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East African Research.

THE "Report of the East African Guaranteed Loan Committee appointed by the Secretary of State for the Colonies" (Cmd. 2701, Aug. 1926, 47 pp., price 9*d*.) directs attention to the urgent need for either a new organisation for the promotion of research in British Crown Colonies and Dependencies or for a more systematic use of existing agencies. The East African Commission, consisting of Messrs. Ormsby-Gore, Church, and Linfield, recommended a guaranteed loan of 10,000,000*l*. to aid the development of the British East African colonies and dependencies. This loan has been sanctioned, and applications for grants from it have been received from the East African Governments amounting to more than 16,000,000*l*., without including interest during construction. These applications have been referred to a Loan Committee consisting of Sir George Schuster, Mr. R. H. Jackson, and Brigadier-General F. D. Hammond.

The report of this Committee has now been issued, prefaced by a warning from the Secretary for the Colonies that he will take no action until he has submitted the proposals to the Governments concerned and has considered their comments. These opinions have already been foreshadowed, and are strongly adverse to some of the recommendations of Sir George Schuster's Committee: thus the railway across south-western Tanganyika Territory from Dodoma to Fife, which was especially recommended by Mr. Ormsby-Gore's Commission, has been set aside as not urgent. The plan for the railway and road development of Nyasaland is regarded as premature without further economic survey; the local authorities, however, maintain that the scheme has been approved by the local experts and that the survey proposed would merely occasion useless expense and delay. The whole scheme of the loan, so far as Kenya Colony is concerned, has been denounced by Major E. S. Grogan, a leading settler, as adding to what he considers the already excessive indebtedness of the Colony.

The disappointing feature of the new report is the inadequate provision for scientific research, the insistence on which was one of the especially valuable features in the East African Commission's Report. Sir George Schuster's Committee welcomes the recognition in its terms of reference "that efficiency of action in every field will be increased if guided by scientific knowledge"; and adds, "We wish particularly to emphasise our belief in the practical value of such work, if properly conducted." The Committee therefore recommends that "as works for the material development of a country are undertaken, a due

provision should at the same time be made for the scientific study of all those factors on which good administration and material development depend."

After these assurances it is disappointing to find that the Committee, out of the total of 10,000,000*l.*, recommends the allocation of 8,949,536*l.* for railways, ports, roads, and waterways, and allocates only 39,000*l.* for research: namely, 4000*l.* for the Amani Institute, 5000*l.* for the Geological Survey in Tanganyika, and 30,000*l.* for a Northern Rhodesia Research Station at Mazabuka. Applications were submitted for larger sums, including 100,000*l.* by the Government of Kenya Colony for research in native welfare, 50,000*l.* by the same colony for a Veterinary Institute at Kabete, near Nairobi, 5000*l.* for the continuance of the Veterinary Laboratory at Mpapwa, and by the Uganda Government for a grant, amount unspecified, for a Sleeping Sickness Station at Entebbe. These research schemes are either so nebulous or so likely to overlap with other work that the Loan Committee is unable to recommend them without fuller information.

The Committee suggests that 1,000,000*l.* out of the loan should be allotted to roads, waterways, and research; and as out of that amount 547,872*l.* is not yet allocated, the balance appears to offer adequate funds if suitable definite research work is proposed. How much is likely to be used for research is doubtful. Of the 452,000*l.* of which the allocation has already been recommended by the Committee, only 8·6 per cent. is for research; and as the Committee has not included in its recommendations anything for road construction in Kenya, Uganda, or Nyasaland, and has invited alternative proposals for the large grant applied for under this head by Kenya Colony, the expenditure on research under this loan may be quite inadequate.

In regard to the Amani Institute for agricultural research, Sir George Schuster's committee proposes a policy which the Secretary of State states definitely in the preface that "he does not accept." Apparently he intends to appoint a Director and trust him to develop a plan for the work, organisation, and relation of the Institute to the technical departments in the East African territories. The Committee doubts the wisdom of this policy, which is certainly speculative, as its success depends entirely on the selection of a suitable man for an ill-defined post. The Committee recommends that a small commission of the best scientific experts available should determine the scope of the work to be undertaken there. If it should then be found impossible to provide the Institute with the necessary funds, the Committee considers that "it would be better to face the facts and close the institute altogether rather than to attempt to run it with an inadequate and second-class staff."

Either the closing of the Amani Institute or its second-rate maintenance would be a national disgrace as well as a calamity to East Africa. The Institute was established when the locality was in German East Africa; it was planned on magnificent lines, was well equipped, and had in progress work of primary importance. Sir Frederick Lugard's appreciation of the former merits of Amani doubtless inspired his excellent suggestion during the recent discussion at the British Association on African race problems, that it would be an appropriate gesture in the development of Tanganyika Territory to reappoint some of the former staff. Sir George Schuster's Committee doubts whether a first-rate scientific expert would be willing to accept the directorship of Amani until the future of the Institute be assured. Men considering the appointment might fear the fate of the former Geological Survey of Tanganyika Territory, where the Director would not agree to the Governor setting aside the method of work which had been agreed to when he accepted the appointment. It would appear difficult to select the right man for the post until the scope of the work to be undertaken at Amani has been defined. An appointment on the lines at present contemplated might follow the too common precedent of selecting as director a man of administrative experience and engaging scientific experts to work under him.

That scientific research should develop on economic and sound lines, the Committee recommends the establishment of a sub-committee under the Committee of Civil Research to consider the foundation of "an Imperial organisation of scientific research, with the object of securing the best possible co-ordination of effort throughout the Empire and of deriving full value from all existing organisations." Any scheme for the extension and better co-ordination of research throughout the British Empire is to be welcomed; but the sub-committee proposed would not serve the urgent needs of British East Africa and would not render unnecessary a special organisation for these territories. The duty proposed for the new sub-committee would, moreover, so far as concerns the scientific development of the economic resources of the Empire overseas, overlap with the Imperial Institute, which was established for that purpose. If that Institute is unable to fulfil its functions, it should be made able: it has a large building and a considerable endowment, and there seems no reason to expect a sub-committee of the Civil Research Committee to be more successful. The insistence by Sir George Schuster's committee that the different British East African territories should co-operate, and that each should specialise in the work for which it has the best

opportunities, is unquestionably sound; and it is not the fault of that committee that it has only been able to recommend for research the meagre pittance of less than 0·4 per cent. of the loan. The proposals received were too indefinite. A sub-committee of the Civil Research Committee appears to be the most easily constituted authority to secure a prompt decision as to the research needs of East Africa; and if the sub-committee were successful with those territories, its efforts to secure co-operation and prevent duplication of work might secure for it the wider function with which the Loan Committee would overburden it at the start.

The Theory of the Gene.

The Theory of the Gene. By Prof. Thomas Hunt Morgan. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xvi+343. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926.) 18*s.* net.

IN this volume is published the series of lectures on the Silliman Foundation recently given by Prof. Morgan. We are not told when the lectures were delivered, but as the book appeared only during the present year, we may take it as representing the latest pronouncement of the American school of geneticists on these matters. In the first chapter is given a formal statement of the theory of the gene, and in view of the fact that some misconception of what it implies is not infrequently to be found among biologists who have not specially studied genetics, it may be as well to reproduce it here.

"The theory states that the characters of the individual are referable to paired elements (genes) in the germinal material that are held together in a definite number of linkage groups; it states that the members of each pair of genes separate when the germ-cells mature in accordance with Mendel's first law, and in consequence each germ-cell comes to contain one set only; it states that the members belonging to different linkage groups assort independently in accordance with Mendel's second law; it states that an orderly interchange—crossing-over—also takes place, at times, between the elements in corresponding linkage groups; and it states that the frequency of crossing-over furnishes evidence of the linear order of the elements in each linkage group and of the relative position of the elements with respect to each other."

It will be noticed that nothing is stated about the chromosomes; though if the linear order of the elements in each linkage group be accepted, and it is clearly the simplest explanation of the facts as they stand, then the interpretation in terms of chromosomes follows almost as a matter of course. Still, the omission is significant, conveying as it does the recognition of the fact that even if the chromosomal interpretation were ultimately to be rejected, the phenomena of segregation and of linkage, the foundations of the theory of the gene, would remain unaltered. At present, however, there are few signs of weakness in the chromosomal interpretation, and in his chapter on "Chromosomes and Genes" Morgan brings forward fresh evidence from Drosophila in demonstration of its strength.

As might be expected, the fruit fly is much to the fore in this volume, though less so than in Morgan's earlier books on "The Mechanism of Mendelian Heredity" and "The Physical Basis of Heredity." Nevertheless, in the chapters on the "Origins of Mutant Characters," on "Chromosomes and Genes," and on "Genes in Related Species," it figures prominently, owing to the unrivalled material which it offers for discussion. The brief chapter giving a comparative account of the operation and arrangement of the genes in several closely allied species of Drosophila is one of the most interesting in the book, and might well have been expanded. Geneticists will look forward with keen interest to the progress of this work, offering as it does one of the most fruitful lines of attack on the problem of species.

Another chapter of much interest is that in which the author discusses the well-known "Presence and Absence" hypothesis. This generalised view of the relation between dominant and recessive characters has never found favour with the American school, and Morgan devotes many pages and much ingenuity in arguing against it. Some of his cases will certainly not bear the strain he puts upon them. For example, the argument that the 'albino' guinea pig cannot be due to absence of the pigment producing gene, because it often has a few coloured hairs on the feet and toes, at once falls to the ground when it is realised that such animals are not true albinos at all, but very slightly pigmented forms analogous to the Himalayan rabbit. So too the objection that the recessive black rabbit actually has more pigment than the dominant wild grey type at once loses its force when it is understood that the question at issue is not of the grade of pigmentation but of a definite inhibitor for pigment. That this is the proper way of looking at it is clear from Onslow's striking research on the chemical nature of this very case. Again, Morgan argues that since there is a dominant white in poultry, there must, on the Presence and Absence hypothesis, exist an inhibitor for this white factor in the wild jungle fowl. The argument supposes that all domestic breeds are descended from *Gallus bankiva*, but in the light of recent work this is almost certainly not true. As a matter of fact, Morgan admits that it is very difficult

to present any clear-cut evidence against the Presence and Absence hypothesis in contradistinction to the existence of positive recessive genes. In the end he falls back upon the familiar argument from multiple allelomorphs, and here we need not follow him; for if the reader will turn to Bateson's paper on "Segregation," which was recently published in the *Journal of Genetics*, he will realise that this group of phenomena, so often adduced against the Presence and Absence hypothesis, may quite well be regarded as one of its chief supports.

Still, the implications involved in the Presence and Absence hypothesis are of such fundamental importance to the science of genetics, and the difficulty of obtaining decisive evidence between the rival hypotheses is so great, that we may be pardoned for commenting upon a case which seems to provide the best evidence of the kind yet obtained. This is the interesting case of the 'bar-eye' in Drosophila to which Morgan has devoted several pages of his book (pp. 86-91). Experiment has shown that when females homozygous for the dominant bar gene (B) are crossed with the recessive normal male, they produce occasional normal sons. Sturtevant demonstrated that this is due to the fact that in the homozygous barred female an irregular process of crossing-over occasionally occurs which results in one of the X chromosomes carrying both of the bar genes while its mate is left without one. The occasional normal male alluded to above is produced when the gamete carrying the X chromosome that has lost its B is fertilised by the Y chromosome gamete of the male. Now since the X chromosome lacking B has been brought to this state through crossing-over with one that also contains B, it cannot contain that positive recessive gene for normal eye postulated by the American school. In other words, it can contain *nothing* from the bar locus. Yet in association with a Y chromosome which also contains *nothing* it gives rise to the normal eye. Hence the appearance of the normal eye must be due to the *absence* of B, and not to a positive recessive gene corresponding to bar. This is surely as good a demonstration of the validity of the Presence and Absence hypothesis as we can hope to obtain.

Nearly one-third of the book is devoted to an account of forms in which the chromosomes depart from the normal diploid arrangement, whether through the loss of a set as in haploids, or through duplication as in triploids, tetraploids, and polyploids, or else through loss or addition of individual chromosomes as in heteroploids. The author has made use of the interesting material that has recently accumulated in wheats and other plants, and especially in Datura through the remarkable researches of Blakeslee and Belling, and has produced an account which will be at once useful and stimulating to the student. There is rather a lack of synthetical grip in the account, but perhaps this is hardly to be expected when dealing with a branch of study where most of the facts are the outcome of the past few years only, and into which they are so rapidly pouring.

Another third of the book is devoted to the subject of sex considered in its relation to the chromosomes. The outstanding problem here is still the relation between the two groups into which dicœcious animals fall, namely, that in which it is the male sex that is heterogametic (the XX-XY type) and that in which it is the female sex that is so constituted (the WZ-ZZ type). Seeing that both types may occur in the same class of animals, as for example in vertebrates, and also in insects, it is difficult to suppose that they will not eventually be harmonised under some common scheme. Morgan inclines to the view that the chromosomes involved in the two types are not homologous, but that the two types have arisen independently through some change in balance. It is not very clear how such a change might be supposed to have come about, and we could have welcomed more discussion on this most important point.

In this portion of the book devoted to sex the reader will find some account of intersexes and of sex-reversal, upon which so much interesting work has been done in recent years. The facts are often accompanied by shrewd bits of criticism which will be of great value to the student, but here again one has the feeling that the author tends to lose grip as he proceeds. The impression conveyed is that of a collection of facts, of the highest interest and fairly set forth, but insufficiently digested, inadequately related to one another. The book as a whole lacks that unity found in Prof. Morgan's other books dealing with heredity—the unity that comes from a thorough assimilation of the facts. We cannot help the suspicion that the author's hand was forced by his appointment as Silliman lecturer, and that if he had had his own way he would have preferred to wait a little longer before writing it. In making such a criticism we do not wish to imply any condemnation of the book. Every geneticist should read it and be grateful to Prof. Morgan. But, judged by the high standard that we have become accustomed to expect from him, we are naturally rather disappointed when he tends to fall below it.

In conclusion, we would direct attention to some errors in the hope that they may be set right when a further edition is called for. On p. 113 a drawing is described as "a periclinal chimaera, S. lycopersicum." It is true that it represents *S. lycopersicum*, but *S.*

lycopersicum is *not* a periclinal chimæra. On p. 175, last line but one, "Fig. 12" should surely read "Fig. 33." On p. 247 the figure of the embryo calves has been so drawn as to omit the direct vascular connexion which was the main point of Lillie's original picture. In the note on p. 265, Crew is quoted as having fertilised the eggs of a hermaphrodite frog with its own sperm. Reference to the original will show that this hermaphrodite only functioned as a male in fertilising the eggs of a normal female. The 'common' cabbage butterfly is a Pieris, not a Colias as given on p. 293. In Figs. 11 and 12 the rules should be arranged as in Fig. 13. In neither case does the male shown on the second line belong to the F_1 generation, nor does the third line represent an F_2 generation as indicated.

One further point may be mentioned in connexion with the bibliography at the end of the book. This runs to some 26 pages and contains numbers of titles to which no reference is made in the text. Yet in the text some 40 papers are quoted for which no reference is given in the bibliography. It is extremely aggravating to the student to find a reference to a paper that he does not know, and to turn to the bibliography to find that it has been omitted; nor is there any consolation in finding the titles of a hundred other papers with which he is already familiar.

R. C. PUNNETT.

Optics—Pure and Applied.

(1) *The Principles of Physical Optics: an Historical and Philosophical Treatment.* By Ernst Mach. Translated by Dr. John S. Anderson and Dr. A. F. A. Young. Pp. xi+324+10 plates. (London: Methuen and Co., Ltd., 1926.) 21*s.* net.

(2) *Handbuch der biologischen Arbeitsmethoden.* Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 187. Abt. 2: *Physikalische Methoden*, Teil 2, Heft 1. *Das Interferometer, seine Anwendung zur Untersuchung von Gasen und Flüssigkeiten*, von Paul Hirsch; *Ultramikroskopie*, von Marie Anna Schirmann; *Refraktometrie*, von Heinrich Kessler. Pp. 737-906. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 7·50 gold marks.

(1) A CERTAIN philosopher once said, "Learn the past, so that you may know the future"; but history appeals very differently to different minds; one sees in it a subject satisfying in itself, while to another the past is dead save in so far as it yields lessons for present and coming days. Prof. Ernst Mach's "Principles of Physical Optics" is bound to make a wide appeal to the many who cannot find much time to go back to the original authors of optical theory and practice, though it must be noted that the matters treated do not extend to the more contentious topics of the present day, such as the nature of light, the problem of the ether, the quantum theory, and so on; they are confined to those older parts of the subject which are adequately treated on the basis of the undulatory theory of light.

It is a common experience that first-hand reference to original books and papers is invaluable. The early investigator was treading a new path, and the subject was developing in his mind in a spontaneous and natural manner. His very mistakes are instructive. The modern text-book, on the other hand, is apt to be written by a much less ingenuous author, who returns to the elementary parts of the theory with a subconscious contempt for, and lack of appreciation of, the difficulties which beset the path of the beginner. Then, again, there are the writers who fail dismally through never having thoroughly mastered the elementary principles of their subjects. On the other hand, an adequate acquaintance with even the works of the main optical writers, Newton, Huygens, Young, Fresnel, and the rest, is a matter for years. Hence the appearance of the book under review will be welcomed, because from its perusal it is possible to obtain a clear idea of the historical development of the subject and of the contributions of the various early thinkers.

It is not a book for the beginner. For such, nothing can take the place of a careful systematic treatment adapted to develop the philosophical sense which is demanded of the reader of the present volume. From its very nature, an historical treatment must deal with matters with which a beginner need not concern himself, such as Newton's "theory of fits." Then, again, the standard of knowledge demanded of the reader of Chapter ii. (on the rectilinear propagation of light) is certainly higher than that of a novice; and the same applies to the several later parts of the book. Nevertheless, it is a valuable book for a teacher or for a student who wishes to get a little beneath the surface of the subject.

The translators have performed their task well, although there are a few places in which the meaning is obscure. The text is full of interest, and the admirable range of portraits gives a human touch to all.

It seems to the writer that one or two references to recent work might well have been added by the translators. For example, the following passage occurs in the description of the Michelson interferometer: "If it is desired to study an interposed substance which is non-homogenous, and upon which the eye must thus accommodate, parallel light cannot be used for this purpose, and the substance may not be traversed *twice* by the rays." Such a statement, although perhaps applicable to the case in

question, should not have been passed without a reference to Twyman's modification of the instrument, in which the interposed substances *are* traversed twice by the 'parallel' rays. There is still an unfortunate gap between the optics of the laboratory and the workshop, and there are several places where this is instanced in the present work.

Prof. Mach occasionally manifests an amusing touch of dogmatism. His introductory letter speaks of "the only possible form of immortality." Has he, then, explored the possibilities of life so thoroughly? Dogmatism emerges, too, in the discussion of colour vision. The conclusive nature of the introspective analysis of a series of sensations is taken for granted, and Thomas Young is accused of introducing confusion into the subject! It is to be hoped that this statement may challenge some to go back to Young's own discussion. In another case where a psychological question is involved, namely, the question of light quantities, the book is vague and unsatisfactory. The coming of physical photometry is foreshadowed in terms which give no hint of the many and serious difficulties which have been encountered since 1913, when the German edition of the book was published. Indeed, the statements on p. 20 would lead the unsuspecting to conclude that a physical measurement of the gross energy of "the *illuminating* rays" (whatever that may mean) is an adequate means of finding the "quantity of light emitted from a light source in unit time." We conclude with regret that the 'philosophy' of the book is lamentably lacking where it might be most helpful. This is yet another instance of a clear call for the insertion of a translator's note directing attention to more recent developments. It is not forgotten that the book deals with physical optics, but every text-book ought to indicate the vital points of connexion between its own subject and allied branches of knowledge.

A feature of the book which deserves especial praise is its treatment of polarisation and double refraction. For several years past, the present writer has encouraged optics students to begin the study of these subjects with the simplest apparatus and natural crystals, such as were available to the early workers. In this way they obtain a thorough acquaintance with the main features of the subject; after a day or two of making retardation plates of mica, and using natural crystals of quartz, they are ready to appreciate the quartz wedge; the natural rhomb of spar affords an introduction to the Nicol prism and its modifications. Thus by easy stages the properties of uniaxial crystals become familiar; and how many students are *really* ready to pass beyond this stage in the limited time of college courses? The book adopts a similar method of approach, and, in addition, describes many beautiful experiments which will be new to the majority of readers.

This book, then, may be commended to all teachers who have occasion, in the midst of the multiplicity of subjects comprised in present-day 'physics,' to give some little attention to 'light.'

(2) This volume is a part only of one of the series of 'Handbooks' with which German scientific literature is so extensively equipped. The present section has articles dealing with (*a*) interference refractometers for gases and liquids, by Paul Hirsch; (*b*) ultra-microscopy, by Marie Anna Schirmann; (*c*) refractometry, by Heinrich Kessler. The object of the whole handbook is to explain to biologists the various physical, chemical, psychological, and other experimental methods employed in biological practice; the discussion of the physical instruments is very elementary and non-mathematical; almost unnecessarily so, in fact. Nevertheless, the practical details are well described, such as the determination of the constituents of serum by the use of the interferometer for liquids. The portable gas-interferometer, which has found a use in detecting fire-damp in coal mines, is described.

The section on ultra-microscopy begins with an exposition of the Abbe theory of microscopic resolution, where the author apparently gets mixed with her two equations, then passes on to a good description of the different methods of 'dark-ground' work, and the methods of Siedentopf and Zsigmondy. The fault of these handbooks is that they are apt to give an undue confidence in their completeness. No mention is made of recent British dark-ground condensers of the focussing type. Nothing becomes out-of-date quite so rapidly as the highly technical handbook.

The section on refractometry appears to be reasonably complete so far as German apparatus and methods go, and there is an abundance of practical detail likely to be of use to the chemist or biologist. The differential method of Hallwachs is described by way of conclusion.

L. C. MARTIN.

Direct Realism.

A Theory of Direct Realism: and the Relation of Realism to Idealism. By Dr. J. E. Turner. (Library of Philosophy.) Pp. 324. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1925.) 12*s.* 6*d.* net.

THIS book is the outcome of a bold and engaging enterprise. It sets out to do two things; first (and chiefly) to cut a clean way through the tangled growth of modern epistemology by justifying the plain man's view that the perceiving mind is in immediate contact with the external world, "as this actually

exists," or that ordinary sense-perception, so far as it goes, "is, in principle, veridical"; secondly, to show that Hegelian idealism is entirely compatible with this supposedly antagonistic realist view.

The second aim is well fulfilled. The last four chapters of the book give a good and well-documented version of what idealism meant for Hegel, and on lines that are not now unfamiliar, pretty completely demolish the charge of subjectivism that for long lay at Hegel's door. But the first part of the book is less satisfactory. One can imagine the sigh of relief that would go up if Dr. Turner or any one else thoroughly established the position which he wants to hold. For 'phenomenalism,' as Dr. Turner sees, is a nuisance to scientific workers and to philosophers alike: and we should all be glad to be persuaded out of it. The trouble is that whenever one starts to reflect upon the process of perception, the extreme complexity of that process drives one obstinately to the conclusion that only by ignoring many plain facts and making some gallant but unverifiable assumptions, is it possible to hold that (to use the simplest terms) 'the-thing-as-it-is-perceived' is 'the-thing-as-it-really-is.' Yet that is what Dr. Turner aims at showing—in his own words, "the existential identity between sensed contents and physical entities" (p. 23).

