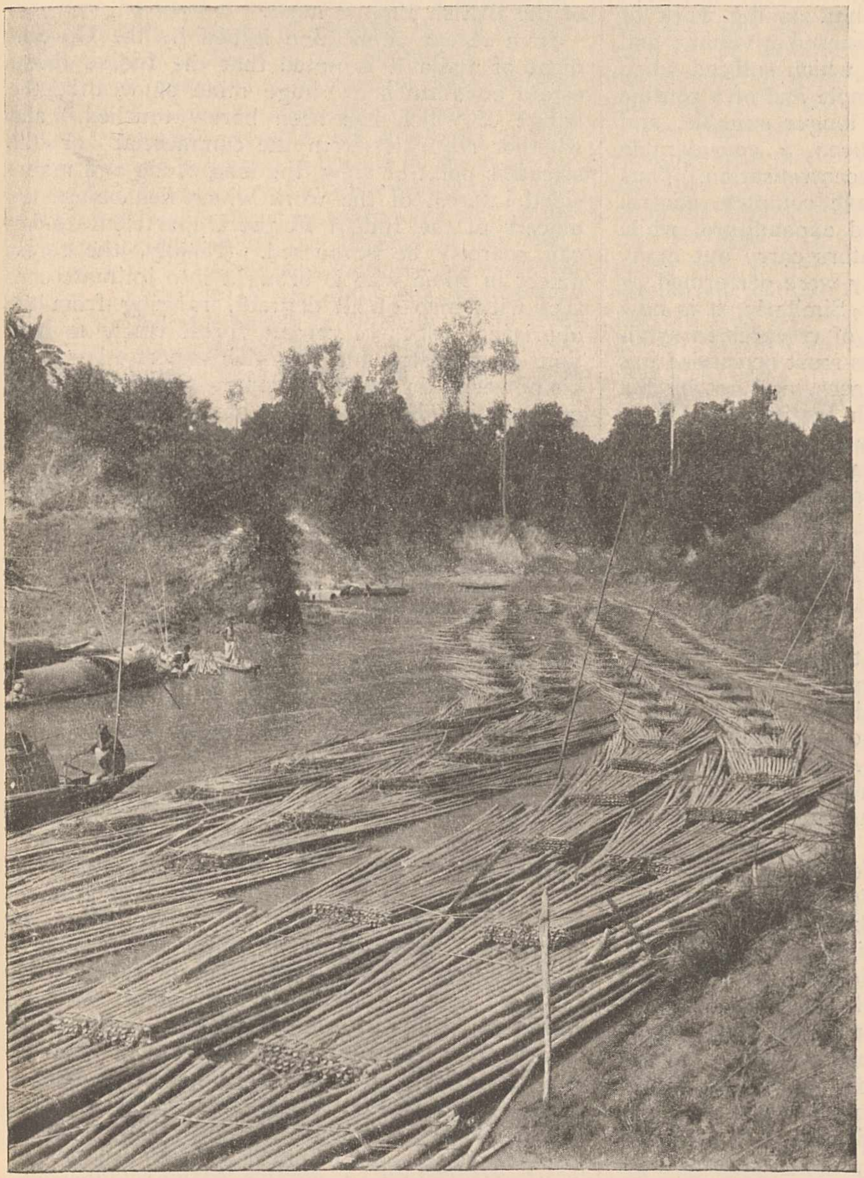


FIG. 3.—Bamboo rafts at Maine Muk, Kasalong river, Chittagong hill tract. From "The Work of the Forest Department in India.

1906 at the instance of Sir S. Eardley Wilmot, provision was made for research work in sylviculture, forest botany, zoology, and chemistry, as well as in forest economic products. A scheme now under consideration contemplates a large increase in the establishment and equipment of this institute, involving the acquisition of a site of 1000 acres and an expenditure of some 500,000*l*.

It is interesting to note that, as the work of the Forest Department has increased in volume and complexity, the organisation which sufficed when forest work was relatively simple and of a routine nature has proved to be no longer suitable, and in recent years there has been a considerable advance in the direction of decentralisation. Thus the major provinces now have complete control over their forest revenue and expenditure, while the provincial chief conservators carry out many of the duties which previously were performed by the head of the department. Similarly, it is now recognised that a great deal of research in sylviculture and economic products must be carried out by local officers in the provinces, and not by the staff of the Central Research Institute at Dehra Dun. At the same time, the value of the assistance and advice which can be obtained from officers who are given opportunities of studying those aspects of problems which are usually not accessible to local provincial officers is fully realised. The Forest Department, in this respect, appears to have realised from actual experience the importance of (1) freedom for the development of local initiative, and (2) mutual good-will, which renders possible loyal co-operation and co-ordination of work for the common good—principles which, after all, constitute the foundation of the British Empire itself.

In a recent publication issued by the Government of India it is noted that the Indian forest estate constitutes a "huge mine of wealth, the fringe of which has been barely touched," and whether regarded from the commercial or the scientific point of view the magnitude and many-sided interest of the work which lies before the officers of the Indian Forest Department to-day can scarcely be surpassed. Finally, the forest officer in India who is brought into intimate contact with men of all degrees, ranging from the aboriginal tribes of remote forest tracts to captains of industry and scientific experts, has it in his power to do much to promote the good-will and co-operation between men of different classes, occupations, races, and creeds which are so important to-day for the welfare of the British Empire and, indeed, of civilisation itself.

The Investigation of Gravity at Sea.

By PROF. W. G. DUFFIELD.

THE most notable attempt to measure the variation of the force of gravity over the surface of the oceans was that made by Hecker in the early years of the present century; in 1901 he surveyed a track across the Atlantic from Lisbon to Bahia, following this up a few years later with the investigation of the Indian and Pacific Oceans and the Black Sea.

Helmert had developed a formula for the variation of gravity with latitude from observations collected from a large number of land stations, and the immediate object of Hecker's investigation was to test its application to determinations made over great ocean depths. The problem of an oceanographic gravity survey has long fascinated geophysicists, because observations on board ship are practically made from the surface of the geoid, and should lead to the determination of the shape of that much-discussed figure; and what is also of importance, its solution should likewise lead to a knowledge of the extent to which isostatic compensation is complete over otherwise inaccessible parts of the globe.

Since observations of gravity must be made with great accuracy if they are to be of any value for such purposes, the examination of the gravitational acceleration at sea is attended by great difficulties; on a moving ship, rolling and pitching produce vertical accelerations which are individually indistinguishable from deviations from the true value of g. Reliance must therefore be placed upon suitable damping devices which will reduce the effect upon the instruments of such extraneous accelerations, or at least enable their mean value to be determined within narrow limits of error.

Hecker's original method depended upon the simultaneous measurement of the atmospheric pressure by means of a mercury barometer and a boiling-point apparatus; the latter determination is independent of the local value of gravity, and, if equated to ρgh for the mercury column, gives the necessary information for the evaluation of g. A fine constriction in the barometer tube provided a heavy damping factor which reduced the amplitude of the oscillations of the mercury surface; some of Hecker's instruments recorded photographically upon a moving film and provided a trace from which the normal level of the mercury might under favourable conditions be gauged.

Hecker considered that his observations showed that Helmert's formula held good within, roughly, one part in 30,000 for both deep and shallow seas, indicating a high degree of isostatic compensation; his conclusions have, however, been subject to a good deal of unfavourable criticism both on this and on the other side of the Atlantic, and it is true that disappointing inconsistencies appear in successive boiling-point determinations and in the simultaneous readings of the four barometers, which possessed different amounts of "lag," and that in certain other respects objections may be urged which prevent us from accepting the verdict on the evidence placed before us; nevertheless, it was pioneering work, and the difficulties to be encountered were largely unknown, and certainly untried, when the investigation was begun. Whether Hecker's conclusion be confirmed or refuted, those who follow will not fail to benefit by his early experiences.

With a view to a further oceanographic gravity survey, Hecker constructed apparatus based upon a different principle, one which had been unsuccessfully tested at sea by William Siemens in 1859. This time he used a barometer with a sealed cistern, so that the column of mercury should be supported by the pressure of the contained air; the cistern was immersed in a vacuum flask packed with cork shavings to keep the temperature, and therefore the pressure of the air, as steady as possible. Hecker arranged that four of these instruments should be mounted at the corners of a rectangular box containing apparatus for the photographic registration of the heights of the mercury columns. The box was mounted upon central gimbals, designed to maintain the barometers vertical as the ship rolled or pitched. It is clear that if the pressure within the cistern is known from temperature observations, the value of g is obtainable.

Lecturing in July, 1913, Prof. A. E. H. Love suggested that the voyage of the British Association to Australia in the following year might afford a valuable opportunity for once more testing the value of gravity at sea, and urged upon British astronomers and physicists the importance of the problem. His appeal proved irresistible. The time for preparation for so great an undertaking was very short; nevertheless, it was found possible, largely through the generous provision of instruments by the Meteorological Office and the Cambridge Scientific Instrument Co., to accumulate apparatus whereby tests could be carried out by three separate methods. Profs. Hecker and Helmert were anxious to have the instrument already described tested at sea, and willingly offered it for trial during the voyage; it was, therefore, brought from Strassburg in June, 1914, and installed on s.s. *Ascanius* in Liverpool.

Of the other pieces of apparatus one depended upon much the same principle as that of Siemens and Hecker—namely, the equilibrium of a column of mercury supported by air pressure within a closed vessel—but there were important differences; it was arranged that the lower surface of the mercury should always be brought to the same level in the cistern, an adjustment determined by an electric contact with a point which completed a telephone buzzer circuit. This ensured a constant volume for the enclosed air. The height of the barometer column was not directly observed, but estimated by measuring the length of the thread of mercury, which it was necessary to introduce into the apparatus through a fine capillary tube in order to secure contact at the lower surface. Assuming that the temperature remained constant, a defect in gravity would demand the addition of mercury in order to lengthen the barometer column sufficiently to balance the pressure of the air in the reservoir. The sensitivity could be made great by adopting a high ratio between the cross-section of the barometer tube and that of the capillary index tube through which the mercury was introduced.

A valuable suggestion for the improvement of this apparatus came from Sir Horace Darwin, who pointed out that the bulk of the difficulty occasioned by fluctuations of temperature might be overcome by employing such a volume of mercury within the apparatus that its expansion would automatically provide the additional height of mercury in the barometer tube necessary to balance the increase of pressure of the air in the reservoir due to a rise in temperature.

The third method consisted in comparing the readings of a mercury barometer with those of an aneroid; both were open to the atmosphere, and, as in the boiling-point method, we have the equation $\Pi = \rho g h$ to give us the variations of g, Π being now given by the aneroid, and h and ρ by the barometer and its attached thermometer. The aneroid was specially constructed and kindly lent by Sir Horace Darwin for this research. On board a ship the voyage of which carries it through many degrees of latitude one of the greatest difficulties is to obviate the effects of large changes of temperature. On the outward voyage this difficulty was very largely overcome by the generous installation by Messrs. Alfred Holt and Sons of a special refrigerating chamber on s.s. *Ascanius,* which served as an excellent laboratory. It was furnished with a separate system of brine pipes, and though at first there were rather large fluctuations, two engineers on day and night duty eventually became so adept at regulating the flow of brine that during the latter stages of the voyage the variation amounted to considerably less than one degree over a period of twenty-four hours, even though the observer was frequently within the chamber for an hour or more at a time. In future work it should, if possible, be arranged that it is not necessary for the experimenter to remain in the chamber for lengthy periods, as it is detrimental to health; but the experience does suggest that it is possible to overcome the very serious difficulty of maintaining a large room at an approximately steady temperature throughout the voyage.

Unfortunately, the outbreak of war at the time the British Association reached the shores of Australia led to the ship being commandeered for troops, so it was not possible to make use of this laboratory on the return voyage, and a good deal of the experience gained was wasted. A place was, however, found in the refrigerating chamber of the P. & O. R.M.S. *Morea* for all the apparatus, so the test was continued, though under very unfavourable conditions on the homeward journey.

