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Living Religions.

FOR nearly two weeks—from September 22 to October 3—a Conference has sat in London to listen to the tenets of some of the principal living religions of the world as expounded by distinguished adherents. It was held on the initiative of the School of Oriental Studies and the Sociological Society. The Conference, it is believed, was the first of its kind and was intended primarily to be educative It aimed both at disseminating accurate information relating to the religions represented and at removing certain popular misunderstandings. Mohammedanism, Hinduism, Buddhism, Taoism, the religion of Sikhs, Jains and Parsis, and primitive religions were represented, for the most part by members of the British Empire. It thus affords some indication, imperfect perhaps, of the great variety of religious belief to be found within this one political organisation.

An exposition of religious dogma at a conference carries with it something of an academic atmosphere, and, however much it may bring out the contrasts of different systems of religious philosophy, it fails to give full emphasis to their moulding force in determining the practical attitude of those who profess them towards their fellow-men and towards life as a whole. The influence of religion may appear imponderable except in times of conflict and stress. Life in a modern community does, no doubt, obscure it, may even weaken it; but for the majority of the inhabitants of the world, it is still all-pervasive and fundamental. This is more especially evident in the case of primitive peoples. It is on this account that study of primitive belief and ritual is an essential precedent condition of success in the administration of backward races.

It is not without significance that the religions of India should have taken a prominent place in the proceedings of the Conference. They rest upon a highly developed theological and philosophical basis; they present marked contrasts; and perhaps nowhere else is it possible to see more clearly the force of religious belief in determining the form and character of social organisation. In Hinduism the system of caste, with its rigid determination of social grades, the doctrine of asceticism, and the emphasis laid upon meditation as a form of religious practice, permeate every phase of Hindu society. The caste divisions, with the doctrine of untouchables and the specialisation of occupation, have proved, and are likely to continue to prove, an insurmountable obstacle to any lasting social and political unity. They have given a static character to social organisation which stands in the way of development.

The effect of religious belief, however, in the daily life of the people is even more clearly to be discerned when attention is directed to primitive conceptions, not

merely as they appear enshrined as survivals in the highly developed philosophical thought of official Hinduism, but in the popular religion, the traditional animistic beliefs, and the regard for the village deities of the mass of the population which were overwhelmed with the Aryan invasion but are still the predominant element in the popular religion. The significance of the survival of these primitive forms of belief lies in the fact that they still tend to keep alive the village community as the effective social unit. It is noteworthy that the modernist movements in India, which aim at a larger unity, seek to break down what, from the social if not from the philosophical point of view, have been the most persistent features in Hinduism. The reform movements in Hinduism, therefore, both Brahmo-Samaj, with its tendency toward universalism in its later developments, and Arya Samaj, with its militant nationalism, aim at ignoring differences of race and caste and seek to mould India into one people. In the same way the differences in doctrine of other forms of religion, whether Mohammedan, Parsi, Sikh, or Jain, are reflected in their social organisation. Yet if they neither observe caste nor practise asceticism in the strict sense of the term, they do not any the less hold themselves strictly apart. How deep is the line of cleavage can be seen in the bitterness of the conflict between Hindu and Moslem, which is repeatedly manifested upon occasions which might seem trivial to an outside observer. At the present moment the attempt at a reconciliation between the two bodies hangs upon an adjustment of their respective attitudes towards the cow, and whether it may be possible for the Mohammedans to devise a method of slaughter of this sacred animal which will not offend the susceptibilities of the Hindu.

The philosophical character of the sacred books, and the fact that information relating to Indian religion has been too exclusively drawn from literary sources, has tended to obscure the practical effect of religious belief in determining the form of Indian social institutions except in their more obvious aspects. But none the less in India, as in other parts of the world where religious beliefs conform to a primitive type, that attitude towards the hidden powers underlying material things which anthropologists call animism is a dominant factor in the form and content of social life. An instance at once suggests itself. The social organisation of the Todas depends entirely upon the sacred character of the cow; it is arranged to meet the requirements of the ritual of the dairy. An analogous case is to be found in East Africa, where the institution of royalty and the whole of the kingly ceremonial among the Bahima is based upon the sacred nature of the cattle and the dependence of their welfare upon the king. Even the diet of the people and their food taboos, whether temporary or permanent, are related to the sacrosanctity of the milk and the care which must be taken to protect it from the slightest danger of ritual uncleanness.

It would be possible to add almost innumerable instances among primitive peoples in which the form and content of social institutions are directly dependent upon the character of their religious beliefs. The widely spread totemic system in its various types, the matriarchate and the prominence given to the mother's brother in all matters in which in the patriarchal system the father holds the authority, are instances striking by their diversity from our own customs. But, as Sir James Frazer has shown in "Psyche's Task" (London: Macmillan and Co.), primitive religious ideas underlie some of the most important functions of modern civilised life. Taboos similar to those which are now observed in the islands of the Pacific lie deep rooted at the base of our ideas of property; the divine right of kings can trace its ancestry to the sacred character of the chief, whose power may rest either with the fact that he embodies the spirits of his ancestors, or that by his power as a magician he can control the hidden forces of the world around. The primitive belief in magic has determined the forms of the law, and the invocation of spirits, assisted by the administration of poison or other form of test, has grown into the trial by ordeal out of which our judicial procedure has developed, still retaining the administration of the oath, formerly a test and now a guarantee of the honesty of a witness.

It may be asked in what sense the term "living religions" has been applied in selecting the forms of religious belief to come before the Conference which has just been held. An attempt to supply an answer to the question has been made by Mr. Victor Branford in an essay [1] which, although not an official publication, was issued as an interpretative study a few days before the Conference met. Mr. Branford, who is a co-worker with Prof. Patrick Geddes, would apply the term only to those religions which show signs of developing along the lines of the larger modernism. As an instance of his meaning he cites the case of Indore, where the ritual processions have been adapted, at the suggestion of Prof. Geddes, to subserve the needs of the city in improved sanitation and housing. In the modern State, he beholds a vision of a cult in which the complete unification of the sciences and arts is directed to the cultivation of the highest faculties in man in a civic environment in perfect harmony with that end. There perhaps the matter may be left without too close an examination of how far the place of religion in an actual modern community falls short of this ideal.

[1] "Living Religions: a Plea for the Larger Modernism." By Victor Branford. Pp. xxxvii + 290. (London: Leplay House; Williams and Norgate, 1924.) 5s. net.

Primitive Medicine.

Medicine, Magic and Religion: the FitzPatrick Lectures delivered before the Royal College of Physicians of London in 1915 and 1916. By Dr. W. H. R. Rivers. (International Library of Psychology, Philosophy and Scientific Method). Pp. viii+147. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1924). 10*s.* 6*d.* net.

HAD Rivers lived for a few more years, there is little doubt that this book would never have seen the light in its present form. The Fitzpatrick Lectures, which he delivered in 1915 and 1916, are now published practically as they were delivered, but Rivers intended, as Prof. Elliot Smith has pointed out in the preface, to make them the basis of a comprehensive treatise on primitive medicine; and to this end he had already collected an enormous bibliography. The loss to science is therefore incalculable; for Rivers was, just before his death, projecting another advance in knowledge, which only he, of British ethnologists at least, if not in the whole world, was capable of making. Shortly before his death, he said that he was going to make it his business to set out in proper form the doctrine of the biological analogy, which has been so discredited through its misapplication, but, nevertheless, is of the utmost importance to the proper understanding of the social process as a whole. With his incomparable knowledge of medicine, psychology, and of ethnology, he would undoubtedly have produced work that would have added a pinnacle to his fame. But this was not to be, and the world will have to wait until another shall arise capable of the feat.

This book has a twofold interest. In the first place, it is a piece of ethnological research which throws much light on the problem of the relations between medicine, magic, and religion, especially in communities of the lower culture. For this reason it will be valuable to the student, especially as much of the material has been collected by Rivers himself, partly in collaboration with Mr. A. M. Hocart, in Melanesia. The scene of action is usually placed in Melanesia, but in the latter part of the book a survey of the world is carried out which serves to give a comparative value to the result of his investigations. This line of work is likely to have a considerable influence on ethnological method in the future.

The second feature of interest in the book lies in the fact that Rivers was facing some of the consequences of his change of attitude towards the problem of accounting for the culture which any community possesses. Having broken away from the orthodox school of Great Britain, and taken his stand on the side of diffusion, he was forced to examine every fact that came under his purview from this point of view. The result is illuminating. It is, also, safe to say that had Rivers not adopted, in his "History of Melanesian Culture," the method of culture-mixture, by which he tried to show how various elements of culture might have arisen as the result of the intermixture of two or more cultural streams, it is probable that he would have moved much faster in the direction in which he was travelling than he actually did. Indeed, there is no doubt that it was this preoccupation with the problem of culture-mixture that prevented him for some time from realising the extent of the revolution he had caused. But, at the same time, there is not much doubt that he would have agreed ultimately entirely with the point of view of Elliot Smith. This is shown in his comments on the discoveries in San Cristoval made by Dr. E. C. Fox, whose book is shortly to be published.

The volume under notice consists of five chapters. Each of the four Fitzpatrick Lectures occupies a chapter, and the Rylands Lecture in 1919 on "Mind and Medicine" is published as the fifth chapter. The first chapter is occupied with the discussion of beliefs concerning the causation of disease among various Melanesian peoples. Peoples of low culture usually ascribe disease to the magical actions of some human being, or to some spiritual agency, which either enters the body of the victim, or else abstracts the vital essence and so causes disease. Sometimes minor ailments are ascribed to natural causes. A sorcerer who causes disease can act in one of three ways. He can project some morbific object or influence into the victim's body; he can abstract something from the body; or he can act on some part of the body, or some object which has been in contact with the body. The last case would be termed one of "sympathetic magic" by Sir James Frazer and his school of thought, the idea being that natives imagine that the two disconnected bodies are really in communication by means of "a kind of invisible ether." Rivers believed that this interpretation is mistaken, and that the "contagious magic" of peoples who practise such rites "rests not on any mystical belief in action at a distance, but on the belief that the sorcerer has in his possession part of the soul of another person, part of the vital essence of the person which he wishes to destroy" (p. 27). That is to say, the magical procedure of these peoples rests on a concrete, logical basis.

Then comes an interesting chapter dealing with diagnosis and prognosis, the bases of which are magical and religious. In this chapter Rivers is at pains to show that the religious element is far more important than is usually assumed, that the formulæ which form so constant a part of the magical rites are very often

supplications, appeals to higher powers, and not charms which are supposed to be efficacious in themselves.

As a result of the native theory of the causation of disease there has been produced, in certain places, an immense variety of specialisation. For example, in Eddystone Island of the Solomons, there is a degree of specialisation that puts Harley Street "in the shade." Practitioners are to be found there who deal exclusively with rheumatism, fever, epilepsy, insanity, and so forth; each has his own particular technique and knows nothing of the manner of treatment of other complaints—a "division of labour" *in excelsis*. Rivers lays great stress, also, on the part played in medical practice among peoples of low culture—in contrast, is it possible, with their more civilised brethren?—of suggestion. He suggests that the savage practitioner is less of an impostor than we are apt to believe, and, what is more, he goes so far as to suggest also that the modern quack is not necessarily always a humbug, but that he may have implicit faith in his nostrum.

The second half of the book is concerned with the problem of transmission of culture. Here Rivers discusses from this point of view the medical practice of various parts of the world, as well as different forms of medical treatment. He shows, for example, that two theories as to the causation of disease are widely held. One, which ascribes disease to the abstraction of the vital essence, is held in Indonesia, Papuo-Melanesia, and America. The other view, that disease is the result of possession, is found pre-eminently in India and Africa. Rivers comments: "If the phenomena of disease are much the same all the world over, and if the similarities of belief and action are due to the uniformity of the human mind, how comes it that men should have been led to these very different beliefs and why should these beliefs have different distributions?" Again he brings forward the case of remedies of what he terms the "domestic order"—massage, vapour-baths, venesection, cupping, and similar treatments, and comments thus:

"Highly as we rate our civilisation, it did not enable us to discover for ourselves practices which, according to advocates of independent origin, must have been discovered by the Melanesian and Papuan. We acquired our practices of bleeding and counter-irritation from the Greeks or Arabs, our massage from the French or other continental people, and our vapour-baths from the Turks and Russians. The civilisation of which we are so proud did not of itself suffice to teach us these remedial arts, but we had to acquire them by contact and mixture with other peoples. If we are to accept the teachings of those who believe in the independent origin of such practices in Africa, Asia, Oceania, and America, we shall have to accept the position that the savage or barbarous peoples who inhabit these continents and islands were somehow able to discover arts which we, who think ourselves so greatly their superiors, were content to learn from other peoples" (p. 85).

Rivers then proceeds to discuss the mechanism of culture-transmission, and to show what modifications may be produced during the process, taking medical practice to illustrate his points. This is one of the most important chapters in the book, revealing as it does, with the utmost clarity, the attitude which Rivers then adopted towards the general problem of the transmission of culture, the problem which is bound, in the next few years, to occupy most of the attention of ethnologists. He studies the factors which determine the survival value of an introduced element of culture, as well as the modifications which it undergoes as the result of introduction into a new environment.