Dr. Turner's main point is that most of the difficulties have arisen because modern analysis has started its work too far up. It begins with and remains within mature adult experience where the distinction between 'appearance' and 'reality' is already entrenched. If, however, we start at a more primitive and simple level of apprehension, we find it free from that embarrassment, since all sensed contents are there taken as '*inherently* existent.' Standing on this ground, therefore, and carrying forward from it, under the guidance of this realised unity, the analysis of perceptual processes, Dr. Turner concludes that it is possible to regard "the entire series of physical and physiological processes as determining, not the actual existence nor real character of the object of perception, but simply *perception itself* as being also a process, but of a higher order than these preliminary basal processes" (p. 160).

The result is disappointing. For even if one grants the validity of the argument by which this thesis is supported, it is hard to see why it should be held to dispose of all the difficulties which have led to phenomenalism, or to justify the desired conclusion that perception is in principle veridical. Yet it is proper to say that in some of the detail of his argument Dr. Turner breaks new ground in an interesting and hopeful way. His discussion of imagery, for example, is acute and good; and if his review of the "causational aspects of perception" will scarcely bear all the weight which he lays upon it, it is nevertheless fresh and valuable.

It must be added that the first section of the book is sadly ill-arranged. Dr. Turner has gone to enormous trouble to make himself acquainted with the views of all important recent writers on realist epistemology. Unhappily, the very fullness of his knowledge prevents his allowing his own story to tell itself. It has to be gathered largely from his criticism of others—often enough on points of no great material importance. It is a pity that Dr. Turner did not take down his scaffolding. He has written a good book, which might easily have been much better.

Our Bookshelf

(1) *Modern Views on Digestion and Gastric Disease.* By Prof. Hugh MacLean. (Modern Medical Monographs.) Pp. x + 170 + 20 plates. (London: Constable and Co., Ltd., 1925.) 12*s.* net.

(2) *Modern Methods of Feeding in Infancy and Childhood.* By Donald Paterson and J. Forest Smith. (Modern Medical Monographs.) Pp. ix + 106. (London: Constable and Co., Ltd., 1926.) 7*s.* 6*d.* net.

THE value of the "Modern Medical Monographs" edited by Prof. Hugh MacLean has already been indicated in these columns. We now welcome the appearance of two additions to the series.

(1) "Modern Views on Digestion and Gastric Disease" is the contribution of the editor of these monographs. Its object is to provide a general account of the physiology of digestion and to indicate the main principles in the treatment of gastric disorders. The early chapters summarise the process of digestion, and include references to the more recent methods of gastric investigation, such as the fractional test-meal. The author emphasises the importance of recognising as a normal feature of digestion the existence of regurgitation from duodenum to stomach, which until recently was looked upon as an abnormal occurrence. The greater part of the book is devoted to the consideration of the main gastric diseases and their diagnosis. Perhaps the most controversial section is that dealing with the etiology of gastric carcinoma. Prof. MacLean records considerable evidence to refute the teaching of many pathologists and surgeons that this condition is often preceded by ulcer. The observations on the great differences in duration of symptoms of gastric ulcer and gastric cancer suggest very strongly that malignancy arising in an ulcer is rare. The section on treatment indicates the importance of basing therapy on physiological knowledge. The book is well illustrated by radiograms, and will be of great assistance to student and physician in the study and treatment of gastric disease.

(2) "Modern Methods of Feeding in Infancy and Childhood." An understanding of this subject is as necessary to the general practitioner as a sound knowledge of digestive disturbance in adult life. Dr. Paterson and Dr. Forest Smith urge the importance of insisting on breast-feeding wherever possible. The difficulties which may arise in connexion with this are

discussed and various methods of artificial feeding are indicated. A number of diet tables are given, covering the period of childhood up to the age of five. If the physician will remember the authors' reiterated maxim that feeding must be varied to suit the individual, he will find this book a very useful guide in an important branch of his practice.

Surveying. By Dr. W. Norman Thomas. Second edition. Pp. viii+548. (London: E. Arnold and Co., 1926.) 25*s.* net.

THIS second edition differs but little from its predecessor. A few more corrections, a revised section on air survey (or "aerial survey" as the author calls it), and an appendix on pivotal errors in theodolites constitute the changes. The book is written for students of civil engineering. Naturally, therefore, it is a text-book on engineering rather than on topographical surveying, and it lacks the practical hints, and models of computation, which should be included for the latter purpose. The civil engineer will, however, find in it a clear explanation of all the methods he is likely to employ. Unlike many authors of works on surveying, Mr. Norman Thomas is at pains to examine the precision of each method he describes. He does so with conspicuous success, and illustrates his mathematics by examples drawn, in the main, from surveys in Great Britain and in the Empire.

There are one or two odd points in the author's sequence. He refers to maps in the chapter on chain surveying, and none of those referred to save those published by the Ordnance Survey were made with the chain. Again, to most of us surveyors, triangulation is the usual preliminary and the most useful friend. It comes late in the book, and when it comes this chapter does not stress sufficiently the importance, in any type of survey, of the theodolite. British theodolite design is diminishing the lead which some continental manufacturers have been allowed to acquire. It is a pity, then, that in his note on "Recent Developments in the Construction of Surveying Instruments" (included in the appendix on pivotal "Errors in Theodolites") some mention of new theodolites has not been made. Nowadays, when labour and transport are so heavy an item, it is more than ever important to get the best of instruments and to economise in time and weight. These, however, are small points, and every surveyor will be well advised to get and study this volume.

An Introduction to Practical Biology: a Course of Work based chiefly upon the Plant and arranged for Use without Special Apparatus in either the Class-room or the Home. By Norman Walker. Pp. viii+224. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 5*s.* net.

ONE of the hindrances to the more frequent introduction of science subjects into the schemes of study under the tutorial class movement has been the difficulty of arranging for the practical work necessary to supplement the theoretical side, if the subject is to be at all successfully taught. Dr. Walker, who has had a long experience of the tutorial class movement in the north of England and has a wide knowledge of the needs and difficulties of adult students of this kind, has outlined a series of practical exercises illustrating some of the elementary principles of biology which can be carried out in the class-room or the home, without any special or elaborate apparatus and at a comparatively trifling cost. The work is based chiefly on plants, but certain exercises involving the use of animals are included. The student is guided, in clear and simple language, through a series of experiments and observations on the structure, physiology, and chemistry of plants and animals, sexuality and fertilisation, inheritance and variation, while the implication of such knowledge on the problems of human society is not overlooked.

The book is admirably conceived and meets a distinct need. It is becoming increasingly necessary that some knowledge of biological principles should form part of the educational equipment of all men and women. Dr. Walker's book shows how this can be acquired in a simple and inexpensive manner, and points the way to a wide dissemination of such knowledge through the medium of tutorial classes for adult students.

A Monograph of the British Lichens: a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part 2. Second edition revised. By Annie Lorrain Smith. Pp. ix+447+63 plates. (London: British Museum (Natural History), 1926.) 20*s.*

A SECOND edition of Part 2 of the well-known "Monograph of the British Lichens," published by the British Museum, has just appeared. Part 1 of the first edition was prepared by Crombie and published in 1894. Part 2, elaborated by Miss A. Lorrain Smith, was published in 1911. Miss Lorrain Smith then proceeded to the difficult but useful task of revising part 1 (1918): she has now laid lichenologists under a further debt of gratitude by revising and bringing up-to-date her own volume, part 2. She states in an introductory note that there are no fundamental changes in the new edition, though the addition of many species, some rearrangement of genera and species, and other alterations will be noted. Only those who have worked at the small saxicolous lichens can fully appreciate the time, care, and patience which are required in describing and naming this group of organisms. British lichenologists are singularly fortunate in having a flora thoroughly up-to-date, and by an authority such as the author, provided in the excellent series of monographs published by the British Museum.

Hydrology and Ground Water: a Practical Text-Book for the Use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water. By J. M. Lacey. Pp. viii+159. (London: Crosby Lockwood and Son, 1926.) 12*s.* 6*d.* net.

WITHIN about a hundred and fifty pages the author has attempted to condense a treatment of the various phenomena associated with rainfall and ground water. Naturally the treatment is summary in places. The earlier chapters on rainfall, especially the sections on cycles of rainfall, are least satisfactory, and would require to be expanded if the volume were to be of general value. But it is planned chiefly to meet the needs of the water engineer, and for this purpose it is certainly well arranged, clear, and useful. The chapters on wells and water storage are of particular value.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Oxygen Spectral Line λ=5577·35 Å.U.

A NUMBER of investigators, including Merton, Barratt, Johnson, Cameron and others, have shown that the spectrum of an element in the gaseous state can be profoundly modified if an electric discharge be passed through it when one or other of the rare gases helium, neon, argon is mixed in excess with it.

For example, Merton and Pilley showed that by this method it is possible to enhance greatly the arc spectrum of atomic nitrogen and even to isolate it completely from the spark spectrum of this element.

Again, it was shown a year ago by McLennan and Shrum that a line of weak intensity existed at λ 5577·35 Å.U. in the spectrum of oxygen, and that this line could be considerably strengthened when helium or neon were added in excess to oxygen excited by the passage of an electric discharge through it.

As McLennan and Shrum put forward the view that this line in the spectrum of oxygen is identical with the famous "green line" λ 5577 Å.U. observed in the spectrum of the light from the night sky, and in the spectrum of the aurora, we were led to engage during the past year in a rather exhaustive study of the main characteristics of the line. The results of this investigation will be given in detail elsewhere, but in the meantime we think it well to state here a few results that are of special interest now.

(1) The spectral line λ 5577 Å.U. has been shown to be obtainable with pure oxygen and with intensity the strongest when the gas is at a pressure of two millimetres of mercury and the exciting electrical discharge is passed through a tube about one metre long and three centimetres in diameter.

(2) When currents varying in strength up to 160 milliamperes were used, the intensity of the line steadily increased with the strength of the exciting electrical current.

(3) A new series of measurements has shown that the wavelength of this spectral line is very close to λ 5577·35 Å.U.

(4) This spectral line, λ 5577·35 Å.U. has never been observed in our experiments in the spectrum of any electrical discharge in the absence of oxygen.

(5) When an electrical discharge was passed through oxygen at a pressure of 2 mm. of mercury mixed with helium, the line was obtained with strongest intensity when the partial pressure of the helium was about 20 mm. of mercury.

(6) A series of carefully executed experiments has shown that the power possessed by the rare gases of enhancing the oxygen line λ 5577·35 Å.U., assuming the strength of the line in oxygen alone to be 1, is as follows: helium 1·7, neon 4·6, argon 84·2.

(7) When argon in excess was mixed with oxygen the line λ 5577·35 Å.U. was obtained with an intensity greater than that of any known line in the spectrum of atomic oxygen having a wavelength shorter than λ 6000 Å.U.

(8) Observations with a powerful echelon spectrograph showed that the oxygen line λ 5577·35 Å.U. is simple and without any fine structure.

(9) In studying the Zeeman effect with the line λ 5577·35 Å.U. it was found that magnetic fields of weak to moderate intensity produced a symmetrical broadening of the line, the magnitude and the character of this broadening being of the order and of the nature respectively of that usually shown by spectral lines having an atomic origin.

(10) It would appear that this spectral line λ 5577·35 Å.U. originates in an electron transition between atomic levels for oxygen provided by one or other of two new singlet-triplet schemes that were based on Hund's theory and were recently put forward (*Proc. Roy. Soc.*, July 1926) by McLennan, Grayson Smith and McLay.

J. C. MCLENNAN.
J. H. MCLEOD (Student of National Research Council of Canada).
W. C. MCQUARRIE.

The Physical Laboratory,
University of Toronto,
September 1.

Interference and Corpuscular Light.

IN the new wave theory of matter (Einstein, L. de Broglie, Schrödinger), the material point is conceived as a singularity in a wave. More precisely, in the absence of any field of force, the wave phenomenon called 'material point' is represented by a sinusoïdal solution of the equation:

$$\Delta u - \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2} = \frac{4\pi^2}{h^2} m_0^2 c^2 u, \quad . \quad . \quad . \quad (1)$$

where m_0 is a constant characteristic of the wave (proper mass of the material point). The function u has a uniformly moving singularity which *is* the material point. If the point at rest has a spherical symmetry, then the solution of (1) will be (the line of motion being chosen as z axis)

$$u = \frac{A}{\sqrt{x^2 + y^2 + \frac{(z - vt)^2}{1 - v^2/c^2}}} \sin 2\pi\nu\left[t - \frac{vz}{c^2}\right].$$

Further, the energy of the moving point is identical with the product $h\nu$.

In the special case of the light quant, we must suppose m_0 to be equal to an extremely small quantity if not to zero. Then the wave equation (1) reduces to the classical form:

$$\Delta u = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}. \quad . \quad . \quad . \quad (1')$$

For each problem of interference or diffraction, classical optics tries to find a solution of the form:

$$u = a(x, y, z)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (2)$$

satisfying the adapted limiting conditions. But, for the new mechanics, the motion of the light quants is given by a solution of (1′) of the form:

$$u = f(x, y, z, t)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (3)$$

where the amplitude f has many moving singularities. The function ϕ is to be the same in (2) and (3), and the singularities, *i.e.* the light quants, must describe the curves normal to the surfaces ϕ = Constant.[1] In substituting (2) and (3) in (1′), we get the two following relations connecting the classical amplitude a and the 'granulated' amplitude f, respectively, with the phase-function ϕ:

$$\frac{2}{a}\frac{\partial a}{\partial n} = \frac{1}{a^2}\frac{\partial(a^2)}{\partial n} = -\frac{\Delta\phi}{\partial\phi/\partial n}, \quad . \quad . \quad (4)$$

$$\frac{\partial\phi}{\partial n}\cdot\frac{\partial f}{\partial n} + \tfrac{1}{2}f\Delta\phi = -\frac{1}{c^2}\frac{\partial f}{\partial t}, \quad . \quad . \quad (5)$$

dn being an element of trajectory.

[1] Of course it remains to prove the existence of such a solution of equation 1′ in each case.

Now, by analogy with the solution for the free spherical material point, we can suppose that the quantity $f/(df/dn)$ is zero at the points occupied by the light quants at a given instant. Then the velocity of a quant in passing by a point M will be, for example, 5 :

$$v_M = \left(-\frac{\partial f/\partial t}{\partial f/\partial n} \right)_M = c^2 \frac{\partial \phi}{\partial n}. \quad . \quad . \quad . \quad (6)$$

The motion of the quants is permanent and $-c^2\phi$ plays the part of a velocity potential.

But, during the motion, the number of quants remains constant and along a very thin tube of trajectories, we must have :

$$\rho\sigma v = \text{constant}, \quad . \quad . \quad . \quad (7)$$

where ρ is the mean density of light quants in the wave and σ the section of the tube.

Hence, we conclude that :

$$\frac{1}{\rho}\frac{\partial \rho}{\partial n} + \frac{1}{v}\frac{\partial v}{\partial n} + \frac{1}{\sigma}\frac{\partial \sigma}{\partial n} = 0. \quad . \quad . \quad . \quad (8)$$

But infinitesimal geometry teaches us that the last term of the first member is equal to twice the mean curvature of the phase surface. Thus, equation (8) gives easily :

$$\frac{1}{\rho}\frac{\partial \rho}{\partial n} = -\frac{\Delta \phi}{\partial \phi/\partial n}, \quad . \quad . \quad . \quad (9)$$

and by comparing (9) and (4) we see that :

$$\rho = c \, . \, a^2. \quad . \quad . \quad . \quad . \quad (10)$$

The density of light quants is to be taken proportional to the classical intensity. In the dark fringes of the classical theory, the density of quants will be zero, but in a bright fringe a great number of quants will pass. Now, the motion being permanent, this explanation of the experimental facts will still be available if the light is very weak (Taylor's experiment) ; we have only to define the density of quants by a time average instead of a space average.

LOUIS DE BROGLIE.

Paris, August 27.

Science and Psychical Research.

I HAVE read the editorial note appended to the letters on this subject published in NATURE of September 11, and desiring to keep within the limits that you wish to be observed in this discussion, I have tried strictly to confine myself in the following remarks to replying to allegations against myself made by Sir Arthur Conan Doyle in that issue, as also to the specific points raised by Dr. Tillyard in his rejoinder to my letter on this subject published in NATURE of August 28.

Sir Arthur Conan Doyle states that my account of the incidents connected with the Combermere photograph, published in the issue of August 28 " is both inaccurate and misleading." It will, I think, be sufficient to direct attention to one only of Sir Arthur Conan Doyle's statements, to show whether he is, or I am, the more accurate person. After telling how I challenged him to publish, in the *Morning Post*, the ghost photograph alongside a photograph of the peer taken in life, Sir Arthur Conan Doyle goes on to say (italics are mine) —" I at once sent up my photograph *without any suggestion whatever that it would not reproduce*. That statement is a pure invention on the part of Mr. Campbell Swinton."

In reply to this, may I quote the opening sentence of Sir Arthur Conan Doyle's letter to the Editor of the *Morning Post*, published in that paper on April 23 ? It is as follows :

" I beg to enclose the Combermere photograph. I am advised that it will not reproduce, but you will be the best judge of that."

These two entirely contradictory statements, both from the pen of Sir Arthur Conan Doyle, show how little reliance can be placed upon the accuracy of what he writes, and I therefore do not propose to make any further reference to the remarks contained in his letter to NATURE except to say that they consist of a tissue of misrepresentation, together with a number of statements which are no more accurate than the one quoted above.

With regard to Dr. Tillyard's rejoinder, I should like, first of all, to say how much I appreciate the spirit in which he has accepted what may have seemed to him my somewhat provocative criticisms. I must, however, further criticise what he now says.

Dr. Tillyard complains that I do not distinguish between spiritualism and psychical research ; but, so far as I can see, the only distinction between the two is that the second includes the first, while I may add that, though the heading under which it appeared was " Science and Psychical Research," Dr. Tillyard's article purported to be a review of a " History of Spiritualism."

Nowhere have I ever suggested that the medium is one of the experimenters, as Dr. Tillyard surmises. On the other hand, I cannot agree with him that the medium is a mere instrument, such as a microscope or spectroscope, for, quite apart from the question of free will, which is probably an illusion, due to the same portion of the brain being concerned in determining both our wishes and our actions, human beings have consciousness and motives, which are things possessed by no man-made instrument or mechanism.

Dr. Tillyard states, " If a medium is found to be fraudulent, then the genuine psychical researcher will not proceed with him, but will endeavour to find a more trustworthy one." But this, anyway, was not the method adopted by Crookes, who, I suppose Dr. Tillyard will agree, was one of the greatest of psychical researchers. If we are to believe the authorised life of Sir William Crookes, written by Dr. Fournier d'Albe, " Crookes does not seem to have taken up the medium (Miss Cook) seriously until after she had been exposed by a Mr. Volckman, who seized ' Katie King ' (supposed to be a spirit) and found himself holding the medium (Miss Cook) dressed up."

Furthermore, Miss Cook, who had by then married and become Mrs. Corner, was again exposed by seizure, when masquerading as a spirit, by Sir George Sitwell, the well-known baronet. A detailed account of this exposure will be found under the heading " Capture of a Spirit " in the *Times* of Jan. 12, 1880, while in the *Times* for Jan. 15 following, there is a letter from the secretary of the British Association of Spiritualists (on whose premises the seance was held), on behalf of the council of that body, stating that Sir George Sitwell's account of what occurred was substantially correct. Sir George Sitwell quite recently told me that this complete exposure, which had wide publicity, made so great a sensation that it nearly wrecked the whole spiritualistic movement of that time ; so Crookes must have known all about it. Yet, a few years later, as recorded in Sir Arthur Conan Doyle's history, we find Crookes giving an unqualified testimonial as to the bona fide mediumship of this twice-convicted impostor.

All scientific men hold Crookes in the highest veneration both as a physicist and as a chemist, but what can they think of his judgment in respect to spiritualistic matters, having regard to what is disclosed above ?

Dr. Tillyard mentions the names of Crookes and of four other scientific men who studied spiritualistic

phenomena, and then asks me whether I can name a single one of these who did not become convinced of their genuineness. Surely this is a case of begging the question, as these are the particular five who did become convinced; but what about the others? What about Faraday, Tyndall, Sir David Brewster, and Dr. Carpenter, among those who are dead, and Prof. R. W. Wood of the U.S.A., Sir E. Ray Lankester, and Sir Bryan Donkin among those who are living? All these and many others have, I believe, made sufficiently serious investigations into the subject, though naturally, having come to the conclusion that there was nothing genuine in the phenomena warranting further research, they did not publish so much as other no more eminent, though perhaps more credulous investigators.

It may also be mentioned that, in 1908, a committee, including such eminent photographic experts as R. Child Bayley, F. J. Mortimer, and E. Sanger-Shepherd, though assisted by such a well-known spiritualist as Mr. A. P. Sinnett and others, failed to secure proof that spirit photography is possible.

Dr. Tillyard suggests that I should visit the National Laboratory for Psychical Research, but I must confess that I am not attracted by its name, which with its suggestion of parallelism with the National Physical Laboratory, seems to me to be *suggestio falsi*. I am informed that it is a purely private concern, with nothing national about it whatever. Apart from this, however, in my opinion thermographic phenomena in connexion with mediums are more a matter for a physiologist than for a physicist. That emotional disturbances affect the temperature of the body is, I think, fairly well known, and there does not seem to me to be any reason for dragging in such supernormal and incredible phenomena as the production of ectoplasm and such like in order to explain what are only commonplace matters. But then, all psychical researchers seem to delight in the maxim *omne ignotum pro magnifico*.

A. A. CAMPBELL SWINTON.

40 Chester Square, London, S.W.1,
September 10.

The Structure of the Continents.

As all the continental discussions of the observations of near earthquakes have been carried out by graphical methods, and as I could not satisfy myself as to the precision obtainable by these methods, I have recently carried out a rediscussion of the principal series of data by the method of least squares. These refer to the Kulpa valley earthquake of 1909, the Wurtemberg one of 1911, the Tauern earthquake of 1923, and the Oppau explosion. The results indicate very definitely that there is an upper layer that transmits compressional waves with a velocity of 5·6 km./sec. (though a velocity of 5·4 km./sec. would fit the Oppau explosion slightly better) and a lower one where the velocity is 7·8 km./sec. In addition, the Tauern earthquake gave rise to a wave with a velocity of 6·2 km./sec., which must have travelled in an intermediate layer. The probable error of all these velocities does not exceed 0·1 km./sec. The result for the upper layer corresponds to that found for granite by E. D. Williamson and L. H. Adams. The recent work of L. H. Adams and R. E. Gibson gives a velocity of 6·4 km./sec. in basaltic glass, and of 8·4 km./sec. in dunite, at ordinary temperatures and at pressures corresponding to depths of some tens of kilometres. If we allow for the higher temperatures within the crust, the basaltic layer below the granite may be in a glassy state, as Daly has suggested, and the lower layer may well be dunite. The evidence indicates that there is no further sudden change to a depth of about 1200 km.