It had scarcely been hoped, when the expedition was planned, to do more than obtain experience and information which would serve as a guide for future work upon gravity at sea, and more than this is not claimed for the results. Briefly, it may be stated that leaks which developed in Hecker's apparatus, and a troublesome temperature gradient between the cistern and the stem of the barometers, demand radical alterations in its design if it is to be rendered efficient. For the brief period of the voyage when the gravity barometer could be favourably observed, results were obtained which seemed to indicate that the method was one of promise, and it may be of interest to state that new apparatus of this type is in course of construction; the design has been modified in the light of experience gained at sea, and of a mathematical examination of the instrument by Sir Arthur Schuster. One specially favourable feature of the instrument is the possibility of completely immersing it in a constant-temperature bath.

Though the particular aneroid "pumped" with the motion of the ship more than was hoped, and had a reduction factor and zero which changed slightly during the voyage, the aneroid method is one which should be further examined, and certain directions in which alterations in the design are desirable were indicated by the experience on the voyage to Australia. With it the general variation of gravity with latitude over the ocean is readily shown, but whether it may be trusted to discriminate between such variations as may be found over deep and shallow waters must be a matter for further examination. We may note, as a matter of interest, that such indications as were obtained with this method suggested a defect of gravity over great ocean depths, along continental seaboards (especially when there was a coastal range of mountains), and an excess of gravity at island stations; but, as we have stated, a more rigorous test with improved apparatus is necessary before this can be accepted. The problem has therefore arrived at an interesting stage; Hecker's observations are in favour of nearly full compensation, whereas the slight evidence of the later work, so far as it goes, suggests that compensation is incomplete.

Reference has already been made to the instrument constructed in 1859 by William Siemens—in that year he was carried in a warship across the Bay of Biscay, his real object being the determination of ocean depths, which he took for granted would be shown by a diminished value of *g*. Dissatisfied with his first apparatus, he did not make a further attempt until 1875, when he constructed an instrument which depended upon balancing the pressure of a column of mercury against the tension of a spring, and this he tested on a cable-laying ship over a portion of the voyage between the Thames and Nova Scotia. The results, in spite of anomalies as regards latitude variation, which puzzled Siemens, show a surprising measure of agreement between predicted and observed depths, which, so far as they go, are in accord with the aneroid observations just referred to. This must not, however, be overemphasised, since Siemens was dissatisfied with this apparatus. Though not really directed at the solution of the problem under discussion—Siemens's "bathometers" were graduated in fathoms—these instruments are of interest in that they appear to have been the first involving gravity measurements to be submitted to an actual test at sea.

Since the Australian meeting of the British Association in 1914, further work has been carried out under the auspices of an influential committee of that body, and certain other points have received attention. From a series of experiments carried out last year on H.M.S. *Plucky*, it appears that the ship's motion through the air may very appreciably affect the pressure recorded by an open barometer, even when carried in cabins below deck; hence, as the "lag" of this instrument is in general different from that of the instrument with which it is being compared, it is very undesirable to adopt barometers of the open type for gravity determinations. On board the destroyer effects as large as one millibar were found to be due to the relative motion of the ship and the air; no doubt a similar disturbing influence affects the readings of a barometer in a building about which a wind is blowing.

Another matter which was examined on H.M.S. *Plucky* was the Eötvös effect; going east with the earth, the centripetal force is greater than when steaming west; consequently a correction for motion in longitude is indicated. After eliminating windage effects, a change equivalent to 0·1 mb. was observed when the course was altered from E. to W. when steaming at 22 knots.

There are other points the investigation of which is not yet complete: the best diameter of capillary tubing to be used in the barometer tube to damp down the effects of the ship's vertical motion, the influence of the throbbing of the ship's engines upon the barometer reading—there is some suspicion that certain divergences between gravity readings in harbour and in the open sea may be accounted for by the change in capillary forces due to this cause—the best form of constant-temperature chamber for use at sea, steady to 1/100 degree: these and allied questions are engaging the attention of those who are contemplating a fresh attack upon the problem.

Obituary.

PROF. H. A. BUMSTEAD.

THE death of Prof. H. A. Bumstead, professor of physics in Yale University, which occurred with tragic suddenness on January 1 when he was travelling from Chicago to Washington, will be felt with the keenest regret by a large number of men of science in this country. There are few American men of science with more English friends than had Prof. Bumstead, and none whose friendship and companionship were more highly prized. Born in 1870, he graduated at Johns Hopkins in 1891. He began in 1893, as instructor in physics in Sheffield Science School, that connection with Yale which continued without interruption until his death, where, for fourteen years, he had been professor of physics and director of the Sloane Physical Laboratory. Prof. Bumstead was the most enthusiastic and devoted of Yale men. He came over to Cambridge in 1904, and worked for a year at the Cavendish Laboratory; the result of his work is contained in a paper in the *Philosophical Magazine* for June, 1906, p. 292, on the heating effects produced by Röntgen rays in different metals. On his return to America he made, in spite of serious ill-health, important researches on the properties of α-rays.

Excellent as Prof. Bumstead's published work is, it gives but an inadequate idea of his powers, or of his singularly clear and sane judgment. He edited the collected works of Willard Gibbs—the greatest physicist ever associated with Yale. When America joined in the war, he threw all his energies into the application of science to the purposes of the war, and at the end of 1917 he came over to this country as Scientific Attaché to the American Embassy. Prof. Bumstead's duties were to co-ordinate the scientific work done in America and in England and France, so that the results obtained in one country should be as soon as possible at the services of the others. For this work his personal qualities and scientific attainments made him especially fitted, and he did most valuable work whilst he was in this country. He was at the time of his death president of the National Research Council in the United States.

Prof. Bumstead had a singularly attractive and charming personality. Sympathetic, modest, without a trace of self-assertion, he was the most delightful companion and most valued friend.

J. J. T.

Prince P. A. Kropotkin.

The death of Prince P. A. Kropotkin at Dmitrov, near Moscow, on Friday last, January 28, deprives the world of a picturesque figure and science of a devoted student. For many years Prince Kropotkin was an esteemed contributor to the columns of Nature, and when he left England to return to Russia in 1917 he wrote to express regret that the very close relationships which had existed between him and us for so long were being severed. He said at the same time that he had been a reader of Nature from the first number, and had even been permitted to receive it while a prisoner in the fortress of St. Peter and St. Paul in St. Petersburg.

Prince Kropotkin was born on December 9, 1842. At the age of fifteen he entered the select military school at St. Petersburg; on leaving he joined a Cossack regiment stationed on the Amur, and while aide-de-camp to the commander of the General Staff in Eastern Siberia, he crossed North Manchuria from Transbaikalia to the Amur and up the Sungari to Kirin, travelling in all as many as 50,000 miles. In 1867 he abandoned a military career, and returned to St. Petersburg, where he entered the University, and devoted himself seriously to geographical work. He then became closely associated with political movements, and gave himself up to propaganda. In 1873 he was arrested and imprisoned, but escaped in the following year and made his way to England, shortly afterwards going to Switzerland. After the assassination of Alexander II., Kropotkin was expelled from Switzerland, and settled in Savoy, where he was arrested in 1883 on a charge of organising a dynamite outrage, and was condemned to five years' imprisonment, but was released in 1886. He then returned to England, and remained here until June, 1917.

In 1876 Kropotkin published his "Researches on the Glacial Period," in which he described a journey in Finland and a short visit to Sweden, both made in 1871, under the auspices of the Russian Geographical Society, for the special purpose of studying the glacial formations and the eskers. His conclusions were that this low tableland was once covered by an immense ice-sheet, which, creeping from Scandinavia, crossed the Gulf of Bothnia and traversed southern Finland in a direction south by east, leaving behind it the marks of its course in the shape of numberless striæ and moraines.

Perhaps Kropotkin's most notable work was "Mutual Aid, a Factor in Evolution," published in 1902. The view put forward was that in the case of animals there is very little evidence of any struggle for existence among members of the same species, though plants, beyond all doubt, jostle their own kin out of existence. Animals, as a rule, are banded together for mutual protection, and those that have the best organisation for mutual defence are those that thrive best. Among men, mutual aid is more general than among animals; among savages, it is the chief factor in evolution. Kropotkin traced the growth of the modern benefit societies, co-operative associations, and trade unions back through successive stages of the history of a nation—through the State, the medieval city with its fortifications and hired defenders, the village communities, and finally to the clan, showing how man has attained his present position chiefly by practising mutual aid. There is no doubt that in the development of this thesis Kropotkin was keenly interested, and that the work itself represents, more closely than anything else he did, the main trend of his conception of the meaning of life and progress.

Kropotkin was a pioneer advocate of the intensive cultivation of crops, and in a suggestive little book entitled "Fields, Factories, and Workshops" he described what was done in this direction in Guernsey, as well as indicated how similar principles of culture could be applied elsewhere. His view was "that 600 persons could easily live on a square mile, and that with cultural methods already used on a large scale 1000 human beings —not idlers—living on 1000 acres could easily, without any kind of overwork, obtain from that area a luxurious vegetable and animal food, as well as the flax, wool, silk, and hides necessary for their clothing."

These two latter works reveal Kropotkin's unbounded faith in man and his hope for a high human destiny through the reconstruction of society and communal production. His knowledge extended over a wide scientific field, and his interest in its advancement never failed. His many friends in this country will long cherish his memory with affection and esteem.

THE death occurred, on January 18, of MR. RUPERT FARRANT, at the age of thirty-six years. Mr. Farrant was educated at the Westminster Hospital, and he studied also at King's College and St. Bartholomew's Hospitals; after he had qualified as a practitioner in 1906, he held many resident posts in various London hospitals. In 1909 he was made a fellow of the Royal College of Surgeons, and on two occasions he delivered Hunterian lectures at the college. Mr. Farrant made a special study of the ductless glands, especially of the thyroid, in connection with the general metabolism of the body, and he put forward a theory of a correlated cycle of changes in the histological appearance and functional activity of the gland under the influence of toxins. He saw active service at Gallipoli, in Egypt, in Mesopotamia, and in France, where he received injuries by a shell explosion, from the concussion of which he never completely recovered.

IT is with deep regret that we learn of the sudden death, on January 31, in his fiftieth year, of DR. J. C. CAIN, editor of the Chemical Society's publications since 1906, and author of leading works on synthetic dyestuffs and intermediate products.

WE much regret to announce the death, on January 30, at sixty-five years of age, of MR. C. E. FAGAN, secretary of the British Museum (Natural History), to whose expected retirement after a long period of devoted service reference was made in our Notes columns on January 13, p. 638.

Notes.

THE gold medal of the Royal Astronomical Society has been awarded by the council to Prof. H. N. Russell for his contributions to the study of stellar evolution. It will be presented to Prof. Russell at the annual general meeting to be held on Friday, February 11, when the president of the society, Prof. A. Fowler, will deliver an address on the notable work for which the award has been made.

THE Lords Commissioners of the Treasury have appointed Sir Robert Robertson, K.B.E., F.R.S., Director of Explosives Branch, Research Department, Woolwich, to be Government Chemist in succession to Sir J. J. Dobbie, who has retired.

A MEMORIAL lecture on the life and work of the late Sir William Abney is to be delivered to the Royal Photographic Society of Great Britain by Mr. Chapman Jones. April 26 next has been provisionally fixed for the date.

THE council of the Chemical Society has arranged to hold the anniversary dinner at the Hotel Cecil on Thursday, March 17 (the day of the annual general meeting), at 7 for 7.30 p.m., and to invite, as guests of honour, the past-presidents who have attained their jubilee as fellows of the society.

DR. W. R. G. ATKINS, of Trinity College, Dublin, has been appointed head of the department of general physiology at the Plymouth Laboratory of the Marine Biological Association.

SIR NORMAN MOORE, president of the Royal College of Physicians, has appointed Dr. Herbert Spencer to deliver the Harveian oration on St. Luke's Day (October 18), and Dr. Michael Grabham, of Madeira, to deliver the Bradshaw lecture in November. The council has appointed Dr. Major Greenwood to deliver the Milroy lectures in 1922.