In the course of this discussion, Rivers lays special stress on the factor of degeneration, which he certainly, so far as our knowledge goes, was the first to stress and to study in detail. He says:

"We are only now emerging from a period in the study of human society during which the factor of degeneration has been almost wholly neglected or greatly underrated, even in the case of the ruder phases of human culture"—adding, also, the characteristic caution: "In seeking to show how great a part degeneration has played, and is still playing, in the history of human society, we must be careful not to go to the opposite extreme, and overrate its frequency and importance" (p. 110).

The final chapter, "Mind and Medicine," is already familiar to many of the readers of NATURE. It is the result of the experience gained by Rivers during the War, when he had charge of men suffering from "war-strain." Rivers was one of the first medical men in Great Britain to advocate and to clarify the views of Freud and his school concerning psycho-pathology; and in this chapter he adumbrates the application of the results of this work to the study of human society and its disorders, which certainly would have formed the great task to which he would next have turned his attention. His masterly treatment of self-knowledge, self-reliance, and suggestion in their social aspects is bound to have important repercussions in the domain of social psychology.

The reader of this work must certainly come away with the feeling that had Rivers lived for another ten years, so as to have been able to gather together the treasures which he had won in so many departments of knowledge, the science of anthropology would have been incalculably the richer. It is a tragedy that he should have gone just when his powers were coming to their full maturity, when he was at last coming into his own.

W. J. PERRY.

Relativity.

(1) *Théorie quantique des spectres. La Relativité.* Par Norman Robert Campbell. (Supplement à l'ouvrage : La Théorie électrique moderne ; théorie électronique.) Traduit de l'anglais par A. Corvisy. Pp. 237. (Paris : J. Hermann, 1924.) 18 francs.

(2) *The Theory of Relativity : Studies and Contributions.* By Archibald Henderson, Allan Wilson Hobbs, and John Wayne Lasley, Jr. Pp. xiii+99. (Chapel Hill, N.C. : University of North Carolina Press ; London : Oxford University Press, 1924.) 11*s.* 6*d.* net.

(3) *Teoria della relatività : saggio di una esposizione secondo il senso fisico.* Da Prof. Paolo Straneo. Pp. 161. (Roma : Dott. G. Bardi, 1924.) 15 lire.

(4) *Einführung in die Tensorrechnung.* Von Prof. Dr. Hermann Rothe. Pp. iv+179. (Wien : L. W. Seidel und Sohn, 1924.) 5*s.*

THE literature of the theory of relativity and of the subjects allied to it is increasing so fast that it is becoming very difficult for any one to keep pace with it, but several of the books in the collection under review present their subject in so novel and interesting a manner as to be well worthy of the attention of the most seasoned student of relativity. Little need be said of the first book (1), for it consists merely of the French translations of the two chapters on the quantum theory of spectra and the theory of relativity issued as supplements to Dr. N. R. Campbell's well-known book on "Modern Electrical Theory." It will be sufficient to state that the French translation expresses the meaning of the original text clearly and fully. It is well printed and commendably free from misprints—the few that remain are fairly obvious and unlikely to mislead the reader—and will certainly prove helpful to those French students of experimental physics to whom the more mathematical text-books on relativity by Becquerel and Galbrun are a stumbling-block.

(2) The second volume gives a succinct account of Einstein's special and general theories of relativity and of the physical experiments on which they are based and by means of which they can be tested. The first chapter of nine pages, by A. W. Hobbs, treats of some experimental anticipations ; it is noteworthy for a very clear account of the theory of the experiment of Michelson and Morley. The second chapter of sixteen pages, by A. Henderson, gives a brief account of the special theory of relativity on conventional lines, whilst the third, by the same author, in forty-six pages deals with the general theory of relativity, including tensor analysis, and its consequences. Both chapters are remarkable for the clear enunciation of the fundamental principles postulated by Einstein and for the unusually complete and up-to-date treatment of the experimental tests of the theory, particularly the deflexion of rays of light and the displacement of spectrum lines. The fourth chapter of twenty-six pages, by J. W. Lasley, Jr., gives a complete, though concise, account of the curvature of manifolds according to the definitions of Gauss, Riemann, and Einstein, as an aid to the understanding of the geometry of the Einstein space. This may perhaps be regarded as the most distinctive feature of the book. Naturally a complete statement of the theory and its consequences cannot be expected in so restricted a space, but the treatment is clear and thorough so far as it goes. The book can be recommended as a brief summary of the theory, although it may, owing to its brevity, very well prove somewhat difficult reading for those who have not already acquired some knowledge of the subject from one or other of the standard treatises.

(3) Prof. Straneo's "Teoria della relatività" is conceived on unusual lines : its purpose is not so much to give a complete account of the theories of relativity, special and general, developed by Einstein and his followers, as to supply physical interpretations of the different stages of their development and of the various results deduced from them. In this respect it invites comparison with Dr. Campbell's supplement, but whilst the latter is written specifically for physics students commencing their study of the theory of relativity, the former appeals to a wider circle of readers, more especially to those who already have a considerable acquaintance with the theory in its mathematical aspects. To these it offers a most interesting and stimulating presentation of an aspect of the theory too often neglected in favour of a more formal treatment, and thus it fills a distinct gap in the literature of relativity. About ten pages are devoted to a sketch of prerelativity physical theories, sixty to the special theory of relativity, ten to the period of transition, and sixty-five to the general theory. In accordance with the plan of the work, mathematical developments, though of course not absolutely ignored, are relegated to the background, whilst particular attention is given to the exhibition of the physical meaning of the various steps in the analytical formulation of the theories and the methodical explanation of the arguments employed in their development.

The general attitude of the author is perhaps best characterised by two theses frequently insisted upon in the book. The first is that the theories of relativity are physical theories and therefore, like other physical theories, must be judged by their capacity for subsuming and explaining the facts of physical experience as a whole, rather than the particular effects so often insisted upon, such as the motion of the perihelion of Mercury, the deflexion of light by the sun and the

displacement of spectrum lines, all of which are on too minute a scale to afford decisive criteria for the acceptance or rejection of theories of so wide a range. The second thesis is that the theories of relativity afford an opportunity for, but do not absolutely compel, a revision of our fundamental ideas of space and time. For though they establish an entirely new relation between them and enable us to use the four-dimensional space-time continuum as a convenient system of reference, yet they leave us with so great a difference in character between the two concepts, that we need not renounce our intuitions of them as essentially different. This truly fascinating monograph offers so much that is new and suggestive within a narrow compass that it can be read by every student of relativity with great profit, be he mathematician, physicist, or philosopher; its translation into English is very much to be desired.

(4) "Tensorrechnung," by H. Rothe, constitutes the first part of a projected treatise on tensor analysis and is an excellent introduction to tensor algebra. It may very well be reviewed with the other books of this collection on account of the close connexion of its subject-matter with the theory of relativity. In about one hundred and eighty pages it deals with its subject exhaustively, but at the same time assumes so little previous knowledge of higher mathematics and is written in such a clear and full manner, that students with even a very slight mathematical equipment can be expected to derive considerable benefit from its study and to find it a great help towards the understanding of standard works on the general theory of relativity. In spite of the fact that complete generality is attained, particularly in the later chapters, the author has contrived, by a judicious and gradually progressive arrangement of his theoretical material and a free use of well-chosen and fully worked examples, to lead the reader onwards from the theory of manifolds of two, three, and n dimensions, by way of the theories of scalars and vectors, to the theories of tensors, linear vector manifolds, and tensor fields of the most general types.

In general, the author has restricted himself to algebraic methods, such as the processes of addition, multiplication, and contraction ("Verjüngung"), and has reserved the study of differential and integral processes for another volume. It is very unfortunate that the completion of the work was cut short by the premature decease of the author; but even in its present incomplete state the book, in so far as it constitutes a complete treatise on tensor algebra, supplies a distinct want and forms one of the best introductions known to the present writer to a difficult and important subject. Like Straneo's work, it is well worthy of translation.

Aeronautical Science.

(1) *Elementary Aeronautical Science.* By Ivor B. Hart and W. Laidler. Pp. vi+288. (Oxford: Clarendon Press; London: Oxford University Press, 1923.) 7*s.* 6*d.* net.

(2) *Les Hélicoptères: Recherches expérimentales sur le fonctionnement le plus général des hélices: Études sur le mécanique de l'hélicoptère.* Par W. Margoulis. Pp. xi+90. (Paris: Gauthier-Villars et Cie, 1922.) 10 francs.

(3) *Étude sur le ballon captif et les aéronefs marins.* Par Le Commandant Charles Lafon. Pp. vi+206. (Paris: Gauthier-Villars et Cie, 1922.) 20 francs.

(4) *Sur la théorie des surfaces portantes.* Par Maurice Roy. (Collection "Scientia," No. 39.) Pp. 130. (Paris: Gauthier-Villars et Cie, 1923.) 12 francs.

(1) AN obvious need in aeronautical literature is a book giving a reasonably competent account of the principles of aviation, and not merely popular or spectacular on one hand, but not containing masses of technical detail of an engineering or mathematical character on the other. Messrs. Hart and Laidler's book is an attempt to provide for this need: it is intended primarily for young students among the aircraft apprentices in the Royal Air Force. The mathematical equipment of such readers is necessarily slender, and the authors do not use any more advanced mathematics than elementary algebra and trigonometry, with a few exceptions where the calculus notation has had to be employed. It may be said at once that the book seems at least to be a very good attempt in a new direction. It is pleasantly written, fairly full but not too big, comparatively cheap and nicely got up, with numerous interesting illustrations.

There are three parts. The first is devoted to historical and mechanical introduction. Part ii. gives the elementary principles of flight. Part iii. deals with the structure of the aeroplane, its parts, the engine, instruments, etc.

The historical portion of Part i. is a survey of the development of aviation from the earliest times to the present day. A lot of space is devoted to Leonardo da Vinci, while the work of the last twenty years is dealt with very summarily—a rather serious error of perspective. The mechanical portion consists of a brief survey of the most important facts and formulæ of elementary mechanics, a useful reminder of things that presumably the student knows already: otherwise it can be of very limited utility.

In Part ii. the authors, after a brief reference to the ornithopter and helicopter, turn to the main topic of the book, namely, the aeroplane. The aerofoil is introduced and its various characteristics. A really gallant effort

is made to explain stability without the use of mathematical analysis, while control, manœuvres, and stunts complete a particularly successful and brief statement of the aeroplane and its motions in about 90 pages of print.

Part iii. discusses the air-screw, graphical statics of aeroplane structures, and all the topics associated with the structure and manœuvring of aeroplanes. An excellent feature of the book is the large number of easy exercises, mostly numerical, to which answers are given.

We can have no hesitation in recommending this excellent book to all students who wish to gain an elementary knowledge of the aeroplane. We would suggest, however, that in a later edition some effort should be made to justify the epithet "aeronautical." In its present form the book is really "elementary *aeroplane* science," and not "*aeronautical* science." The student would understand aeroplane flight much better if he had side by side with the theory of the aeroplane a brief and equally competent account of the airship and the balloon: the contrast in sustentation and the analogy in control would be eminently educative.

(2) From time to time we are allowed a peep behind the scenes and told of the progress made in the designing of helicopters in Great Britain and elsewhere. While it may be doubted whether the special encouragement given to this type of aerial locomotion will be justified by events, the attempt to produce efficient and stable machines on the helicopter principle will be not only a practical achievement of great significance, but will also represent a source of useful information that will have its repercussion on other branches of aeronautical study and practice.

M. Margoulis attacks the problem of the helicopter from its fundamental aspects, *i.e.* he bases his book on the study of the air-screw in its most general form. He first takes the case where the plane of rotation of the screw is perpendicular to the direction of motion, paying particular attention to the fixed air-screw. He then uses the results of observations made at St. Cyr, at the National Physical Laboratory, and by Riabouchinsky, to discuss the general case in which the plane of rotation makes any angle with the direction of motion.

The results are applied to the helicopter in the form of an aeroplane, with air-screws rotating round vertical axes for purposes of sustentation when the horizontal speed is small or nil. Vertical flight and horizontal flight are discussed separately, and then the case of general flight is considered.

(3) M. Lafon's book has a twofold object. We have first a brief and interesting account of the naval captive balloon, with notes about its manipulation, "first aid" in connexion with accidents to the balloon or its attachments, meteorological notes, etc. This occupies 40 pages. The remaining 160 pages are devoted to "études beaucoup plus ardues," *i.e.* investigations of an engineering or mathematical character. This review must necessarily deal mainly with the latter.

First we have the theory of cables used with captive balloons, including the effect of wind. The author is clearly not a professional mathematician (it is to be hoped that non-mathematical readers will not misinterpret this remark), and the result is that he devotes a considerable amount of space in doing clumsily what can be done much more conveniently otherwise, and what indeed is fairly well known to such as have studied the forms of heavy chains. Interesting conclusions are reached when the wind is taken into account. The form is, of course, not that of the uniform catenary. If the weight is neglected M. Lafon gets a parabola with horizontal axis, as should be obvious *a priori* in view of the assumption made that the pressure of the wind is horizontal and proportional to the vertical projection of an element of cable. In general we have complicated curves (*not circles*, the author points out!), and it is of interest that the balloon can be in advance of the cable by the latter becoming vertical at some point below the balloon.