The times of arrival of all the waves were linear functions of the epicentral distance; the consistency of the observations was great enough to give good determinations of the gradients of these functions, and hence of the velocities, but it was not enough to establish any departure from linearity. Hence there was no material for a determination of the depths of the foci or of the variation of velocity with depth in the various layers. By combining the results for near quakes with those for distant ones, however, it was possible to estimate the rate of increase of velocity with depth in the lower layer.

The observations permit a rough determination of the depths of the granitic and basaltic layers. The former may be about 12 km., the latter about 20 km., but both are subject to an accidental error of about 4 km. In addition there is a possibility of systematic error. Uncertainty as to the depth of focus may allow the thickness of the granitic layer to be doubled. On the other hand, the movement on the seismogram due to the indirect waves starts more gradually than that due to the direct one, and this may cause a slight delay in their measured time of arrival, especially as most of the observations seem to have been made on instruments recording on smoked paper. On this ground the depths determined may require some reduction.

I think, therefore, that determinations of the depths of the layers by means of near earthquakes are not more reliable than those based on the earth's thermal state, isostatic balance between continents and oceans, and the group-velocities of surface waves. All of these are affected by uncertainty concerning the thickness of the basaltic layer, but the uncertainties of the method based on the compressional waves from near earthquakes appear more serious. The results, taken as a whole, are as consistent as can be expected; a thickness of 10 to 15 km. for each layer would be within the range of uncertainty of every method.

HAROLD JEFFREYS.

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Curved Path of Wireless Waves.

IN a recent number of the *Proceedings of the Royal Society* (Series A, vol. 111, N.S. 757) there appears under the title of "Discussion on the Electrical State of the Upper Air," a paper giving the views of several of the authorities who have contributed to the examination of this subject.

The discussion really turns on the question as to why wireless waves follow the curvature of the earth instead of spreading into space.

Heaviside supposed that this was due to a hypothetical conducting layer of the atmosphere existing at a great altitude above the earth's surface, which would act as a reflecting barrier and would compel the wave to remain within the envelope formed by it. Only one contributor to the discussion referred to refraction and diffraction as possible causes.

If it were assumed that the speed of long waves is the same as that of ordinary light, and depends in the same way on the density of the air, then refraction would account for, roughly, one-tenth of the observed deflection. I believe, however, that there are no direct measures of the velocity of long waves, and there is no sufficient knowledge of the nature of the 'ether' or of its relation to ponderable matter to allow of any certain, or even probable, theoretical deductions on this point.

As regards the velocity of visible light in air, the shorter the wave-length the less the velocity, but if it is true that X-rays are only shorter but otherwise similar waves, then since it is found that their refractive index for all substances through which they can pass is practically unity, there must be, at and after a certain shortness of wave-length is reached, a condition in which a decrease of wave-length is accompanied by an increase in velocity.

At the other end of the spectrum (where wireless wave-lengths are reckoned in miles) it seems not impossible that there may be a drop in velocity as the wave-length increases, although at present a physical explanation may be wanting.

A case of diminished velocity with increased period would occur in air if the waves were of such great length that the heat due to compression had time to diffuse. For such waves the velocity would tend to approach that given by Newton.

If it were found that for 'wireless' waves the velocity increased about one part in four thousand (the velocity of light is scarcely known to this degree of accuracy) per mile of height above the ground, the reason for such waves following the curvature of the earth would require no further explanation, and until experiment proves that there is no such change, it would be reasonable to impute the observed curvature of path to this kind of cause.

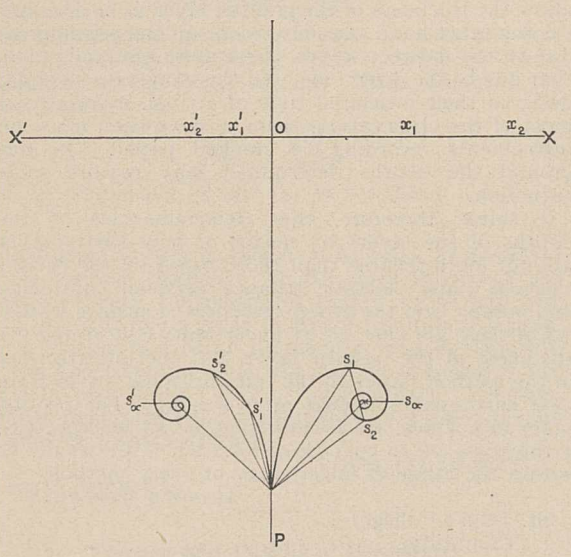

FIG. 1.

Assuming for the moment that the velocity of the long waves is in part dependent on the atmospheric conditions and increases with the elevation, it is certain that it will vary at different parts of the earth's surface, and this being so, the variation in the intensity and direction of trains of long waves would be only a leisurely analogue of the 'twinkling' of the stars.

Diffraction would have a slight effect in favour of increasing the audibility of signals when the observing station was within the 'shadow' of an obstruction, but this would only be noticeable for distances which were small fractions of the earth's radius. Diffraction would also cause variations of intensity at different levels above the boundary of the shadow, but it is unlikely that these 'bands' could be recognised without some instrumental aid in comparing intensities.

Nearly fifty years ago I gave [1] a graphical construction for determining diffraction effects, which as it was not published and is of very general application, I reproduce below.

Let it be required to know the intensity of the light at a given point in the normal to a wave surface.

For simplicity let the problem be one in two dimensions, and the wave surface be a line $X'OX$ (Fig. 1) emitting co-phasic waves confined to the plane of the paper. It is required to know the intensity at P due to all the partial waves emanating from $X'OX$.

Starting from P draw the curves S and S', such that the elements of arc at S and S' are proportional to the amplitude at P of the waves received from the elements dx and dx' at x and x', and also that the angle which the tangents at S and S' make with the normal OP, are the differences in phase in which the partial waves from x and x' reach P from the corresponding phase of the wave from O. Then the square of the chords PS and PS' are proportional to the intensity of the light which reaches P from either side of the normal between the limits x and x', and the total intensity at P is the square of the resultant of PS and PS' and the phase is given by the angle which the resultant makes with OP.

If x and x' are both infinite the intensity is given by $2PS_\infty^2$, and the phase is the same as that which reaches P from O.

If $x=\infty$ and $x'=0$ the intensity is PS_∞^2, and the phase differs from that of the wave from O by $\pi/4$. (This is the intensity at the edge of the geometrical shadow of O.)

If the source of illumination consists of disconnected portions of the line XOX', lying, say, between the limits x_1x_2, x_3x_4, etc., the resulting intensity at P due to each portion will be given by the squares of the chords s_1s_2 . s_3s_4, etc., and the square of the resultant of these chords will give the total intensity.

The formal proof of this construction is simple and need not occupy space here.

I have recently been told that a somewhat similar construction was given by Cornu, but this I have not seen.

A. MALLOCK.

9 Baring Crescent,
Exeter.

[1] This was in a Report to the Royal Society on the ruling of diffraction gratings, and on the variation of the intensities of the different orders of spectra as affected by the form of the cross section of the grooves.

Schroedinger's Quantum Theory and the Stark Effect.

THE theory of atomic oscillations recently advanced by Schroedinger is of extraordinary importance since it throws a new light on the problems of atomic structure and, at the same time, offers a convenient practical method for calculating the Heisenberg-Born intensity matrices. It seemed desirable to apply it to as many special cases as possible. A complete theory of the Stark effect in hydrogen was, therefore, developed.

The first order effect (displacement of lines proportional to the first power of the electric field) turned out to be identical with that obtained by the writer on the basis of Bohr's theory (*Ann. d. Phys.*, 50, 489, 1916). The second order effect (displacement proportional to the square of the field) differs slightly from the expression found in the old theory by the writer (*Ann. d. Phys.*, 51, 184, 1916) and independently by Mr. Mosharrafa (*Phil. Mag.*, 46, 753, 1923). The dependence of this term on the three quantic numbers n_1, n_2, n_3 is expressed in the new theory by

$$-(n_1+n_2+n_3)^4\{17(n_1+n_2+n_3)^2-3(n_1-n_2)^2 - 9n_3^2+18n_3+10\},$$

while in the old theory the terms $18n_3+10$ were

absent. Messrs. Takamine and Kokubu found a slight second order displacement of the central components of the H_γ line in a field of 130 kilovolts. Both formulæ give for this displacement practically the same value of 0·3 Å.U. in the right direction (while the absolute value of 0·3 Å.U. seems of the right order of magnitude, but somewhat smaller than the observed shift), so that the additional terms do not permit us to distinguish in favour of either theory.

Most interesting are the new intensity formulæ—comparatively simple closed expressions. It is known that in the old theory the correspondence principle was not sufficient to account for the intensities completely and that certain orbits ($n_3 = 0$) had to be eliminated by a special ruling prohibiting the electron from falling into the nucleus. Such a dualism is not necessary in the new theory; the state $n_3 = 0$ simply does not occur, and there is no need of any artificial restriction. So far, only the intensities of the *p*-components have been calculated. Comparing the calculated values with Stark's observations, the writer found the same situation which was stated by H. N. Russel in his work on intensities of multiplets (NATURE, **115**, 835, 1925). The values estimated by observers agree, not with the calculated intensities, but with their square roots, *i.e.* with the absolute values of the amplitudes. Allowing for this, the agreement is fair, as appears from the following tables:

H_α line.			H_β line.		
Z.	Obs.	Calc. Ampl.	Z.	Obs.	Calc. Ampl.
2	1	0·8	0	1·4	0
3	1·1	1·1	2	1·2	1·8
4	1·2	1·3	6	4·8	4·8
			8	9·1	8·3
			10	11·5	9·9
H_δ line.			H_γ line.		
0	0	0	2	1·6	1·6
4	1	0·8	5	1·5	1·7
8	1·2	0·8	8	1	1
12	1·5	1·7	12	2·0	2·2
16	1·2	1·2	15	7·2	6·2
24	2·8	6·1	18	10·8	9·8
28	7·2	6·7			

We can say that the new theory based on Schroedinger's ideas accounts for the Stark effect at least as well as the old one.

PAUL S. EPSTEIN.
California Institute of Technology,
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July 24.

Atomic Volumes of Carbon and Hydrogen.

PROF. INGOLD has introduced an important modification of Baeyer's strain theory, which brings the calculated ring strains into closer agreement with the thermal data of the cycloparaffins and with the general chemistry of the formation and decomposition of this series of saturated hydrocarbons (*Trans. Chem. Soc.*, 119, 305, 1921). He has pointed out that the carbon atoms in a cycloparaffin are secondary and, by assuming that the carbon atoms attached to the central one occupy more of the surrounding space than the two hydrogen atoms, has calculated the angle (115·3°) between the carbon to carbon valencies from the atomic volumes of carbon and hydrogen.

Objection may, however, be taken both to the method of calculation and to the values (Traube's) employed for the atomic volumes. In deducing the equation for the angle it is assumed that the two spheres representing the attached carbon atoms and the two spheres representing the hydrogen atoms are in mutual contact. This assumes either that the central carbon atom has a very much smaller volume than the carbon atoms united with it, or that the domains of the atoms are far from mutually exclusive. Neither of these assumptions appears to be in harmony with the main thesis that the value of the angle is determined by the volumes of the attached groups. It is possible, having determined the angle by this arrangement, to allow the small internal carbon sphere to assume its normal size without altering the angle, but, since the four attached spheres would then be moved through unequal distances, it is difficult to see how the arrangement then obtained depends directly on the volumes of the surrounding atoms.

Now the two spheres representing the attached carbon atoms and those representing two hydrogen atoms may be placed in contact with a sphere, representing the central carbon atom, in such a way that the inner tangents from the centre of the central sphere to each pair of adjacent spheres (in the plane through their centres) make equal angles. In such an arrangement allowance for the different atomic volumes of carbon and hydrogen is made directly, and, if the atomic volumes of carbon and hydrogen are taken as 4 : 1, it can be shown that the angle of the carbon to carbon valencies is 116° 34′. It would appear from recent investigations that the ratio 4 : 1 is a better measure of the atomic volumes which Prof. Ingold employed.

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June 21.

A Glaciated Ochreous Flint from Cromer.

DURING a recent visit to Cromer I found upon the foreshore site there, a flint of pyramidal form, and typical ochreous colouration. The more or less flat base of the pyramid is extensively glaciated (Fig. 1),

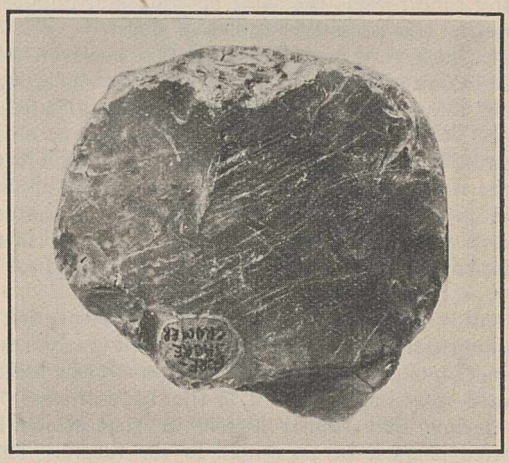

FIG. 1.—Glaciated surface of an ochreous flint found upon the foreshore site at Cromer. Half natural size.

and the striæ were obviously imposed after the flint was patinated. The ochreous specimens from Cromer are, as a rule, remarkably free from striation, but it is evident that this particular flint was exposed to the effects of moving ice—possibly of the second glacial epoch of East Anglia. In any case the specimen is, without doubt, glaciated, and its discovery affords final proof of the great antiquity of the ochreous flints found upon the Cromer foreshore.

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Psychological Aspects of Our Penal System.[1]

By Dr. JAMES DREVER.

THE root idea in punishment as ordinarily understood is the infliction of some kind of disagreeableness, pain, or loss on an individual, because he has been guilty of some misdeed. There are thus two aspects—on one hand the infliction of hurt, on the other hand the relation of this to some wrongdoing or crime. Originally any end to be gained by such infliction was scarcely conscious, if it existed at all—any end, that is to say, beyond the satisfaction of the anger evoked by the misdeed itself. The psychological source is to be found in the anger caused by the wrong. From this primitive source to the modern conception the evolution of theories of punishment, conscious or unconscious, may be said to have passed through four stages or phases. These may be designated the vindictive, the retributive, the protective or deterrent, and the reformatory or curative.

To begin with, an individual who has suffered injury by the wrongdoing of another responds to the injury with the emotion and impulse of anger. This is satisfied by the infliction of some hurt on the wrongdoer. At the simplest and crudest stage of development—the stage where we have to deal with the mere instinctive impulse of the brute or the savage—the hurt inflicted on the wrongdoer may have no direct relation, either in kind or in degree, to the injury done, but only to the intensity of the anger evoked. Of course this is not really punishment in any strict sense. Nevertheless it is unquestionably the psychological origin, and it therefore marks the first stage in the evolution of what became punishment in the strict sense. This is the vindictive stage or phase. In so far as punishment at any time reveals the same emotion and impulse it represents this primitive vindictive stage.

Even in a very primitive social life, however, some crude notion of justice must very early act as a determining influence on the hurt that may be inflicted on another for some injury done. So far as some notion of justice is a conscious determinant of the hurt inflicted on the wrongdoer by the injured individual, this hurt takes on the character of retribution, and punishment as such comes into being. This phase or stage in the evolution of punishment is the retributive phase or stage.

Another factor must have made its influence felt in a rudimentary way at a comparatively early stage. The notion of punishment must have involved a looking forward as well as backward, in the shape at least of a dim feeling that similar actions to that which has incurred it must be prevented in the future. There can be little doubt, that is to say, that at a comparatively early stage primitive society must have felt vaguely that punishment had a protective function, since by means of punishment of a culprit the individual and society were protecting themselves against the repetition of an injurious act.

The general line of evolution of our modern penal systems is thus clear. First of all we have purely vindictive action on the part of the injured individual. Then there is some sort of legalising—if we may use that word—of retributive action on the part of the injured, so long as this retributive action does not go beyond the limits of 'justice,' this being regulated by social law. Finally, recognising that punishment has a protective function as far as social life is concerned, society itself takes over the infliction of punishment, and a penal system is inaugurated. This stage or phase is the protective or deterrent stage or phase.

Evolution of a Penal System.

To leave the matter thus, however, would be to obscure important aspects and phases of the actual course of events, and could not fail to produce a misleading impression of the facts. Stages in social evolution are never clear-cut. Thus the development of the retributive view of punishment by no means involved the discontinuance in practice of vindictive punishment. Still less did the realisation of protection as the primary social function of punishment alter the practice which had been founded on the older and more primitive conceptions. Practice lagged a long way behind theory in this, as in so many other cases.

The psychological explanation of the actual facts would appear to be that the crude emotion of anger remained the driving force behind punishment, though it was cloaked and obscured by other motives, and by various forms of rationalisation. After all, the reaction of anger is a natural reaction to an act which society agrees in reprobating. One leading authority on criminal law has indeed placed on record his conviction that it is "highly desirable that criminals should be hated, that the punishments inflicted upon them should be so contrived as to give expression to that hatred, and to justify it so far as the public provision of means for expressing and gratifying a healthy natural sentiment can justify and encourage it." I am afraid the learned author's thoughts have become somewhat mixed up in the latter portion of this statement. It sounds as if his rationalisation were not very satisfactory, even to himself.

However that may be, it is certain that the realisation by society in theory that the function of punishment from the point of view of society was primarily protective did not prevent an almost religious sanction continuing to be attached to the *lex talionis*. This remained, in fact, an assumption at the base of all penal systems which no one seriously challenged; and it is equally certain that the protective function of punishment was frequently made the excuse, as in the writer just quoted, for continuing the practice of vindictive punishment—'for deterrent purposes' was the usual rationalisation—even when it was quite evident that the psychological situation thus produced was often inimical to the ends sought. One need only instance the brutalising influence of capital punishment on society at large, and its inevitable tendency to increase the frequency of the crime of murder, during the period when it was the punishment also for less serious crimes, to show the kind of psychological situation which was created. Curiously enough the more humane—and indeed saner—attitude and practice of modern times in civilised countries were

[1] From the presidenial address to Section J (Psychology) of the British Association, delivered at Oxford on August 6.

due far less to recognition of the fact that vindictive punishment for deterrent purposes was frequently an entire failure, than to the fact that the infliction of pain and suffering on human beings became objectionable to the general sense of society.

The phase or stage of evolution at which we have now arrived is characterised, on one hand, by the discontinuance, or the radical limitation, of what was virtually the primitive vindictive punishment in disguise, and on the other hand by the recognition of social punishments as possibly possessing a reformatory or curative function. We may speak, therefore, of the present phase or stage as the reformatory phase or stage in the evolution of social punishment. The actual situation, however, is somewhat complex. Practically punishment still rests, in law and in popular thought, on the retributive basis—the *lex talionis*. Theoretically it is recognised that from the point of view of society punishment is protective, and this is its primary function, and also, I believe, that society is not directly concerned with the retributive aspect of punishment as such, but only indirectly because of the deterrent effect of retributive punishment. Moreover —and this is the mark of the phase of evolution at which we have arrived—it is realised that, so far as the individual is concerned, social punishment may be made reformatory, and that the reformatory function of punishment is worth keeping in view, if only because reformation of the individual means protection of society against the repetition of the injury so far as that individual is concerned, always provided that the attempt to reform the criminal does not involve the sacrifice of the primary aim.

PUNISHMENT OR REFORMATION?

The psychological problems of social punishment fall into two groups: on one hand those involved in the effects of punishment on the individual who is punished, and on the other hand those connected with the effects of punishment on the community itself. Of course there is a repercussion on society of the effects on the individual, so that the problems of punishment are ultimately in every case social problems. Nevertheless, we shall find it convenient to consider the two groups of problems separately in the meantime.

Consider first the problems arising in connexion with the effects of punishment on the individual who is punished. So long as the retributive aspect of punishment is placed in the foreground, the only psychological problems of serious import are those involved in the question of the responsibility of the offender. This question of responsibility is one over which medical and legal minds have long been at loggerheads. The source of this age-old controversy between lawyer and medical man lies primarily in the fact that the two use the word 'responsibility' in entirely different senses. For the lawyer 'responsibility' is purely a legal term, and the question of responsibility is to be determined on the basis of evidence germane to its legal meaning. For the medical man 'responsibility' is an ethical term, and the question of responsibility therefore raises much wider issues.

The psychological problems involved in the legal definition of responsibility are, more especially in so far as the question of control is raised, extremely difficult. I do not believe, however, that responsibility in this sense is a practical issue at all in connexion with any penal system. At least it does not arise in the form in which it is usually raised, or at the point at which it is usually raised, in a practical consideration of the problems of punishment as affecting the individual who has infringed social laws.

It is when we emphasise the protective and particularly the reformatory aspects of punishment that the vital psychological problems emerge. So far as we base our practice in social punishments upon these two functions, it is not too much to say that our whole practice must be guided primarily by the outcome of psychological inquiry. The two functions are not in conflict. We may aim at the protection of society by the reform of the delinquent. Treatment which is successful in eliminating a particular tendency to delinquency in an individual will *ipso facto* protect the community against the repetition of this delinquency by the same individual. Of course it will not necessarily protect society against the same form of delinquency in another individual. That is why we have to consider punishment, rather than reformation pure and simple, and that is why the silly and sickly sentimentality which regards the wrongdoer as a suffering victim rather than a criminal will always fail to appeal to any one, no matter how soft-hearted, who regards the whole situation frankly and sanely.

It is obvious also that the failure of reformatory measures must not be taken to imply the failure of society to protect itself. Other measures must be available, which are merely protective, and not at all, or only indirectly, reformatory. On the other hand, it is clear that reformation is, as a rule, the more economical way to secure protection for the community, provided there is reasonable hope of success, and so long as we restrict our attention to the individual delinquent. The reform of the delinquent is doubly a social gain. From being a minus quantity with respect to social efficiency he becomes a plus quantity. This point is especially important in the case of the juvenile delinquent.

Punishment exerts its influence through disagreeableness, or the fear of disagreeableness. The function normally performed by unpleasantness encountered in the activity of any living organism is to guide the activity so that unpleasantness may in future be avoided. The fear of unpleasantness again checks the immediacy of impulse, and so allows time for a new kind of behaviour to be substituted for the old kind which led to unpleasantness—the beginnings in the case of the human being, it is worth noting, of self-control. But it is only low down the scale of organic life that the phenomena are to be seen in their simplicity. As we pass up the scale the inner conditions which determine behaviour become more and more complex, and the actual results of any unpleasantness or fear become more and more difficult to foretell. With the human being the complexity of the inner situation has become enormous. The web of impulse and motive is so intricately and so subtly interwoven that the introduction of a new impulse and motive may come to have a result wholly unforeseen and entirely different from the result intended.

Practical Difficulties.