A DISCUSSION on gravity at sea will be held in the rooms of the Royal Astronomical Society, Burlington House, to-morrow, February 4, at 5 p.m. The chair will be taken by Sir Arthur Schuster. Prof. W. G. Duffield will open the discussion, which will be continued by Sir S. G. Burrard, Dr. H. Jeffreys, Dr. J. W. Evans, and Dr. A. Morley Davies.

A SPECIAL joint meeting of the Society of Chemical Industry and of the Institution of Mechanical Engineers will be held at the rooms of the institution, Storey's Gate, Westminster, S.W.1, on Friday, March 4, at 6 p.m., when M. Paul Kestner, president of the Société de Chimie Industrielle, will read a paper on "The De-gassing and Purification of Boiler Feedwater."

AT the meeting of the London Mathematical Society to be held in the rooms of the Royal Astronomical Society at Burlington House, W.1, on Thursday, February 10, at 5 p.m., Prof. A. S. Eddington will deliver a lecture on "World Geometry." The lecture will be concerned with the mathematical side of the general theory of relativity, with especial reference to electricity and gravitation and the work of Prof. H. Weyl. Visitors from other societies will be welcome.

IN the issue of NATURE for January 27 there appeared an illustration (p. 699, Fig. 2) of a sculptured group from the decoration of the building of the Institute of Human Palæontology in Paris. The official description which was supplied with the photograph stated, no doubt by inadvertence, that the anthropoid forming part of the group was an orang-utan. A close inspection, however, shows that it is undoubtedly a gorilla.

Science of January 14 announces that the Rockefeller Foundation has given to France complete control over the elaborate anti-tuberculosis organisation established in the Department of Eure-et-Loir at a cost of 4,000,000 francs. The organisation consists of twenty-four dispensaries, four complete isolation services, and a departmental sanatorium and laboratory. The system will serve as a model for similar organisations to be established by the Government throughout the country. The Rockefeller Foundation is now assisting in the anti-tuberculosis campaign in thirty-eight of the eighty-seven Departments of France, and work is contemplated which will last for another two years.

AT the annual general meeting of the Royal Meteorological Society on January 19 the following were elected officers and members of council:—*President:* Mr. R. H. Hooker. *Vice-Presidents:* Mr. J. Baxendell, Mr. W. W. Bryant, Sir Napier Shaw, and Dr. E. M. Wedderburn. *Treasurer:* Mr. W. V. Graham. *Secretaries:* Mr. J. S. Dines, Mr. L. F. Richardson, and Mr. G. Thomson. *Foreign Secretary:* Mr. R. G. K. Lempfert. *Councillors:* Mr. C. E. P. Brooks, Capt. C. J. P. Cave, Mr. J. E. Clark, Mr. R. Corless, Dr. H. N. Dickson, Mr. G. M. B. Dobson, Mr. F. Druce, Mr. J. Fairgrieve, Mr. H. Mellish, Mr. M. de C. S. Salter, Dr. G. C. Simpson, and Mr. F. J. W. Whipple.

THE MINISTER OF HEALTH, with the concurrence of the University Grants Committee, has appointed a Committee "to investigate the needs of medical practitioners and other graduates for further education in medicine in London, and to submit proposals for a practicable scheme for meeting them." The members of the Committee are as follows:—The Earl of Athlone (chairman), Mr. H. J. Cardale, Sir Wilmot Herringham, Sir George Makins, Sir George Newman, Sir Robert Newman, Sir Edward Penton, Sir E. Cooper Perry, Mr. J. Dill Russell, and Dr. T. W. Shore. Mr. A. L. Hetherington will act as secretary of the Committee, and all communications should be addressed to him at the Ministry of Health, Whitehall, London, S.W.1.

AT a meeting of the award committee, consisting of the presidents of the principal representative British engineering institutions, held in London on Tuesday, January 25, the first triennial award of the Kelvin gold medal was made to Dr. W. C. Unwin, who was, in the opinion of the committee, after consideration of representations received from leading engineering bodies in all parts of the world, the most worthy to receive this recognition of pre-eminence in the branches of engineering with which Lord Kelvin's scientific work and researches were closely identified. The arrangements for the presentation of the medal will be announced shortly. The Kelvin gold medal was established in 1914 as part of a memorial to the late Lord Kelvin and in association with the window placed in Westminster Abbey in his memory by British and American engineers.

THE members of Mr. L. H. Dudley Buxton's expedition have now returned from a stay of some weeks in the Island of Malta. The object of the expedition was to collect material for a study of the physical anthropology of this island. About 1000 adults, men and women, were measured. The fine series of ancient bones which Prof. Zammit excavated in the Hypogæum at Hal-Saflieni and elsewhere was collected together and measured. A long series of skeletal remains from a modern ossuary was also examined. A special visit, lasting for two days, was paid to Gozo by Mrs. Jenkinson and Miss Moss to work at the physical anthropology of that island. The expedition has collected an immense mass of valuable material, which will take some time to arrange and digest. As soon as this work is sufficiently far advanced Mr. Buxton hopes to submit a preliminary account of the results of the expedition to the Royal Anthropological Institute.

AT an extraordinary general meeting of the Chemical Society held in May, 1919, for the purpose of dealing with various modifications of the by-laws, amongst which was the provision for the admission of women as fellows on the same terms as men, the council was authorised to apply to the Crown for a supplemental charter giving the power to make the necessary alterations in the by-laws. The petition for the supplemental charter received the assent of his Majesty the King, and all the additional powers sought by the society were thus secured. The new by-laws recommended by the council received the approval of the general body of fellows at an extraordinary general meeting held on April 29, 1920, and came into operation on June 1. At the ballot for the election of fellows held on December 2 last, of the ninety-seven who were elected fellows twenty-one were women, and amongst the candidates for whom a ballot will be held on February 17 appear the names of six women.

REFERENCE was made last week to correspondence in the *Times* on the effects of the discharge of oil from ships into the sea. Oil enters the sea in various ways, *e.g.* the "steaming-out" of the "tankers" and accidental leakages. The "benzene" oils must evaporate quickly, but the heavy fuel-oils may be more persistent. So far the evil is local, and there is no evidence of any widespread effect upon the larger fisheries. Sir Arthur Shipley suggests, on the authority of Prof. A. Meek, that 1916–17–18 were bad years for plaice fry, and that some factor was in operation during that period which was detrimental to fish-life. This factor may have been the discharge of oil from sunken ships. On the other hand, there is strong statistical evidence that plaice were more abundant in the North Sea during the years 1919–20 than during the years immediately before the war. This is also the case in the Irish Sea, 1910 being a maximum, 1918 a minimum, while 1920 and 1921 tend towards another maximum. Prof. H. E. Armstrong refers to the failure of the Loch Fyne herring fishery, and suggests that this was due to "floating defilement from the Clyde," but the herrings are now returning to Loch Fyne. The question is a very complex one, and investigation is obviously called for. In connection with the subject discussed, Lord Rayleigh refers in the *Times* of January 27 to experiments made by his father in 1889, which showed that a continuous film of oil on the surface of water need not be so much as a ten-millionth part of an inch in thickness. "On the basis of his figures it may be calculated that the ocean could be covered by 500,000 tons of oil—not beyond the carrying power of a fleet of very large ships."

SIR ROBERT HADFIELD contributed recently an article to the *Iron and Coal Trades Review* on "The World Hunger for Steel." It appears that in 1913 the exports of steel from the three chief steel-producing countries were as follows:—Germany, 5,500,000 tons; Great Britain, 5,000,000 tons; and the United States of America, 2,750,000 tons. Against this the estimates of the exports in 1920 were as follows:—Germany, 200,000 tons; Great Britain, 3,300,000 tons; and the United States, 4,300,000 tons. The statistics of production reinforce the lesson given by the export figures. In 1913 the world's production in pig-iron amounted to about 76,000,000 tons; last year it is estimated to have been not more than 56,000,000 tons. Taking these figures as well-founded, it will be recognised readily that the world is very short of supplies of iron and steel. Sir Robert Hadfield points out that this shortage is a very serious matter, and that the development of modern civilisation must be greatly hindered unless increasing supplies can be obtained. He estimates the shortage of steel at from 25,000,000 tons to 30,000,000 tons. He then goes on to consider the question of costs of production, and points out how vital is the price of fuel. Two months ago it is estimated that the cost of coal at the pit's mouth in this country was 34*s*. a ton, whilst in America it was about half that figure. In both countries it takes about $1\frac{3}{4}$ tons of coal to produce 1 ton of iron. There are, however, countries where coal is produced more cheaply than in America, and Sir Robert states that in South Africa, India, and China it is being raised and sold at very little more than 5*s*. a ton. In spite of these considerable differences of price, he holds the view that there is no reason why there should not be a greatly increased production in this country owing to the demand caused by the shortage of steel, which has been emphasised. Whether this will prove to be the case depends principally upon the extent of co-operation between employers and employed.

FROM the *Brooklyn Museum Quarterly* for April, 1920, we learn that the expedition sent by that museum to make collections in the coastal waters of Peru has been most successful. Mr. R. C. Murphy, who was in charge of the expedition, reports large collections of marine animals and plants and geological specimens. A series of kinematograph pictures of wild life on the coast and of the Peruvian guano industry was also obtained. Special attention was paid to the investigation of the conditions of marine life dependent on the Humboldt current.

IN the *Museums Journal* for January Mr. E. N. Fallaize formulates a scheme for the classification of the subject-matter of anthropology, in which human structure and activities rank before divisions of time and space. The reasons for the arrangement are discussed, and the actual scheme will follow in the February issue. The Headmaster of Winchester gives sound advice on lantern-slides of Renaissance art; Prof. Aldred Barker, of Leeds, reviews a guide to carpet-knotting and weaving; and Mr. R. L. Hobson, of the British Museum, writes on Pountney's "Old Bristol Potteries." A technical criticism of the Wallace Collection from the museum curator's point of view, and other reviews and notes, make up an interesting number. Dr. Bather, who has taken charge of the journal for ten months, now hands over the editorship to Mr. J. Bailey, who is retiring from the Victoria and Albert Museum.

WE have recently received the July number (vol. ii., No. 3) of the *Queensland Naturalist*, which, owing to the difficulties of the past few years, has been in abeyance since April, 1917. It is the organ of the Queensland Field Naturalists' Club, and is described in the foreword of the present number as the only journal of its kind published in a State which is, from a natural history viewpoint, probably the richest field in the whole of Australia. The editor refers to the success of the club in initiating or aiding efforts for the better protection of the fauna and flora of the Macpherson and Bunya ranges, and of particular birds and animals. Among the short articles included in this number is a description of a new fossil plant from Petrie's Quarry, near Brisbane, and a critical account, by Mr. C. T. White, of two native phalloid fungi, one of which is endemic in South-Eastern Queensland.

THE myriopods, or more correctly the Diplopoda, of the sub-family Pyrgodesminæ, are small creatures from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. long, with the back curiously covered with processes or tubercles, and bearing also bristles or papillæ. These latter gather the dirt, and often so encrust the body as to mask its form and merge its colour in that of the ground, so, though they cannot really be rare, from the Orient we have hitherto known representatives of only two genera, the Pyrgodesmus and Lophodesmus of Pocock (1892). Now in the Records of the Indian Museum (vol. xix., part 4) Dr. F. Silvestri describes five new genera based on species from Cochin, Ceylon, and New Guinea. His Latin descriptions are illustrated by excellent drawings, which, in the absence of an artist's name, we must assign to the author's own pen. Some of these show the body *humo indutum*, others *humo denudatum*.

IN spite of war difficulties, Dr. Annandale, in his Report on the Zoological Survey of India for the years 1917–20, has been able to record an amount of work important in itself and remarkable as conducted by a scientific staff of four persons only. The purely zoological inquiries happened to deal with various aspects of river- and lake-life. Thus the return to India of troops infected with Schistosoma and the fears that the infection might spread led to an extensive search for possible molluscan hosts; the results, fortunately negative, saved the expenditure of large sums of money on needless precautions. Some interesting points of wider application crop up in some of these investigations. The resemblance of the fauna in a muddy creek of the Ganges to that of the deep sea is assigned by Dr. Kemp to the common factors of a muddy bottom and low visibility. The discovery that the peculiar sculpture of the shell in certain Viviparidæ is connected with the persistence of structures present on the edge of the mantle in the embryos of smooth-shelled forms bears on the origin of the varied ornament in those molluscs. These and many other interesting results have suggested to Dr. Annandale the need for a survey of the macroscopic fauna of the lakes of Asia.