A topic to which the author directs special attention is one of tactics. The chief duty of the aerial scout is to give information as to the disposition of enemy ships. He must therefore observe, and this entails following an enemy ship at constant distance from it. We get the following problem in kinematics: A body moves in a given straight line (say) with given speed; a second body has given speed and is to move so as to be always at the same distance from the first: find the curve described by the second body. The author calls such a curve a "courbe encerclante"; he discusses the problem in great detail with tables and charts for the cases where the ratio of the speeds is 2 and 1·6 respectively. These and other matters form an interesting *mélange*, even if the author's claims to originality are occasionally rather feeble.

(4) The results of classical hydrodynamics are clearly not applicable to real problems, for obviously the statement that a sphere may move uniformly through a liquid without any resistance is at variance with the facts. Hence in the discussion of fluid resistance some departure from classical theory is required. Three main lines of departure have so far been suggested, and to some extent developed. In the theory of discontinuous fluid motion it is assumed that when a solid moves through a liquid there is a body of liquid behind the solid moving with it, while there is a surface of discontinuity separating this liquid from the remaining liquid where the motion is different at different points, and follows the laws of classical hydrodynamics. This theory has been developed in two dimensions by

Kirchhoff, Rayleigh, Mitchell, Greenhill, Levi-Civita, Cisotti, Villat, and others, while a suggestion for three-dimensional work on this theory has recently been made by Volterra. The second line of departure is the introduction of viscosity. The investigations made by Stokes have been extended by Rayleigh, Lamb, and others too numerous to mention, while the ideas of Oseen and his followers have led to interesting developments. Great promise attaches to the work of Bairstow and his assistants; a certain number of results have already been published.

The third line of departure from classical hydrodynamics is the subject of the present book by M. Roy. It is well known that d'Alembert's paradox, namely, that a body moving steadily through a frictionless liquid experiences zero resultant thrust, is true only if there is no circulation. When circulation exists we get a non-zero resultant thrust, as can be easily seen in the case of a circular cylinder. About twenty years ago a remarkable theorem was proved by Joukowsky, namely, that in two-dimensional steady motion there is a resultant thrust proportional to the density, to the relative velocity of stream and body, and to the circulation, in a direction perpendicular to the relative velocity: this thrust is quite independent of the shape of the cylindrical section.

It was very soon suggested that this theorem could be used to explain the remarkably high values of lift obtained with cambered aerofoils. As a matter of fact, similar suggestions were made on general lines by Lanchester in Great Britain, but his ideas were not followed up by any mathematical investigations. It was left to Kutta and others to apply mathematical analysis to this idea. At first artificial shapes were dealt with, like circular arcs, but during the last few years considerable progress has been made by a very active school of workers at Göttingen under the direction and inspiration of Prof. Prandtl—so much so that the theory is "popularly" known as the Prandtl theory. Considerable success has been obtained also by Glauert in England.

M. Roy gives a brief account of the method and of its chief applications, based on what is called the "linear theory," *i.e.* the theory in which the difference between the motions of any two particles of liquid is assumed small compared to the relative velocity between the liquid and the rigid barrier, so that only the first power of this difference is taken into account. The book is interesting and useful, but occasionally rather obscure, and difficult to understand. The main notion is, however, quite simple, and honours students in mathematics should certainly be introduced to it in preference to so many merely formal results included in orthodox courses on hydrodynamics. S. BRODETSKY.

Our Bookshelf.

Contributions to the Biology of the Rotifera. By C. Wesenberg-Lund. 1: The Males of the Rotifera. (Kgl. Danske Videnskabernes Selskabs Skrifter: Naturvidenskabelig og Mathematisk Afdeling, 8de Række, IV. 3.) Pp. 191-345+15 plates. (København: Andr. Fred. Høst og Søn, 1923.) Kr. 21.25.

As a result of more than twenty years' careful and systematic observations carried out on the Rotifers of numerous ponds in North and Middle Iceland, the author of this important monograph has added greatly to our knowledge of a very puzzling group of animals. It was Ehrenberg who first clearly separated the Rotifera from the Protozoa, with which they had previously been associated on account of their microscopic size and general appearance, but he made the serious error of regarding them as hermaphrodite, and it was not until 1848 that a male Rotifer was recognised as such by Brightwell. It is still commonly supposed that the males are very scarce, and until the appearance of the work under review, males had been found in little more than 100 out of the 1000 known species. This apparent scarcity is now shown to be due very largely to the fact that males are produced only at certain periods of the year, but they may then appear in enormous numbers. The ordinary method of reproduction is by means of parthenogenetic eggs, but periodically, in some species once, in others twice a year—and only under favourable conditions—an enormous increase in numbers takes place, and this "maximum" heralds the appearance of the males from special male-producing eggs. They live only for a few days at most and then disappear completely and almost simultaneously. The fertilised females produce the well-known "resting eggs," which always give rise to females and inaugurate a new period of parthenogenesis. The males of many species are still unknown, but it seems probable that all give rise to males under suitable conditions.

It is interesting to observe that the author agrees with de Beauchamp in considering the Rotifera to be most nearly allied to the Turbellaria.

The work is accompanied by fifteen plates of excellent figures, and the author is to be congratulated very heartily on his interesting and valuable results.

Die Kolloidchemie als Hilfswissenschaft der Mineralogie und Lagerstättenlehre und ihre Anwendung auf die metasomatischen Blei-Zink-Lagerstätten. Von Dr. F. Bernauer. Pp. viii+83. (Berlin: Gebrüder Borntraeger, 1924.) 5*s*.

THE original object of this small work, as stated in the preface, was to inquire what part colloidal processes, and more particularly gel formation, played in metasomatosis. Although the conception that many minerals were gels had been systematically developed by Cornu, and had been adopted by Doelter and his collaborators, the author states that he could not find anywhere a synopsis of the properties of mineral gels, and therefore devotes the first part of the book to a description of their characteristics and to the methods of diagnosis. The definition of a simple gel prepared *in vitro* is not easy, and does not become more so in the

case of systems which may have undergone secondary transformations like re-crystallisation, so that diagnosis must rest on the simultaneous occurrence of a number of criteria. Due attention is given to a number of secondary phenomena, like fissures due to shrinkage, accidental double refraction, the influence of gels on crystal habitus, etc., which cumulatively point to a mineral having at some time passed through a gel stage.

The second part is devoted to the description and detailed investigation of metasomatic zinc-lead deposits, more particularly the well-known Wiesloch deposit, with especial attention to schalenblende and galena. Only the briefest summary of the author's conclusions is possible: he distinguishes three types of zinc sulphide, for at least two of which a gel may have been the original material, and three types of galena. The latter is always crystalline and the difference is one of habitus, which the author assumes to have been determined chiefly by the ratio of lead sulphide to zinc sulphide.

The book is an interesting example of the growing number of attempts to apply the results of colloid chemistry to the elucidation of natural phenomena, the direct imitation of which is unfortunately precluded chiefly by the time factor.

Kant's Treatment of Causality. By Dr. A. C. Ewing. Pp. viii + 243. (London: Kegan Paul and Co., Ltd., 1924.) 10*s.* 6*d.* net.

THE publication of Dr. Ewing's book followed upon its being accepted by the University of Oxford for the doctorate in philosophy. The plan of the work is daring. In the first place, Dr. Ewing has written a work on one of the Categories of Kant in isolation from the whole, and, in the second place, he has endeavoured to elaborate and correct Kant in such a way as to present before the reader a restatement of Kant's proof "in a form in which it can stand by itself and make a good claim on all schools of thought." The former plan, naturally, being less pretentious, is carried out with more success than the latter, although the author's strong insistence on certain fundamental aspects of causality may, on further elucidation, "work the trick."

As a student of Kant, the author shows gifts of understanding and knowledge which must be unique in so young a student, and his insistence on the metaphysical interpretation, as opposed to the merely psychological, in the transcendental deduction and the analogy, and his strong insistence on the teleological aspect of Kant's late works, show him to possess a mind which reads and criticises freshly and a firm belief in his own powers of interpretation. In this part of the work, all students of Kant will find real interest and fresh enlightenment. We fear, however, that his hope that Kant can be restated in such a way as to prove causality is rather sanguine, and we are unable to follow his startling contention that we have direct synthetic *a priori* knowledge in some of our psychic states. His insistence on the "must" in causal laws will also draw protest from certain schools of thought, although it is time that the necessity was again pointed out, and we are glad that Dr. Ewing has had the courage to do it. The work can be thoroughly recommended to all students of philosophy.

Behind and Before: Two Essays on the Relation of History, Politics and Eugenist Warnings. By W. E. Heitland. Pp. xv + 166. (Cambridge: At the University Press, 1924.) 6*s.* net.

MR. HEITLAND, of St. John's College, Cambridge, has written a short but very thoughtful and suggestive book, mainly on the question of how far we may argue from history as to our action in the present and its results in the future. In general, he admits the possibility, and then proceeds to enforce the urgency of the study. But the bulk of his essay suggests various cautions and raises numerous problems. In particular he emphasises the need of distinguishing the behaviour of mankind in masses and groups from that of the same persons taken as individuals. This is, of course, the fundamental principle, in fact the *raison d'être*, of sociology. He also holds that if lessons are to be learnt from history as an equipment for practical politics, it is in the experience of recent times that they must be chiefly sought. This again is now a dominant principle in the school teaching of history, and it is thought by many people that the pendulum has swung too far in the direction of modernity.

There is no main thesis in the book which the author is concerned to defend as a new gospel, but he inspires a salutary sense of the importance of social biological study and drops many wise hints on the way. "A searching test," he tells us, "of the soundness of our civilisation is the frank and loyal acceptance of the consequences of our own imperfection." He is emphatic on the need of leadership, but avoids the common eugenic fallacy that the good stocks, which should naturally lead, are being bred out and swamped by inferior material. "What evidence is there," he asks, "that men risen from the ranks do lower the moral of the governing class?" Do not their better elements produce citizens of high quality, sometimes of distinguished merit? Do not they add strength to the governing classes? And where did these upper classes come from? A very interesting and well-balanced book.

F. S. M.

The Nature of Art: an Open Letter to the Professor of Poetry in the University of Oxford. By Prof. J. A. Smith. Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 2*s.* net.

PROF. SMITH'S Open Letter is one of those delightful attempts to place before a brother professor a little of the knowledge which, although belonging more properly to the sphere of the writer's particular branch of learning, ought to be shared by his confrère. The letter was not written for publication, and, for that reason, is all the more delectable, for it shows a spirit of true learning, willing co-operation, and kindly friendliness which, in these days of commercial antagonism, is all the more refreshing. The preface tells us that after a discussion with the professor of poetry at Oxford, Prof. Smith desired further to explain his own position with regard to the nature of poetry and art and took the opportunity of doing so in this letter. That we have the privilege of reading it is due, apparently, to the impression that the letter made on the recipient. We do not know whether the sender made a convert, but the present writer, for one, is heartily

glad that the letter has been published. The aim of the letter is primarily to explain the theory of art which Prof. Smith himself holds. He points out that any criticism of art requires a ground for criticism, and that this, again, requires a theory. The writer holds such a theory and begs leave to present it to his friend. The theory is not his own, but that of a master, but he holds it none the less sincerely for that and hopes that it is, first, intelligible and, secondly, acceptable. The theory is, of course, that of Gentile, and the letter is a clear exposition of the Italian master's views on art. This we refrain from criticising, but we admire and commend both the matter of the letter and the spirit which prompted the writing of it. Those who have any interest, either in letters or art, will thoroughly enjoy the reading of it.

An Introduction to the Study of Heredity. By Prof. E. W. MacBride. (Home University Library of Modern Knowledge.) Pp. 256. (London: Williams and Norgate; New York: H. Holt and Co., 1924.) 2*s*. 6*d*. net.

OUR knowledge of heredity has long since passed the stage when it could be summed up in a few simple aphorisms such as "like begets like." During the past thirty years especially, many diverse lines of approach have been explored; biometry has attempted the measurement of likeness, cytology and experimental embryology have unveiled some of the mysteries of begetting, and Mendelian research has given one answer to the question why like sometimes begets unlike. To sketch an intelligible outline of the results obtained in these varied fields and to present them in ordered and logical sequence is no light undertaking; to compress it within the space of 250 pages might well seem impossible. Prof. MacBride, however, is an experienced teacher, with a gift for lucid and forcible exposition, and this little book is well fitted to arouse interest and to stimulate the reader to further study.

In such a survey it is impossible, even if it were desirable, to avoid some degree of dogmatism, and Prof. MacBride maintains his own point of view with vigour and occasionally with a touch of asperity. Some may think that he gives too easy credence to the claims of the Vienna school, or that he overestimates the adequacy of Tornier's hypothesis of "germ weakening" to account for the origin of mutations, and specialists in various fields will doubtless detect minor inaccuracies. It is a little difficult to reconcile the statement on the last page, "The study of biology teaches unequivocally that all progress in the animal world has been brought about by natural selection," with the tenor of some earlier passages, notably on page 138.