The most important source of practical difficulty is frequently our almost complete ignorance of the inner conditions which issue in any particular misdemeanour. This necessarily involves ignorance of the effect which our punishment is likely to produce. So far as the reformatory aspect of punishment is concerned, this is a very serious matter. We have to deal with an individual, and we must know the facts of that individual case. Any psychologist who has had experience of conflict cases among juvenile delinquents, can easily find illustrations from his experience. The usual form of misdemeanour that occurs is stealing, and frequently irrational and apparently motiveless stealing. Thus money, jewellery, and all kinds of things may be stolen and given away, or even thrown away. Until the inner conditions are understood and the causes of the trouble removed, no kind of treatment seems to be of any avail. Or sometimes, where punishment is apparently successful in eliminating the tendency to one particular kind of misdemeanour, there is a criminal outbreak in a totally different direction, the result of the punishment itself, which more than counterbalances any apparent success.

Cases of this kind tend to make one speak and think of treatment rather than punishment. It might be asked whether this is not the point of view from which all cases should be approached, not as a matter of ethics, but as a matter of practical expediency, punishment being merely a particular method of treatment. The proposition is arguable, but only so long as we confine attention to the individual delinquent, and that is only one side of the picture, as we shall see presently. Personally, I do not think the point of view will matter very much so long as we keep firmly in mind the essential fact that the action taken, whether we call it treatment or punishment, is primarily action taken by society for its own protection, the reform of the criminal being a means adopted to this end. There is undoubtedly a class of offender in whose case treatment, rather than punishment, is the appropriate notion and procedure. Other cases occur with fair frequency in which punishment as ordinarily understood is quite ineffective as regards the reform of the individual. The case of serious mental defect may be instanced.

The facts are such that we find the old problems of responsibility, so far as they were practical problems at all, cropping up in a new guise, and in new surroundings. It may be possible to determine beforehand, without waiting for the event, whether punishment will be effective for reform, and if so what kind of punishment, or whether the case is one demanding treatment, and not punishment at all, and if so what kind of treatment. The problems now, however, are neither legal nor ethical problems, but purely psychological problems.

The suggestion that in some cases punishment, as ordinarily understood, may be quite ineffective leads us on to the consideration of the measures society takes, and must take, for its own protection in certain instances. The most important method of protection that society utilises is the restraint of the offender in some appropriate institution—so far as the idea of punishment is concerned, some sort of prison. The restraint or imprisonment may be merely temporary, or it may be permanent. In the first case it is clear that the reformatory aspect of punishment ought still to be kept in view, so far as the psychological situation is taken into account. If it is not, it does not require much foresight to prophesy somewhat lamentable results. In particular, if the criminal is returned to social life, not only with his tendency to the original form of misdeed unaffected, but with other anti-social tendencies developed by his prison life, or by circumstances arising out of his prison life, our only possible verdict is that society is playing the fool. On the other hand, when the restraint is permanent, while reformatory measures must not be entirely excluded as intrinsically hopeless in every case, it is clear that the whole psychological situation and outlook are different. The prisoner will never be returned to civil life. For the protection of society he must be kept in restraint permanently. But he is a human being, and the moral sense of society will demand that he be treated as such, not merely negatively by the avoidance of inhuman conditions, but also positively by the provision of such amelioration of his lot as is possible without sacrificing essential principles.

Every one is agreed, I think, as regards these general matters. There will also be general agreement that the stigma of prison life means in itself the very serious modification of the psychological situation in the case of every individual who incurs it, so serious that no psychologist can regard short-term prison sentences with anything but dismay. It must be recognised that it is with respect to prison treatment especially that society, in protecting itself, or attempting to do so, runs the risk of making matters worse instead of better, and the gravest practical problems arise with regard to this type of punishment. Much has been done in recent years to remove acknowledged evils and defects of our prison system. Much may still be done. Nevertheless, I personally, and I imagine most psychologists, would look upon any further advance in the directions hitherto pursued with serious misgivings as to psychological results, until we have first attacked more fundamental problems, and reviewed our whole penal system in the light of the psychological knowledge of to-day.

Need for Psychological Data.

Let me try to indicate where, in my opinion, the crux of the whole matter lies. I think all will agree that the very first essential is that we should have the requisite knowledge and understanding of the psychological situation with which we are faced, and the psychological effects likely to be produced by the action taken. Society has to decide whether an individual delinquent is to be punished in this way or that way, whether he cannot be reformed but must be placed under restraint for life, or can be reformed during temporary restraint by appropriate treatment, or can be reformed without undergoing prison life, and in each case what can and ought to be aimed at. No general theories concerning the causation of crime, no systems of penal philosophy, not even the best intentions in the world, can take the place of a thorough knowledge and understanding of the individual case. This is precisely where our whole penal system is at present most defective. Moreover, the defect is one

that can be remedied without serious difficulty in the present state of development of modern science, medical and psychological, but no opportunity is afforded.

The first and essential step towards the further reform of our penal system lies in affording this opportunity. This could be done by instituting a clinical examination, medical and psychological, of every delinquent before sentence is passed, and by taking advantage wherever possible of modern psychological knowledge. The psychological clinic is at present practically non-existent in Great Britain. It is high time this state of matters was remedied. School and law-court both demand its institution. That is the first step. When we have taken that step, we shall be able to take further steps in penal reform with the advantage of acting with adequate knowledge of what can be done, and what we are really doing in each particular case. Until that step is taken, every other change we introduce by way of reform has a hit or miss character, which cannot fail to be profoundly disturbing to any thoughtful student of social development.

It may be objected that we are in danger of losing sight of the fact that the topic under discussion is punishment, not simply the reformation of the criminal. The suggestion was made above that in certain cases at least it might be more appropriate to speak of treatment than of punishment, the suggestion involving the view that delinquency ought to be looked on as the outcome of something not unlike disease. However that may be, I do not think there is any warrant for excluding either the idea or the fact of punishment, provided we look to the future, and not simply to the past, in our conception of punishment. The action taken against an individual in the form of punishment must involve some disagreeableness or deprivation, and the reason for the punishment is some past act of the individual. But its purpose is the prevention of similar acts in the future. The fact that hitherto we have been discussing the individual aspect only has tended somewhat to obscure this deterrent function, and the consideration of this function will lead us over to the discussion of the social aspect.

The deterrent function of punishment has played no inconsiderable part in the discussion of penal measures at all times. The severity of past penal systems has been largely due—almost entirely so far as it has had a rational basis at all—to the attempt to deter others from similar offences to those for which punishment is inflicted on an offender. It is unquestionably the case that many a misdeed is prevented by the fact that the individual who is tempted knows that he will inevitably pay the penalty, and it is also a well-known fact that where, through the inefficiency of the police or other cause, punishment is easily evaded, crime shows a corresponding increase.

It cannot be lightly assumed, however, that the deterrent effect of punishment depends merely on fear of the disagreeableness or suffering which the punishment in itself involves. The penal system is an expression, however imperfect, of the sentiments of society with respect to certain acts—sentiments of hatred in varying degrees. It is not the result of a purely intellectual review of the social results and bearing of these acts. Apart, therefore, from the punishment by law decreed and legally inflicted, the criminal act is inhibited, so far as the normal socialised individual is concerned, by this sentiment in himself and in his fellows, how developed we cannot at present stop to consider, but resting ultimately on the primitive anger evoked by injury. "The sentence of the law," to quote again the legal authority already quoted, "is the moral sentiment of the public in relation to any offence what a seal is to hot wax. It converts into a permanent final judgment what might otherwise be a transient sentiment." Fear of the punishment as such, fear of the social disapprobation dependent on the evoking of the moral sentiment, of which the punishment is a concrete and tangible embodiment, recoil from the act because of the existence in the individual who is tempted of the moral sentiment in question in however feeble, attenuated, and fragmentary a form—all these are motives holding back an individual member of society from wrongdoing. The legal punishment exercises its deterrent influence because it, as it were, embodies and presents all of them in unmistakable and arresting fashion. The relative force of the different motives will vary with individuals. But until we can rely on the last of these motives being of itself sufficiently powerful to restrain every individual member of society from the breach of social laws—which would seem to involve a radical change both in the existing social structure and in human nature—the social necessity of some kind of penal system, in the strict sense, must remain.

In conclusion I would revert to the varying motives upon which the deterrent influence of punishment depends. Two points in particular demand notice. In the first place we cannot assume that penal law and moral sentiment will always be in harmony, and so reinforce one another. There may, in fact, be acute conflict between the two, so far as a considerable minority of the members of a community are concerned. In certain cases also they may be, so to speak, indifferent to one another. In either case the psychological situation is very radically modified, and the problems of punishment may in practice become very difficult.

In the second place the influence of the different motives may, as we have seen, vary with the individual. If that be so, two consequences would appear to follow. On one hand—and this refers more particularly to the adult criminal—our penal system must be such as to appeal with sufficient cogency to all the motives, so far as the criminally disposed individual is concerned. On the other hand—and now we have in mind chiefly the juvenile delinquent—it is of capital importance that we should recognise as early as possible in their criminal career those individuals who, either by nature or circumstances, or both, are tending towards abnormality in their reactions to social claims and social penalties. This brings us back to the crux of the whole situation. Means must be provided by which a knowledge of the individual case may be made available, before the decision is taken as to how any offender is to be treated. The temperamentally defective individual may be born, the habitual criminal is largely made. It ought at least to be possible to prevent the making of criminals. Again the glaring defect of our penal system stands revealed. No provision whatever is made for the diagnosis of incipient criminality. It is not merely a case of locking the door after the horse is stolen; it is a case of providing neither lock nor door.

The Use of High Pressures for Steam Turbine Installations.

By STANLEY S. COOK.

THREE different methods are available for the measurement of the performance of a steam engine, and serve that purpose from different points of view according to the particular feature of merit it is desired to emphasise. Thus, from the point of view of the manufacturer whose aim is to produce a turbine of the highest efficiency, that is, one which will convert into useful work the highest possible proportion of the pressure energy that is available in the steam, a figure expressing this proportion appears to meet the requirements of the case. This figure is almost (that is, except for the work of restoring the water of condensation to the boiler) identical with the 'efficiency ratio' as defined by Willans and Sankey in terms of the Rankine cycle, a ratio for many years accepted as the criterion of merit of a steam engine. The user of a turbine, on the other hand, is not so interested in what may be called the intrinsic efficiency of the engine, as in knowing how many pounds of steam per hour he has to generate in his boilers in order to produce a horsepower or kilowatt of output; consequently, a more significant expression of the engine's efficiency from his point of view is the consumption in pounds of steam per horse-power hour, under standard conditions of steam generation.

The latter method of statement of performance has also been commonly adopted, is if anything more familiar than the former and in a sense more practical. Used without qualification, however, it gives the manufacturer of the engine credit for any improvement he may make or find in the vacuum or in the steam conditions, although these are frequently taken into account by means of correction factors which reduce the consumption rate to a standard basis.

It must be recognised, however, that neither of these values supplies the user with the exact information he requires as to the cost of producing a unit of energy. It might easily be found, for example, that as the result of utilising higher pressures or lower vacua the efficiency ratio was reduced, but all the same a better overall result secured as measured in pounds of steam per horsepower, and even actually. At the same time, an improvement in consumption rate by improved steam conditions and improved vacua fails to take into account the increased cost of generating the steam under the new conditions.

A third and more comprehensive method is required to give an adequate measure of the performance of the steam engine as a heat engine. It must be remembered that a turbine is not correctly speaking a heat engine, but only a part of it. The expansion which is carried out in the turbine is only one of the processes in the complete cycle of the heat engine, which consists also of processes of heat rejection, re-compression and heat reception. The complete heat engine therefore includes the boiler in which heat is given to the steam, the condenser in which heat is extracted from it, and the condensate pump and feed pump which restore the condensed steam to boiler pressure.

The third method therefore relates to the heat engine as a whole, and aims at expressing its performance as a ratio of the net output, in equivalent heat units, to the heat energy latent in the fuel consumed. Such a ratio is known as the overall thermal efficiency. Its use is clearly necessary if satisfactory comparison is to be made between heat engines of different types, employing thermodynamic cycles of different character.

Inquiry must therefore be made into the conditions which make for the highest thermal efficiency. Now if it be presupposed that the highest possible efficiency of heat transmission in the boiler has been obtained, and the highest possible intrinsic efficiency of the turbine, there still remains another factor of supreme importance, namely, the efficiency of the thermodynamic steam cycle which alone determines the ratio between the heat supplied to the steam and the pressure energy that is available for the turbine. The turbine is able to use efficiently all the available energy that can be given to it, and it therefore remains to provide that the efficiency of the thermodynamic cycle shall be made as high as possible subject to practical conditions. At this point the problem becomes a thermodynamic one, and this ratio is a function of the conditions of heat reception and heat rejection.

The law which governs this question was enunciated by Carnot more than a century ago. It is that in order to obtain the maximum thermodynamic efficiency the temperature of heat reception must be made as high as possible and the temperature of heat rejection as low as possible. In the perfect Carnot cycle heat is received at a constant high temperature and abstracted at a constant low temperature. The heat received is proportional to the absolute temperature of reception, and the heat abstracted to the absolute temperature of rejection. The difference between these quantities of heat is the amount transformed into work, so that the thermodynamic efficiency of the perfect engine becomes $(T_1 - T_2)/T_1$ where T_1 and T_2 are the higher and lower absolute temperatures. It is easily seen that this ratio is increased by increasing T_1, or by decreasing T_2, or both.

The past success of the steam engine as a prime mover is due to two causes, the high value of the latent heat of steam and its ability to work on what is known as the Rankine Cycle. In the latter the compression stage of the Carnot cycle is replaced by the simple process of elevating the condensed water to boiler pressure. The consequent reduction of negative work gives this cycle a great practical superiority.

On the other hand, the employment of such a cycle involves a departure from the above-mentioned principle of heat reception at a constant maximum temperature. The heat is in fact supplied to the steam at a variety of temperatures. The feed water has to be raised from condenser temperature to the boiling point corresponding to the pressure of the boiler. Evaporation in the boiler takes place at that temperature, and the temperature of the steam is then raised continuously to the maximum temperature of superheat. The thermodynamic efficiency of each portion of the heat so supplied is conditioned by the ratio of the absolute temperature of supply to the absolute temperature at which all the heat is abstracted in the condenser.

Now the heat given to the steam during the process of evaporation, namely, the latent heat, is a large proportion of the total heat supplied. For example, with a boiler pressure of 250 lb. per square inch, a superheat of 200° F. and a condenser vacuum of 29 in. Hg. the latent heat is 836 B. Th. U. per lb. of steam out of a total supplied of 1276 B. Th. U. per lb. during the three processes just mentioned, or 65·5 per cent of that total. Omitting the heat required to heat the feed water, since, as will be seen presently, the disability of the low temperature of this process can be overcome, the total heat required for evaporation and superheat is 950 B. Th. U., of which the latent heat added during evaporation is 88 per cent. It is clearly, therefore, of importance from the point of view of obtaining the highest thermodynamic efficiency of the cycle that the heat supplied during the stage of evaporation shall be supplied at as high a temperature as possible. The temperature of this part of the heat reception can only be raised by increasing the boiler pressure.

At the same time, an increase of the maximum temperature of the superheated steam will lead to further improvement in efficiency, since this means additional heat reception at the highest temperature. In the case of superheat, there is the additional advantage that with a higher degree of initial superheat, the steam is in a dryer condition in the final stages of its expansion.

The circumstances are best visualised by means of an entropy temperature diagram. Fig. 1 is such a

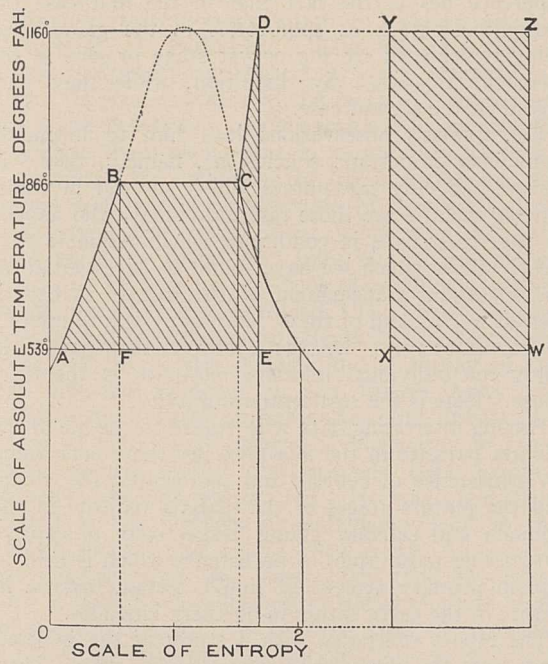

FIG. 1.—Entropy temperature diagram for the Rankine cycle for steam with boiler pressure 250 lb., condenser temperature 79° F. and superheat to 700° F.

diagram representing the Rankine cycle for steam with a boiler pressure of 250 lb. gauge, a condenser temperature of 79° F., and superheat up to a maximum temperature of 700° F. Each stage of the cycle is represented by a curve on the diagram, and the property of the diagram is that, with absolute temperature as the vertical ordinate, the area vertically beneath any curve, or portion of a curve, which corresponds to a change of state is proportional to the heat taken in or given out during that change. The rising curve *AB* represents the heating of the feed water to boiler temperature, by whatever means it is carried out; the line *BC* represents the generation of steam and is horizontal because this takes place at constant temperature; the rising curve *CD* represents the superheating of the steam. No heat is taken in or given out during expansion in the turbine, so that the vertical line *DE* represents expansion of the steam down to the temperature of the condenser. In the condenser, condensation takes place at constant temperature, and is therefore represented by a horizontal line *EA*, which completes the cycle. The area enclosed by the cycle *ABCDEA* represents the excess of the heat taken in from the boiler along *ABCD*, over that rejected into the condenser along *EA*. This area therefore represents the energy which is available for conversion into work.

The shortcomings of this cycle can be seen at a glance if we compare it with another cycle *XYZWX* in which all the heat received from the source is taken in at the highest temperature along *YZ*, and that rejected is rejected at the lowest temperature along *WX*. Here the work done is represented by the area of the rectangle *XYZW*, whilst the heat taken in is represented by the larger rectangle from *YZ* down to the base line. The proportion of the work done to the heat taken in is much higher than in the cycle *ABCDE*, and this is clearly seen to be due to the high temperature at which all the heat is taken in along *YZ*. The underlying areas of the first diagram shew us at once that, of the heat taken in along *AB*, that is, during the heating of the cold feed in the boiler, only a small percentage is converted into useful work. The heat taken in along *BC*, which is the latent heat of the steam, contributes a larger percentage, but still considerably less than the maximum. Even that received along *CD* during the process of superheating, yields less than the ideal maximum efficiency.

While the diagram thus exhibits the shortcomings of the Rankine cycle in comparison with an ideal Carnot cycle, it is of interest to remark that similar departures from the ideal are present in any type of engine in practical use. The internal-combustion engine, for example, contains an even greater departure from the ideal of constant temperature reception of heat, although its actual temperatures both of reception and rejection are higher throughout than in the steam engine.

Returning to the Rankine cycle for steam, it has been stated that the heat received during evaporation is a large proportion of the total heat received. That this is the case is readily seen from the diagram, this heat being represented by the area below *BC* down to the base line. By what is known as cascade feed heating, that is by heating the feed water by steam bled from the turbine at suitable successive stages, it is possible to a large extent to eliminate that part of the diagram which underlies *AB*, since by this process if carried out in its entirety the heat represented by the area from *AB* down to the base line can be saved, at the expense of a loss of work which can be shown to be equivalent to the area *ABF* for each lb. of steam. To raise the temperature of reception of the heat absorbed during

evaporation, which in the case already considered is 88 per cent. of the total heat absorbed along *BCD*, would clearly result in considerable improvement of the efficiency of the thermodynamic cycle. Thus not only high temperatures, as in the case of the adoption of high superheat, but also high boiler pressures, lead to a substantial increase in over-all thermal efficiency.

The question of the improvement of the thermal efficiency of the steam engine by such means is one of prominent interest in the engineering world at the present time. Advances in this direction have already been made for land installations, and recently we have witnessed an application of the same principles to marine work, which had been awaited with keen interest, and was not without an historic setting. It is just a quarter of a century since the first commercial application of the steam turbine to marine work was made in the Clyde river steamer the *King Edward*, which, built in 1901, has continued in successful service season by season up to the present time. A new vessel, which has a high-pressure steam installation of geared turbines on the lines indicated above, has been built for the same owners and for the same service. This vessel, which has been named *King George V*, becomes in its turn the pioneer of the new system.

Malaria and the Mosquito.

THE enthusiast who is 'eradicating' malaria by any or all of the well known methods, should cease for a while from his labours and study the short report recently issued by the League of Nations and referred to below.[1] In Col. James's words, "He will at least realise what a great waste of effort is involved in measures directed against the breeding-places of mosquitoes as a whole and even in similar measures directed against one species. He will begin to appreciate how the secret of a successful control of malaria lies not in the general knowledge that the disease is spread by mosquitoes of a certain kind, but in the particular exact knowledge of the life history of the few individual mosquitoes which succeed in becoming transmitters of the disease."

This is a refreshingly new aspect of the problem. The enthusiast eradicates all mosquitoes. He does not stop to distinguish a Culicine (non-malaria) from an Anopheline (malaria) mosquito; he is out to destroy them all. Now he is advised to study not only the species of Anopheles which are concerned in transmission, for all are not, but also actually to concern himself about infected individuals! Why should he do this? It is because "Malaria is essentially a household disease and particularly a disease of certain kinds of houses . . . . Malaria should be dealt with in the houses of the people rather than in the environment." We have called this a new aspect of the problem, but the author points out that some twenty-five years ago Stephens and Christophers in their reports to the Royal Society directed attention to "fever houses." They state: "We may look upon such a house and its accessory hovels as one infected with malaria or as 'a fever house.' Such is the universal condition of European houses indeed in the remote stations situated in the African bush. It is in such houses that the malarial cachectic is living, exposed to frequent or even constant re-infection and in which every traveller staying the night is liable to infection. From such fever houses the majority of our cases of blackwater have come."

It has always been somewhat disconcerting that while, for example, in a native African village more than 75 per cent. of the children may be infected with malaria, yet the infection rate of sporozoites (infective stage of the malaria parasite) among the anophelines may be low, less than 5 per cent. Once infected, however, a single mosquito becomes exceedingly dangerous; how much so is shown by the fact that a mosquito which has lived (in captivity) 1-3 months and has bitten nearly half a hundred people in that time may still have numerous sporozoites in its salivary glands and is consequently still potent for mischief. But, on the other hand, if not bitten oneself, one may draw comfort from the fact that a mosquito is gradually purging itself of infection by biting other people, so that while 85 per cent. of mosquitoes showed a salivary glands infection on the 50th day, on the 70th day this was reduced to 20 per cent. (the glands, moreover, containing but few sporozoites), the mosquitoes having bitten about a dozen people in the interval. This at first sight appears inconsistent with the previous statement, but the difference lies in the fact that in the first case the mosquitoes' stock of sporozoites in the glands was being replenished by the oocyst stage present in the stomach, as shown by dissection, while they were absent in the second case.

Col. James's observations lead him to formulate some very important conclusions, namely, that "in Nature the only mosquitoes which succeed in transmitting malaria are those rare individuals who happen to pass their lives in conditions which resemble very closely those which we have found to be essential for the successful transmission of the disease in experimental work" and of these "not many will ultimately become infective." Let the sanitarian then pause and study the individual infective mosquito in the fever house. Here is the real centre of gravity.