AT the request of Alderman F. C. Clayton, some members of the botanical department of Birmingham University visited the Birmingham Water Department's reservoirs at Shustoke, near Whitacre, on October 14 last. The water in the smaller of the two reservoirs (about 8 acres in extent) had been drained off at the end of July for cleaning purposes, leaving the bottom covered to a depth of 1½ ft. to 2½ ft. with a mixture of vegetation and mud. The small reservoir had not previously been cleaned, except at the sides, since its completion in 1883. The vegetation appeared to have consisted mainly of green algæ, together with a number of aquatic flowering plants and a marginal zone of *Fontinalis antipyretica*. The algæ were represented by a number of genera, *Cladophora fracta* being the dominant species. An allied species, probably a form of *C. crispata,* occurs regularly in the slow sand filter-beds at the neighbouring waterworks. During the cooler months this alga often covers the bottoms of the filter-beds with a matted felt of algal filaments, locally known as "blanket weed." So long as the alga remains on the bottom it appears to assist materially in the process of filtration. On the advent of hot weather the alga tends to rise, and has to be removed. Another feature of interest is the very rapid colonisation by plants of the drying, muddy bottom of the reservoir. Although only some two and a half months had elapsed since the lowering of the water-level, the surface of the mud was already occupied by an open association of plants which included algæ, together with patches of stunted land forms of aquatic flowering plants. In addition to the true aquatics, semi-aquatics, and even land plants, were spreading rapidly in a centrifugal direction over the surface.

ON Friday, January 28, a general meeting of the Association of Economic Biologists, presided over by Sir David Prain, was held in the Imperial College of Science. Mr. E. E. Green showed a large Gasteropod which has been introduced into Ceylon, and is now present in destructive numbers. Dr. Llewellyn Lloyd gave an account of his investigations on the greenhouse white-fly and measures for its control, and described interesting new details in the structure and life-history of the insect. The only successful treatment is hydrocyanic fumigation, this being carried out at intervals of fourteen days in summer and of twenty-five days during the winter months. Light is a very important factor; the temperature should be between 40°–60°, and the dosage ¼ oz. of sodium cyanide to every 1000 cubic ft. space. Atmospheric humidity is relatively unimportant, but if cyanide-burning of the foliage is to be eliminated the plants should have dry roots. An animated discussion took place, in which Mr. Green, Prof. V. H. Blackman, Dr. Imms, Dr. Hargreaves, Mr. Dykes, and Mr. Emptage participated. Mr. Brierley then gave a paper on "Personal Impressions of some American Biologists and their Problems." Mr. Brierley was one of the three foreign representatives invited to the American Phytopathological Congress in 1920, and afterwards visited the principal scientific institutions and many regions of botanical or agricultural interest.

THE system of colour notation introduced by Munsell in 1905 has been found of such practical value by the manufacturers of colours and of coloured goods in America that the U.S. Bureau of Standards has undertaken an examination of the system with a view to its improvement. An account of the work done by Messrs. Priest, Gibson, and McNicolas forms Technologic Paper No. 167 of the Bureau. Colours are specified by their hue, their purity or chroma, and their brightness, luminosity, or "value," and the Munsell atlas contains coloured cards of six different hues—grey, red, yellow, green, blue, and purple—each in different degrees of purity and luminosity. These cards have been examined by means of the spectrophotometer, and curves which show the amount of light reflected of each wave-length are given. From these it appears that the Munsell "values" are proportional to the square roots of the amounts of sunlight reflected, and the authors suggest that in future editions of the atlas the numbers indicating the luminosities should be proportional to the logarithms of the reflections. In order to secure this and other suggested improvements, the Optical Society of America and the Bureau are now consulting those interested in colours.

ONE of the largest steel-frame buildings which have been constructed by welding methods in Great Britain is illustrated in *Engineering* for January 14. This building constitutes the new workshops of Messrs. the Double Arc Electric Welders, Ltd., and is situated in Glasgow. The steelwork throughout was welded by the company on its system. The name of this firm is derived from the special flux with which it coats its welding electrodes. The flux is conducting, and it is claimed that an independent arc is formed between the flux and the work, as well as the arc between the electrode and the work; this gives the double arc. The building is 27 ft. wide and 50 ft. long; there are five roof principals carried on columns having welded-on bases. The roof principals are built of angles and channels, both of which members are welded to the webs of the columns. The secondary members of the trusses, together with purlins, etc., are all welded at the points of attachment. Even the steel door-frames are welded. Electric welding would appear to offer many points of advantage in the field of construction, and is obtaining a sound footing.

THE latest catalogue (No. 409) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, consists of particulars of nearly a thousand books, maps, engravings, and drawings relating to North America (United States and Canada). Many items will be of interest to readers of NATURE, *e.g.* a number of works on the Indian tribes of North America, Audubon's "The Birds of America," the very rare book by T. Morton entitled "New England Canaan, or New Canaan," and the silver ticket of Benjamin Franklin's membership of the Royal Society of Edinburgh. The catalogue will be sent free of charge by the publisher.

IN the Fauna of British India Series the further volumes which the editor, Sir Arthur E. Shipley, with the assistance of Dr. Guy A. K. Marshall and the sanction of the Secretary of State for India, has arranged for are: Butterflies (Lycænidæ and Hesperiidæ), Mr. N. D. Riley; The Ixodidæ and Argasidæ, Prof. G. H. F. Nuttall and Mr. C. Warburton; Leeches, Mr. W. A. Harding; The Diptera Brachycera, Mr. E. Brunetti; The Operculata, Mr. G. K. Gude; The Curculionidæ, Dr. G. A. K. Marshall; The Carabidæ, Mr. H. E. Andrewes; The Meloidæ, Mr. K. G. Blair; The Erotylidæ and Endomychidæ, Mr. G. J. Arrow; The Culicidæ, Capt. P. J. Barraud, Major S. R. Christophers, and Mr. F. W. Edwards; The Chrysomelidæ, Mr. S. Maulik; The Oligochætæ, Lt.-Col. J. Stephenson; The Scolytidæ and Platypodidæ, Lt.-Col. Winn Sampson, together with a revised edition of Mammalia by Mr. Martin A. C. Hinton and Mr. R. C. Wroughton, and of Birds (4 vols.) by Mr. E. C. Stuart Baker.

THE list of new books and new editions added to Lewis's Medical and Scientific Circulating Library during October to December, 1920, has reached us from Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. Although intended primarily for subscribers to the library, it should be of great service to all who wish to keep in touch with medical and scientific literature, being practically a complete catalogue of important books in English on medicine and science issued during the period named. It is carefully classified according to subjects, and will be sent gratis upon application.

MESSRS. L. OERTLING, LTD., Turnmill Street, London, E.C.1, ask us to announce that they are recommencing their service of attendance to balances in customers' own laboratories throughout the United Kingdom. This service was discontinued during the war owing to the extreme pressure of work in the firm's manufacturing departments and to the lack of mechanics possessing the necessary technical ability.

Our Astronomical Column.

PLANETS NOW VISIBLE.—In the second week of February all the bright planets will be visible to the naked eye. Venus, Mars, and Mercury will be in the western sky, while Jupiter and Saturn will appear in the eastern.

Mercury will be at greatest elongation on February 15, when it sets about 1¾ hours after the sun. Venus will set on February 13 at 9.40 p.m., and Mars at 8.32 p.m. On February 9 the crescent of the new moon will be in conjunction with Mercury, and with Mars on February 11. Venus will be a very conspicuous object, but Mars will appear unduly faint, owing to its great distance from the earth.

Jupiter rises on February 14 at 7.33 p.m. and on February 28 at 5.52 p.m., while Saturn rises about 40 minutes later. These objects are situated in the southern part of Leo, and will be in the same region as the moon on February 23.

THE DIAMETERS OF STARS.—*Popular Astronomy* for January states that the observations of the diameter of Betelgeux were made on December 13 by Mr. F. G. Pease and Dr. J. A. Anderson, the method being due to Prof. A. A. Michelson. The measured diameter is given as 0·047″.

Prof. H. N. Russell, before the result was known, published the following estimates of the angular diameters of the brighter red stars:—Betelgeux, 0·031″; Antares, 0·028″; Aldebaran, 0·024″; Arcturus, 0·019″; β Crucis, 0·026″; and β Gruis, 0·020″. All these are within the range of possible measurement. The angular diameters of the stars of types A, B, and F are very much smaller (Sirius being 0·007″), and there is little prospect of success with them.

It is of interest to note that the parallax of Arcturus has recently been redetermined at Yerkes Observatory by Messrs. O. J. Lee and G. van Biesbroeck (*Pop. Astr.*, January). The result, 0·095″±0·006″, is larger than previous values. Russell's angular diameter would imply a linear diameter of one-fifth astronomical unit, or twenty-two times that of the sun. The thwart velocity would be 24 astronomical units per annum, or 70 miles/sec.

MINOR PLANETS.—The remarkable body HZ was observed at Algiers, January 12·3, in R.A. 0h. 17·5m., N. decl. 26° 52′, mag. 13·8. The planet has now been under observation for 2½ months, and the orbit already published in this column, with perihelion near Mars and aphelion near Saturn, is fully confirmed. Such an orbit is obviously of a cometary character, yet careful scrutiny has failed to show any sign of nebulosity.

Nine hundred and thirty-three minor planets have now received permanent numbers. The difficulty of keeping such a large number under regular observation is considerable, so it is satisfactory to note that tables giving the approximate perturbations by Jupiter of about 100 planets have lately been published in *Astr. Nachr.*, which should be of great assistance in preparing accurate ephemerides. One planet in particular, 170 Maria, has been studied in great detail by K. Boda (*Astr. Nachr.*, 5080). This belongs to the Hestia type (period about ⅓ of Jupiter's), and has small eccentricity, but considerable inclination. The tables are compared with observations from 1877 to 1916. The largest residuals (Obs.—Tab.) are + 58″ in 1889 and −50″ in 1904. Greater accuracy could not be attained without very elaborate tables.

The chief centres of minor planet observation during the past year have been Algiers (MM. Gonnessiat and Jekhowsky), Barcelona (Prof. Comas Sola), Heidelberg (Dr. Max Wolf), and Hamburg. Marseilles observatory has assisted by circulating observations and ephemerides.

The London School of Tropical Medicine.

THE London School of Tropical Medicine, which in its new domicile in the Hospital for Tropical Diseases in Endsleigh Gardens, Euston Road, London, recently, under Royal auspices, commemorated its nativity, came into being twenty-one years ago.

The idea of a school emanated from Sir Patrick Manson, who at the time was Medical Adviser to the Colonial Office; it was at once grasped by his far-seeing official chief, the late Right Hon. Joseph Chamberlain; and it was aptly embodied forthwith in the benign fabric of the Seamen's Hospital Society, the solicitude of which for the brotherhood of the sea includes all the tropics in its range.

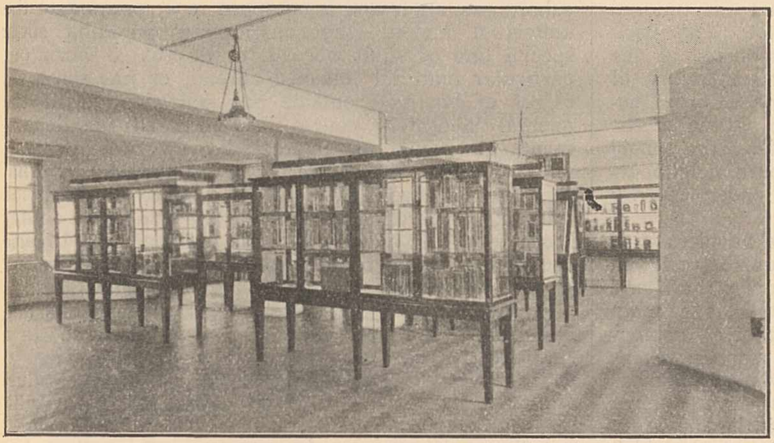


FIG. 1.—The museum, London School of Tropical Medicine.