Entdeckte Verborgenheiten aus dem Alltagsgetriebe des Mikrokosmos. Von Prof. Dr. Paul Lindner. Pp. viii + 291. (Berlin: Paul Parey, 1923.) 6*s*.

PROF. LINDNER'S book is a comprehensive treatise on a great variety of sciences that require the microscope as their principal instrument of research. It deals in a discursive way with the structure of the eye, the history of the microscope, the manufacture of leather, the brewing of beer, as well as with the biology of the common microscopic animals and plants, and with many other topics. As might be expected in a book of such wide scope, the quality and treatment of all the subjects dealt with is not consistently good. Many readers will be glad to have in a convenient abbreviated form the results of the distinguished author's researches on the fermentation processes, and the chapters dealing with the biology of wine making, of brewing, on the bacterial decomposition of the food in the alimentary canal, on the formation of honey dew, and many other examples of interesting symbiotic relations between animals and plants, are all excellent.

In other chapters the information given in the text is not trustworthy. The larvæ of the ox warble fly are not transferred from the legs to the œsophagus by the tongue as stated on p. 259, but, as proved by Carpenter, penetrate the skin and find a passage through the tissues to the alimentary canal. The principal cause of infestation by miners' worms (Anchylostoma) is not by drinking polluted water. The names of some of the most prevalent parasites and pests need revision. There is no justification, for example, for the retention of *Distomum hæmatobium* and *Musca vomitoria*, for the Bilharzia parasite and the blow-fly respectively. Many of the figures in the text are so small and so badly printed that they are misleading instead of helpful to the reader.

Ordnance Survey Professional Papers. New Series, No. 7. *Air Survey and Archæology*. By O. G. S. Crawford. Pp. 39 + 13 plates, 5 diagrams + 2 maps. (Southampton: Ordnance Survey Office; London: H.M. Stationery Office.) 5*s*. net.

IN recent years field archæology has received an unexpected but very valuable addition to its apparatus of investigation, in the shape of air-photography. In suitable country, especially in the down land of southern England, we can look through the veil of the past and see on the air-photographs the dim traces of a long-vanished race; we can detect the lines of field-boundaries and lynchets, of roads and earthworks, all invisible to an observer on the ground. It is shown by Mr. Crawford, in the volume before us, that not only can the features above indicated very often be discovered by means of photography, but also that it is possible to draw from the photographs important inferences as to the relative ages of the earthworks. Mr. Crawford deals particularly with the period of Celtic occupation of England, which may, in his opinion, have begun about 450 B.C., and, no doubt, lasted until the final disappearance of the Romans about A.D. 450. An examination of the air-photographs shows a network of field boundaries, banks and roads associated with upland villages; some of these were certainly in existence at the coming of the Romans, and some certainly persisted until their departure.

All who are interested in the history of rural England during this long period of some thousand years will find this publication well worth studying; it is admirably produced and illustrated, and incidentally shows the reconstruction, from air-photographs, of the eastern branch of the Stonehenge Avenue leading down to the river Avon.

Power Station Efficiency Control: a Treatise for the Power Station Engineer on Boiler-Room Efficiency, Turbine-Room Efficiency, Heat Balance Control, Methods of Recording and Tabulating Operating Results and Keeping a Day to Day Check on Operating Efficiency. By John Bruce. With an Appendix by R. H. Parsons. Pp. xiii+244. (London: Sir Isaac Pitman and Sons, Ltd., 1924.) 12*s.* 6*d.* net.

IN the management of the boiler-house of power stations, great improvements have been made in recent years, with a consequent increase in the over-all efficiency of generation. All the coal used is now weighed with high accuracy. The temperature of the furnaces and of the flue gases is recorded and chemical analyses of the products of combustion are continually being made. The results are recorded, tabulated, and suitably analysed. The staff are always striving to improve their methods and are always ready to consider the possibilities of new inventions and of new fuels. Six years ago, the ratio of the heat equivalent of the kilowatts generated to the heat equivalent of the fuel consumed was commonly only about 10 per cent. To-day, thanks to scientific investigations, there are power stations in various places with a thermal efficiency of more than 18 per cent. Most of the improvement is due to increased efficiency in the boiler-house. The author asks the reader to look on this book as addressed to power station operating engineers, and states that it is not a highly technical treatise but a general talk on the salient factors influencing efficient operation. We can recommend the book to both students and engineers, as it gives a good introduction to many problems which engineers are successfully solving.

The Microscope. Part 2. An Advanced Handbook: a Sequel to "The Microscope, a Simple Handbook." By Conrad Beck. Pp. 231. (London: R. and J. Beck, Ltd., 1924.) n.p.

THIS book may be regarded as an advanced supplement to the author's simple handbook on the microscope, already noticed in these columns. It deals in particular with the optical theory of the microscope and on somewhat novel lines. What we would especially commend is the manner in which the reader is carried on from point to point with the use of simple geometrical diagrams and without reference to advanced mathematics.

In addition to the general optics of lenses, excellent chapters are introduced on microscopic photometry, resolution, and illumination. In the last named, dark ground illumination is dealt with and details are given of the Barnard special illuminator which permits of the use of objectives up to 1·27 N.A. In Chapter viii. various microscopes for special purposes are described, *e.g.* measuring, tank, dissecting, and research, also the Barnard appliance for testing rigidity by an interferometer method. The final chapter deals with polarised light and its various applications to the microscope.

The book is one to be recommended to the non-mathematical reader who desires to understand the optical theory of the microscope. Where Mr. Beck expresses views somewhat different from those current, he at least supports them with reasoned explanations and experiments.

Elements of Electrical Design. By Prof. Alfred Still. Pp. xxi+535. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 25*s.* net.

MANY problems connected with the design of electrical machines and apparatus are discussed in this volume. It is shown that in many cases sufficiently accurate solutions can be found by applying elementary mathematics and known physical laws. When designing high-voltage insulators, the reader is shown how to picture for himself the tubes of electrostatic induction in the insulator and the surrounding space, and when studying the action of electric generators and motors he pictures the conductors as cutting the magnetic flux. A concrete mental conception can thus be obtained of the actions which produce easily measurable results. The author points out that the difference between a laboratory course and a course in machine design is that the former is mainly concerned with analysis, separating out the losses in a machine, whilst the latter is concerned with synthesis, the building up of a machine. A course in design is a link between academic studies and practical engineering. It helps to develop engineering judgment, the student learning the relative importance of the many factors which enter into a commercial problem.

A First Chemistry for Schools. By W. H. Hewitt and S. T. E. Dark. Pp. viii+316. (London: Methuen and Co., Ltd., 1924.) 5*s.*

THIS book consists mainly of directions for the carrying out of a large number of experiments by a class of boys. The results when discussed in class should provide excellent material on which to build a sound structure, though more discussion in the text would be welcome. Our curiosity, which is aroused on p. 28 by a reference to the "chemist's definition" of acids in Chapter ix., is unfortunately not satisfied, and the laws of chemical combination are dealt with somewhat casually in a chapter headed "Reduction, Oxidation." The book contains some good features, for example, hints on keeping a note-book, though the practice of copying original readings into a best note-book is to be deplored. Molecules are discussed before atoms. This unusual method of approaching what is probably the most difficult part of the subject for beginners is sound, but the necessity for using two distinct units is not clearly brought out, and some confusion may arise as to the difference between the "ultimate" particles called molecules and the "indivisible" particles called atoms.

I principî della meccanica alla luce della critica. By Giuseppe Casazza. Pp. 174. (Roma, Milano and Napoli: Albrighi, Segati and C., 1921.) n.p.

"A NEW assault upon the rock of crystallised ideas of the nature of force" is what the author claims for this book. One or two headings will suffice to show how weak are his conceptions and poor his standards of scientific value: "Carnot's Cycle (or the prettiest cycle of nonsense or contrasense that can be imagined)," "Astronomical Mechanics (or the greatest scientific joke that has ever appeared under the heavens)," "The Principle of Relativity (or a comedy full of laughter)." S. B.

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.*]

Earth Tides, Ocean Tides, and Local Geology.

IT was a source of satisfaction to me to read Dr. J. W. Evans's letter in NATURE of July 12, p. 49, and to note that he recognises the importance of a further study of earth tides. I quite agree with him in thinking that more earth-tide work is likely to be done if seismographic apparatus is adapted to that purpose than if observations are made only with an apparatus of the Michelson-Gale type, or with other apparatus equally refined and specialised. The results that can be obtained with seismographic instruments seem to me well worth having, even if the curves do not show the beautiful smoothness of those of the Michelson-Gale apparatus.

I am obliged, however, to differ with Dr. Evans, for reasons presently to be stated, in regard to the importance which he assigns to the local geology as a cause of anomalous results. Although our knowledge of the tides at sea and our command of mathematical methods are not sufficient for a rigorous computation of the effects of ocean tides on earth tides of like period, nevertheless they are sufficient not only to estimate the order of magnitude of these effects, but also to determine roughly their amount. It thus appears that the effects of the ocean tides are large enough to explain the observed anomalies in the earth tides, and that, in the cases treated by the Japanese investigators cited in my communication to NATURE of June 21 (vol. 113, p. 889), they do explain the anomalies quite as well as the inaccuracies of the method would allow one to expect. Furthermore, the influence of the local geology, although it must exist, is easily seen to be small. The French phrase for earth tides, *marées de l'écorce terrestre*, might seem to imply that earth tides are essentially a crustal phenomenon. Of course, we can observe only in or near the surface of the crust, but the tidal forces extend down to the centre of the earth, and, unless the matter of which the earth is composed is absolutely rigid, the tidal yielding must extend down to the centre also.

We may conceive the earth as divided into concentric spheroidal shells, and we may further suppose that the outermost shell is so thick that within it local geological differences die out, and that every shell within is homogeneous. The tide-producing force is a body force, acting on each particle of matter. Each shell receives the tidal distortion due to all the shells within it, and adds a small contribution of its own.[1] The tidal distortion of the outermost shell is mainly what it receives from the shells within, for we assume that the hypothetical shells never lose contact with one another. They are formed by mere hypothetical boundaries which we insert for our own convenience into a continuous body. The yielding of different parts of the outermost shell to tidal forces must be somewhat different, corresponding to local geologic and geographic conditions, but this difference must be decidedly small in comparison with the whole distortion accumulated from the centre outward.

In the preceding paragraphs the earth tides proper alone have been considered, not the secondary effects of ocean tides of like period. In respect to the latter, the local geologic conditions might be of more importance than in respect to the primary earth tides, for the ocean tides exert a surface pressure, not a body force acting from centre to surface like that which causes the primary earth tides. Even here, however, the effect of local conditions is probably not important, for the secondary effect of the oceanic tides becomes large only when the oceanic tide, that is, the surface pressure, is in approximately the same phase over large tracts of ocean. But when the pressure is applied over a large area it goes deep, that is, a considerable depth must be attained before the effects of surface pressure become small in comparison with the values at the surface. In thus going deep the pressure involves portions of strata that presumably are nearly alike all over the earth and depend but little for their properties on the geology and geography of the portions of the outermost stratum directly above them. The earth tides show the effect of the yielding of the earth as a whole, and to this the outer crust will generally contribute but a small part.

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[1] The outer shells, of course, react on the inner shells, which therefore behave differently from what they would if the outer shells were absent.

The Resonance Theory of Hearing.

IT is surprising that the resonance theory of hearing continues to be revived in one form or another. As soon as the ear is considered in relation to the other sense organs, it becomes apparent that all forms of resonance theory are profoundly unsatisfactory and unphysiological.

In the course of evolution the hearing apparatus derives from the tactile sense. In primitive fishes we have the organs of the lateral line. One of these, placed at the cephalic end, becomes invaginated to form the otic vesicle, which develops into the complicated membranous labyrinth. At first, the sensations are purely tactile, being shocks transmitted through the watery medium. When the surrounding medium becomes air, and the vibrations assume a periodic character, these are registered in the cochlea —a derivation of the otic vesicle—and perceived as sound. Why is the ear alone of all sense organs credited with the capacity for analysing the particular stimulus to which it is adapted to react? We do not claim this faculty for other organs. The retina perceives white light and does not analyse this into its component spectrum. If there are any analysing structures in the fundus of the eye, these are admittedly scattered all over the retina. The skin, it is true, possesses separate end organs for the sensations of pressure, pain, cold, and heat. But who has ever imagined one end organ which will register say 40° C., and that particular temperature only, while another registers 45°? Yet it is an apposition of a series of such separately functioning end organs in the cochlea that the supporters of the resonance theory ask us to accept.