Among interesting data with regard to the life of the malaria parasite in the mosquito are those concerning the persistence of oocysts and sporozoites, the young and the mature stages of the malaria parasite in the stomach and salivary glands respectively of captive hibernating mosquitoes, a persistence which is held to explain primary attacks of simple tertian malaria in Nature in the early spring in northern latitudes.

The report concludes with a study of the infected cases from the clinical and microscopical sides. They suggest that we shall have to revise somewhat our idea of the Golgi cycle in relation to the temperature chart, but in blood work we must never forget that the peripheral blood is almost certainly not the same thing as that of the spleen or marrows. Very prudently, we consider, the author refuses to sail on the troubled sea of immunity where shipwrecks are inevitable. The report is written in an agreeably clear fashion with an absence of assumption of authority quite charming.

J. W. W. S.

[1] League of Nations: Health Organisation—Malaria Commission. Report on the First Results of Laboratory Work on Malaria in England. By Lieut.-Colonel S. P. James and P. G. Shute. (C.H./Malaria/57) (1).) Pp. 30. Geneva: League of Nations; London: Constable and Co., Ltd., 1926.)

Obituary.

PROF. J. G. ADAMI, C.B.E., F.R.S.

GEORGE ADAMI was a great pathologist, though not a 'laboratory man' in later years. A scholar and Darwin prizeman of Christ's College, Cambridge, he took a first class in the Natural Science Tripos, then studied in Paris with Pasteur and Roux, in Breslau with Heidenhain, and in Cambridge with Roy and Michael Foster. Afterwards he became John Lucas Walker student, and at the early age of thirty, professor of pathology and bacteriology at McGill University, Montreal. Through his inspiration, Sir Humphry Rolleston has written: "a continuous stream of papers" issued "from his laboratory dealing with all branches of pathology and its application to other sciences." He was awarded the F.R.S. in 1905 and the Fothergillian gold medal of the Medical Society of London in 1914. He was an ex-president of the Association of American Physicians, a fellow of both Jesus and Christ's Colleges, and held many honorary degrees. During the War, Adami became assistant director of Medical Services in the Canadian Army, for which he received the C.B.E. A member of the War Office Committee on the Medical History of the War, he published in 1918 vol. 1 of the "War Story of the Canadian Medical Corps." He was chairman of the Committee on Bacteriological Procedures, Medical Research Committee, and was largely responsible for the standardisation of Wassermann technique in the laboratories of Great Britain.

Adami's greatest contribution to science was the "Principles of Pathology." The first volume on general pathology, published in 1908, marked an epoch. It was, as stated in the preface, "not a mere record and description of phenomena, but an attempt to analyse those phenomena in an ordinary manner." It contained his exposition of inflammation and his original and helpful classification of neoplasms upon an embryological basis. Four years later he published with his friend Dr. John McCrae, of McGill University, his popular text-book of pathology. Other contributions to science included "The Physiology and Pathology of the Mammalian Heart" with Roy (*Phil. Trans.*), Pictou cattle disease, and a survey of the 1918 influenza epidemic in the British Army. In his Croonian lectures on adaptation and disease, delivered at the Royal College of Physicians in 1917, Adami argued against the doctrine that acquired characters are not transmitted. He was greatly interested in the problem of malignancy, and in the *Medical Journal and Record*, New York, August 18, 1926, controverted the view "that one particular order of microbe is concerned in the production of all malignant tumours;" he believed that the colloidal lead treatment was an "advance."

Adami accepted in 1919 the arduous post of vice-chancellor of the University of Liverpool. By his broad and practical outlook on life, his buoyant energy, his genial friendship, and his high ideals, he ennobled the University and the City of Liverpool and brought the two into closer and more intimate relationship. He faced his gradually failing health with unflinching courage, carrying out his duties to within a few weeks of his death.

ERNEST GLYNN.

THE news of Vice-Chancellor Adami's death came as a great shock to his personal friends, and no man had more: for so great was his passion for pleasant intercourse, and his enjoyment of human fellowship, that he sought and made firm friendships where other men would have only multiplied acquaintances. To meet him was a pleasure which he always actively developed, striking sparks from stones, and even finding entertainment in dullards. Doubtless it was partly this side of his character which found satisfaction in the very onerous post of vice-chancellor in the midst of this busily employed provincial city: a post which he filled with distinction, and with a grace which few could imitate. Not very different was that other interest which could leave no medical problem untouched, and carried him, enthusiastically always, through the wide-spread fields of knowledge in the subject of which he was a master, ever curious to meet new developments and always with the firm hand which grasped what others were satisfied with merely touching.

Gifted with this spirit of adventurous and penetrating curiosity, a man of incessant industry, and with a natural facility of expression and delight in exposition, his scientific papers and lectures have since his earliest days excited marked admiration: and to many it was a matter for regret that this more widely-known side of his activities was submerged in the daily routine of an administrative post. However, in Liverpool, an occasional lecture to a local society frequently disclosed the talents which his administrative duties otherwise concealed: and even to those to whom his main subject was a closed book, he was a shining example of the light which the University represented in the lives of the younger generation to which he patiently struggled to make it more and more accessible.

Resident long in Canada, familiar with methods of co-operation better known there than in our more conservative home-surroundings, Adami was sincerely an advocate of modes of procedure, methods and manners of organisation, which are not quite our own: and this advocacy was not without some discovery that habits and tastes were not readily remodelled. Such surprises must come to every man of action who ventures into new fields, and there the weaker spirit fails. Adami's spirit never flinched. Through every temporary conflict his buoyancy survived, and the geniality of his character helped him ably to overcome any lingering remnant of hostility.

Nor is this perhaps without some application to the endeavours in medical progress with which Adami has been most closely associated in the last few years of his life. Cancer, as he phrased it, is a *killer*, therefore it must be fought, and that by *team-work*. Absolute sincerity, tremendous enthusiasm, great breadth of knowledge and keenness of insight, and yet opposition, as natural as the clouds, which he somehow failed to understand.

Splendid gifts, sturdily continued efforts, great endeavours, all carried in a nature that was poised and balanced as by an internal gyrostat of goodwill and honourable intention; none of these qualities have

been without success in the realms of science, medicine, and affairs. In Liverpool his efforts to strip the University of its shell and bare it to the life of the City have left a permanent effect of greatest value, by which he will be remembered here for many years to come. *Vale!* J. S. MACDONALD.

DR. J. L. E. DREYER.

ON September 14, Dr. John Louis Emil Dreyer died at the age of seventy-four years from an illness which he had resisted for the greater part of a year with an astonishing vitality. By his death astronomers are deprived of the presence of one of the most distinguished historians of their science. There are others who have treated the history of astronomy more comprehensively, but within the wide range of his labours there is certainly none who has excelled Dr. Dreyer in the combination of learning, sagacity, scholarly precision, and clear and well proportioned exposition.

Dr. Dreyer was descended from a family which had long been distinguished, largely as soldiers, in the public service of Denmark. The son of Lieutenant-General F. Dreyer, he was born at Copenhagen in 1852 and was educated at the University of Copenhagen. In 1874 he came to Ireland as astronomer at Lord Rosse's Observatory at Birr Castle. Lord Rosse's famous telescope had been found to be specially adapted to the observation of nebulæ, and Dreyer in consequence embarked on the study of nebulæ, with which, next to his studies in the history of astronomy, his name is most closely associated. In 1878 his work on nebulæ was interrupted by his appointment as assistant astronomer at the Royal Observatory at Dunsink, but it was revived on his appointment in 1882 to be director of the Armagh Observatory. While at Birr he prepared for publication the whole series of observations made with Lord Rosse's telescope from 1848 to 1878, published by Lord Rosse in the *Transactions of the Royal Dublin Society*, 1880, and he also published a supplement to Herschel's catalogue of nebulæ with numerous corrections. At Armagh, in addition to minor studies on nebulæ, he produced in 1888 the "New General Catalogue of Nebulæ and Clusters of Stars," included in the forty-ninth volume of the *Memoirs of the Royal Astronomical Society*, which, with his two supplementary catalogues published in the same series in 1895 (vol. 51) and 1908 (vol. 59), form the standard catalogues to which reference is always made.

While at Dunsink, Dreyer joined Copeland in founding an international astronomical journal called *Urania*, the first number of which appeared in January 1881. In July of that year its name was changed to *Copernicus*. The last number appeared in June 1884. The editors contributed their full share of reports and articles, and the journal is full of matter which, after more than forty years, remains both interesting and instructive. Dreyer's most important contribution was his "New Determination of the Constant of Precession," vol. 2, pp. 135-155, which, though never adopted in practical work, was used by Newcomb in his classical determinations.

At Armagh Dreyer produced in 1886 the "Second Armagh Catalogue of 3300 Stars," but his subsequent publications have been restricted to nebulæ and astronomical history. In 1890 he produced "Tycho Brahe, a Picture of Scientific Life and Work in the Sixteenth Century." Danish patriotism has given rise to much research on Tycho Brahe, but Dreyer found no scholarly biography, which should at once establish the facts in the light of the evidence available and at the same time place Tycho in his true position in relation to the progress of astronomy and to the life and thought of his time. Dreyer's volume, which is as illuminating as it is scholarly, supplies this want. In 1913 he began the publication of a complete edition of Tycho's works, of which ten volumes have appeared and the remaining four are stated to be complete in manuscript. This edition must probably be regarded as in the main a work of piety. The preparation of the text must have been a laborious task. The notes, in Latin, are brief, but exhibit the editor's usual scholarship. He has among other things taken the pains to discover what editions of the classics Tycho used.

In 1906 appeared Dreyer's "History of Planetary Systems from Thales to Kepler." The history of planetary systems for those ages is practically the history of astronomical theory. Here as usual we find that mastery of authorities and that sober judgment in weighing doubtful evidence that we should expect from a scholar alone, combined with that skilful interpretation and sympathetic exposition that only an astronomer could give. Dreyer returned to parts of this subject in two papers contributed to *Monthly Notices of the Royal Astronomical Society* in 1917 and 1918, in which he effectively disposed of the long prevailing idea that Ptolemy's star catalogue did not rest on his own observations, but on those of Hipparchus or Menelaus reduced to his own time. In 1920 he succeeded, largely as a result of research on manuscripts at Oxford, in restoring the original form of the Alfontine Tables (*Mon. Not. R.A.S.*, vol. 80, pp. 243-62). He took the leading part in the editing of Sir William Herschel's "Scientific Papers," published in 1912, and a very large share in the volume which the Royal Astronomical Society has recently produced on the first hundred years of its history.

Distinctions came as a matter of course. In 1916 Dreyer received the gold medal of the Royal Astronomical Society, of which he was president from 1923 until 1925. He received the honorary degree of D.Sc. from the University of Belfast, and of M.A. from the University of Oxford, in which city he had settled on his retirement from Armagh in 1916.

In private life Dreyer was unobtrusive, but accessible. He spoke quietly, and with the same deliberation and authority with which he expressed himself in public. His learning was always available to those who wished to benefit by it, and he will be greatly missed. His wife, a daughter of John Tuthill, of Kilmore, Co. Limerick, whom her friends hold in affectionate remembrance, died in 1923. He leaves three sons, all distinguished in the fighting services of the British Crown, and one daughter, who is married to Mr. Warham Shaw-Hamilton, late of Dartan, Co. Armagh.

MR. J. H. MUMMERY, C.B.E.

THE death of John Howard Mummery on August 30, whilst on a holiday visit to Cornwall, deprives the world of an eminent microscopist. Born on January 19,

1847, he was educated privately, previous to entering the medical school of University College Hospital. After qualifying as a member of the Royal College of Surgeons, and taking his L.D.S. diploma, he joined his father, a well-known dental surgeon and research worker, in practice in Cavendish Place, London, W.

During his studentship, whilst working under Sharpey, Mummery showed great aptitude for microscopic technique; this bent he developed to a remarkable degree. Specialising in dental histology, admittedly one of the most difficult branches of the art, he achieved a world-wide reputation. His most important papers were contributed to the *Philosophical Transactions of the Royal Society*, and include "Some points in the Structure and Development of Dentine," Ser. B, vol. 182, 1892; "On the Distribution of the Nerves of the Dental Pulp," Ser. B, vol. 202, 1912; "On the Process of Calcification in Enamel and Dentine," Ser. B, vol. 205, 1914; "On the Nature of the Tubes in Marsupial Enamel and its Bearing on Enamel Development," Ser. B, vol. 205, 1914; "On the Structure and Development of the Tubular Enamel of the Sparidæ and Labridæ," Ser. B, vol. 208, 1914; "The Epithelial Sheath of Hertwig in Man, etc.," Ser. B, vol. 209, 1919; "On the Nerve-end Cells of the Dental Pulp," Ser. B, vol. 209, 1920. Of these, the most remarkable is that dealing with the final distribution of the nerves of the dental pulp. Here was a problem the solution of which had been attempted by many workers; by dogged patience Mummery succeeded in demonstrating the passage of fine neuro-fibrils into the dentinal tubes. His work, too, on enamel tends to prove that this tissue is not wholly inorganic in structure but possesses an organic content, and is capable of exhibiting a vital reaction to injury and disease.

It is impossible here to allude to all of Mummery's numerous papers, dealing not only with the histology of normal tissues, but also many others of a pathological nature. These are to be found in the *Transactions of the Odontological Society of Great Britain*, *Proceedings of the Royal Society of Medicine*, and various British and foreign medical and dental journals; his last, "The Pathology of Chronic Perforating Hyperplasia of the Pulp," appeared in the *British Dental Journal* within a month of his death.

In 1919 Mummery published his text-book "The Microscopic Anatomy of the Teeth," which at once became popular with students. A second edition in 1924 was enlarged to include the general anatomy of the teeth, both human and comparative, and will no doubt remain a standard text-book for years to come.

Mummery was a first-class draughtsman, and his publications are enriched and their value enhanced by his own delightful drawings, in addition to the photomicrographs of his brilliant sections. He was also a water-colour painter of considerable merit.

It is given to but few to remain in active work, with intellectual powers undiminished, for four score years. To his intimate friends Mummery never appeared old. After visiting him in his study one came away stimulated by the suggestions emanating from his fertile brain, and steeped in admiration of his broad and catholic outlook.

Many honours came to Mummery; he was a past president of the old Odontological Society of Great Britain, and the first president of the Section of Odontology of the Royal Society of Medicine, which Society afterwards elected him an honorary fellow. The Royal College of Surgeons of England elected him a fellow and awarded him the Sir John Tomes Prize in 1897. He was a past president of the British Dental Association, and chairman of its representative board. International honours were also his; the University of Pennsylvania gave him its D.Sc. degree; he was president of the sixth International Dental Congress, and was awarded the Miller Prize by the International Dental Federation in 1922 for his original research in dental histology. During the War he acted as superintendent and registrar of the Maxillo-Facial Hospital, for injuries of the face and jaws, at Kennington, and for his services there received the C.B.E.

Mummery will ever rank among the worthies of his profession, as a distinguished follower of Thomas Bell, James Salter, John and Charles Tomes. M. F. H.

WE regret to announce the following deaths:

Prof. F. W. Gamble, F.R.S., Mason professor of zoology and comparative anatomy in the University of Birmingham, on September 14, at fifty-seven years of age.

Dr. A. W. Rowe, Lyell medallist of the Geological Society in 1911, who was distinguished for his researches on the zones of the White Chalk of Kent and Sussex, on September 17.

News and Views.

ON September 17, the *Morning Post* published a Reuter message from Berlin to the effect that Profs. Paneth and Peters of that city had, after years of experimenting, succeeded in transforming hydrogen into helium "with the aid of particles of metal." This announcement, if correct, is of great importance and will evoke even more interest than the claim by Miethe and Stammreich to have transmuted mercury into gold. The two claims differ, however, in the important respect that whereas the experiments of Miethe and Stammreich, and of Smits, indicated disintegration of heavy atoms into lighter ones, those now announced involve the synthesis of an element from a lighter one, thus more nearly approaching the alchemist's dream of changing the relatively light base metals into the heavier gold and silver.

To judge by the published literature, recent efforts at the transmutation of elements seem to have been concentrated on disintegrating heavy atoms—a course doubtless suggested by radio-active disintegration and by Rutherford's transmutation experiments with α-particles—but modern views on atomic structure also adumbrate the possibility of synthetic transformations. According to these views the hydrogen atom consists of one positively charged unit of electricity (a proton) with a single electron revolving round it; and the helium atom contains a nucleus

of four protons and two electrons with two external electrons; so that the problem, on paper, consists in condensing, as it were, four hydrogen atoms into one helium atom, or of bringing into close association four independent protons and two electrons. No particulars are yet to hand concerning the methods adopted by Profs. Paneth and Peters, for the statement "with the aid of particles of metal" is meaningless as it stands. The experimental difficulties must be very great, not only in obtaining the energy necessary for such a change, but also in applying it under the appropriate conditions. Moreover, helium is an atmospheric gas, and traces of it are extremely difficult to eliminate by the methods of evacuation and adsorption at present in use; so that belief or disbelief in the Reuter message must be reserved pending further and more definite evidence.

THE German Scientific and Medical Association (Gesellschaft Deutscher Naturforscher und Ärzte) has now issued a handbook of the eighty-ninth assembly at Düsseldorf on September 19-26. From May to October of this year there is in Düsseldorf an exhibition for Hygiene, Social Welfare, and Physical Exercises: 'Gesolei' (GEsundheitspflege, SOziale Fürsorge, und LEIbesübungen). A series of separate societies hold their meetings at the close of the association assembly, which has therefore something of the character of a federation. Excursions include Bonn, Eifel, Neanderthal, and Holland, but chiefly the Rhine-Westphalian industrial area, for example, the Leverkusen dye-works. Düsseldorf is not now in the occupied area, but it has been occupied and is still near the occupied area. As in Innsbruck in 1924, the emotional undertone of the meeting may emphasise that political boundaries cannot divide the solidarity of civilisation (Kulturgemeinschaft).

THE Press bureau at Düsseldorf is in charge of Dr. R. Plohn, and two kinds of abstracts will be prepared—a general report for the daily Press and detailed abstracts for the technical Press. Those using the Press bureau are asked to acknowledge its assistance by sending two copies of any published report. The long list of papers to be presented is arranged in 34 sections. Sections 1 to 15 are the scientific sections. Section 15, presided over by Dr. Rein, is concerned with scientific education; and to the discussion on educational reform medical members are particularly invited. The remaining sections, 16 to 34, are medical, but 16 deals also with the general history of science. The chief addresses will appear in *Die Naturwissenschaften* and also as *Verhandlungen*, to be obtained by members and *Teilnehmer* for 4·50 gold marks either in Düsseldorf or by sending to the Geschäftstelle der Gesellschaft, Leipzig, Gustav-Adolf Strasse 12, to the public through booksellers for 6 gold marks.

A VIVID and intriguing discussion of possible developments in the cotton industry, by Dr. W. Lawrence Balls, will be found in the pages of the *Nineteenth Century* for August. Dr. Balls points out that cotton as a crop suffers from the fact that it inevitably competes for space which is suitable for a food crop, a competition in which the scales are weighted against it in the long run by the continual growth of population; on the other hand, some forms of its new competitor, artificial silk, are made from wood pulp and can be nourished by the spaces in the world that are not available for arable cultivation. Reference is made to the difficulty met with by the grower in the new areas trying to develop cotton production, when he tries to learn what demands the industry makes as to quality in his crop. The industry is so complicated, and divided into so many water-tight compartments, that from different types of spinner and weaver different and often contradictory demands are emphasised, often on very inadequate because too specialised experience. From that point forward, Dr. Balls indicates the inestimable value of the formation of the British Cotton Industry Research Association and the Empire Cotton Growing Corporation; these two organisations have made it possible "for the man from overseas to learn more in a day than he could formerly glean in a month, while the mill manager has become independent of Press stunts." The growing extension and improvement in technique in the production of artificial silk have undoubtedly brought about a new stage in the development of the cotton industry. Much interest therefore attaches to Dr. Balls' forecast, which he admits is heterodox, that whilst cotton will retain its place as a 'structural' material it will lose it as a mere 'covering' material; a change that implies a considerable shrinkage in volume of the cotton industry coupled with specialisation in quality, both of raw product and manufactured article.

PROF. JOHN M. COULTER gives an account of the new Boyce Thompson Institute for Plant Research at Yonkers, New York, in the *Scientific Monthly* for August. This account, with its accompanying photographs, shows how private endowment in the United States has supplied an instrument for fundamental research upon plants which has no counterpart in Great Britain. The only endowed institute which is directing research into fundamental problems of plant culture in Britain is the John Innes Horticultural Research Institution, which, under the late Dr. Bateson, obtained world-wide recognition as a centre of investigation into genetics, and under its new director, Sir Daniel Hall, may be expected to widen its field of attack. The new Boyce Thompson Institute provides a laboratory and greenhouse equipment for the study of the plant under controlled conditions which far exceeds that at the disposal of any British research station whether supported by public funds or private endowment. Col. W. Boyce Thompson was impressed, in making his liberal endowment of the institute that bears his name, with the dependence of the whole population upon plants and their products. In a crowded isle like Britain this is even more impressed upon the consideration of both Government and liberally minded citizens, and though the resources provided by the State may not permit of such extensive researches upon physiological problems of plant development and growth, the annual reports for

1925 of such stations as Long Ashton, near Bristol, and East Malling in Kent, which have recently been issued, show what extensive and thoroughly scientific work into problems of fruit and vegetable culture is in progress.

EAST Malling Research Station has now been established for some fourteen years, whilst Long Ashton commenced work about the beginning of the century. Both these stations have to confine themselves to fruit and vegetable problems, but for many years the Edinburgh Botanic Gardens have been noted for their experimental study of problems of propagation with both garden and greenhouse plants. Valuable aid in the study of commercial greenhouse plants is also given now by the Cheshunt Station in the Lea Valley, which has been associated both with Rothamsted and with the Department of Plant Physiology of the Imperial College of Science and Technology. A brief account of the work of this station from the pen of Prof. Mangham, appears in *Modern Science* for August 1926.

THE *Chemist and Druggist* for July 10 contains a beautifully illustrated account of the chief botanical gardens of Europe, and also a separate account, with equally charming illustrations, of the wonderful gardens established by the late Sir Thomas Hanbury at La Mortola. British botanists will be interested in both these articles, and many of them will have benefited by the generous policy pursued at La Mortola in the distribution of seed to British botanical departments. Another article of considerable interest in the same issue is the account by Prof. Jan Muszyński, of Vilna, of the medicinal herb fair held annually at that town on June 24. No fewer than 122 different kinds of herbs are collected and offered for sale by the peasant drug harvesters at the annual fair, and as the author, who is professor of materia medica at the University, points out, recent work on vitamins, hormones, etc., rather stresses the fact that the herb may mean considerably more in therapeutics than the pure drug extracted from it.