Not only did the society accept the idea, it also magnanimously advanced the funds needed for its realisation, and in October, 1899, the young school was actually established, under the ægis of Sir Patrick Manson, as an adjunct to the society's branch hospital at the Albert Dock.

The school was, above all, designed to give practical training in the fundamental laboratory methods of investigating disease while keeping the laboratory in touch with the wards of the hospital, and collating the lessons of laboratory and clinic in set lectures by specialists versed in the medical and sanitary problems of the tropics, the ultimate object being not merely to teach a class how the prevalent diseases of tropical countries are recognised and treated, but also to train the individual man for the experimental investigation of disease in the course of his own career and field of opportunity abroad. It was, moreover, recognised as a vital necessity that members of the teaching staff should go afield from time to time in order to keep in touch with tropical diseases in their endemic areas.

In the early days of the school the main laboratory course was, perforce, conducted by a single whole-time teacher; but as—thanks to the powerful advocacy of Mr. Joseph Chamberlain—the financial position improved, additional whole-time teachers were appointed, a helminthologist and a protozoologist in 1905 and a medical entomologist in 1907, and so gradually the laboratory teaching became both fuller and more intensive.

Thus prior to the war the school in its sequestered situation at the docks had assumed its present stature, if not its present finish. It had been affiliated to London University; the practical worth of its curriculum was held in world-wide regard by the medical profession; its bead-roll included the names of nearly two thousand students drawn from every medical vocation and medical service in the tropical Dominions, as well as from many foreign countries; it had undertaken fifteen oversea expeditions for the study of specific pathological problems; and it was steadily countenanced by annual grants from official sources. That at this stage the school had also acquired public esteem outside official and professional circles may be inferred from the benefactions for the advancement of knowledge that were entrusted to its administration. In 1909 a scholarship of the annual value of 50*l*. was founded by Lord and Lady Sheffield; in 1912 a munificent bequest of 10,000*l*. by Lord Wandsworth was allotted by Sir William Bennett for the institution of a scholarship; and in the same year a sum of 70,000*l*. was collected for general purposes by Mr. Austen Chamberlain as a filial tribute to the memory of the founder.

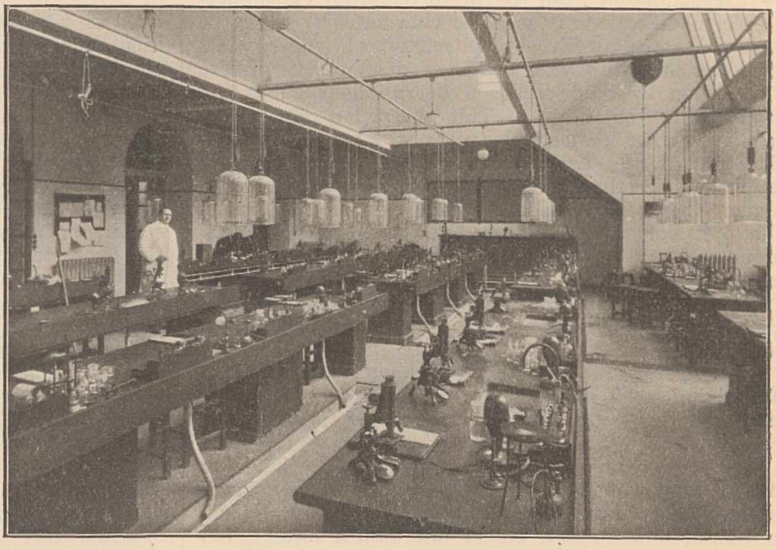


FIG. 2.—A portion of the class laboratory, London School of Tropical Medicine.

The war, which revealed so clearly to this island its dumb dependence on the unconquerable soul of the merchant seaman, brought at its close to the Seamen's Hospital Society a practical expression of gratitude and admiration so full as to reflect some of its splendour on the society's Tropical School. As a tribute to the dauntless spirit maintained during the war by the merchant seaman, the British Red Cross Society and the Society of St. John together gave to the Seamen's Hospital Society the sum of 100,000*l.* for the purchase of the large building in Endsleigh Gardens which had been used in war-time as an officers' hospital, and for its endowment as a hospital in the first instance for sailors and soldiers who had contracted tropical diseases on service, and ultimately for the sailors in perpetuity. Room in this new Hospital for Tropical Diseases being available, the society decided that the kindred school should be included in the project. This decision was applauded by the school's sponsors at the Colonial Office, and by the stimulating influence of Lord Milner it attracted the necessary financial co-operation of a liberal and appreciative section of the public. Early in the year 1920, therefore, the school was translated from the remote, uncouth neighbourhood of the docks to an accessible London quarter strong in academic associations.

Re-established under such favourable auspices in a central position, the school now prosecutes its original design in all its fullness with an ampler staff and equipment. The well-avouched scheme of a main laboratory course, supplemented by clinical demonstrations and a system of lectures, is unchanged, as it both meets the wants of the man who already has some knowledge of tropical conditions and inspires the man to whom tropical responsibilities are prospective. The clinical instruction, moreover, which appeals so strongly to the practitioner coming home for a season for professional rejuvenation, is improved by the institution of a special clinical laboratory attached directly to the hospital and administered by its staff.

It is, however, to the advanced student—to the inquirer whose interests are not entirely engrossed in medical practice and who appreciates the unlimited opportunities for research that the tropics afford—that the recent developments of the school are more particularly adapted. The departments of protozoology, medical entomology, and helminthology have been reconstituted as distinct units, leaving the original nucleus of tropical pathology as a fourth independent unit. Each unit has its own director, assistant, and subordinate staff, and is equipped to accommodate the individual student who contemplates pursuing some special line of study abroad, or desires to work out particular material collected abroad, or has some set object of his own outside any participation in the general laboratory course in which all the departments co-operate as before. By this arrangement, which also permits a director or an assistant alternatively to go abroad without disturbance of the home routine, research in tropical medicine is doubly seconded. The advanced or special student will also benefit by the proximity of the Tropical Diseases Bureau, which is now housed with the school, and is about to permit a considerable part of its books and serials to be incorporated, as a permanent loan, in a common library.

The changes thus briefly outlined, however, illustrate that inexorable concatenation of pain with pleasure which supplied one of the texts of Socrates' valedictory discourse; for much as the school has gained by its removal, it has lost—for the present, whatever recompense may lie in the womb of Time—the mess and all the concurrent social amenities which graced its old home in the wilderness.

New Experiments on the Inheritance of Somatogenic Modifications.

By PROF. ARTHUR DENDY, F.R.S.

IT has long been suspected that the problem of the transmission from parent to offspring of somatogenic modifications ("acquired characters") might be solved more readily by physiological experiments directly involving the complex metabolism of the body than by crude surgical operations such as the amputation of limbs. This suspicion has been justified in a remarkable manner by the work of Messrs. M. F. Guyer and E. A. Smith, recently published in the *Journal of Experimental Zoology* under the general title "Studies on Cytolysins."[1] The physiologists, through their brilliant investigations of serum reactions, have placed a whole armoury of new weapons in the hands of the zoologist, and have even furnished him with a chemical means of determining the degree of relationship, and consequently the correct systematic position, of different "species" of animals. We now have to thank them for giving us a new means of approach to what is perhaps the most difficult problem in biological science.

It has been known for some time that the injection of foreign proteids into the blood of a vertebrate animal calls forth a most profound physiological response, and Messrs. Guyer and Smith have taken full advantage of this knowledge in devising their experiments. Bordet showed a quarter of a century ago that when the red corpuscles of the rabbit are repeatedly injected into the blood of the guinea-pig the latter acquires the power of destroying them, and serum prepared from these "sensitised" guinea-pigs will rapidly dissolve the red corpuscles of the rabbit *in vitro,* while the serum of untreated guinea-pigs has little or no effect. This experiment formed the commencement of our knowledge of a whole class of substances known as "cytolysins," which appear in the blood as the appropriate "antibodies" in response to the injection of such substances as red corpuscles, leucocytes, nervous tissue, spermatozoa, and crystalline lens, all of which, "when injected into the blood of an unrelated species, will form lytic substances more or less specific for the antigen used in the sensitising process," the antigens being presumably the characteristic proteids of the substances injected.

The "antibody" or "antitoxin" may be produced in large excess of the amount actually required to destroy the injected foreign proteid, and a highly sensitised serum may thus be obtained. It was with such a serum, sensitised to the crystalline lens of the rabbit, that Messrs. Guyer and Smith conducted their experiments. The serum was prepared by grinding up rabbits' lenses with normal salt solution and injecting the fluid into fowls. A "lens-sensitised" serum was thus obtained, *i.e.* a serum which would dissolve the lens-substance of the rabbit.

When this lens-sensitised serum is injected into the veins of a pregnant rabbit the young exhibit a tendency to develop defective eyes—especially as regards the lens, which may be more or less opaque or liquefied. The eyes of the parent are not affected, possibly because in the adult eye the blood-supply to the lens is so meagre that the sensitised serum cannot reach it, or the adult lens may be too tough to be affected by minute quantities of the lysin. The lens of the developing embryo, however, is a very

[1] "Some Prenatal Effects of Lens Antibodies" (*Journ. Exp. Zool.*, vol. xxvi., May, 1918); "Transmission of Induced Eye Defects" (*op. cit.*, vol. xxxi., August, 1920).

delicate structure with an abundant blood-supply, and no doubt the lysin reaches it through the maternal and fœtal circulation.

So far, of course, there is no question of any transmission of somatogenic modifications, or "inheritance of acquired characters." The authors have shown, however, that when the young rabbits with defective eyes in their turn produce offspring the defect is inherited. Moreover, it does not gradually diminish and finally disappear in succeeding generations, like the curious somatogenic modification of the shell investigated by Agar in Simocephalus, but actually tends to increase from generation to generation, until the whole eye may almost disappear. The transmission has now been observed through six generations, and—what is still more important as showing that we are dealing with a true case of the "inheritance of acquired characters"—the defect may be transmitted through the male parent only, thus precluding the possibility that it may be due to the action of the maternal blood upon the offspring *in utero*.

How the germ-cells are affected by the lens lysin is, of course, entirely unknown, and Messrs. Guyer and Smith are commendably cautious with regard to theoretical considerations. It would seem, however, that we have here as clear-cut a case of the inheritance of somatogenic characters as we are ever likely to obtain, and one which may be expected to throw much light on the problem of heredity in general.

The Planet Mars.

MR. G. H. HAMILTON (Lowell Observatory Bulletin, No. 82) gives a detailed account, with many drawings, of his observations of the planet Mars at Flagstaff during the apparition of 1918. His observations closely corroborate those of Lowell. He notes that the dark band round the polar cap appears only when the cap is melting; when it is forming, its edges are indistinct. This difference is opposed to the merely optical character of the dark band upheld by some authorities. He also saw a large lake travelling away from the polar cap until it joined the Lucus Hyperboreas. It behaved like surface-water resulting from the melting cap. Mr. Hamilton also claims to have seen the same seasonal development of the canals, proceeding equatorwards, that Lowell described. He notes that the seeing depends on the Martian atmosphere as well as on our own; the details were sometimes blurred and dim, with excellent local seeing.

Conferenze e Prolusioni for December last contains a lecture on Mars by Prof. Pio L. Emanuelli, of the Vatican Observatory. Prof. Emanuelli denies the existence of the geometrical canals, pinning his faith to the results of the largest telescopes. He quotes an interesting observation by Prof. Hale made with the 60-in. reflector at Mount Wilson in 1909. The seeing was very good, permitting the use of a power of 800; the structure of the surface appeared exceedingly complex, far more so than could be shown in a sketch; the dark areas were covered with fine details, not, however, arranged in geometrical patterns. The two canals from the Sinus Sabæus were seen as broad stripes, resolved into minute detail like interrupted and twisted filaments. Prof. Emanuelli quotes similar results from the Yerkes Observatory, and those made in 1909 by M. Antoniadi with the 30-in. refractor at Meudon. He makes, however, no allusion to the necessity of prolonged observation, at various seasons of the Martian year, required to gain an insight into the nature of the processes going on on the planet's surface.