The analogy which compares the fibres of the basilar membrane to piano strings continues to appear in all the text-books of physiology. A continuous, very small, spread-out membrane, varying in width from the base upwards in the proportions of approximately 1 and 10, is supposed to contain a series of end organs which must number at least 2000. Each is delicately attuned to vibrate in sympathy with one periodic vibration only. This marvellous collection of resonators must be fully developed at birth. It must remain unchanged throughout life, from the moment a baby picks up sounds until

death at a ripe old age, while every other structure in the body is subject to the laws of growth and degeneration. Helmholtz himself at first thought that the external pillars of the organ of Corti were the resonators. When it was shown that these do not exist in birds, which have particularly acute hearing, he abandoned the external pillars in favour of the fibres of the basilar membrane. Nearly every other structure of the cochlea (*e.g.* the tectorial membrane, the hairlets) has at one time or another been credited with the functions of resonator. As Bonnier, in his work "L'Audition," so forcibly expresses it, "pendant plus de deux siècles on tortura pour elle [the resonance theory] l'anatomie, la physique, l'expérimentation et la clinique."

No theory of hearing will be satisfactory unless it starts with the assumption that the cochlea *as a whole* responds to sound vibrations. Each sound picture will create a pattern and make a composite impression in the cochlea, just as each visual impression leaves a composite impression or picture on the retina. Examples of very interesting theories, built up on these lines, are those of Wrightson and Keith, and that evolved by Bonnier. The ear is no more an analysing apparatus than the blackened drum which registers the vibrations of a tuning-fork.

J. KEEN.

Leicester, September 27.

Organ-Pipes of Unusual Shapes.

THE work of Principal J. A. Aldis (NATURE, Aug. 30, p. 309) on the Bicylindron is not only of practical importance to the scientific pipe-builder, but also constitutes an important addition to the acoustical theory of the organ-pipe. The Bicylindron as invented by Mr. Aldis is new to organ-practice, but there has existed for several hundred years a form of pipe, the theory of which is similar to that of the Bicylindron, although differing greatly in its solution. I refer to the Rohrflöte or Flûte à Cheminée (a particular case of which is found also in the Flauto d'Amore), the invention of which may probably be claimed by the German organ-builders of the seventeenth century. It was found that a stopped pipe of medium scale could be given a very beautiful smoothness of tone if the stopper were perforated by a narrow cylindrical hole, coaxial with the pipe. In old German organs the four-foot stopped diapason in wood was sometimes treated in this way, thereby replacing the rather nasal stopped diapason quality by one more desirable in a small organ. Later, the perforation was extended to metal pipes, a particular stop known as the Rohrflöte being constructed, which owed its peculiar ringing quality to the extension of the main body of the pipe in a short narrow "chimney," and to the provision of a semicircular mouth with large ears, which enable the pipe to be tuned exactly.

The theory of the Rohrflöte was mathematically established by Dr. Robert Gerhardt in 1884.[1] Since his treatise is inaccessible to me, and I can find no adequate summary of his work, I have attempted the investigation with the following results, which I hope any one possessing Dr. Gerhardt's work will correct if his results and mine are at variance. The Rohrflöte is obviously a Bicylindron of which both pipes are open, and the one of larger diameter contains the mouth. The solution is, therefore, markedly different from that of Mr. Aldis. But in both cases the displacement is discontinuous at the plane joining the two tubes, although the differential coefficient of the displacement, with respect to measurement along the axis of the pipe, is continuous at that plane. Using the same treatment as that used for the Bicylindron, the solution for the Rohrflöte is

$$\frac{\tan mh}{\tan mk} = -\frac{r^2}{R^2},$$

where $m = 2\pi/\lambda$, λ being the wave-length of the resultant fundamental vibration, and h and k the speaking lengths, and r and R the radii of cross-section of the chimney and body respectively. If $r/R = \tan \pi/n$, a series of upper partials will be obtained, given by

$$1,\ n-1,\ n+1,\ 2n-1,\ 2n+1,\ \ldots \text{ etc.}$$

Even if "n" is not an integer, and the upper partials consequently inharmonic, their difference tones will give the octave of the fundamental, and hence the effect may not be altogether displeasing.

The solution of the equation has certain points of interest. If $k = qh$, the fundamental frequency will be $2q/n$ times that given by the body of the pipe, without a chimney, when closed. For particular examples one can use the expanded form of the relation:

$$-\frac{R^2}{r^2} = \frac{q - qC_3 \tan^2 mh + qC_5 \tan^4 mh - \ldots}{1 - qC_2 \tan^2 mh + qC_4 \tan^4 mh - \ldots}.$$

The equation may also be written:

$$\left(1 + \frac{r^2}{R^2}\right) \sin (1+q)mh = \left(1 - \frac{r^2}{R^2}\right) \sin (q-1)mh,$$

which, by taking the cases $q = 1$ and $r^2/R^2 = 1$, demonstrates the correctness of the expression. If for convenience we put $r^2/R^2 = w$, we are only concerned here with values of w between 0 and 1, although the equation would also serve for $w > 1$. Taking these limits into consideration, it is easily seen that $\left[\frac{\partial m}{\partial h}\right]_{w,k}$ is negative while $\left[\frac{\partial m}{\partial w}\right]_{h,k}$ is positive. This is in agreement with Dr. Audsley's statement that "if the diameter of the chimney be retained, the lengthening of it flattens the pitch of the pipe; while, on the other hand, if the length is retained and the diameter of the chimney is increased, the pitch is sharpened."[2]

It can also be shown that for any value of q, n may only vary between two definite limits if w varies from 0 to 1. When $q = 2$, n must lie between 3 and 4. When $q = 3$, n may vary from 4 to 6; and when $q = 4$, n may have values from 5 to 8·03. The region of possible values of n, therefore, increases in magnitude as q increases, and the mean value of n rises as q increases. The most desirable values of n are 5 and 7 for the Rohrflöte, and these can be obtained if the length of the chimney is between a third and a quarter of the length of the body of the pipe. This is not entirely in agreement with practice. Dom Bedos gives the design of a pipe in which the chimney is exactly one-third the diameter and one-half the length of the body. From the above theory this would give $n = 3{\cdot}75$, with a series of partials not very pleasing to the ear. But Dr. Audsley recommends a shorter chimney, as he considers the quality of the stop seriously impaired by the use of chimneys more than half the length of the body. "Let the chimneys be one-fourth the diameters of the respective bodies and from one-third to one-half the speaking lengths of the bodies, according to the quality of tone desired." This is very well supported by the theory. But from

[1] "Nova Acta der Kgl. Leop.-Carol-Deutschen Akademie der Naturforscher." Band XLVII., No. 1. Halle, 1884.

[2] "The Organ of the Twentieth Century." (London, 1919. Sampson Low, Marston and Co.)

the simple theory the best pipe of all would be one having the chimney one-fourth the length of the body and 0·337 of its diameter. The resulting series would be

1, 6, 8, 13, 15, 20, 22 . . .,

that is, $n=7$, with a fundamental frequency of $1\frac{1}{2}$, that given by the body of the pipe, without a chimney, when closed. The tone of such a pipe would be very smooth, with a gentle ringing quality, and none of the open diapason richness given by the octave, twelfth, and double octave, and also none of the dull nasal quality exhibited by the closed diapason when the odd harmonics are present in excess.

The theory, moreover, offers an explanation of a phenomenon which puzzled organ-builders greatly on its discovery. It was found that if the chimney was turned inwards, and faced downwards instead of projecting outside the body of the pipe, neither pitch nor quality was altered. An examination of the formula shows that this would be so, the stationary vibration in the chimney being then composite.

We must also realise that the simple theory must be modified by the introduction of the end-corrections required at the mouth of the pipe and at the upper open end of the chimney. The correction at the mouth is large and amounts to nearly twice the depth if the pipe is of rectangular section (Brillouin), or three and a third times its radius if cylindrical (Cavaillé-Coll). In the case of the Rohrflöte, the correction is increased by the presence of the ears. The correction required at the upper end of the chimney is of unknown magnitude, although it would probably be proportional to the radius of cross-section of the chimney. The difficulty lies in the experimental fact that very little sound indeed is propagated from the open end of an open labial pipe, if the mouth is of the simple bay-leaf type and not inverted. Hence the open-end correction, which is required by the transmission of stationary vibration to spherical propagation, may be imaginary in this case. If, however, the mouthpiece of the pipe were removed and resonance determined by tuning-forks, both open ends would require a correction as given by Lord Rayleigh's formula.

Enough has perhaps been said to indicate the interest of the problem and how well worthy it would be of careful experimental investigation.

W. E. BENTON.

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University of Birmingham.

A Sidelight on Bird Migration.

IT is usually accepted as an axiom of ornithology that the annual migration of birds consists of a movement from winter-quarters to breeding-quarters and back. The following notes, taken from observations made by me during the last five years on the North-west Frontier of India, may suggest that this view of migration does not entirely cover every case.

The crested lark (*Galerita cristata*) and the common pied bush-chat (*Pratincola caprata*) appear to come to the Peshawar valley to breed, and, at any rate in some cases, to leave the valley as soon as their young are able to fly, and spend the hottest months in the nearest hills. Between the end of August and the middle of September both species return to the valley. The movements of the two species are not identical, and must therefore be described separately.

Crested larks may be seen in the Peshawar valley at all seasons. During the winter months they congregate in small flocks. About the beginning of March the number of flocks begin to increase. By the end of the month most of them have paired, and during the first few days of April the number of larks seems to decrease. During April the eggs of this species may be found in every field and on every piece of waste ground. The earliest date on which I have found a nest containing eggs in this district is April 1, and the latest April 29. By the end of May, crested larks have become scarcer in the valley than they are at any other season. This scarcity continues until about the end of August, when the numbers again greatly increase. About the middle of October a slight decrease again takes place, after which they appear to remain constant until the cycle of movement recommences in March.

No common pied bush-chats appear to remain in the Peshawar valley for the winter. The earliest date on which I have noted the appearance of this species is Feb. 28. The majority of this species seem to lay in April. The earliest date on which I have found a nest of this species containing eggs is April 7, and the latest (except for two nests containing hatching eggs found on July 11, 1922) is May 17. By far the majority of eggs are laid during the second and third weeks of April. By the end of May, bush-chats, like the larks, become scarce in the valley, about the middle of September their numbers again increase, and soon after they leave for the winter. The latest date on which I have observed them is Oct. 1.

During the summer months, when crested larks and pied bush-chats become scarce in the Peshawar valley itself, their numbers undergo a considerable increase on the hillsides below Cherat, at elevations varying from two thousand to three thousand feet above the general level of the valley. The large proportion of young birds to be seen on these hillsides at this time is very striking, and one is almost irresistibly led to the conclusion that these two species, like the human inhabitants of Peshawar, have taken their families to the hills.

From the foregoing observations the following two deductions are, perhaps, permissible:

First: that the common pied bush-chat, coming from somewhere "down country," breeds in the Peshawar valley, spends, in a great number of cases, the hottest months in the hills, and returns to winter-quarters through the Peshawar valley.

Secondly: that some of those crested larks that breed in the Peshawar valley also go to the hills for three or four months after breeding.

If this is a true reading of the facts, is it not possible that other species of birds also may migrate between three localities instead of the more usual two? The matter would bear the attention of all observers of birds.

F. S. BRIGGS.

Peshawar, India.

Rockets and High Altitude Research.

A RECENT book review in NATURE for August 23, 1924, page 270, of Herr Oberth's "Die Rakete zu den Planetenräumen," 1923, calls for a brief comment.

Following the tone of the book, Oberth is credited with being more ambitious than the writer of this comment, in suggesting the construction of a rocket large enough to carry passengers, even to the distances of the planets, whereas my main object is presented as the sending of a rocket to the moon, propelled by successive charges of nitrocellulose.

I first became seriously interested in the general problem of high altitude research in 1899, and in 1907 I submitted, *for publication*, an article discussing the use of heat for expelling material at a high velocity, in order to furnish a propulsive force sufficient to permit navigation of interplanetary space.

The idea of using hydrogen and oxygen in multiple

rockets was conceived in 1909; the general theory was put in satisfactory form in 1912; and the use of these substances mentioned in Smithsonian Miscellaneous Collections, Vol. 71, No. 2, for 1919. Oberth, on the other hand, claims in his book to have made his first finished plan of a rocket to use wet gun-cotton in 1909, and to have drawn up his first plan of an hydrogen-oxygen rocket in 1912.

Further, as to the use of liquid propellants and continuous combustion, these were suggested by me, *by publication*, in 1914, and were *tested experimentally* in 1921, the development carried on under my direction since that time having been confined entirely to rockets of this type.

It may be mentioned here that a request was received from Herr Oberth, dated May 3, 1922, stating that he had been working for some years on the problem of passing over the atmosphere of the earth, and requesting me to send any books I might have on the subject. Compliance was made by sending a copy of the above Smithsonian publication; and a copy of Herr Oberth's monograph, which incidentally deals with theory rather than with experiments performed, was received on July 19, 1923.

As to the idea of a passenger-carrying rocket, and the reaching of planetary distances, it is only fair to say that, while I have considered these matters with much care, and have gone so far as to make laboratory tests to check my conclusions, I am now, and always have been, only too well aware of the conservatism of the average person regarding new applications of physics. Thus, because it has been my desire to make actual progress and to conduct actual experiments, I have endeavoured, so far as possible, to focus attention on the problems that lie immediately ahead, the first of which is an exploration of the earth's atmosphere, and have restricted the discussion of certain sensational, but nevertheless interesting and realisable, matters to confidential reports.