THERE are so many phenomena in connexion with the reception of long-distance radio signals that it is very difficult to give satisfactory explanations of the variations in the intensities of the signals. Mr. L. W. Austin in the *Journal of the Washington Academy* (vol. 16, p. 398) gives a résumé of measurements made by the Bureau of Standards on these signals and on atmospheric disturbances during 1925. One of the methods used was to compare the intensity of the received signal with that of an artificial signal of adjustable intensity produced by a local radio frequency generator. The principle of the method is identical with some of those used in Europe. No certain relationship has been discovered between sunspots and abnormal signals. To do this a complete study over at least one complete sunspot cycle would be necessary. Directional measurements on the atmospheric disturbances were made at frequencies of 21·4 and 15 kilocycles at the U.S. Naval receiving stations at Colon and Balboa, the two ends of the Panama Canal. During the dry season, that is, from January 15 to April 1, the disturbances at both stations come almost entirely from the direction of the high Andes in Northern Colombia. When the dry season is over, local storms begin and disturbances coming from the low mountains of the isthmus are prominent. In midsummer the direction of the incoming disturbances at Colon is roughly south-east, while at Balboa the direction of the disturbances is north or north-west. The observations prove that both stations give equally good reception to signals coming from the north during the dry season, but during the rest of the season the Colon station should give much better reception. Observations in Washington show that in winter the prevailing afternoon disturbances seem to come from the direction of eastern South America or possibly from Africa. In summer the direction is south-westerly, apparently from Mexico or the south-western United States. This agrees with the hypothesis that disturbances generally originate over land and are most intense in the afternoon and evening in the regions where the sun passes very nearly overhead.

MR. J. T. CUSWORTH, Upperthorpe, Sheffield, sends us a copy of notes made by him during the severe winter of 1885–6 on the vitality of a frog which was frozen in the centre of a block of solid ice. At the end of eight weeks the block of ice was carefully broken, and the frog, which was frozen stiff, was placed near a fire. In less than half an hour it was leaping about. Mr. E. G. Boulenger, director of the Aquarium at the Zoological Gardens, Regent's Park, has been good enough to send us the following comments upon this communication: "It is well-known that batrachians and fishes may revive after having been frozen stiff for several months. So far as I am aware, however, exactly how long life may be thus suspended is not established. In the rivers of Siberia, which may be frozen solid, fishes are often imprisoned for months on end and during such period assume a rigid condition, their vital functions being temporarily suspended. This fact suggested experiments in the freezing of live fish for transportation, and some were conducted in Switzerland and America several years ago. As a result of these, it was found that fish could be frozen stiff for from two to three months, showing no signs of ill-health, when thawed, as a result of their prolonged imprisonment. The fish which in certain parts of America are now sometimes transported on a commercial scale embedded in ice, are first placed in a closed tub of water into which oxygen under pressure is introduced. After being kept just above freezing-point for three days they are frozen solid. The blocks of ice containing the fish are then removed from the tubs and are surrounded with heat insulating packing. Under such conditions they can be kept in cold storage until wanted. The cost of transporting live fish in water is prohibitive, about ten gallons being required for each pound of fish. The freezing method therefore saves expense."

PROF. J. W. MCBAIN, Leverhulme professor of physical chemistry, who for twenty years has been

on the staff of University College and the University of Bristol, has now accepted an appointment at Stanford University, California, U.S.A., where he will take up his duties after Christmas of this year. Miss M. E. Laing and Miss M. H. Norris have also been appointed to the staff of Stanford University.

THE Mineralogical Society, which was instituted on February 3, 1876, has just celebrated its jubilee in London. The programme included visits of delegates from foreign mineralogical and geological societies and invited guests to the British Museum (Natural History), South Kensington, and to other museums and institutions in London; a conversazione in the Geological Society's Rooms at Burlington House on September 21; and a dinner at the Connaught Rooms on the following evening. The celebration in London was preceded by an excursion (September 12-18) to Devon and Cornwall under the direction of Mr. Arthur Russell, and is to be followed by an excursion (September 23-30) to the north of England under the direction of Prof. A. Hutchinson.

THE news columns of the daily papers during the past few days have contained long accounts of the disastrous hurricane which visited Florida on the night of September 17. According to the New York correspondent of the *Times*, the coastal region from Palm Beach to Miami was the area most affected, and it is estimated that 800-1500 lives were lost. The material damage is put at 30,000,000*l*. In Miami, wooden houses were ripped apart, concrete houses broken from their foundations, 'skyscrapers' were badly twisted, small shipping were lifted into the Royal Park, and the new docks were destroyed. The wind is stated to have reached a velocity of 130 miles per hour, and the first visitation lasted nine hours. Farther north there were also damage and casualties. The West Indies is one of the five regions of the globe where these violent tropical cyclones occur. When such storms arise in or near the West Indies, they generally pursue a curved path towards the north-west or into the Gulf of Mexico and then north-eastward along the Atlantic coast. They lose their violence as they pass into the temperate zone. The Galveston hurricane was apparently of even greater violence than that which has just occurred. It occurred in the same region on September 8, 1900; and on this occasion 6000 lives were lost and 6,000,000*l*. worth of damage was done. The wind velocity was estimated as 120 miles per hour, and much destruction was caused by high tides and a storm wave. These storms occur in the West Indies most frequently between August and October. It seems a little remarkable that buildings of the character of 'skyscrapers' should ever have been erected in a region which is known to be liable to these violent tropical cyclones.

AN attractive series of lectures or popular 'talks,' calculated to interest the most diverse tastes, has been arranged for the coming winter on behalf of King Edward's Hospital Fund for London. The lecturers and subjects announced are as follows: Mr. H. L. Baird on seeing by wireless (October 7); Air Vice-Marshal Sir Sefton Brancker on flying to-day and to-morrow (October 14); Mr. W. E. Garner on liquid air (November 12); Sir Richard Paget on the artificial production of the human voice (November 19); Mrs. Rosita Forbes on her trans-Saharan journey (November 25); Dr. Ezer Griffiths on the romance of refrigeration (November 26). The lecture hour in each case is 5 P.M. The fact that these distinguished people are giving their services, and that the charges for the lectures are moderate, should insure that King Edward's Hospital Fund derives considerable financial benefit from the lectures, details of which can be obtained from the secretary of the Fund, 7 Walbrook, London, E.C.4.

IT has been pointed out that the table in the article on "Patent Office Statistics" in NATURE for September 18, p. 428, contains errors arising from the fact that 'inclusive' salaries and those carrying bonus are shown intermingled in the estimates. The writer of the article has accordingly prepared the following corrected table:

Department.	Total personnel.	Number of personnel with salaries rising to a maximum of		Total of higher posts.	Percentage of higher posts.
		1000*l*. to 1800*l*.	2000*l*. and over.		
Treasury . .	331	17	9	26	7·8
Foreign Office .	839	24	3	27	3·2
Ministry of Transport. . .	524	9	2	11	2·1
Board of Trade .	567	7	5	12	1·8
Ministry of Agriculture . .	1197	14	3	17	1·4
Patent Office with Trade Marks and Design Branches .	685	4	0	4	0·38

A SHORT manual on First Order Triangulation, by Rev. C. V. Hodgson, forms *Special Publication* No. 120 of the United States Coast and Geodetic Survey. Its purpose is to summarise the methods employed in executing first-order triangulation and base measurement. The Survey now uses the term 'first order' in place of the term 'precise' or its earlier equivalent 'primary.' First order triangulation must have an average triangle closure of about 1″ or less, and a maximum closure not exceeding 3″. The closure in length upon a measured base must not exceed an error of 1/25000. The pamphlet contains chapters on instruments, organisation of parties, routine, sources of error, field computations, and base-line measurement. It is essentially practical, and pays little attention to theoretical considerations.

A CATALOGUE (Dept. No. 3, August) of second-hand books on natural history has reached us from Messrs. W. and G. Foyle, Ltd., 121 Charing Cross Road, W.C.2. It should be seen by readers on the look-out for natural history books, the range being large and the prices low.

DR. C. W. STILES, secretary of the International Commission on Zoological Nomenclature, informs us that a new (English) edition of the International Rules,

together with the summaries of 'Opinions' 1 to 90, has been printed in the *Proceedings of the Biological Society of Washington*, D.C., vol. 39, pp. 75-104, July 1926. Copies can be obtained from Dr. Thomas E. Snyder, the Secretary of the Society (address: Bureau of Entomology, U.S. Dept. of Agriculture, Washington, D.C.), price 1 dollar.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist for research work on the evaporation rates and the ignition temperatures of vapours, of certain inflammable spirits used in industry as solvents, under the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1. (September 29). A head of the mining department of the Central School of Science and Technology, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (September 30). An assistant for technical records work in connexion with the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (October 4). A senior lecturer in electro-technics at the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (October 15). An engineer to take charge of the section of Wood Preservation of the Forest Products Research Laboratory at Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (December 1). A director of agriculture in the Territory of New Guinea—The Official Secretary for Australia, Australia House, Strand, W.C.2 (December 15). An assistant lecturer in agriculture at the South-Eastern Agricultural College, Wye, Kent—The Secretary. Junior professional assistants in the Meteorological Office—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A senior woman library assistant at the School of Oriental Studies—The Librarian, School of Oriental Studies, Finsbury Circus, E.C.2. A laboratory assistant for the Veterinary Research division of the Agricultural Department of the Government of Kenya—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/14661). A mistress for physics at the Cowley Girls' School, St. Helens—The Secretary to the Governors of the school, 17 Cotham Street, St. Helens.

Our Astronomical Column.

RECENT NAKED-EYE SUNSPOTS.—The last naked-eye group of sunspots noted in these columns was No. 9, seen on the sun's central meridian on July 30. Another large group bordering on naked-eye visibility was in transit across the disc between August 10 and 22, but as some observers failed to see it, a number has not been assigned to it in our tabular list of these large spots. Since September 13, however, an important group has been an easy naked-eye object. This new group is composed of two very large spots, both of which could be seen separately through morning fog on September 18. On that day their apparent separation was $3\frac{1}{2}'$, corresponding to $14\frac{1}{2}°$ of solar longitude between their respective centres.

When the spots first appeared round the sun's east limb on September 13, they were evidently of recent origin and growing rapidly, for within 48 hours their total area had doubled. On September 18 the area of the group was 3000 million square miles or 1/400th of the sun's hemisphere. The group ranks accordingly in size with the spot of last December as the second largest group seen as yet this cycle. The region of the sun in which the group occurs is very near that of No. 8, the central meridian passage of which was June 29. During the interval between the disappearance of group No. 8 and the formation of No. 10, the photosphere of that region was marked fairly strongly with faculæ. Particulars of position and area of the August and September spots are given below:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
—	Aug. 10-22	Aug. 16·2	18° S.	1/1400
10	Sept. 13-25	Sept. 19·5	24° N.	1/400

COMETS.—Two periodic comets, Giacobini-Zinner and Neujmin, are due at perihelion in a few months. The former is interesting from the near approach that its orbit makes to that of the earth. Mr. Cripps has calculated the perturbation and finds December 7 as the date of perihelion. The following ephemeris for 0^h U.T. is from the B.A.A. Handbook:

	R.A.	N. Decl.	log r.	log Δ.
Sept. 30	$16^h\ 50{\cdot}3^m$	7° 15′	0·136	0·144
Oct. 8	17 8·2	5 5	0·115	0·133
,, 16	17 28·5	2 48	0·093	0·120
,, 24	17 51·7	0 25	0·070	0·105

The comet is fairly well placed in the evening sky, being on the meridian about 4 P.M.

THE SPECTRUM OF ø PERSEI.—The results of a detailed photometric study of certain features of the spectrum of the star ø Persei (Sp. type Bope), by Dr. W. J. S. Lockyer, Director of the Norman Lockyer Observatory, are recorded in *Monthly Notices, R.A.S.*, vol. 86, p. 474 (1926). Bright hydrogen lines appear in this spectrum, superposed on broad absorption lines. Each of these bright lines appears double, owing to the superposition of a fine absorption line which undergoes a periodic oscillation, presumably due to a Doppler effect. The two bright components accordingly undergo a periodic change of relative intensity, and the paper records the measurement of this change by the wedge photometer at frequent intervals throughout a complete cycle (Sept. 9, 1925–Jan. 13, 1926). Interesting conclusions are drawn from the measurements, some of which are contrary to what was expected from the observations of other workers. A similar study of the narrow absorption lines of hydrogen confirms an indication of a preliminary investigation that a variation of short period with quite a considerable amplitude is superposed on the primary variation. Pulses of activity are suggested, which seem to increase up to the epoch of maximum negative velocity and decrease down to that of maximum positive velocity. Bright lines of helium and other substances also occur in the spectrum, and the paper includes some comments on their behaviour. The character and intensity of the helium lines suggest a period of variation equal to half that of the primary variation, but the components of the bright ionised metallic lines, although their relative intensities occasionally alter, do not all behave alike, nor do they present any apparent cyclical change.

Research Items.

'SÔMA.'—A note by Prof. G. Jouveau Dubreuil, in the *Indian Antiquary* for September, deals with the identity of the sacred Sôma plant. Dr. Vincent Smith pointed out that while the plant used in the sacrifices of the Parsis of Yezd and Kirmân, as well as of the Deccan and Bombay, is identified with one or other of the species of Asclepias, the real Sôma plant may have been different. Mr. Havell has suggested that it is Eleusine, the common millet still found in the Himalayas. An inquiry has been made as to the plant used by the Sômayagis, who practise the Sôma sacrifice, among the Nambudris, a very high caste of Brahmans in the district of Malabar who, having been sheltered from invasion and change, have thus preserved the Vedic tradition. A reply was received from the great temple of Taliparamba where are the best examples of the *agnidrîyas*—the temples of the Vedic fire—that the Sômavalli plant was a rare plant found in the mountains and was obtained from a raja who lived at Kollangôd (ten miles south of Pâlghât). After some difficulty a specimen of the plant was obtained. It proved to be a climbing plant having a stem which was green, bare, round, and woody, and containing a milky liquor. It is absolutely without foliage, and has been identified as belonging to the genus Asclepias.

ANTIQUITIES FROM KEDAH.—Mr. Ivor H. N. Evans, in the *Journal of the Federated Malay States Museums*, vol. 12, pt. 3, describes the results of a visit to the Langkawi Islands, the neighbourhood of Sungai Patani, Baling, and Weng, to obtain additional examples of antiquities from these localities, and in the last-named place to collect specimens of the manufactures of the Negritos, whose presence had been reported there. Excavation work was undertaken on the Sungai Batu estate towards the foot of the Kedah Peak, where an ancient statue, some brickwork, and four worked stones had been obtained in 1921 and 1923. Of these last, two were conduit stones, and another had apparently at some time borne a bas-relief of an elephant-headed god (Ganesha). The excavations revealed the remains of a shrine consisting of wallings of laterite and bricks and, apparently, the sill of a doorway, as well as boulders embedded in a cement of laterite. A number of sculptured stones were found including a highly conventionalised ancient Hindu *Yoni* (female sex organ) apparently of quartzite, a sharpening stone with two depressions for holding the water used in whetting, and two stones with spiral markings, probably the terminals of a balustrade. The conclusion suggested is that the early inhabitants of Sungai Batu were Hindus and worshippers of Siva or related deities. Probably they were non-Malayan traders or miners or, if Malays, they had learnt the art of stone carving from Indian sources. Occupation goes back to a time when stone implements were in use, as is shown by a beautifully made chalcedony celt, and lasted until an ancient Mohammedan settlement. Here also strong Hindu influence is to be observed in four graves of obviously important personages.

INTESTINAL SECRETION OF INSECTS.—In *Memoirs of the College of Science, Kyoto University*, Series B., Vol. 2, No. 2, 1926, Mr. Osamu Shinoda contributes an important paper on this subject. It has long been known that in insects the mid-intestine performs the dual function of digestion and absorption. There exist various theories and hypotheses as to whether these two functions are performed by two distinct kinds of cells or whether they represent different physiological phases of the same kind of cells. Mr. Shinoda's studies were mainly carried out on larvæ of the Saturniid moth *Dictyoploca japonica*. He finds that the epithelial layer is composed of goblet cells and ciliated cylindrical cells which are, in his opinion, homomorphous at different phases of their activity. The cylindrical cells are those in the phases of secretion and absorption, while the goblet cells are nothing more than a resting phase of the cylindrical cells. In the secretory phase the nuclei of the cylindrical cells are large and loosely filled with irregularly shaped basophile granules: the nuclei, it may be added, are situated slightly higher than the middle points of the cells. The cytoplasm just beneath the ciliated border is filled with secretory granules. In the stage of absorption the nuclei lie near the distal ends of the cells; they are small and densely filled with chromatic granules. When the phase of absorption is over the accumulation of secretory granules begins while the nuclei increase in volume and migrate downwards in the cells.

INSECTS AND THE TRANSMISSION OF RINDERPEST.—Very few attempts appear to have been made to transmit rinderpest by the agency of arthropods. Certain bacteriological data obtained by the Director of the Veterinary Research Institute at Muktesar, India, seemed to indicate that the causative organism of rinderpest was possibly not very unlike the Leptospira of yellow fever, which is transmitted from host to host by the mosquito *Ædes argenteus*. This analogy appeared to be worth following up with reference to the possible insect-transmission of rinderpest, and a lengthy paper on this subject has recently appeared in *Memoirs of the Dept. of Agriculture in India*, Vol. 9, No. 5, May 1926. The author, Mr. S. K. Sen, carried out a series of transmission experiments which resolve themselves into three categories. In one series the mosquito *Ædes albopicta* was used as the transmitting agent. The results of the experiments on hill bulls were negative, but some of the rabbits employed showed thermal reactions when infected mosquitoes fed upon them. In another series the possibility of the mechanical transmission of rinderpest through the agency of *Musca domestica* was tested. In a fair proportion of the experiments positive results were obtained when bodies of flies fed upon infective material were inoculated into susceptible bulls. The results, however, were negative when the trials were carried out with reference to transmission under conditions more likely to occur in a state of Nature. The third series was carried out with *Pediculus humanus*. The infectivity of saline suspensions of crushed infested lice was tested upon three bulls, and one of these developed rinderpest. The effects of the transference of infested lice on to a healthy bull, however, were negative.

THE CLIMATE OF NORTH-EAST LAND.—In a paper in the *Geographical Journal* for September on the weather of North-East Land, Spitsbergen, during one month in the summer of 1924, Mr. K. S. Sandford has collected some evidence of value in relation to the problem of glacial anticyclones. In this relatively small but almost entirely ice-covered area he found no fixed anticyclone but a definite tendency towards the establishment of anticyclonic conditions with radial gravitational winds. This intermittent glacial anticyclone is blotted out by interference from outside the area but quickly re-establishes itself. Winds are markedly outflowing and lead to an augmentation of the bordering ice at the expense of the higher parts of the interior. On the other hand, interference from outside is great and leads to melting

of ice in the bordering zone and to a less extent in the interior. During the maintenance of anticyclonic conditions there is some indication of a pulsation, from calm to blizzard. Mr. Sandford believes that in New Friesland, on the mainland of Spitsbergen, there is a similar but modified system. Other parts of Spitsbergen have an insufficient ice-covering for its development. Up to the present there are no winter observations available from North-East Land.

THE NEW MAP OF FRANCE.—The standard map of France is the Carte d'État Major on a scale of 1 to 80,000, from which other scales are derived. So long ago as 1881, on the completion of this map, it was proposed to produce a new coloured map on a scale of 1 to 50,000. In the *Revue Scientifique* (Nos. 12 and 13, 1926) Col. G. Perrier traces the history of these proposals. It was not until 1899 that a specimen sheet of the new map was prepared and then the project was again suspended, eventually to be resumed, but restricted to certain regions in the north-east, east, and south-east for purely military purposes. In 1914 the number of published sheets was only 42. Some provisional sheets for Alsace-Lorraine were produced during the War, and a few for the Saar basin have been since published. But the scheme, which embraces about 1000 sheets, is now definitely suspended owing to expense. Apart from the provisional issues, only 53 sheets are available of this new survey.

THE AGE OF THE EARTH.—In the *Transactions of the New Zealand Institute* (March 6, 1926) the Hon. Sir Frederick Chapman discusses the origin of living organisms and their evolution with the view of reaching a reasonable idea of the period during which the earth has been inhabited. He thinks it is now possible to draw the conclusion that the first organisms were very minute; perhaps far smaller than the typhus bacillus or the invisible microbe of foot-and-mouth disease. Traces of micro-organisms have been found by Walcott in the pre-Cambrian rocks of North America, and from that beginning organisms have become larger and larger up to the massive creatures of the Mesozoic and the 150-ton whales of to-day. The broad question is raised: how many generations are required, and how long would it take, for evolutionary processes, to develop such enormous animals from ancestors of which a thousand million would make up less than a pin's head in bulk? No definite estimate is suggested, for the author recognises that no law of uniformity—either arithmetical or geometrical—can possibly be assumed. Nevertheless, it is made clear that his own sympathies are in favour of the longer estimates of geological time. He rightly protests against the idea that the evolution of the horse within the Cainozoic era could have been accomplished in the four million years that were formerly allowed to that era by certain geologists, then intimidated by the authority of Lord Kelvin. However, this is now of no more than historical interest. It is scarcely likely that Sir Frederick Chapman's problem will ever be directly soluble, even by the integration of its parts. Biologists will probably do better to take their time-scale from the study of geological and radioactive processes, and to make such deductions as to the rate of evolution as may be useful for their purposes. The only direct contribution from palæontology is the broad conclusion that hundreds of millions of years would be preferable to tens of millions.

THE NATURE OF ISOSTASY.—An important paper on isostasy from the pen of Dr. Harold Jeffreys appears in *Gerland's Beitrage zur Geophysik* (Bd. 15, 1926, p. 167). He shows that the work on which the theory of isostasy has been founded is adequate to prove that surface inequalities are compensated at depths of the order of tens of kilometres, but that it fails to provide satisfactory criteria for discriminating between the Pratt and Airy types of compensation or between local and regional compensation. Theoretically there is an infinite number of density distributions which would fit the gravity data, but excluding those that are physically unplausible there is a general likeness between those that are left. The Airy compensation is found to be much the more probable from the point of view of the physical and geological processes involved; and regional compensation spread out to a distance comparable with the depth of compensation as usually inferred is more probable than local compensation. Unfortunately, the depth of the compensating matter and its lateral extent are complementary in the sense that they cannot be disentangled by gravity observations alone. However, regional compensation must be effected at a smaller depth than an equivalent local compensation, and from this consideration it is inferred that the thickness of the granitic layer of the continents must be about half the least value (41 km.) found for the depth of compensation on the local hypothesis. As seismic and thermal evidence suggests a thickness of 15 or 20 km. there is already independent evidence in favour of Jeffrey's conclusions.

TRIETHYLAMINE AND DIETHYLAMINE.—A communication received from the Mellon Institute of Industrial Research, Pittsburg, Pa., states that a new process for manufacturing triethylamine and diethylamine has been developed there by Dr. D. K. Tressler and his assistants. The cost of production of the amines is said to have been considerably reduced, and it is anticipated that they will find extensive industrial applications, many of these being suggested. No details of the method are disclosed.

THE HISTORY OF CHEMISTRY IN AMERICA.—We have received a copy of a paper by E. F. Smith, reprinted from the *Journal of Chemical Education*, Vol. 3, No. 6, June 1926, containing fragments relating to the history of chemistry in America. The six sections refer to such varied subjects as Dr. L. Spalding's "New Nomenclature of Chemistry," 1799; Priestley's visit to America, 1794; alchemists in the New England Colonies, *c.* 1700; mineral analysis, 1824; Amos Eaton's "Chemical Instructor," a very practical text-book, *c.* 1800; and articles from the *Pennsylvania Magazine*, or the *American Monthly*, first published in 1775 by Robert Aitken.