The Journal of the Astronomical Society of India (vol. x., Nos. 7, 8, and 9) contains an article on Mars by Dr. D. N. Mallik, who confines himself, however, to the single question of the Martian origin of the stray wireless signals, concerning which there was considerable discussion in the daily Press last year. Dr. Mallik has no difficulty in establishing the utter improbability of such an origin, though he inclines to the view that animal and vegetable evolution on the two planets would proceed on similar lines, so that if higher forms of life are present on Mars they would be comparable with those on the earth. He is less convincing on the subject of the hopelessness of arranging mutually intelligible signals, assuming the simultaneous desire to communicate and the conquest of the mechanical difficulties. There is little doubt that under these conditions the united intelligence of the two planets would at least make some progress in communication. The problem recalls the decipherment of cuneiform, being easier in some respects and more difficult in others.

A. C. D. C.

Land Reclamation.

ATTEMPTS are being made to reclaim some of the many waste acres in the British Isles, and the problems of reclamation are fully discussed in the 1919 volume of the Journal of the Royal Agricultural Society of England. The general problem is dealt with by Mr. W. Gavin. There is no definite information available as to the extent of either the total uncultivated land or the uncultivated land likely to be capable of cultivation in this country, but Sir Daniel Hall in his report to the Reconstruction Committee tentatively suggested 250,000 acres as the probable area reclaimable for agricultural purposes. Land reclamation has been going on more or less continuously since the beginning of agriculture, and in a closely settled country like England the greater part of the land showing prospects of immediate profitable cultivation has been reclaimed. Therefore, to reclaim the remaining waste land generally requires an expenditure in excess of the immediate value of the land when reclaimed. In some few districts there is land which would pay to reclaim, and in many cases private owners could do the work more cheaply than could the State. On the other hand, such reclamation adds to the national wealth more than the actual value of the land, so that the State can afford to spend more than a private owner. Further, in times of industrial depression it may be of social advantage to the State to provide employment by starting some reclamation schemes.

At a time such as this, when maximum home production is of vital importance to the well-being of the country, Mr. Gavin appeals to all landowners and occupiers to endeavour by some means to increase their cultivated-land area, even though it may not yield immediate profits. It must be remembered that some years must elapse before the full value of any reclamation scheme becomes apparent, though in any case the labour expended is never in vain, since the reclaimed land is sheer gain to the cultivated area, and means an increase not only in production, but also in national wealth by the commercial exchange promoted and the new addition of rates and taxes.

The scientific and technical problems of land reclamation are dealt with by Dr. E. J. Russell, who discusses especially the reclamation of sandy and clay soils. In devising reclamation schemes for a given area the first essential is to find the defects of the soil and then to decide on some means of remedying them. This cannot be done simply by analysis; field trials must be made, though analysis affords considerable aid by indicating the points on which the field tests should give information. Of the two methods possible the safer, but also the slower, is to set up on a typical part of the land to be reclaimed a series of trials based on the analytical data. The other method, which is quicker and almost as safe, is to compare in detail the waste land and the cultivated soil immediately surrounding it. In this way any important defects would be revealed and remedies could be considered.

For farming reclaimed sandy lands three methods are in general use: the winter feeding of sheep, market-gardening, and the growing of special crops. The last-named is practised at Methwold, where the reclamation scheme has been very successful. The crops grown are specially suited to the conditions, and an intelligent use of artificial fertilisers is required so as to reduce to a minimum the possibility of loss.

With regard to clay soils, reclamation can generally be effected either by conversion into arable land or by utilisation as grass land. In the arable land scheme lime is absolutely indispensable, while other manures, especially basic slag, are also necessary. If the land is to be used as grass land, there must be adequate drainage and heavy dressings of basic slag. If, however, the percentage of clay rises above certain limits—37 per cent. for a 30-in. rainfall and 35 per cent. for a 40-in. rainfall—then the grass scheme does not pay, for not only does drainage become too expensive, but also the grass suffers in dry weather by the shrinking and cracking of the soil. Such land, if allowed to run wild in England, is soon covered with a dense growth of bushes, and to reclaim this it is necessary first to clear the land and stub the roots, and then to improve the soil. These are expensive processes, and, although such schemes have been worked in some cases, it is improbable that any individual would undertake them at the present day. The only thing, therefore, is to hope that proper afforestation methods will be used.

University and Educational Intelligence.

CAMBRIDGE.—Dr. W. L. H. Duckworth, Jesus College, has been appointed to the newly created readership in anatomy, and Mr. V. C. Pennell, Pembroke College, as an additional junior demonstrator in anatomy.

New statutes have been framed for the establishment of the degrees of M.Litt. and M.Sc. for research students of the University. These will not be operative when approved until the change in the statutes can be effected, but they should be in operation in the coming academical year.

In connection with the growth of the department of biochemistry, it is proposed that two additional University lecturers and one additional demonstrator in biochemistry should be appointed.

Two fly-sheets have been circulated to resident members of the Senate in opposition to the scheme for a separate women's university at Cambridge—a scheme which is to be voted on next week. One comes, naturally, from the supporters of scheme A, which was defeated last term. The alternative offered by the other members of the Syndicate obviously has no more attractions now than formerly to those who wish to offer women full membership of the University. The second fly-sheet comes from the party which claims a desire to redress any real grievance under which women students suffer without giving them any hand in the control of men's education. The signatories of this report include three of the original signatories of report B, who now definitely oppose their own proposal. They urge the appointment of a new Syndicate to draft a statute giving women titular degrees with no voting power in the University, and reserving rights to the University over the number of women students whom it will undertake to teach. Other privileges, but no powers, are to be granted to the women, and machinery is to be provided by which women teachers could confer with the Boards of Studies in the University. It is something that the centre party on this question, with whom lies the ultimate decision between the two extreme wings, should have got so far forward as to admit the justice of the women's claims to degrees. The nature of the reception of their proposal by the women's colleges will be awaited with some interest, but it may be anticipated that at most it will amount to lukewarm acceptance, and that it will satisfy neither the women's desires nor demands.

The Lees Knowles lectures will be given by Major-Gen. Sir F. H. Sykes on "Aviation Before, During, and After the War."

LONDON.—H.R.H. the Prince of Wales has consented to accept the honorary degrees of Master of Commerce and Doctor of Science, which will be conferred on him on Presentation Day in May of this year. On only one occasion in the history of the University have honorary degrees been conferred—in 1903, when their Majesties the King and Queen (then Prince and Princess of Wales) received respectively the Doctorate of Laws and the Doctorate of Music. On the same day degrees were also conferred on Lords Kelvin and Lister, both of whom have since died. The Prince will thus be only the fifth honorary graduate of the University—the third on the roll of living persons on whom such degrees have been conferred.

SIR FREDERICK BLACK will distribute prizes and certificates at the Sir John Cass Technical Institute, Aldgate, on Thursday, February 10, and will unveil the memorial window erected by the governors of the institute to the memory of members of the staff and students who fell in the war. He will also give an address on "Liquid Fuel in Peace and War."

ON Tuesday next, February 8, at 8 p.m., Mr. F. H. Carr will open a discussion on "Post-Graduate Training in Industrial Chemistry" at a meeting of the Old Students' Association of the Royal College of Science, London, to be held in the Imperial College Union, Prince Consort Road, South Kensington. Non-members of the association interested in the subject are invited to be present. The annual dinner of the association, which had been arranged for February 8, has been postponed to Tuesday, March 8, when the annual general meeting will be held.

THE eighteenth annual dinner of "Old Centralians" (the Old Students' Association of the City and Guilds (Engineering) College of the Imperial College of Science, London) will be held at 7 p.m. on Friday, February 11, at the Hotel Cecil, London, and it is hoped that every past student of the college will make an attempt to be present. Invitations have been accepted by Sir A. Keogh, Prof. H. E. Armstrong, Sir Richard Gregory, the professors of the City and Guilds (Engineering) College, and others. Tickets (price 15s. each) may be obtained from Mr. G. W. Tripp, Lyndhurst, Hayes Road, Bromley, Kent.

THE Military Education Committee of the University of London has arranged a course of six lectures on the scientific aspects of warfare, to be delivered on Mondays, commencing February 14, at 5.30 p.m., in the Theatre of King's College, Strand. The subjects of the lectures will be:—Chemical Warfare, Prof. A. J. Allmand; Transportation Services, Lt.-Col. F. R. M. de Paula: Wireless Telegraphy and Telephony, Mr. Philip R. Coursey; Military Railways, Lt.-Col. V. M. Barrington-Ward; Sound Ranging, Prof. E. N. da C. Andrade; and Intercommunication during the War, Major R. E. Priestley. Admission to the lectures is free, without ticket.

A COPY of the first annual report of the library committee of the British Red Cross Society and Order of St. John Hospital Library has been received. The library is the outcome of a petition for the reorganisation of the War Library of the British Red Cross Society, and it has now a record of more than a year's splendid work behind it. The men of the Army and Navy who are still suffering from the effects of the war have the first claim on the library, after which civilian hospitals are supplied so far as possible. During the past year 33 British military hospitals oversea have received consignments of books from the library, while as many as 488 civilian institutions have been supplied. An interesting feature is the growing demand for special books by individual patients, and it is in this direction that readers of NATURE may be of assistance. No request is made for funds, for it is estimated that the grant made by the British Red Cross Society will pay the working expenses of the library, but an urgent appeal is addressed to all who have books and magazines to spare. Gifts of books and papers should be sent to the British Red Cross Society and Order of St. John Hospital Library, 48 Queen's Gardens, London, W.2.

THE Vice-Chancellor of the University of London, Dr. Russell Wells, visited the Horticultural College, Swanley, on January 27 and addressed the students. The occasion was a memorable one, for the college is now recognised by the University for preparation for the new degree of B.Sc. in horticulture. The Vice-Chancellor was greeted by Sir John Cockburn, acting chairman for the board of governors, and the principal, Miss F. M. G. Micklethwait, members of the board of governors, and other distinguished guests, including Dr. Goodchild (of the University of London), Mr. Dallinger (representing the Ministry of Agriculture), Dame Meriel Talbot, Mr. Salter Davies (Director of Education, Kent Education Committee), and Mr. Dykes (secretary of the Royal Horticultural Society), were also present. The Vice-Chancellor in his address said that he was one of those who had had a great deal to do behind the scenes with the founding of the new B.Sc. in horticulture, which had been proposed by Sir Albert Rollit. One of the difficulties had been to convince some of the members of the Senate that gardening was worthy of academic distinction. Practical experience proved, however, that the "rule of thumb" gardener could not progress far without expert advice, and he hoped in the future such advice would be provided by Swanley College.

Calendar of Scientific Pioneers.

February 3, 1862. Jean Baptiste Biot died.—Biot worked assiduously all his life at physics and made valuable contributions on the polarisation of light. His famous balloon ascent with Gay-Lussac, his geodetical work with Arago, his biographical writings, and his activity as a member of the French Institute all made his name widely known.

February 3, 1890. Christoforus Henricus Diedericus Buys-Ballot died.—Director of the Meteorological Institute and professor of experimental physics at Utrecht, Buys-Ballot was an initiator of weather reports and international meteorology.

February 3, 1894. Edmond Frémy died.—The author with Pelouze of a large treatise on chemistry, Frémy was an investigator and teacher of industrial chemistry, and in his later years succeeded in making artificial rubies.

February 4, 1615. Giovanni Battista della Porta died.—The compiler of "Magia Naturalis," a volume of physical experiments, and the inventor of the camera obscura, Porta rendered many services to the science of his day.

February 5, 1907. Nikola Alexandrovitch Menschutkin died.—A contemporary and fellow professor of Mendeléeff at Petersburg, Menschutkin added to the knowledge of chemical structure and was a pioneer in the study of chemical dynamics.