R. H. GODDARD.
Director of Physical Laboratories,
Clark University,
Worcester, Massachusetts, U.S.A.

Five- (and Six)-Point Support: "Right as a Trivet."

As practical problems are usually a function of several variables, individual opinions are determined by the order of importance attached to the variables. The more numerous the conditions, the truer becomes the old expression, "Quot homines tot sententiae."

If in this question of fits we place pure mathematical and geometrical principles first, we have one point of view. As there are others which I think largely determine the workshop attitude and possibly the "Enfield Tradition," I should like to refer to some of them very briefly; to do so fully is not possible in a letter.

Let us consider the example from Thomson and Tait quoted by Sir George Greenhill in his letter in NATURE of September 27. It is stated therein that "the rifle may be replaced any number of times in precisely the same position." If much accuracy is demanded, that statement is not correct, because the materials at the points of support, where the forces of impact may be considerable, swage or wear away and quickly so when the parts are handled as they must be in the workshop.

In designing our apparatus we must consider the physical properties of the materials as well as the geometrical principles involved. The materials determine the areas over which the loads must be distributed and, if they cannot be approximately points, what value are we to attach to the principles of geometrical fits?

To demonstrate the practical application of these principles Thomson and Tait selected a bad example; as in the case of a rifle the convex abutments cannot be placed in their more proper geometrical position within the bore. Suppose a cylinder mounted in the manner described has longitudinal freedom and is constrained transversely: the slightest bend of the cylinder under its own weight, or by the action of the sun on one side of it, may destroy the longitudinal freedom, as the circular section of the fixed abutments must then accommodate an elliptic section of the piece.

The geometrical principle is based on the assumption that *all* the parts involved are absolutely rigid. We practical men, whose business it is to understand the limitations of materials, dare make no such assumption. In the workshop most of us are thoroughly familiar with geometrical principles. We were taught them in the universities and colleges. If we do not slavishly adopt them, it is generally with good reasons.

There has been within the past few years a good deal of adverse criticism of the practical trial-and-error type of man in industry, the articles having usually for their text "The Neglect of Science by Industry." If the writers of these articles were better informed, I feel sure they would find the converse text "The Neglect of Industry by Science" a more appropriate one.

JAMES W. FRENCH.
Anniesland, Glasgow, W.2,
October 7.

Fine Structures in Non-Hydrogenic Atoms.[1]

FOR some months we have been studying the data on fine structures of the lines of non-hydrogenic atoms. These fine structures arise, in every case so far studied, from transitions between the components of complex spectral levels. Save for a few isolated examples, it can be readily proved that fine structures are not due to isotopy. (See Scientific Paper No. 490 of the Bureau of Standards.)

It is necessary in certain cases to introduce a *fine quantum number f*, the values of which characterise the different components of a complex level. In some elements, a selection principle for this quantum number makes its presence felt, and the separations of the components are in integral ratios. So far, attempts to establish intensity rules have failed, but this part of the work is not finished.

Nagaoka, Sugiura, and Mishima (*Jap. Jour. of Physics*, 2, 121, 1923) have published measurements of mercury fine structures which are precise to almost 10^{-4} A. These data have enabled us to analyse successfully the complicated fine structures of nearly all the mercury lines they studied.

The phenomena of fine structures are so diverse that we cannot hope to have a unified physical explanation for them. In isolated cases, such as the 4_4 terms of Al^+ studied by Paschen, they may be due to relativity. In other cases, the components of a complex level behave like a tiny multiplet, and the structure may depend on magnetism for its origin. In other cases, magnetic fields do not affect the fine structures, and we must look to unknown dynamical peculiarities of the individual element for an explanation.

A paper covering the whole field will soon be published.

ARTHUR E. RUARK.
F. L. MOHLER.
R. L. CHENAULT.
Bureau of Standards,
Washington, D.C., U.S.A.,
August 23.

[1] Published by permission of the Director, Bureau of Standards, of the U.S. Department of Commerce.

The Shrinkage of Gelatine.

IN the *Kolloid-Zeitschrift* for August my friend Mr. Emil Hatschek describes some beautiful and symmetrical figures which result from the slow drying and consequent shrinkage of variously shaped blocks of gelatine. A squat cylinder shrinks into a biconcave disc with deeply grooved periphery; a cube becomes a beautiful stellate figure, with apices corresponding to the eight corners of the cube, and with sides which sag in towards a more or less cubical central hollow. The former case shows a striking resemblance to a simple vertebra, such as that of a cartilaginous fish; and it is very curious to see how so simple a phenomenon as shrinkage converts a cylindrical block into the form of an "amphicœlous" vertebra.

For the moment, however, I am less concerned with biological analogies than with what I believe to be a simple general explanation of these "shrinkage-figures." In one of Plateau's experiments, we take two parallel hoops of wire (within certain limits of distance apart), blow a soap-bubble between them, and then gradually exhaust the bubble; we thereby obtain a figure bounded above and below by concave spherical surfaces, and surrounded by a peripheral groove which is a portion of a catenoid. Again, if we dip a skeleton-cube of wire into soap-solution, films run inwards from the twelve sides in such a way that the common edge of three films meets either each corner of a plane quadrilateral fenestra, or each corner of a little central cube; the latter is the more symmetrical figure of the two, but in each case a figure *minimæ areæ* is realised, automatically and instantaneously.

The two gelatine shrinkage-figures which I have mentioned are nothing more nor less than *approximations* to these minimal configurations. The corners and edges of the gelatine block are the first parts to show shrinkage, for here the surface for evaporation has the highest ratio to the content within; thus edges and corners become rigid in comparison with the rest, and form (as it were) a framework for the whole mass. Bounded by this skeletal framework the mass of gelatine shrinks away; and its surfaces tend to realise, slowly and imperfectly, the self-same minimal-surface configurations which the soap-film achieves in immediate perfection. The actual curved surfaces of the shrinking cube are very beautiful: I take them to be conformal transformations between the original plane side of the cube and the square truncated pyramid which the four films on each side bound, as they pass from the outer skeleton to the little central cube; but the full elucidation of these surfaces is a job for the mathematician.

Only in small particulars, easy of explanation, do the actual shrinkage-figures differ from the above description. The shrinking edges and corners are not lines or points but graded areas, and the subsequent form of the curved surfaces is somewhat complicated thereby. Again, while the edges tend to become rigid, they do so imperfectly; they act not precisely as do the wire edges of our skeleton-cube, but rather as these would do were they replaced by threads. That is to say, the edges themselves tend to sag inwards, and do so, doubtless, in circular arcs. A minor point, to which Mr. Hatschek has directed attention, is that at first the sides of the several figures bulge slightly outwards—they show a temporary convexity before they become concave. This is simply due to the fact that the edges of the figure contract perceptibly before the whole volume is materially reduced.

D'ARCY W. THOMPSON.

St. Andrews, October 4.

Microseisms associated with the Incidence of the South-west Monsoon.

THE late Dr. Klotz was the first to suggest a relationship between disturbed weather in the North Atlantic and the largest microseismic movements at Ottawa. The microseisms recorded by the Milne-Shaw seismograph at the Colaba Observatory during the burst of the monsoon on the west coast of the Indian Peninsula present many interesting features and indicate the possibilities of a forecast being made of the approaching monsoon at least a week ahead. The seismograph, which is installed in an underground constant temperature room, gives records remarkably free from microseisms during the cold weather period.

Microseismic movements of a type which is quite characteristic of the south-west monsoon period make their first appearance in the seismograms at the end of May with the advance of the monsoon in the south-east Arabian Sea, becoming more and more pronounced as the monsoon currents approach Bombay. They become less marked or disappear during a temporary break in the monsoon and reappear with the strengthening of the currents. This year the first indication of disturbed weather in the south-east Arabian Sea was obtained on May 21, and microseisms of the monsoon type made their first appearance in the Colaba records on the next day; these became more marked on June 2, when the monsoon finally appeared on the Malabar coast with rough seas and heavy rain. Very well-marked microseismic movements were noticed in the record for June 12, on which day Bombay received its first monsoon rainfall.

S. K. BANERJI.

The Observatory, Bombay,
September 12.

Potential Gradient and Atmospheric Pollution.

RECENT correspondence (NATURE, April 5 and June 14) on the connexion between the potential gradient and the degree of pollution of the atmosphere prompts me to put forward a suggestion to explain the alleged influence of a high-tension electric field on plant growth.

It is well known to all workers with high tension that, owing to the fact that the corona discharge takes place more readily from negatively than from positively charged wires, the dust-particles of the surrounding air become negatively charged and are rapidly precipitated upon neutral or positively charged surfaces, the air being thus freed from pollution. Conjoin with this fact the unquestionable deleterious influence of an excessive dust content in the air upon vegetation, as illustrated, for example, in the difficulties of the urban horticulturist as compared with his rural competitor, or in the damage wreaked by a cement-works upon all vegetation in its lee, and we have at least a possible *vera causa* for the beneficial action of the high-tension network.

The conflicting evidence obtained by different observers, and particularly the difference, noted by some, in the effect in dry and wet seasons, would also find a ready explanation in the obvious fact that the greatest benefit would accrue under conditions of maximum atmospheric pollution.

KERR GRANT.

The University of Adelaide,
August 4.

Optical Records and Relativity.

By Prof. C. LLOYD MORGAN, F.R.S.

PROBABLY the majority of physicists acknowledge the existence of events (and the clusters of events we call things), out there in the external world, whether we have sensory acquaintance with them or not. They believe that an object of vision is seen only when light-waves, transmitted from some cluster of physical events as their proximate source, reach the retina of the eye, and that on receipt of advenient influence which stirs sundry retinal events, there somehow arises conscious reference to an object of vision. It is not within their province to consider how this conscious reference may best be interpreted. That falls within the province of the psychologist. Just as it is for the physicist to tell the story of the manner in which light-waves take origin in some proximate source, how they reach the retina, and what is the set of physical events in the retinal record, so it is for the psychologist to tell the story of the manner in which conscious reference to the object of vision has come about.

The physicist, then, tells *his* story and leaves the psychologist to tell his story. Broadly speaking, the former is that of radiant influence from its proximate source to its proximate outcome; the latter that of perceptual reference to the object of vision.

I take it that from the physical point of view we may distinguish two sets of events. There is a set of events beyond the confines of our body, and there is a set of events within the confines of our body. In the set of external events there are specialised groups of events from which radiant influence is transmitted in ways which it is for the physicist to describe and interpret. When such radiant influence is advenient to one of the more highly developed organisms, such as we are, it forms an optical "image" on the retina of the eye. A set of events in the pattern of the image is called into being in the spread-out and curved surface of the retina. This "receptor-pattern" may be regarded as a record (within the confines of the organism) of some group of events beyond the confines of the organism. It is no less physical, as a set of inter-related events which occur in the optical record of the retina, than the set of events in the external world which is the proximate source of that record.

Beyond the record, in our present context, the physicist is not concerned to trace the further course of events within the organism. However important this may be for the elucidation of perceptual process, he leaves that to the physiologist. Hence he restricts his inquiry to the task of co-relating (*a*) the events in the proximate source of the record in the external world, with (*b*) the events in the optical record itself; but he cannot get along with this (his proper) task without conscious reference to (*a*) and to (*b*). Since this does not fall within his province, he must accept some working hypothesis as to its nature from those within whose province it does fall for consideration. There are, however, two in the field. It may be (*α*) that the spatio-temporal relations in the retinal record *reveal* those that obtain in the source of that record; that is, that in and through the record the mind directly apprehends the spatio-temporal course of events in its source; or it may be (*β*) that the nature of conscious reference in perception is such that the object of vision is fashioned on the spatio-temporal configuration *of the record*; that is, that changes in the record are referred to that which is the external source of that record.

With the aid of photography, other optical records than those in the retina may be obtained. But the photographic record, when it is seen, is an object of vision, and therefore implies a retinal record; so that we have here only an instance of vision at second-hand.

Now the first-hand optical record in the retina, or its substitute at second-hand in the photograph, has a quite definite shape, as a snapshot phase of changing spatio-temporal relations therein; and whatever may be that shape in the record, that too is the shape of the object of vision. That which gives an elliptical record is seen, under naïve perception, as elliptical. In matters terrestrial, and in matters that can be brought within the range of manipulation under touch-contact (and its ancillary measuring-rods, callipers, and so forth), there is opportunity for co-relating the spatio-temporal relations in the optical record, and in the source of that record as dealt with by manipulation. There is need for such co-relation; for the shape of a thing, say a coin, as given under reference from touch-manipulation, is often different from the shape of that thing as given in the optical record, and as referred to the object of vision.