IGNITION OF GASES.—Paper No. 24 (Part 1, by N. S. Walls and R. V. Wheeler; Part 2, by W. Rintoul and A. G. White), published by the Safety in Mines Research Board, describes some of the work being carried out on the ignition of gases. When mixtures of methane and air are exposed to flame, combustion does not take place instantaneously, but an exposure of a definite period is required. The period depends on the character of the flame, being shorter for larger flames. With fully aerated flames, mixtures containing between 9·5 and 10 per cent. of methane are the most readily ignited, but if the flame is not completely aerated and abstracts oxygen from the mixture to which it is exposed, the most readily fired mixtures are those containing an excess of oxygen. When fully oxidised explosives are employed to ignite the mixtures, the optimum methane content is 9·25 per cent., suggesting that the flame of the explosive is not the only factor involved.

Industrial Psychology.

IN the programme of Section J (Psychology) at the Oxford meeting of the British Association, industrial psychology was the subject of several papers and demonstrations of which the following is a brief review :

(1) Mr. R. J. Bartlett, King's College, read a paper on the judgment of value of individual advertisements. The paper arose from an inquiry undertaken by the National Institute of Industrial Psychology three years ago. The first essential of a good advertisement is attracting power and the second holding power. The grading of individual advertisements according to 'attracting-holding' power was taken as the principal task. But in a world as inconstant as that of Paris fashion a 'scale' for measuring this power can have only a temporary value. The scatter of some 180 advertisements when arranged in a scale of 7 grades was found to be normal. Most advertisements fell in the central three grades and very few indeed in grades 1 or 7. For the advertiser the lesson is the old one : 'There's plenty of room at the top.' Another feature is that when the 16 Bovril posters were judged by 15 members of the advertising profession, great variability of judgment from subject to subject was exhibited, yet the resulting order of merit correlated with the winning ballot order as high as $0{\cdot}8 \pm 0{\cdot}1$, showing that there is a common factor in the judgments which is shared by the large population that contributed to the ballot figures.

It was concluded that with a small number of advertisements, up to say 20, the method of paired comparisons, though tedious, is trustworthy. Above that number a fractionation method using 7 groups was recommended. Some practised subjects are even capable of employing this method using 15 groups. Simplicity and unity of design coupled with artistic treatment of shape and balance make for the good advertisement, while overcrowding, distraction from competing foci, and failure to secure the illusion of perspective are among the principal causes of failure. In conclusion, two kinds of variability were discussed, namely, the common variability from some nodal value, and that founded on the limited appeal of certain advertisements ; for example, pipe smokers agreeing very closely in their disagreements with cigarette smokers. The latter kind is important and deserves further study. This, however, was set aside in forming the present scales, the aim being to assess the value of an advertisement on the assumption that the reader is a prospective purchaser.

(2) Mr. Arthur Stephenson, of the National Institute of Industrial Psychology, read a paper on some observations on accidents in industry. Although one must not belittle the success of mechanical safeguards, yet 90 per cent. of present-day accidents are to be accounted for as failures on the part of the human subject. The U.S. Federal Board for Vocational Education gives many examples of efficient safety work in various industries, but only one-third of the reductions in the personnel sustaining accidents has been effected by mechanical safeguards : two-thirds have been accomplished through organisation and education. Mr. Davis, Secretary of Labour, states that the fatal industrial accidents in the U.S.A. probably exceed 23,000 per annum and non-fatal accidents $2\frac{1}{2}$ millions, and he is advised by experts that 85 per cent. of these are preventable. In Great Britain there are about 1200 fatal accidents per annum in factories and workshops, and another 1200 in coal mines and quarries. Non-fatal accidents of sufficient severity to cause disablement for a week or more number 120,000 a year in factories, and 200,000 a year in coal mines.

The National Institute of Industrial Psychology, so far back as 1922, recommended preliminary surface instruction of youths entering the mine and applied a scheme of training. Mr. Stephenson described an experiment where learners were trained in an industrial process along certain lines. Some of the learners were raw novices while others had had previous experience. Periodical tests of efficiency were made and those who proved incapable of profiting by instructions were discharged. After the scheme had been in operation for 10 months the accident frequency was analysed. The frequency rate for novices dismissed was $1\frac{1}{2}$ times as great as for novices retained, while for experienced learners dismissed it was $3\frac{3}{4}$ times as great as for experienced learners retained. The data obtained made it probable that ability to acquire the neuro-muscular co-ordination required by the particular process, is at least as important a factor as age or experience. Whilst agreeing that a considerable advance may be made by educational and propaganda methods, it is considered probable that the scientific selection of the workers would probably tend to diminish the frequency rate of accidents.

(3) Mr. A. Angles read a paper on restriction of output. In no case within the experience of the National Institute of Industrial Psychology has restriction of output been attributable to the particular trades union as such. It is usually brought about by a strong feeling of class loyalty which, in known cases, has even overcome individual self-interest. Two of the reasons given by workers for this policy are sufficiently frequent to be outstanding :

(*a*) Fear of rate-cutting. Examples are on record where employers have reduced rates in order to keep the workers down to a certain minimum.

(*b*) Fear of unemployment, or increased short-time. The work is spread out so that time-rate workers shall have the benefit of longer hours and more pay. Other reasons are : The fear of discharge of less competent workers, general dissatisfaction with present conditions, influence of the foreman, satisfaction with present earnings. General conditions and systems of wages vary enormously according to the efficiency of the management, but where the 'mental atmosphere' of the factory is good, restriction of output will very rarely be found.

(4) Miss W. Spielman gave a lecture on recent progress in vocational selection. The older methods of vocational selection were compared with modern methods employing mental and physical tests. This lecture served as an introduction to the demonstration given at the conversazione, by Miss Spielman and her assistants, of psychological tests in use at the National Institute of Industrial Psychology. There were tests for vocational guidance (*e.g.* of intelligence, mechanical ability, and manual dexterity) ; and tests for vocational selection (*e.g.* for engaging weavers, packers, clerks, sales assistants, etc.). In addition, the material collected from various countries by the Research Committee on Vocational Guidance was on view and the various reports of this Committee were distributed to those interested.

(5) Mr. Eric Farmer, investigator to the Industrial Fatigue Research Board, arranged an exhibition, and gave a demonstration at the conversazione, of apparatus designed for the Board by Dr. Schuster, namely, a pursuit-meter, steadiness-meter, a fatigue-inducing apparatus, a dotting apparatus, an original type of chronoscope for serial reactions, and a figure-setting apparatus which serves excellently as a non-verbal test of intelligence. All were original in design and ingenious in workmanship and well calculated to render effective service in the hands of the industrial psychologist. LL. W. J.

Early Egypt and the Caucasus.

DURING the recent meeting of the British Association at Oxford, the question of the origin and date of the Badarian culture of Egypt was again raised by Sir Flinders Petrie, and provided the material for an animated discussion which, with two closely related papers on the geology and archæology of the Fayum by Miss Gardner and Miss Caton-Thompson respectively, occupied the whole of an afternoon session in Section H (Anthropology).

Sir Flinders Petrie in opening gave a brief summary of the paper which he read before the Section last year at the Southampton meeting. It may perhaps be a convenience to recapitulate here the facts. While working at Badari, a site thirty miles south of Asyut, four seasons ago, members of the British School of Archæology in Egypt discovered a settlement which had in its lowest stratum pottery of a very fine type, entirely hand made, and the thinnest and hardest of any age, with a polish never surpassed. With it were associated ivory statuettes and flints finely worked in technique and form and resembling the Solutrean, and identical with the finely worked flints already known, though from surface finds only, to occur in the Fayum and across the desert up to Palestine. A later investigation by Miss Caton-Thompson produced similar implements from the settlement sites of the Fayum.

Sir Flinders Petrie suggested an Asiatic origin for this culture, its centre possibly being the Caucasus. As regards its dating, basing his conclusions in the levels of the Nile as a time scale, he suggested something like 12,000 to 15,000 B.C. as the period at which the sites had still been uncovered. The chronological evidence was thus, on this reckoning, not contradictory of an attribution of the culture to the Solutrean, following the indication of form and technique in the flint work. Obvious difficulties stand in the way of accepting the Badarian culture as an Egyptian offshoot of a Solutrean culture, not the least of course being the presence of pottery. To this the reply is that while one branch of the original Solutrean culture on its migration into Europe along a glacial fringe lost certain elements in that culture, such as the pottery, the other branch, proceeding southward in easier conditions of travel, was able to retain them.

Further, among other criticisms, it has been pointed out that flint working of this delicate type occurs at what is known and admitted to be a later date: it is not to be accepted as being beyond question Solutrean on the ground of its form and technique. In Scandinavia, implements known to be neolithic present a resemblance to the Solutrean form and technique. Sir Flinders Petrie is prepared to accept the facts, but not necessarily as militating against his conclusions. Just as the European Solutrean lost in its way across the Continent, so the south-western branch lost something and degenerated after it had reached Egypt; there was a descent from the finest to the coarsest pottery and from the finest to the coarsest flint work. The recurrence of the finer technique is to be regarded as evidence of a long-continuing Asiatic civilisation which sent off branches from time to time at long intervals.

Apart from the recapitulation and expansion of the argument in favour of the Solutrean date of the Badarian culture, Sir Flinders Petrie brought forward at Oxford two pieces of evidence bearing upon the question of its northern origin, one of which is certainly of first-rate importance if it should be ratified by subsequent examination. Among the finds made by Miss Caton-Thompson in her excavations on the settlement sites of the Fayum during the past season, straw granaries were found buried in the ground which were made of the straw of wheat. This wheat has been pronounced to be neither the old wheat of Babylon and Egypt nor the wheat of Roman times, but a northern wheat. This wheat was certainly unknown in later times, and if the claim that it is of a northern origin can be substantiated, it is a conclusive piece of evidence for, at least, an intrusive element from the north.

The second class of evidence which, in Sir Flinders Petrie's opinion, pointed to a Caucasian origin, was derived from the coincidence between names mentioned in the "Book of the Dead" and certain place-names in the Caucasus. Recently Mr. Fessenden of U.S.A. has advanced the view that in the Caucasus area we are to find the cradle of civilisation, basing his theory upon a multitude of coincidences between Caucasian place-names and names mentioned in legend and tradition. Among others he identified names mentioned in the "Book of the Dead." Sir Flinders Petrie has carried the investigation further. Extracting place-names in the "Book of the Dead" in their local relation to one another, he finds that they equate with place-names in the Caucasus, and, what is more, their local relation corresponds to the correct geographical relation of the equivalent place-names in that area. Further, the mention of a lake of fire in a fertile valley surrounded by barren hills could only correspond in actual fact to the conditions of a naphtha lake in the Caucasus. The traditional origin of Osiris, the god of the corn, in this legendary region is corroborated by the northern origin of the corn now discovered.

It is perhaps scarcely necessary to say that Sir Flinders Petrie's theories found many stern critics, ranging from Prof. Sollas, who pointed out that the conditions of the Badarian culture could not be regarded as corresponding to the conditions of the Solutrean, certainly as regards dating, to Mr. Peake, who, while inclined to accept the northern origin of the culture of the pottery and the grain-growing worshippers of Osiris, not only raised the question as to the equation of Badari and the Fayum, but also in regard to the last argument pointed out the necessity for certainty in the transliteration of the names taken from the "Book of the Dead." Such experts in the technique of flint working as the Abbé Breuil, Dr. Bosch Gimpera, and Mr. M. C. Burkitt concurred in thinking that the finely worked flint might be an independently developed Solutrean-like technique entirely African in origin.

It was, however, the papers by Miss Gardiner and Miss Caton-Thompson which most strongly emphasised the difficulties inherent in Sir Flinders Petrie's theories. As already mentioned, he had based his dating of the Badarian culture on the height of the water level. Miss Gardiner's investigations of the recent geology of the Fayum showed that the lake beds north of the Birket Qarun must be divided into at least two series—those of an earlier lake occurring up to 222 ft. above the Birket Qarun level, which were at one time connected with the Nile, as is shown by the fauna, and a later series which only reached the maximum of 205 ft. above the present level. Miss Caton-Thompson's examination of the settlements yielded flint implements of the characteristic type, pottery, and ample evidence of the agricultural, hunting, and fishing culture of the people. It is a characteristic culture of advanced neolithic type. Further, it was found that the sites fringe the shore of the second lake period, resting upon the sands and clays of the old high-level lake. There is

no sign of subsequent submergence. Both topography and the distribution of the high-level gravels emphasise the long period which elapsed between middle palæolithic times and the arrival of the Fayum flint-workers.

It would appear that both the geological evidence and the evidence of culture—unless we are to revise entirely our conception of the culture attainable by a palæolithic people—preclude the attribution of a very high antiquity to this civilisation of the Fayum. In so far it has failed to support the early dating of the analogous culture found at Badari, where too it must be remembered that it has been stated that copper beads were found, not, it is true, in the settlement, but in a grave in the adjacent cemetery.

Animal Breeding and Genetics.[1]

THE report under notice contains the record of a series of most interesting researches, not by any means all of which deal with what may be termed genetical problems, for a considerable number consist in studies of abnormal development. Thus the Director, Dr. F. A. E. Crew, has studied the so-called 'bull-dog calf.' These calves are born dead, and their anatomy shows a close resemblance to the so-called achondroplasia in human dwarfs. Dr. Crew maintains that the tendency to produce such offspring is hereditary and 'mendelises' when crossed with the type. He attributes it to the retardation of the coming into action of the pituitary gland; this may be so, but the immediate mechanism is doubtless as it is in human dwarfs, amniotic pressure, *i.e.* a too closely clinging amnion.

Mr. Nichols investigated a cross between Leicester and Cheviot sheep, the result of which had been stated to produce a hybrid of stable character. When the F_2 generation was raised, however, it was found that whereas 64 out of 103 resembled their F_1 parents, 18 approached the Leicester type and 20 had mixed characteristics of both Cheviot and Leicester. This result does not, as Mr. Nichols imagines, prove Mendelian segregation in the proper sense of the word. It is a result always obtained when two natural races are crossed; every conceivable intermediate turns up, but the attempt to express the result in 'factors' leads to interminable confusion. The number examined (100) is far too small to warrant any statistical conclusions.

Mr. Blyth has been engaged in a microscopical survey of the various types of wool raised in the British Islands. Four types are distinguished, namely, mountain long wool, lustre (also long wool), mountain short wool, and short wool (Down breeds). There are two main types of hairs making up the fleeces, namely, (*a*) long coarse hairs with reticular scale markings, and (*b*) short, fine hairs with coronal markings. Type (*a*) is found only in the long wools, type (*b*) in varying proportions in all the breeds. Short coarse fibres called 'Kemp,' frequently shed, are found in all the breeds. This and type (*a*) are regarded as equivalent to the primitive hair of the wild progenitor, whilst type (*b*) represents the original wool.

Mr. Greenwood has been following the fate of grafts of gonads implanted in fowls. This is especially interesting in view of the claim of Zawadovsky to have changed a cock into a hen by two operations, (*a*) cutting out the testes, (*b*) implanting an ovary. Mr. Greenwood finds that the ingrafted ovary frequently assumes a testicular structure by the ingrowth of sex-tubules from its periphery, and that sometimes the removal of the ovary stimulates the development of the vestigial right gonad. This gonad in one case was testicular in structure, in another ovarian, but with ingrowth of sex-cords indicating that it was being transformed into a testis.

Mr. L. Tamura is engaged in investigating the sex dimorphism of the suprarenal gland, which, as a result of previous work, he asserts, is different in the two sexes, the gland of the female showing a wide zona reticularis, whilst this region is vestigial in the male gland. It was found that when the male was castrated the suprarenal underwent enlargement, which was entirely due to the appearance of a wide zona reticularis. A sterile Dingo bitch which was investigated showed an infantile vagina and uterus with degenerating ovaries whilst the teats were normally developed, but not only the suprarenal but also the thyroid and pituitary glands showed obvious and gross signs of degeneration.

In conclusion, we should like to congratulate Dr. Crew on the variety and interest of the researches which are being carried on under his supervision.

E. W. M.

[1] Animal Breeding Research Department, the University, Edinburgh. Report of the Director for the year April 12, 1924, to March 31, 1925 (being the Fifth Annual Report). Pp. 21. (Edinburgh.)

University and Educational Intelligence.

THE Brighton Technical College in its calendar for 1926–27 is able to offer substantial evidence of the efficiency of their instruction in engineering subjects, six of the students having gained directly from the College the B.Sc. (Engineering) degree of the University of London in 1926. The College has a flourishing school of pharmacy, and provides courses of building, architecture, commercial subjects, and domestic science, as well as in arts and pure science subjects.

THE Technical College, Bradford, gives particulars in its prospectus for 1926–27 of diploma courses in textile industries, arranged with special reference to the needs of the worsted industry, chemistry, dyeing, civil, mechanical and electrical engineering, physics, and, exceptionally, biology. In recognition of the importance to students in all branches of technology of a knowledge of the fundamental principles of economics, courses in the department of commerce and banking have been developed in relation to those in the various other departments of the College, and particularly to those in the department of textile industries. Conversely, a special course for merchants has been established to equip those students who are to be engaged in the distributive side of the industry with a sufficient knowledge of dyeing and textile subjects.

FROM the Czech Academy of Sciences and Arts, Prague, we have received an "Almanach" for 1924. It is beautifully printed on 240 pages and is embellished with a large number of remarkably fine portraits accompanying biographical notices. It is printed throughout in the Czech language without any summary or abstracts in more widely known languages, and it was with some difficulty that we ascertained the purport of even the title-page. One of the recommendations made by the Directors of National University offices at their recent reunion at Paris was that the official publications of universities should, if printed in a language the use of which is not widely diffused throughout the world, have appended to them abstracts in one of the languages in more general use. The adoption of this recommendation is no doubt impossible in many cases without a certain sacrifice of *amour propre*, but it is

one the practical utility of which is obvious, and the "Almanach" in question is a case in point.

THE London County Council Education Officer has issued a remarkably attractive programme for 1926–27 of lectures and classes for teachers. Ninety-three different courses are offered, each course comprising, in most cases, six or more lectures. They are designed with the admirable objects of bringing London teachers into touch with the latest developments in educational methods and giving them opportunities of hearing leading authorities on questions of national and civic importance. Under the general heading of science are ten courses and four special single lectures. These four are: on eugenics, by Prof. Karl Pearson; production of voice sounds, by Sir Richard Paget; talking by light, by Prof. Rankine, of the Imperial College of Science; and surveying by aerial photography, by Dr. H. H. Thomas, of Cambridge. Among the most valuable of the courses is one on the relationship between science (physics, chemistry, biology, bacteriology, economics) and domestic work, by members of the staff of the Household and Social Science Department, King's College for Women.

THE Royal Technical College, Glasgow, directs attention in its calendar for 1926–27 to the fact that its new building (completed 1910), comprising over seven acres of floor space, forms the largest structure in Great Britain devoted to education. It might also boast that of all institutions included in the University Grants Committee's returns it had in 1924–25 the largest number, 2645, of part-time students, the next largest being the 1926 of the London School of Economics. Among the specialist courses provided by the college which are recognised by the University of Glasgow for attendance by students preparing for the degree of B.Sc. in applied chemistry may be mentioned: fuels, dyes and their applications, oils and fats, sugar manufacture, technical bacteriology, metallurgical chemistry, coal tar and intermediate products. The college maintains one of the five principal schools of pharmacy in Great Britain. The Glasgow School of Architecture is under the superintendence of a committee representative of the College and the School of Art. Among the numerous courses in technology not forming parts of degree courses are important series, both day and evening, in textile manufacture.

THE functions of municipal universities are discussed in a paper by George F. Zook, President of the Municipal University of Akron, published in the May number of *School Life*. The paper is concerned chiefly with the question whether municipal universities should continue to regard the traditional four-year curricula as their main business or should develop, alongside of these, one-year, two-year and three-year completion courses of a technical or semi-professional character. It is admitted that the experience of the land-grant colleges in establishing and maintaining one- and two-year curricula in agriculture and mechanic arts has not been very encouraging, but conditions in the municipal universities are very different and they would be failing in their duty to the communities which support them if they did not cater for the requirements of the large number of young people who, after completing their high school course, want to spend less than four years in university studies in preparation for such careers as those of pharmacist, librarian, school teaching, nursing, and the hundred and one occupations lumped under the headings of 'business' and 'industry.' In this connexion it is pointed out that the whole field of evening instruction, both general and technical, is awaiting vigorous development.

Contemporary Birthdays.

September 24, 1874. Prof. Alexander Findlay.
September 26, 1854. Major Percy Alexander MacMahon, F.R.S.
September 28, 1873. Prof. Julian Lowell Coolidge.
October 2, 1875. Prof. Arthur William Conway, F.R.S.
October 2, 1876. Mr. Thomas Sheppard.
October 3, 1858. Prof. Percy Faraday Frankland, C.B.E., F.R.S.

Prof. FINDLAY, occupant of the chair of chemistry in the University of Aberdeen since 1919, was educated at that city's grammar school, proceeding afterwards to the University there, and to the University of Leipzig. Early he was a research student in University College, London, whilst from 1902 until 1911 he held a lectureship in chemistry in the University of Birmingham, leaving to take up a professorship in science at University College, Aberystwyth. He has published several books, among them being a stimulating volume entitled "Chemistry in the Service of Man."

Major MACMAHON (Royal Artillery, retired), late Deputy Warden of the Standards, Board of Trade, was born at Malta. He was educated at Cheltenham College, passing thence into the Royal Military Academy, Woolwich, where later (1882–88) he was instructor in mathematics. The Royal Society awarded him a Royal medal in 1900 on the ground of the number and range of his contributions to science in the department of pure mathematics. Further recognition by the Society came with the allotment of the Sylvester medal to Major MacMahon for studies in the partition of numbers. General secretary of the British Association from 1902 until 1914, he is a past president of the London Mathematical Society.

Prof. J. L. COOLIDGE, mathematician, was born at Brookline, Mass., U.S.A. A graduate of Harvard, he also studied at the Universities of Oxford and Bonn. He has been successively instructor in mathematics, assistant professor, and, from 1918, professor in that subject at Harvard. Prof. Coolidge is an Officer of the Legion of Honour. He is the author of "Elements of Non-Euclidean Geometry" (1909), and "Geometry of the Complex Domain" (1924).

Prof. CONWAY, registrar and professor of mathematical physics in University College, Dublin, was born at Wexford. He was educated at Dublin and Corpus Christi College, Oxford.

Mr. THOMAS SHEPPARD, the zealous director of the Hull Museum, was born at South Ferriby, Lincolnshire. He has long rendered sterling service as editor of various Yorkshire society publications relating to natural history, numismatics, geology and archæology. Mr. Sheppard is the author of "Yorkshire's Contribution to Science" (1915).