February 6, 1804. Joseph Priestley died.—Five years younger than Black and two years younger than Cavendish, Priestley—the father of pneumatic chemistry—was born near Leeds in 1733, and was trained for the Nonconformist ministry. Attracted to the study of chemistry and electricity, he discovered several gases. His discovery of oxygen or "dephlogisticated air" was made in 1774, when he was librarian to Lord Shelburne. In spite of his own discoveries, Priestley clung to the phlogistic theory, leading Cuvier to describe him as "le père de la chimie moderne qui ne voulait pas reconnaître sa fille." From 1780 to 1791 he was a Unitarian minister at Birmingham. A lover of freedom and known for his sympathy with the French Revolution, on the second anniversary of the fall of the Bastille, July 14, 1791, a mob set fire to his house. His library, apparatus, note-books, and register of experiments were all destroyed. Priestley himself fled to Heath Forge, near Dudley, and thence by Kidderminster and Worcester to London. Three years later he sailed for America, passing the last ten years of his life at Northumberland, Pennsylvania.

February 7, 1903. James Glaisher died.—Head of the magnetical and meteorological department at Greenwich Observatory, Glaisher made many balloon ascents for scientific purposes.

February 9, 1811. Nevil Maskelyne died.—Like Lalande and Messier, Maskelyne was attracted to astronomy by the solar eclipse of July 25, 1748. He became Astronomer-Royal in 1765, founded the Nautical Almanac, and made improvements in methods of observing.

February 9, 1865. James Melville Gilliss died.—Trained for the United States Navy, Gilliss published the first American volume of astronomical observations and prepared the first American star catalogue. In 1861 he succeeded Maury as director of the Naval Observatory at Washington.

February 9, 1883. Henry John Stephen Smith died.—Savilian professor of geometry at Oxford, Smith did important work in elliptic functions, theory of numbers, and modern geometry. He has been called the greatest disciple of Gauss.

E. C. S.

Societies and Academies.

LONDON.

Geological Society, January 19.—Mr. R. D. Oldham, president, in the chair.—Dr. L. J. **Wills** and B. **Smith**: The Lower Palæozoic rocks of the Llangollen district, with especial reference to the tectonics. The general sequence of rocks and details of their components in various localities are given. The Lower Palæozoic rocks are, in the main, folded on approximately east-and-west axes, to which the cleavage and some of the major faults are closely parallel in direction. The folding and part of the faulting are Devonian, and appear to have set up torsional stresses affecting a greater area than that considered here. The concertina-folding in the synclinoria appears to be related to the tough anticlinal nodes of the northern Ordovician outcrops. The master-faults separate blocks of country which appear to have been displaced laterally in post-Carboniferous times. The minor faults appear to be adjustments that allow the strata to comply with torsional stresses.

PARIS.

Academy of Sciences, January 3.—M. G. Lemoine in the chair.—E. **Picard**: Certain functions connected with closed surfaces.—P. **Termier** and L. **Joleaud**: The age of transport phenomena in the region of Avignon.—L. **Fabry**: The use of geocentric latitudes for facilitating the identification of the minor planets. Two minor planets were notified in Circular 138 of the Marseilles Observatory which appeared to be new. The author has applied the method of geocentric latitudes to the photographic observations, and shows that one of these is identical with Mnemosyne (57).—R. **de Forcrand**: The melting point of heptane and the law of alternation of melting points. Hexane gave a melting point of $-93 \cdot 5^\circ$ C., as against -95° C. found by Guttmann, and octane $-57 \cdot 4^\circ$ C. (Guttmann $-98 \cdot 2^\circ$ C.). It has been shown that the melting points of many series of carbon compounds show an irregular-toothed curve, such that in passing from a compound with an even number of carbon atoms to the next higher homologue with an odd number the melting point fell. The data for the C_1 to C_8 paraffin hydrocarbons appeared to give an exceptional curve, but with the substitution of $-57 \cdot 4^\circ$ C. for the $-98 \cdot 2^\circ$ C. of Guttmann the curve becomes normal, and would indicate -94° C. as the melting point of heptane. Pure heptane was prepared and found to have a melting point of $-94 \cdot 75^\circ$ C.—H. **Parenty**: The reconstitution of certain invisible details of old pictures. With reference to a recent paper by A. Chéron on the use of radiography for the recognition of ancient pictures, the author recalls a paper published in 1913 in which photography was used for the same purpose, and mentions two cases in which his conclusions based on ordinary photographs have been confirmed.—P. **Vuillemin**: The aberrations of floral symmetry.—M. **Angelesco**: Certain completely integrable linear differential equations.—A. **Petot**: Shocks in the change-gears of motor-cars.—M. **Dumanois**: The determination of a criterion of general fatigue in internal-combustion motors. A discussion of a formula for the factor of safety in the construction of internal-combustion motors, with special reference to Diesel engines.—H. **Corblin**: A compressor with a membrane. The gas compressor described and illustrated has, in effect, a liquid piston, with an elastic metallic membrane separating the liquid and the gas being compressed. The compression is nearly isothermal, and air can be carried from atmospheric pressure to 100 kg. per sq. cm. at one step.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the third quarter of 1920. Observations were made on eighty-eight days during the quarter and the results are shown in three tables, giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—L. A. **Herdt** and R. B. **Owens**: The direction of ships at the entrance of ports and channels by a submerged electric cable. An account of experiments carried out in Canada in 1904, and suggestions for the development of the method.—M. **Liénard**: Scalar and vector potentials due to the motion of electric charges. A formula recently developed by Anderson (*Phil. Mag.*, August, 1920) is not in agreement with one given by the author in 1898. A mathematical investigation of the cause of the discrepancy is given.—G. **Ferrié**, R. **Jouaust**, R. **Mesny**, and A. **Perot**: Studies in radiogoniometry. Under normal conditions the direction of the electromagnetic waves in wireless telegraphy can be determined within 1°, but under certain conditions the azimuth of a transmitting post varies capriciously, and at certain times during the day no position can be found. These effects have been carefully studied, but although there is some evidence of a seasonal influence the exact cause of these deviations has not yet been elucidated.—A. **Chéron**: The radiography of pictures. In the preparation of the canvas at the present time white lead is used, whilst in early times calcium carbonate and wax were preferred. These differ markedly in transparency to the X-rays, and the materials of old and modern paints also show differences in this respect. Hence radiography may serve to distinguish between old and modern pictures, and in certain cases can bring out restorations.—E. **Rengade**: Saline double decompositions and the phase rule. It is shown by experiment that if a mixture of sodium nitrate and ammonium chloride is treated with a quantity of water insufficient for complete solution, crystals of sodium chloride are formed. This is opposed to the conclusion arrived at by M. Raveau in a recent communication.—G. **Denigès**: Remarks on a recent note by M. A. Bolland on the microchemical reactions of iodic acid. A claim for priority.—A. **Kling** and D. **Florentin**: The properties and constitution of the group ($CO.Cl_3$). The complete substitution of hydrogen by chlorine in the group $—OCH_3$ gives rise to abnormal properties. From its reactions it has a modified structure and behaves as phosgene *plus* chlorine.—C. **Dufraisse**: The ethylene isomerism of the ω-bromostyrolenes. Both these stereo-isomers are liquids at the ordinary temperature, and differ in colour and smell. An account is given of their reciprocal transformations.—J. **Durand**: The action of the alkaline metals on the ether oxides. It has hitherto been supposed that ordinary ethyl ether and its homologues are without action on sodium and the other alkaline metals, but the author shows that this is not the case. Details of the reaction between sodium (or the liquid alloy of sodium and potassium) on ethyl and *iso*amyl ethers, veratrol, ethylbenzyl ether, and diphenyl ether are given. The exact mechanism has still to be worked out.—F. **Grandjean**: The existence of equidistant differentiated planes normal to the optic axis in liquid crystals.—P. **Négris**: The glacial oscillations of the Quaternary period and the corresponding movements of the lithosphere.—E. **Chaput**: Observations on the ancient alluvium of the Seine.—E. **Mesnard**: Contribution to the history of earthquakes.—P. **Lesage**: Saline plants and period of anomalies.—G. **Nicolas**: Contribution to the study of the mechanism of the fertilising action of sulphur. Sulphur increases the assimilation of carbon from the air by the action of chlorophyll.—M. **Barlot**: A new reagent for Lactarius and Russula. The reagent is methyl chloroantimoniale in methyl alcohol solution. The colour reactions with eighteen species of Russula are given.—A. **Pézard**: The law of "all or nothing" or of functional constancy relating to the action of the testicle.—M. **Bezssonoff**: The antiscorbutic action of raw potato, ground and intact.—J. **Nageotte**: The structure of the cornea.—R. **Dubois**: Maternal affection in the electric skate (*Torpedo mormorotae*). Just before the birth of her young a specimen of this fish gave strong electric shocks, but after the birth of seven young the fish, although vigorous, gave no more shocks, and with the young fish about it could be readily handled. When the young were removed the shocks were as strong as before. This shows that the electrical discharge is not a reflex action, but voluntary, and can be suppressed when likely to be a danger to the young.—MM. **Cluzet, Rochaix,** and **Kofman**: The bactericidal action of the radiation from radium tubes employed in radium therapy.—F. **d'Herelle**: The bacteriophage micro-organism, the agent of immunity in plague and barbone.—A. **Paine** and A. **Peyron**: The neoplasic transformation of striated muscular fibre with visceral metastasis in the evolution of experimental sarcoma in birds.

Books Received.

Basic Slags: Their Production and Utilisation in Agriculture. (A General Discussion held by the Faraday Society on Tuesday, March 23, 1920.) Pp. 259–335. (London: The Faraday Society.) 7*s*. 6*d*.

The Botanical Society and Exchange Club of the British Isles. Vol. v., part v. Report for 1919. (Arbroath: T. Buncle and Co.) 7*s*. 6*d*.

The Observer's Handbook for 1921. (Thirteenth year of publication.) Pp. 64. (Toronto: Royal Astronomical Society of Canada.)

State of Connecticut. Public Document No. 24. Forty-third Annual Report of the Connecticut Agricultural Experiment Station, being the Annual Report for the Year ended October 31, 1919. Pp. xvi+506+lvi plates. (New Haven, Conn.)

Department of the Interior. U.S. Geological Survey. Bulletin 682: Marble Resources of South-eastern Alaska. By E. F. Burchard. Pp. 118+xxvi plates. Bulletin 697: Gypsum Deposits of the United States. By R. W. Stone and others. Pp. 326+xxxvii plates. Bulletin 712: Mineral Resources of Alaska. Report on Progress of Investigations in 1918. By G. C. Martin and others. Pp. iii+204+xv+vi plates. (Washington: Government Printing Office.)

Inorganic Chemistry. By E. I. Lewis. Third edition. Pp. xv+443. (Cambridge: At the University Press.) 9*s*. net.

Approved Technique of the Rideal-Walker Test. By Dr. S. Rideal and Capt. J. T. A. Walker. Pp. 12. (London: H. K. Lewis and Co., Ltd.) 1*s*. net.

The Subject-Index to Periodicals, 1917–19. F: Education and Child Welfare. Pp. 87. (London: The Library Association.) 4*s*. net.

The Bases of Agricultural Practice and Economics in the United Provinces, India. By Dr. H. M. Leake. Pp. viii+277. (Cambridge: W. Heffer and Sons, Ltd.) 15*s*. net.

Wisconsin Geological and Natural History Survey. Bulletin No. 57. Scientific Series No. 12: Phytoplankton of the Inland Lakes of Wisconsin. Part i. By G. M. Smith. Pp. iii+243+51 plates. (Madison, Wis.)

The Bahama Floras. By Prof. N. L. Britton and Dr. C. F. Millspaugh. Pp. viii+695. (New York: Published by the authors.)

Introduction to Qualitative Chemical Analysis. By Th. W. Fresenius. Seventeenth edition of the original work by C. R. Fresenius. Translated by C. Ainsworth Mitchell. Pp. xx+954. (London: J. and A. Churchill.) 36*s*. net.

Department of Marine Biology of the Carnegie Institution of Washington. Vol. x.: The Echinoderm Fauna of Torres Strait: Its Composition and its Origin. By H. L. Clark. (Publication No. 214.) Pp. viii+223+38 plates. (Washington: Carnegie Institution.)

Diseases of the Ear. By Dr. P. D. Kerrison. Second edition. Pp. xxi+596+vi plates. (Philadelphia and London: J. B. Lippincott Co.) 35*s*. net.