Let us admit that the coin as a physical thing is, for our knowledge, a "construct" which we deliberately frame for scientific purposes by combining the net result of all visual and (in the case of this and other terrestrial things) all tactual records obtained in the course of manipulation. It is on this basis that the physicist acknowledges a physical thing existent in its own right; and where vision is concerned, that thing is the source of advenient influence that reaches the retina and gives an optical record. The inquirer in what may be called the field of "classical optics" (briefly characterised as "the science of light regarded as the medium of sight") is one whose special business it is to co-relate the story of physical influence with that of perceptual reference with its location of the object of vision. He has reached certain generalisations with regard to the occurrences he observes in this twofold aspect. Perhaps the most salient is this: No matter how devious the course of a light ray in accordance with the non-homogeneous medium of physical events through which it is transmitted (under refraction, reflection, and so forth), conscious reference to the object of vision is along the line of the final path of that ray by which it reaches the recording retina. This is projective reference or, as Sir Charles Sherrington calls it, "projicience" ("Integrative Action of the Nervous System," p. 324). He distinctly states that it is a *psychical* process. He traces its connexion with the evolution of "distance receptors." Initially naïvely perceptual with meaning (including visual distance) for the practical behaviour of animal life, it leads up, under further mental elaboration, to conscious reference to the object of vision. The gradually

acquired location of the object of vision is commonly interpreted in terms of this elaboration. Under optical inquiry an orderly co-relation of the "place of location" of the object of vision with the "assigned place" of the proximate source of the light rays from a physical object, is set forth in the text-books of classical optics. This is the interpretation of perceptual reference that I labelled (β) in a previous paragraph.

Under (α)—the doctrine of direct apprehension—the interpretation is quite different. It is advocated by new realists of the type of Prof. Alexander, by critical realists of the older type (represented by Prof. Dawes Hicks), and of the newer type (represented by Prof. Santayana). It underlies Prof. Whitehead's "Concept of Nature" and Mr. Bertrand Russell's "Analysis of Mind." It is certainly widely accepted on grounds not always clearly set forth; and it has authoritative expression.

What is its interpretation of conscious reference? Subject to correction, I think it comes to this in its selective form as advocated by Prof. Alexander. The entity which we call a mind is "compresent" with a vast number of certain other entities named, let us say, "sensa." Just as, in physical regard, physical influence flows in to some given physical entity from some other physical entity or entities, so too, in psychical regard, psychical influence flows in to the mind from some sensum or sensa with which it is compresent, or, at any rate, the mind is affected by them; and on receipt of such influence (or such affection) there is what we call reference on the part of that mind to the sensum or sensa. Reference, therefore, is the psychical reaction of the mind in its relation to sensa, and it discloses or reveals the intrinsic nature of the sensum with which the mind is compresent. Revelation of this order is illustrated by the direct apprehension of a certain kind of sensa in vision.

Such in its essential features is, if I mistake not, the doctrine of reference which is alternative to that of projicience or projection. The sense-organs—in our context the retinal records—are only *instrumental* to direct apprehension, for example, of a distant sensum which has in itself the quality of redness. It may be true enough that, whenever colour vision is in evidence, there always occur in the receptor-pattern of the retina, or the choroid, certain complex chemical changes. But what of that? It merely shows (if such be the facts) that the bodily instrument used by the mind in direct apprehension is of such and such a nature. It may be that it takes the human infant some seven or eight weeks clearly to focus and locate an object of vision, and perhaps another seven or eight weeks (cf. Milicent Shinn, "Biography of a Baby") to co-relate the seeing and the manipulation of that which then becomes for its apprehension one and the same object. What of that? It merely shows, if the inference from the observed facts be valid, that the physiological means subservient to the psychical end of apprehension are subject to a process of progressive development. Physiologists and biologists discuss such subsidiary matters. Direct apprehension on the part of the mind is there from the first and all the time.

We have then an α-interpretation and a β-interpretation, both distinctively concerned with a mental or psychical process; and the point of emphasis is that there are *alternative* hypotheses as to the nature and outcome of conscious reference in naïve perception. The difference between them may be illustrated by the alternative interpretations of "mirror images." When a man shaves all that happens, in manipulative touch under the razor, to his chin that he cannot see, happens also to the mirror image that he does see. Clearly there is need for co-relating these several events. The interpretation of classical optics is familiar enough. On the "sensum theory"—either in its "selective" or in its "generative" form—the co-relation of the visual sensa, apprehended as mirror-images, with the tactual sensa apprehended under manipulation of the razor (together with sundry auditory and olfactory sensa) demands a much more intricate and elaborate treatment such as is discussed in Mr. Broad's "Scientific Thought." There are, then, two quite different interpretations. Of these one or other claims acceptance under the searching criticism which leads from an initial assumption to acknowledgment of its validity as a basis for further procedure.

Furthermore, apart from the projicience or projection entertained as a policy in classical optics, and discussed from an evolutionary point of view by Sir Charles Sherrington—apart, let us say, from the biological and psychological arguments in favour of reference *from* the record *to* the object of vision—it is sufficiently well known that there is, in the wider field of thought, a philosophical hypothesis based wholly on projicience—that which Prof. Wildon Carr has presented in "The Theory of Monads"; and it is also pretty clear that other idealist systems, in so far as objective, proceed on the basis of the hypothesis of projicience rather than of that of direct apprehension. So here again—apart from "subjectivism," which we may regard as out of court—we have to realise that there are *two* alternative interpretations of conscious reference, no doubt in somewhat variant forms.

Revert now to the concept of the optical record, photographic or retinal. All that we experience in visual perception when there is an object of vision implies an optical record, whatever else it may imply in focussing the eyes and in the very complex set of factors concerned in the perception of visual distance. In the case of a coin, all that we visually know concerning it is based on a vast number of varying optical records with intrinsic spatial relations of positional points distinguishable within it. On this basis we speak of the object of vision as round, elliptical, and so forth. Speaking of the coin: Such and such (we say) it is as object of vision. But what is *it*?

There are other records of "it"—those based on tactual contact-records, with behaviour in manipulation. These, too, are records of "the coin." We co-relate these contact-records with those optical records, and we incorporate both in a pretty consistent scheme where each has meaning in terms of the other. In the optical record we take into consideration (*a*) the point of view from which the record is obtained, (*b*) the physical path of the light-waves that reach that record from some physical source, and so on. Then, concurrently, we co-relate the whole set of optical records with the whole set of contact-records given in respect of the things, such as the coin, which lie within the limited reach of manipulation. Combining all the data

afforded by all the records, we construct "the coin" as it has, step by step, taken form in our knowledge based on these records. But what is "it"? What is "the coin"? Some may say it is just this construct. Others may say: This no doubt it is for the knowledge which gradually took form in our childhood. But this construct is founded on conscious reference—if you like on a great number of co-related acts of referring—to a physical thing, existent "on its own" independently of all such percipient processes.

Now whether this belief or acknowledgment of the independent existence of a specific cluster of physical events which is the source of no less physical records is justifiable at the bar of logic or not, I submit that the man of practical common sense, *and* the man of science as physicist, *do* proceed, in all their work-aday hours, on the basis of this acknowledgment, as a policy if not as a creed. I feel confident that most physicists, and the general public who are interested in the outcome of their inquiries, do claim that recently acquired knowledge with regard to relativity demands not only a radical modification of policy in dealing with the physical universe, which was a "going concern" long before man came on to the scene of events, but also a radical modification of the orthodox scientific creed now spoken of, in the past tense, as that of "classical mechanics."

A physical outsider meddles with relativity at his peril. He may, however, ask questions, even if he be not competent to make assertions. Here let it be said that, unless he be smitten with the incurable disease of senile folly, he must freely and fully accept all that physical science has securely established in its splendid advance since the days of his youth. That being so, he may still venture to ask questions.

(1) Are we not, in the crucial issues that arise under physical relativity, dealing only with optical records, photographic or retinal, and with an acknowledged physical source of those records?

(2) Must we not regard the records as physical no less than their source?

(3) Are we not, from the nature of the phenomena in evidence, precluded from obtaining any contact-records, under touch-manipulation, of the spatio-temporal events in the distant source, though we deal largely, on this wise, with the optical record, spectroscopic or other, on the photographic plate?

(4) Are we not, therefore, in physical regard, co-relating, under some relevant transformation formula, Lorentzian or other, the physical events optically recorded, with the distant source-events thus recorded?

(5) Is not the outcome: Such and such is the co-relation of *these* events with *those*?

(6) May we, on the basal principle of relativity, give primacy in "reality" to either set of events thus co-related, since each is acknowledged as physically "real" in the same sense?

(7) In terms of so-called "warping," are we justified in saying more than that these source-events *or* those record-events are "warped"—*i.e.* stand in need of transformation—each relatively to the other?

(8) Is it not for convenience of policy only that "warp" is assigned to one or the other?

(9) If, as a matter of scientific creed, primacy in "reality" be given to one or the other, and we be bidden to believe that these and not those are "warped," is this on strictly physical grounds?

(10) Or is it on grounds other than physical—*meta*-physical in the Aristotelian sense—namely, in accordance with a doctrine of perceptual reference, *i.e.* of the nature of a *mental* process (however simple or however complex) and its outcome?

(11) Is there one universally accepted doctrine of perceptual reference in vision, or are there two, (α) direct apprehension, and (β) projicience (or projection)?

(12) Since, as a matter of plain history, there have been, and still are, two different hypotheses, is it for the physicist as such to pronounce judgment one way or the other?

(13) If (α) be accepted by this or that physicist on the basis of one of the two "metaphysical" hypotheses, should not this be stated?

(14) If the physicist, as a wise cobbler, sticks to his last, and says that the nature and origin of perceptual reference is not his business, should he not leave the matter open? If it be no concern of his, *qua* physicist, should he not hand it over to those who make it their special province of inquiry?

(15) If some of those who have given careful and prolonged consideration to this problem in all its bearings (and its bearings are many) regard the balance of evidence as, in their judgment, in favour of visual projicience, does this imply rejection of physical relativity or of any valid inference therefrom?

(16) What does all this mean for the man in the street, or the smoking-room, who is interested in such matters?

Expressed in terms which may perhaps be "understanded of the people," it means something like this:

(i.) All the established results of physical science, as such, and all valid inferences therefrom, are fully and gladly accepted.

(ii.) There are two quite different hypotheses in respect of perceptual reference. On *this* hypothesis, just as the shape of a coin as seen from any given position is that of the "image" on the retina; just as the partially immersed rod looks bent because such is its record in the retinal receptor-pattern; just as the "mirror image" of a man's chin is located differently by its owner and the barber who shaves him; just as, in these terrestrial matters of common experience, what happens in the record is the basis of all that we see, and is projiciently referred to the set of physical events which give that record; so too are all spatio-temporal changes as optically recorded (subject to Lorentzian or other transformation) projiciently referred to their distant physical source—for such is the nature of vision.

(iii.) It follows that "local spaces" and "local times" are, broadly speaking, illusions of vision, none the less interesting, none the less matters for scientific inquiry, none the less germane to the policy of physical interpretation, but still having their seat in the optical record and not in the source of events thus recorded, though projiciently referred thereto.

(iv.) It follows, too, that if transformation of events be interpreted in terms of projicience and not in terms of direct apprehension, the source-events themselves are nowise transformed, and the scientific creed of classical mechanics stands in no need of revision.

Archæology from the Air.

By O. G. S. CRAWFORD.

LONG before aeroplanes were invented it was confidently hoped that vertical photographs would some day be taken; and it was felt certain that, if so, they would greatly assist archæology. Major Elsdale was the pioneer of air-photography in the British Army. Between about 1880 and 1887 he carried out many experiments from free balloons, and also invented a method of sending up small balloons, just large

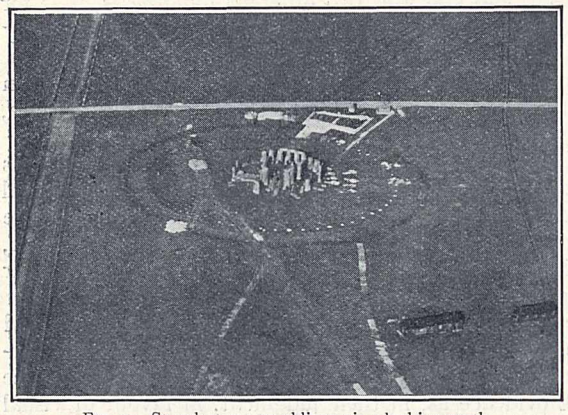

FIG. 1.—Stonehenge: an oblique view looking north.

enough to carry a camera, which exposed a certain number of plates automatically; then the balloon emptied itself of some of its gas and came down. Some of the results were quite good considering the difficulties. In 1891 Lieut. C. F. Close (now Col. Sir Charles Close) suggested to the Surveyor-General of India that the India Office should be asked to send out similar apparatus to photograph from the air the ancient ruined cities round Agra, with the view of constructing a map from the air-photos. The scheme was approved and the apparatus was sent to India; but official difficulties of the usual type supervened. The result was that Agra was cut out of the scheme; and a few photos were taken over Calcutta at an unfavourable season of the year, and the opportunity was lost. After Major Elsdale left the Balloon Establishment in 1888, little or nothing was done at home in this matter: and after 1892 the Survey of India took no more interest in balloon photography. Major Elsdale spent much of his own money on the experiments in question; but ballooning was not much in favour in the 'eighties, although some progress was made, and he received little or no official support in his balloon-photo experiments.