Prof. PERCY FRANKLAND is a Londoner. He was educated at University College School, the Royal School of Mines, and the University of Würzburg. From 1888 until 1894 he was occupant of the chair of chemistry in University College, Dundee, leaving there to take up a similar post in Mason College, Birmingham, continued also in its University. He was president of the Institute of Chemistry in 1906, and of the Chemical Society in 1911. Prof. Frankland was awarded the Davy medal of the Royal Society in 1919 for distinguished work in chemistry, especially on optical activity, and on fermentation.

Societies and Academies.

LONDON.

The Institute of Metals (Liége meeting), September 2.—L. **Boscheron**: An account of the non-ferrous metals industry in the Liége district. An historical account is given of the development of the zinc industry of the Liége district, with particular reference to the discovery of the distillation process by Dony and the subsequent improvement and application of this process. The absence of water-power and the high cost of electrical energy in Belgium renders the new electrothermic and electrolytic methods of manufacture of zinc inapplicable in Belgium. The discovery of a method of continuous production would be welcomed.—A. G. C. **Gwyer** and H. W. L. **Phillips**: The constitution and structure of the commercial aluminium-silicon alloys, with an appendix by D. **Stockdale** and I. **Wilkinson** upon the properties of the modified aluminium-silicon alloys. The investigation deals with the constitution, structure, and mechanical properties of modified aluminium-silicon alloys, and a theory based upon colloidal lines is put forward to explain the nature of the modified structures. The alloys possess good founding qualities; are appreciably lighter than pure aluminium, and in both chill- and sand-cast states possess a high resistance to shock, excellent ductility, and a high degree of incorrodibility.—J. D. **Grogan**: Some mechanical properties of silicon-aluminium alloys. The sodium and 'salts' methods of modifying these alloys are described. The 'salts' method is preferred. Ternary alloys containing also magnesium or zinc are not superior to the binary alloys.—Buntaro **Otani**: Silumin and its structure. The chief development of aluminium-silicon alloys during the last three years has been in the direction of a marked increase in mechanical properties, due to the modifying action caused by the addition of metallic sodium or alkali fluoride to the molten alloy. The present paper puts forward a theory to explain the process of modification.—H. J. **Gough**, S. J. **Wright**, and D. **Hanson**: Some further experiments on the behaviour of single crystals of aluminium under reversed tortional stresses. The resulting distortion under this complex type of straining action is observed using slip-band measurements, and is related to the atomic orientation of the crystals by means of X-ray analysis. The complicated system of slip-bands observed is in agreement with the simple law that slip is confined at any point of the surface of the crystal to one of the octahedral planes and in the direction of the most highly stressed (shear stress) principal lines of atoms. The progressive hardening during a long endurance test has been studied.—P. **Chevenard**: Thermal anomalies of certain solid solutions. Certain feebly magnetic solid solutions show transformations which are similar to those of ferromagnetic substances in that they occur without change of phase (that is, change of space lattice), they are spread out over a large range of temperature, they are subject to relatively slight hysteresis, and result in anomalies in the different physical properties, dilatation, specific heat, resistivity, thermo-electric power, etc. They differ from the magnetic transformations in that the temperature of their occurrence does not vary with change of composition. Evidence is given of the existence of these so-called 'X' transformations in copper-aluminium, nickel-chromium, and copper-nickel solid solutions, and a detailed study is made of their effect on the dilatation of the first two groups of alloys and on the resistivity of the last.—W. T. **Cook** and W. R. D. **Jones**: Preliminary experiments on the copper-magnesium alloys. The chief feature is the production of sound chill-cast bars free from smooth-sided internal gas cavities by means of a double-melting process similar to that recently recommended by Archbutt for the production of castings in aluminium free from pinholes. Details are given of the method adopted of a type of bottom-pouring crucible used to eliminate inclusions of flux and slag.—Kotaro **Honda**: A comparison of static and dynamic tensile and notched-bar tests. Machines for testing materials have recently considerably increased in number; for example, referring to the methods of testing, there are the following tests: tension, bending, torsion, toughness, fatigue, abrasion, hardness, and single and repeated impact tests, etc. Since for each of these tests we have several types of machines, it is of importance to study the merits and demerits of these machines and to make a selection of those which are best for the purpose.

September 3.—C. J. **Smithells**, H. P. **Rooksby**, and W. R. **Pitkin**: The deformation of tungsten crystals. When metals are rolled or drawn the crystal fragments tend to take up a definite orientation with respect to the direction of working; the same effect is produced during the swaging of tungsten rods. The micro-structure and X-ray diffraction pattern at various stages of the swaging have been examined with the view of learning the mechanism by which this preferred orientation is attained.—A. **Pinkerton** and W. H. **Tait**: Season-cracking in arsenical tubes. While severely hollow sunk tubes made from arsenic-free, deoxidised copper are not liable to season-cracking, tubes made from arsenical copper, according to the British Engineering Standard specification, are liable to season-cracking when made under certain conditions. The temperature at which annealing renders such tubes immune from season-cracking has also been determined.—Cyril S. **Smith** and C. R. **Hayward**: The action of hydrogen on hot solid copper. When copper (wire) containing oxygen is heated in hydrogen, maximum brittleness is obtained at intermediate temperatures, and a marked recovery occurs when the action is carried out at temperatures approaching the melting-point. The rate of penetration of hydrogen into cast copper has been determined and certain peculiarities observed. When the oxygen in the copper exceeds 0·07 per cent the depth of penetration in a given time is greater at about 800° C. than at higher temperatures. When brittle gassed copper is annealed and forged in a non-oxidising atmosphere, the cracks responsible for the brittleness close, and metal of remarkable properties is obtained.—Francis W. **Rowe**: Bronze worm-gear blanks produced by centrifugal casting.—Kathleen E. **Bingham**: The constitution and age-hardening of some ternary and quaternary alloys of aluminium containing nickel. This investigation is part of a scheme of research on aluminium alloys which has been in progress in the Metallurgy Department of the National Physical Laboratory, under the direction of Dr. W. Rosenhain. The first part deals with the age-hardening of some of the ternary alloys of copper, nickel, and aluminium; and the second with the constitution and age-hardening of similar alloys, with the addition of small percentages of magnesium.—Captain F. R. **Barton**: Development of the use of nickel in coinage. In its pure form, and also as a constituent of binary alloys, nickel has been widely adopted during the last half-century as a coinage metal. Experience shows that pure nickel coins wear longer in circulation than those made of silver, and that they were equally proof against counterfeiture.—C. H. M. **Jenkins**: The constitution and the physical properties of the alloys of

cadmium and zinc. The constitution and properties of the zinc-rich alloys seem to be considerably influenced by the two polymorphic changes which appear to exist in zinc. One of these changes caused an increase in the solid solubility of cadmium in zinc above the eutectic temperature; the resulting equilibrium diagram is therefore somewhat unusual, containing a region representing a completely solid alloy occurring above an area which is composed of both liquid and solid alloys. The cold-worked alloys very slowly soften at room temperature, but the effect of ageing does not cause any unfavourable alteration. The zinc-rich alloys should not, however, be annealed after this ageing. The properties of cast and rolled zinc are improved by the addition of cadmium. The eutectic alloy previously proposed for use as a medium hard solder possesses very suitable physical properties for this purpose.—G. B. **Phillips**: The primitive copper industry of America (Pt. 2). Many thousands of copper objects have been investigated; they show a somewhat sporadic industry, but considerable mechanical skill and artistic taste in their manufacture with stone and bone tools by the aborigines. Analysis indicates the source of the metal to be the native copper from the mines of northern Michigan and not copper brought from Europe.

PARIS.

Academy of Sciences, August 23.—**Bigourdan**: A means of verifying the uniformity of the earth's rotation.—A. **Bigot**: The Bathonian of Chailloué (Orne).—Jacques **Chokhatte**: Some applications of the polynomials of Tchebycheff with several variables.—N. **Stoyko**: The precision of time of the rhythmic signals of the Bureau International de l'Heure.—Louis de **Broglie**: The possibility of connecting the phenomena of interference and diffraction with the quantum theory of light.—J. **Cayrel**: Double detection with galena and chalcosine. The generality of the phenomenon.—Robert **Régnier** and Roger **Pussard**: The conditions under which the disease communicated to field mice by the Danysz virus is propagated.—E. P. **Fortin**: Histological investigations on certain elements of the retina.—P. **Wintrebert** and Yung **Ko-Ching**: The protoplasmic contraction of the early embryonic forms in *Gasterosteus aculeatus* and *Pygosteus pungitius*.—E. **Iwanow**: Time of persistence of the fertilising property of the spermatozoids of mammals in the epididymus separated from the organism.—L. **Nattan-Larrier**, G. **Ramon**, and E. **Grasset**: Antitetanus immunity in the newly-born.

CAPE TOWN.

Royal Society of South Africa, July 21.—J. Smeath **Thomas**: The action of sulphur chloride on mercaptan—the existence of diethyl-tetrasulphide. The author has previously shown that in the case of the alkali metals the maximum number of S atoms that can be introduced into the polysulphide molecule increases with increasing electro-positivity of the metal, that in the polysulphide series some members are of greater stability than others, and that only these more stable compounds are obtained by ordinary laboratory methods of preparation. In every case the disulphide is stable, but the composition of the higher stable compound varies; the more electropositive the metal the greater the number of S atoms in the molecule of the higher stable polysulphide. An extension of the work to organic polysulphides led to a similar conclusion. Here again the disulphides are always stable and the higher stable polysulphide, in the case of the alkyl compounds, seems to be the pentasulphide. Thus both sodium *tetrasulphide* and potassium pentasulphide on treatment with ethyl iodide yield diethyl pentasulphide mixed with a little disulphide.—W. A. **Jolly**: On the rhythmical functions of the spinal cord. The author discussed the oscillations which appear on the electromyograms in reflexes and the intraspinal delays, and pointed out the relation which subsists between the time intervals in the two phenomena.—J. **Moir**: Colour and chemical constitution, Part xxii.—A study of methyl derivatives of the phenolphthaleins. Nearly all the methyl derivations of phenolphthalein (ordinary and orthopara) have been examined. The effect of all substitutions on colour is additive, each item acting independently.

SYDNEY.

Royal Society of New South Wales, August 4.—R. H. **Cambage**: Acacia seedlings. Part xii. The seedlings are described of the following ten species: *Acacia bivenosa*, *A. Burkittii*, *A. Cambagei*, *A. Cuthbertsoni*, *A. latipes*, *A. leptoclada*, *A. pruinosa*, *A. restiacea*, *A. rupicola*, *A. salicina*. In regard to the vitality of Acacia seeds in the soil, it is recorded in the paper that 200 seedlings of *Acacia mollissima* sprang up immediately after the ploughing of an area of four acres which had not been cultivated and on which Acacia trees had not grown for sixty years. In a second case, six acres of grass land had been enclosed and ploughed. No Acacia trees had grown on the area since it was cultivated sixty-eight years before, although some were growing a quarter of a mile away, but after the land had been ploughed, more than 1000 seedlings sprang up on one particular acre of the enclosed area, evidently at a spot where many trees of the same species formerly grew.—A. R. **Penfold**: The essential oil of *Zieria macrophylla* (Bonpland), and the presence of a new cyclic ketone. The leaves and terminal branchlets yield from 0·3 to 0·66 per cent. of a brownish coloured oil of peculiar odour. The following constituents have been identified: d-limonene (10-20 per cent.), a new cyclic ketone, $C_{13}H_{20}O$, about 50-60 per cent. (called zierone), together with sesquiterpene, sesquiterpene alcohol, amyl alcohol, a low boiling isovalerianic ester, etc.—F. R. **Morrison**: The fixed oil of the kidney fat of the emu. The oil, which was yellow in colour, had an odour resembling mutton fat, and was of a soft buttery consistency during the winter months. The oil consisted of the glycerides of oleic, linolenic, palmitic and stearic acids. The occurrence of linolenic acid is of interest, this acid being rarely found in animal oils.—A. **Grady** and H. **Hogbin**: Mountain lagoon and the Kurrajong fault. Mountain lagoon is apparently formed by the damming up of a small stream by the rising Kurrajong fault. The lagoon is a topographic feature which will soon disappear, for creeks, on all sides, have cut back by headward erosion, almost to the lagoon itself.

Official Publications Received.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 35, No. 1, 1926. Pp. xii+988. (London: Institute of Metals.) 31*s.* 6*d.* net.

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Vol. 16, Article 1: Third Report on a Forest Survey of Illinois. By Clarence J. Telford. Pp. iv+102+4 maps. (Urbana, Ill.)

Department of the Interior: U.S. Geological Survey. Bulletin 779: Guide to Ore in the Leadville District, Colorado. By G. F. Laughlin. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1925. (Washington, D.C.: Government Printing Office.)

Department of Marine Biology of the Carnegie Institution of Washington. Vol. 21: Samoan Foraminifera. By Joseph Augustine Cushman. (Washington, D.C.: Smithsonian Institution.)

The Hydrostatic System of Trees. By D. T. MacDougal. (Publication No. 373.) (Washington, D.C.: Smithsonian Institution.)

University of Bristol. Proceedings of the Spelæological Society for 1925. Vol. 3, No. 2. Pp. v+190-315. (Bristol.) 3s. net.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 215. The Cretaceous Plant-Bearing Rocks of Western Greenland. By Dr. A. C. Seward. (B. 422.) Pp. 57-175. (London: Harrison and Sons, Ltd.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok 7, 1925. 5: Hydrografiska mätningar i Sverige. (Stockholm.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 8, July: Studies in Ethiopian Braconidae, with a Catalogue of the African Species. By Charles T. Brues. Pp. 205-436+2 plates. (Boston, Mass.)

Transactions of the Royal Society of Canada. Third Series, 1925, Vol. 19, Section 3. Visualization and Energy Survey of a High Frequency Diffraction Beam. By R. W. Boyle, J. F. Lehmann and C. D. Reid. Pp. 167-196+plates 13-14. Third Series, 1926, Vol. 20, Section 3. Practical Experiments on the Detection of Icebergs and on Sounding by Means of an Ultra-Sonic Beam. By R. W. Boyle and C. D. Reid. Pp. 233-243+plates 2-3. Reflection Powers of various Materials for Ultra-Sonic Waves. By R. W. Boyle and G. B. Taylor. Pp. 245-257+1 plate. (Ottawa: Royal Society of Canada.)

Sixth Annual Report of the Scientific and Industrial Research Council of Alberta, 1925. Report No. 16. Pp. 65. (Edmonton: University of Alberta.)

The Royal Technical College, Glasgow. Calendar for the 131st Session, 1926-27. Pp. xxxi+409. (Glasgow.)

Annals of the Pickett-Thomson Research Laboratory. Edited by D. Thomson and R. Thomson. Vol. 2, No. 2, July. Pp. iv+29-203+50 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox.) 42s. net.

The Present Status of the Wild-Fowl of Europe, with special reference to those of the British Isles. By Percy R. Lowe. Pp. 20. (London: International Committee for the Protection of Wild Birds, Natural History Museum.)

Prospectus of the Royal College of Art, South Kensington, London, Session 1926-1927. Pp. iv+28. (London: H.M. Stationery Office.) 6d. net.

Madras Fisheries Department. Administration Report for the Year 1923-24. By Dr. B. Sundara Raj. (Report No. 1 of 1925, Madras Fisheries Bulletin, Vol. 19.) Pp. 58+5 plates. (Madras: Government Press.) 12 annas.

Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 5: Algae of the Loktak Lake. By Paul Brühl and Kalipada Biswas. Pp. 257-316. (Calcutta: Asiatic Society of Bengal.) 7.5 rupees.

Survey of India. Map Publication and Office Work, 1924-25: from 1st October 1924 to 31st March 1925. Pp. vii+17+5 maps. (Calcutta: Survey of India.) 1 rupee; 1s. 9d.

Department of the Interior: Bureau of Education. Bulletin, 1926, No. 5: General University Extension. By G. H. Shelby. Pp. 22. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 528: Experimental Study of the Relation between Intermittent and Nonintermittent Sector-Wheel Photographic Exposures. By Raymond Davis. Pp. 95-139. (Washington, D.C.: Government Printing Office.)

Aeronautical Research Committee: Reports and Memoranda. No. 951 (Ae. 170): An Investigation of the Air-Flow Pattern in the Wake of an Aerofoil of Finite Span. By A. Fage and L. F. G. Simmons. (A. 3. a. Aerofoils—general, 149—T. 2041.) Pp. 28. 1s. net. No. 997 (Ae. 209): The Distribution of Pressure over a Biplane with Wings of Unequal Chord and Span. By H. B. Irving and A. S. Batson. (A. 3. 1. Pressure Distribution, 13—T. 2164.) Pp. 15+10 plates. 1s. net. No. 1024 (M. 40): Some further Experiments on Single Crystals of Aluminium employing Reversed Direct Stresses. By H. J. Gough, Dr. D. Hanson and S. J. Wright. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Metals, 48.—T. 2176.) Pp. 14. 9d. net. (London: H.M. Stationery Office.)

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1925; with Report and Notes of the Director, Rev. E. D. O'Connor. Pp. xxxi+45. (Blackburn.)

Journal of the Federated Malay States Museums. Vol. 12, Part 3, July: xii: Results of an Expedition to Kedah. By Ivor H. N. Evans. Pp. 73-82+8 plates. (Kuala Lumpur and Taiping.)

Aeronautical Research Committee: Reports and Memoranda. No. 1008 (Ae. 214): Wind Channel Tests of Slot and Aileron Control on a Wing of R.A.F. 15 Section. Part i: When the Central Portion of the Wing is R.A.F. 15; Part ii: When the Central Portion of the Wing is Slotted and Fitted with a Flap. By F. B. Bradfield, A. S. Hartshorn and L. E. Caygill. (A. 2. a. Stability Calculations and Model Experiments, 101 and 104—T. 2161, T. 2181.) Pp. 30+19 plates. 1s. 6d. net. No. 1011 (M. 34): Some Mechanical Tests of Cast Bars of Alpax. By H. J. Tapsell. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (L.A. 48.) Pp. 9+2 plates. 9d. net. No. 1025 (M. 41): A Test on a Specimen consisting of three Crystals under Reversed Torsional Stresses. By H. J. Gough, S. J. Wright and Dr. D. Hanson. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Metals, 49—T. 2177.) Pp. 5+3 plates. 6d. net. No. 1026 (Ae. 222): The Analysis of Experimental Results in the Windmill Brake and Vortex Ring States of an Airscrew. By H. Glauert. (A. 3. d. Airscrews, 89—T. 2236.) Pp. 8+2 plates. 3d. net. (London: H.M Stationery Office.)

New Zealand: Dominion Museum. Bulletin No. 7: The Maori Canoe; an Account of various Types of Vessels used by the Maori of New Zealand in Former Times, with some Description of those of the Isles of the Pacific, and a Brief Account of the Peopling of New Zealand. By Elsdon Best. Pp. iv+312. (Wellington, N.Z.: W. A. G. Skinner.) 15s.

Journal of the Municipal College of Technology, Manchester: a Record of Investigations undertaken by Members of the Manchester College of Technology. Vol. 12, 1926. Pp. 160. (Manchester.)

Technical College, Bradford. Diploma and Special Day Courses, Session 1926-27. Pp. 204+10 plates. (Bradford.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 9, July: Studies in the Urea Series; Transformations of Nitroguanidine. By Tenney L. Davis and Armand J. J. Abrams. Pp. 437-457. 50 cents. Vol. 61, No. 10, July: On the Distribution of Intensity in Stellar Absorption Lines. By Cecilia H. Payne and Harlow Shapley. Pp. 459-486. 50 cents. Vol. 61, No. 11, August: Changes during the last Twenty Years in the World's Speed Records of Racing Animals. By A. E. Kennelly. Pp. 487-523. 50 cents. (Boston, Mass.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 69: Spectroscopic Study on the Discharge in Helium. By Toshio Takamine. Pp. 55-61. 40 sen. (Tokyo.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 15: The Digestive Diverticula in the Lamellibranchs. By Dr. C. M. Yonge. Pp. 703-718+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s. 9d.

Diary of Societies.

SATURDAY, SEPTEMBER 25.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students Section) (at Newcastle-upon-Tyne), at 3.—Prof. G. Hickling: The Chemical Relations of the Principal Varieties of Coal.

MONDAY, SEPTEMBER 27.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Hereford), at 8.45 P.M.

TUESDAY, SEPTEMBER 28.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Hereford).—Dr. G. H. Pethybridge: Mycology and Plant Pathology (Presidential Address).

WEDNESDAY, SEPTEMBER 29.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Hereford), at 8.30 P.M.—J. Ramsbottom: Fungi (Lecture).

THURSDAY, SEPTEMBER 30.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (East Midland District) (at Gainsborough), at 11 A.M.

INSTITUTION OF LOCOMOTIVE ENGINEERS (at Engineers' Club, Coventry Street, W.), at 7.15.—Sir Seymour B. Tritton: Presidential Address.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Hereford).

FRIDAY, OCTOBER 1.

FARADAY SOCIETY.—General Discussion: Physical Phenomena at Interfaces, with Special Reference to Molecular Orientation (at Chemical Society), at 2.30.—Dr. E. K. Rideal: Introductory Address.—Prof. H. Freundlich: Electrification at Interfaces.—R. K. Schofield: Electrification at Interfaces.—Dr. W. E. Garner: Adsorption on Solids.—Dr. G. Shearer: Orientation in Solids.—At 5.—N. K. Adam and G. Jessop: Insoluble Films on Liquid Surfaces.—Prof. E. Gorter: On the Spreading of Proteins.—Prof. W. Ramsden: Adsorption of Proteins.—Dr. S. Sugden: The Arrangement of Molecules on the Surface of Pure Liquids.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—L. Smith: Notes on Transformer Testing and Test Plant Requirements.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Hereford), at 8.30 P.M.—Dr. M. Wilson and J. S. L. Waldie: Some Fungi occurring on Leaves of Conifers.

SATURDAY, OCTOBER 2.

ELECTRICAL ASSOCIATION FOR WOMEN.—Visit to All-Electric Farm of Mr. Borlase Matthews, Greater Felcourt, East Grinstead.

CONGRESSES.

SEPTEMBER 24 AND 25.

READING AND DISTRICT TEACHERS' ASSOCIATION (at Reading University).—Discussion on Education and Life.

September 24.—Prof. Winifred Cullis: The Teaching of Biology in Schools.

September 25.—Mrs. A. H. Radice: The Changing Child.—N. Richmond: The Physiological Basis of Change.

SEPTEMBER 24 TO 27.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Balliol College, Oxford).

SEPTEMBER 26 TO 29.

INTERNATIONAL CONGRESS OF INDIVIDUAL PSYCHOLOGY (at Düsseldorf).

SEPTEMBER 26 TO OCTOBER 2.

CONGRÈS DE CHIMIE INDUSTRIELLE (at Brussels).

SEPTEMBER 27 TO 30.

ALL RUSSIAN OPHTHALMOLOGICAL CONGRESS (at Moscow).

SEPTEMBER 30 TO OCTOBER 2.

GERMAN SOCIETY OF UROLOGY (at Vienna).

OCTOBER 13 TO 26.

GERMAN SOCIETY FOR THE STUDY OF DISEASES OF DIGESTION AND METABOLISM (at Berlin).

OCTOBER 25 TO 28.

ITALIAN CONGRESS OF SURGERY (at Padua).