Chemie der Hefe und der Alkoholischen Garung. By Prof. H. Euler and Prof. P. Lindner. Pp. x+350+2 Tafel. (Leipzig: Gustav Fock.)

Kieselsaure und Silicate. By H. Le Chatelier. Berechtigte Uebersetzung by Dr. H. Finkelstein. Pp. xi+458. (Leipzig: Gustav Fock.)

Piezochemie Kondensierter Systeme. By Prof. E. Cohen and Dr. W. Schut. Pp. ix+449. (Leipzig: Gustav Fock.)

Die Chemische Literatur und die Organisation der Wissenschaft. By W. Ostwald. Pp. iv+120. (Leipzig: Gustav Fock.)

A Dictionary of Applied Chemistry. By Sir Edward Thorpe. Vol. i.: A–Calcium. Revised and enlarged edition. Pp. x+752. (London: Longmans, Green and Co.) 60*s*. net.

Ancient Egypt. Part i., 1921. (London and New York: Macmillan and Co.; Boston: Egyptian Research Account.) 2*s*.

A Manual of Photographic Technique: Describing Apparatus, Materials, and the Details of Procedure. By L. J. Hibbert. Pp. x+118. (London: Sir I. Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Diary of Societies.

THURSDAY, FEBRUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. A. Herdman: Oceanography (Great Exploring Expeditions).

ROYAL SOCIETY, at 4.30.—Dr. G. B. Jeffery: The Field of an Electron on Einstein's Theory of Gravitation.—Dr. M. N. Saha: A Physical Theory of Stellar Spectra.—W. F. Darke, J. W. McBain, and C. S. Salmon: The Ultra-microscopic Structure of Soaps.—Dr. J. Mercer: Linear Transformations and Functions of Positive Type.

CHINA SOCIETY (at School of Oriental Studies), at 5.—E. H. C. Walsh: Central Tibet and Lhasa.

LINNEAN SOCIETY, at 5.—Miller Christy: Wistman's Wood, Dartmoor; Specimens of Slides.—Dr. Agnes Arber: Leaf-tips of Monocotyledons.—T. A. Dymes: Seedlings of *Ruscus aculeatus*, with Remarks on their Germination and Growth.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Major G. Dobson: The Use of Meteorology to Aviation and *Vice-versa*.—Wing-Comdr. H. W. S. Outram: Ground Engineering.

ROYAL SOCIETY OF MEDICINE, at 5.30.—Prof. F. Hobday: The Diseases of Animals which are Contagious to Man.

LONDON DERMATOLOGICAL SOCIETY, at 6.—Dr. W. Griffith: Parasitic Diseases of the Skin (Chesterfield Lecture).

CHEMICAL SOCIETY, at 8.—Informal Meeting.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—F. C. Pybus: An Unusual Type of a Tuberculous Peritubal Cyst.—Dr. T. W. Eden and F. L. Provis: X-ray Treatment of Uterine Fibroids and Chronic Metritis.

FRIDAY, FEBRUARY 4.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—On Gravity at Sea: Opened by Prof. G. W. Duffield, and continued by Sir S. G. Burrard, Dr. H. Jeffreys, Dr. J. W. Evans, and Dr. A. M. Davies. Chairman: Sir Arthur Schuster.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. C. W. G. Bryan: The Early and Late Effects of Injuries of the Diaphragm, with Social Reference to Wounds jointly involving Thoracic and Abdominal Viscera.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—F. R. Wade and Others: Our Part in the Industrial Crisis of To-day.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—W. H. Ballantyne: Surface Tension and Some of its Industrial Applications.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Drs. Rowbotham and I. Magill: Anæsthesia in the Plastic Surgery of the Face and Jaws.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. A. D. Waller: The Electrical Expression of Human Emotion.

SATURDAY, FEBRUARY 5.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Lecture.

MONDAY, FEBRUARY 7.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Dr. A. J. McC. Routh: Motherhood.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. Platt: The Surgery of the Peripheral Nerve Injuries of Warfare.
SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—Lord Headley: Presidential Address.
ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—Prof. R. F. A. Hoernle: Contributions to a Phenomenology of Meaning.
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. O. Silberrad: The Erosion of Bronze Propellers.
SURVEYORS' INSTITUTION, at 8.—A. H. Davis: The Acquisition of Land for Public Purposes in Egypt.
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Dr. J. M. Arthur: Mount Kenya.
MEDICAL SOCIETY OF LONDON, at 9.—G. E. Gask: Surgery of the Lung and Pleura (Lettsomian Lecture).

TUESDAY, FEBRUARY 8.

ROYAL HORTICULTURAL SOCIETY, at 3.
INSTITUTION OF CIVIL ENGINEERS, at 5.30.—G. Ellson: Cannon Street Bridge Strengthening.—F. W. A. Handman: Reconstruction of a Viaduct.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. P. Chalmers Mitchell: Report on the Additions made to the Society's Menagerie during the months of November and December, 1920.—Dr. C. F. Sonntag: 1. The Comparative Anatomy of the Tongues of the Mammalia. II., Fam. Simiidæ. 2. A Contribution to the Anatomy of the Three-toed Sloth (*Bradypus tridactylus*).—Prof. J. P. Hill: Exhibition of, and Remarks upon, a Fœtus of the Three-toed Sloth (*Bradypus tridactylus*).—R. I. Pocock: Notes on the External Anatomy of the Three-toed Sloth (*Bradypus tridactylus*).—Lieut.-Col. S. Monckton Copeman: Note on the Capture of a Rare Parasitic Fly, *Hammomyia* (*Hylephila*) *unilineata*, Zett.—D. M. S. Watson: The Basis of Classification of the Theriodontia.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—R. Davis: A New Method for the Measurement of Photographic Filter Factors.—F. C. Toy: A Description of a Monochromatic Illuminator designed for a Special Purpose.—Dr. L. A. Levy and T. Thorne Baker: High-speed Radiography.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Annual General Meeting.
ROYAL SOCIETY OF ARTS, at 8.—E. C. de Segundo: Some of the Problems of Unemployment.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prof. A. Keith: Tailed Men.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. W. A. Potts: Mental Tests.

WEDNESDAY, FEBRUARY 9.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. Platt: The Surgery of the Peripheral Nerve Injuries of Warfare.
ROYAL SOCIETY OF MEDICINE (Surgery: Proctology Sub-section), at 5.30.—W. B. Gabriel: The Results of an Experimental and Histological Investigation into Seventy-five Cases of Rectal Fistulæ.—H. Graeme Anderson: Method of Abdomino-perineal Excision of the Rectum in Three Stages.
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—J. H. Barker: Machinery Applied to Mass Production.
ROYAL SOCIETY OF ARTS, at 8.—Prof. W. Rothenstein: Possibilities for the Improvement of Industrial Art in England.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.
INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at 28 Victoria Street), at 8.

THURSDAY, FEBRUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. A. Herdman: Oceanography (Problems of the Plankton).
ROYAL SOCIETY, at 4.30.—Rev. John Roscoe: A *Résumé* of the Results obtained by the Mackie Anthropological Expedition to Uganda.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. A. S. Eddington: World Geometry (Lecture).
INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on Electric Appliances for Domestic Purposes, to be introduced by Dr. E. Griffiths and F. H. Schofield in a Paper on Some Thermal Characteristics of Electric Ovens and Hot Plates.
OPTICAL SOCIETY, at 7.30.—R. S. Whipple: The Design and Construction of Scientific Instruments.—T. Smith: The Galilean Binocular.—R. J. Trump: A Shutterless Continuous-feed Kinematograph.
ROYAL SOCIETY OF MEDICINE (Neurology Section) (at National Hospital for Paralysis and Epilepsy), at 8.

FRIDAY, FEBRUARY 11.

GILBERT WHITE FELLOWSHIP.—Founders' Day Celebrations.
ROYAL ASTRONOMICAL SOCIETY (Anniversary Meeting), at 5.
ROYAL SOCIETY OF MEDICINE (Clinical Medicine, Surgery), Joint Meeting, at 5.—Dr. H. Mackenzie, J. Berry, and Others: Discussion: The Medical and Surgical Treatment of Graves' Disease.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. G. T. Fisher: Loose Bodies in Joints.
PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.15.—Discussion on Absolute Measurements of Electrical Resistance, and Instruments Based on the Temperature-variation of Resistance.—Sir Richard Glazebrook and F. E. Smith: Absolute Measurements of Electrical Resistance.—Resistance Thermometry: Prof. H. L. Callendar: The Compensated Resistance Bridge, and Instrument for the Measurement of Radiation.—C. R. Darling: The Early Work of Siemens on the Resistance-Pyrometer.—C. Jakeman: The Measurement of Steam Temperatures.—The Hot-Wire Microphone: Major W. S. Tucker: The Function of the Convection Current in the Hot-Wire Microphone.—Capt. E. J. Paris: Theory of the Tucker Microphone.—Anemometry and Heat Convection: Prof. J. T. McGregor Morris: A Hot-Wire Anemometer.—Dr. J. S. G. Thomas. A Directional Hot-Wire Anemometer.—A. H. Davis: An Instrument for Measuring Convected Heat.—Miscellaneous Applications: Dr. G. A. Shakspear: A Gas Permeameter.—Prof. Leonard Hill: The Caleometer.—E. A. Griffiths: Liquid Depth Gauge (Distant Reading Type).—Dr. Daynes: A CO_2 Recorder.—Dr. E. Griffiths: Electrical Hygrometers.
MONTESSORI SOCIETY (at University College), at 5.45.—Miss M. Drummond: The Psychological Basis of the Montessori Method.
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—B. T. Lang: Scotometry.—Dr. T. H. Butler: Late Infections after Sclerectomy.—M. L. Hepburn: Some Notes on Trephining.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. F. W. Aston: Isotopes and Atomic Weights.

SATURDAY, FEBRUARY 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Fowler: Spectroscopy (Experimental Spectroscopy).
PHYSIOLOGICAL SOCIETY (at National Institute for Medical Research, Mount Vernon, Hampstead), at 4.

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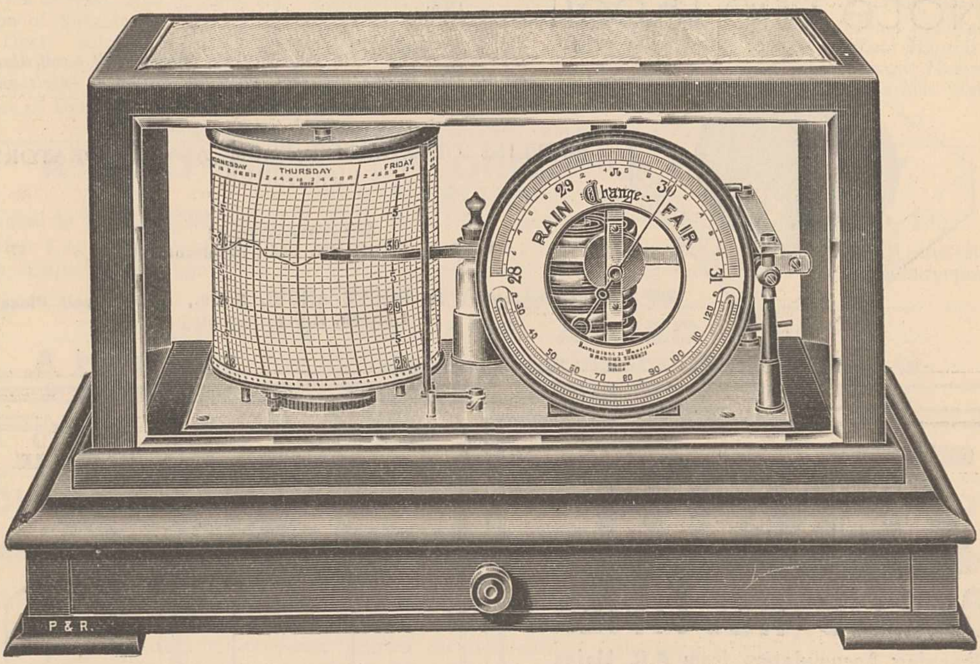

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