In 1906 Lieut. P. H. Sharpe took a vertical and an oblique photograph of Stonehenge from a war-balloon; these were published in *Archæologia* (vol. 60) by Col. Capper. During several years immediately preceding the War, Mr. Henry S. Wellcome successfully used large box-kites, with specially devised automatic control cameras for photographing his archæological sites and excavations in the Upper Nile regions of the Anglo-Egyptian Sudan.

During the War, when aeroplane photographs first became common, it might have been expected that archæological features would have been observed; but in the British sector in France none were seen, so far as I know. The photographs were often taken at a great height, over country which is archæologically barren, or which was too rankly overgrown to show results. Moreover, the interpretation of air-photographs for military purposes was a new art and in itself sufficiently fascinating to oust academic interests for a time. Only on other fronts was time found for archæology in the air, and again it was an officer of the Royal Engineers who led the way. Col. Beazeley observed and photographed in Iraq in 1917, cities of which the ruins were unintelligible on the ground. On an air-photograph these ruins were seen as an orderly arrangement of streets and houses. This marked a very definite advance, for it proved that air-photography could add to knowledge, and that it would be an invaluable aid to excavation. To Col. Beazeley is due the credit for the first actual application of air-photography to archæology. In the first flush of excitement it has sometimes been forgotten that he was the pioneer in practice, and that he was the first man to take air-photographs from an aeroplane for a purely archæological purpose. So far as I know, Col. Beazeley has not followed up his first results; but it is to be hoped that some one will, for Iraq is a most suitable country for "archæography."

The birth of the new study in England may be said to date from 1922 when Air Commodore Clark Hall observed certain curious marks on R.A.F. air-photos taken in Hampshire. With him must be mentioned Flight-Lieut. Haslam, who took a number of photo-

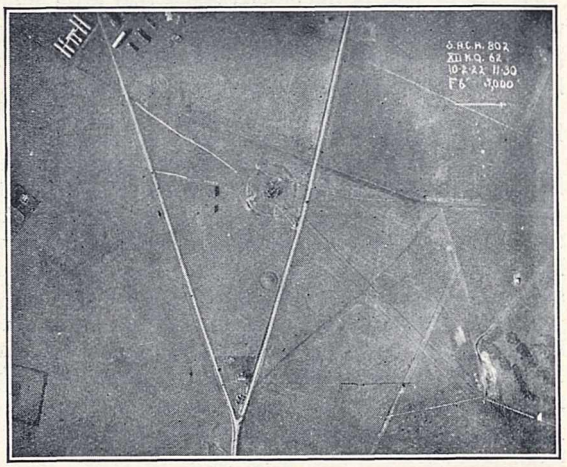

FIG. 2.—Stonehenge and environs.

graphs near Winchester showing what turned out to be Celtic fields. Air Commodore Clark Hall showed these photographs to Dr. Williams-Freeman, who took me to see them. Dr. Williams-Freeman and I had always been hoping for air-photographs of English soil; and looking at these we saw that our expectations were fulfilled, and even surpassed, by what was revealed. It was possible from these photographs to make a map of the Celtic field-system near Winchester; it was published in the *Geographical Journal* for May, 1923, and reprinted in "Air Survey and Archæology,"

1924 (Ordnance Survey Professional Paper No. 7). Many archæological air-photographs have been taken by the School of Army Co-operation at Old Sarum.

Recently the Air Ministry has sanctioned the transfer to the Ordnance Survey Office of all air-photographs containing archæological information, which are not

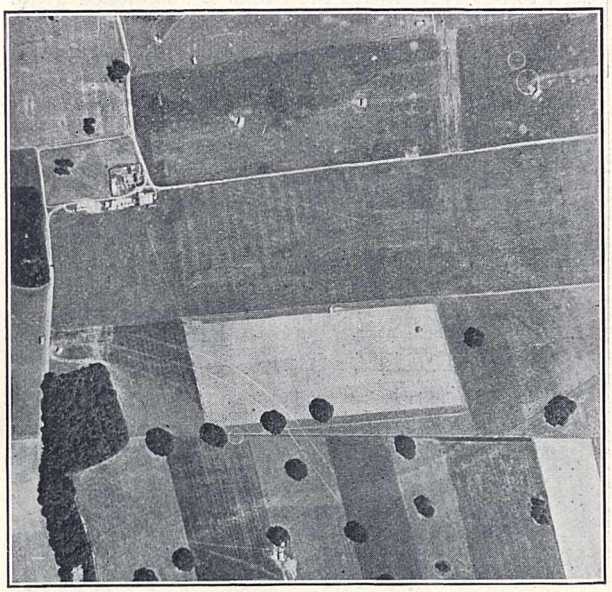

FIG. 3.—Stonehenge Avenue and tumuli (1921). The avenue is shown running from just above the highest point of the wood shown in the bottom left-hand corner of the illustration and curving towards the first line of tree-clumps, the third of which from the left stands partly on the avenue. The tumuli appeared as faint circular markings. The course of the avenue has been slightly emphasised in preparing the illustration.

required for service purposes. Thus, the connexion between air-photography and the Royal Engineers, begun about 1880 by Major Elsdale and continued by Col. Beazeley, has been maintained. Needless to point out, air-photographs are of great use, when checked and supplemented by field work, in revising the archæological information on the Ordnance Maps.

Popular interest was first aroused by the discovery of negatives showing, for the first time, the complete course of the Stonehenge Avenue (eastern branch) (Fig. 3). The history of this has been told before, and I do not propose to repeat it here. Full details will be found in my monograph on "Air Survey and Archæology." The photographs of the avenue were taken in the dry year of 1921 by the Old Sarum squadron; but their archæological importance was not recognised until two years later, in 1923. At the present moment the problem before us is to find a suitable method of reproducing air-photographs, so that the pictures may become generally accessible to archæologists for purposes of study.

It is usually imagined that the camera, when fixed in an aeroplane, records marks on the ground which are invisible to the eye of an observer. That is not so. The observer can see these marks more plainly than the camera, for he sees them in colour. The most remarkable discoveries which have been made are due to plants, which are sensitive to slight differences of soil and moisture. For example, if a ditch has been dug on a chalk down and the down has afterwards been ploughed flat and sown with corn, for ever afterwards the subsoil filling (or silt) of that ditch differs from the adjacent never-disturbed soil. Nothing can ever restore chalk once dug to its former state. Archæologists have long known this, for one of the principal needs in excavation is to distinguish between disturbed and undisturbed soil. But one cannot dig up a whole field or several fields to find a ditch which after all may not exist. Here it is that a vertical view helps; for the effect of this moister silt upon a crop of corn is to promote its growth and deepen its colour. Thus from above one sees, and can photograph, a belt of darker green corn following the line of the vanished ditch. These lines are sometimes visible on the ground, from across a valley or at even closer quarters. Sometimes (as in parts of the Stonehenge Avenue) they are quite invisible. But always, when more than a single ditch is concerned, the *distant* view is necessary to convert chaos into order. The reason for this necessity can best be explained by means of a comparison. If one looks through a magnifying-glass at a half-tone illustration made through a coarse screen, it ceases to be seen as a picture and becomes a meaningless maze of blurred dots. If one holds it some distance off and looks at it with the naked eye it becomes a picture again. The observer on the ground is like the user of the magnifying-glass; the observer (or camera) in the air is like him who looks at the half-tone picture from a distance.

Now the majority of our prehistoric sites, and many later ones, were seamed with ditches and pits, dug for drainage, storage, habitation, defence or boundary purposes. Many exist to-day on the downs, undisturbed and turf covered; many more have been flattened by cultivation. All of the latter can be re-

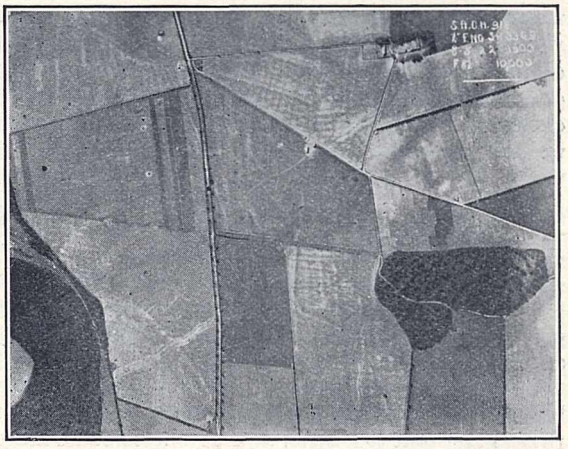

FIG. 4.—Celtic lynchets and ditches on Borough Down near Winchester.

discovered by air-photography, provided only that the arable has not been allowed to revert to grass. Even then traces of the ditches are sometimes visible, especially on poor soils and in dry summers, by a belt of darker green. Air observation, however, is most fruitful when young crops are growing; then discovery is easy and rapid, and every flight is productive. Such sites may afterwards be seen to exist by an observer on the ground; but few of them could ever have been *discovered* except from the air. Chalk is not the only soil that produces these streak-sites; they have been

observed on oolitic limestone near Bath and plateau gravel near Exbury.

A few words only are necessary to describe the other factors which enable air-photography to record ancient sites. Prehistoric cultivation-banks—what I have called lynchets of Celtic type—are revealed because they either throw slight shadows or because when ploughed they appear as belts of lighter soil, from the chalk

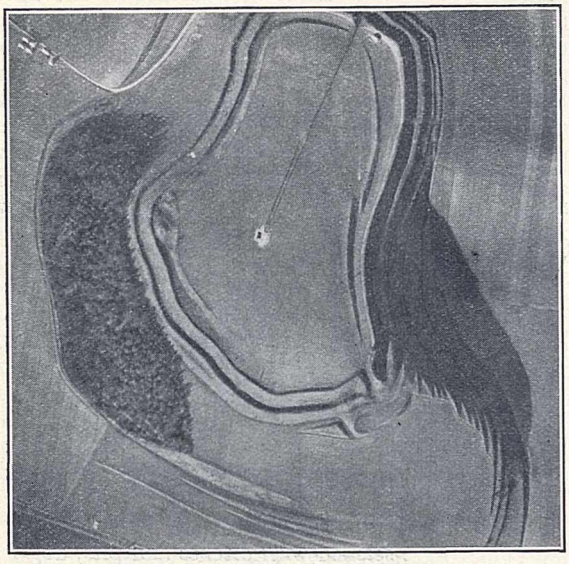

FIG. 5.—Battlesbury Camp, Wiltshire.

grains mixed with them. From photographs the Celtic field-system of a district can be accurately mapped. Again, rabbits work in the looser silt of filled-up ditches (as well as in the soil of the lynchets), and if there are many rabbits a white line, or row of white patches, is visible from the air. Daisies and poppies grow for choice above these ditches, and barrows and hill-top camps have thus been revealed by white and scarlet circles. "A single field which I have looked upon," we may say with Wordsworth (almost), "speaks of something that is gone; the daisy at my feet doth the same tale repeat."

Lastly, the low shadows at sunrise and sunset etch the outline of low banks in deep black. That is the time to photograph lynchets. On a June morning before breakfast the greater part of Salisbury Plain is seen to be covered with the banks of abandoned Celtic fields; but afterwards they "fade into the common light of day." The great ramparts of hill-top camps are strong enough to throw a shadow even at mid-day, but they are best photographed when the sun is low, for then not only do the ramparts stand out best, but the banks and pits of the habitations also.

Air-photography has only recently been harnessed to the chariot of archæology; but it has already found a generous and enthusiastic patron in Mr. Alexander Keiller, and its future is assured.

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Obituary.

MR. OTTO HEHNER.

A NOTICE of the scientific career and work of Mr. Otto Hehner, whose death is announced, will be practically the history of English Analytical Chemistry during the past fifty years.

Born at Marienberg in 1853, and educated at Wiesbaden under Fresenius, Hehner came to Britain in 1873 as assistant to Bischof at the Andersonian College, Glasgow, where he had Ramsay for a colleague. In 1874 he became assistant to Arthur Hill Hassall, who was prosecuting researches, largely microscopical, into the composition of foods, and on the means of detecting adulterations, and it was here that Hehner worked out his methods of butter analysis, far in advance of the knowledge of the day, and the foundation of modern methods; by this research he won his spurs and established his reputation for original thought. In 1877 he moved to London and established a consulting practice, which in 1881 was removed to 11 Billiter Square. Problem after problem was tackled, and Hehner's publications, chiefly in the *Analyst*, and the Journal of the Society of Chemical Industry, show the varied scope of his investigations, beeswax, glycerin, oils and fats being but a few of the subjects in which he was a pioneer worker.

Hehner was a very active member of the Society of Public Analysts, and though not an original member, he was early (1883) elected secretary, and was president in 1891. His association with the Institute of Chemistry was nearly as intimate; elected a fellow in 1878, he was one of the leaders of the movement that in 1887 enlarged the scope of the Institute by removing the narrow restrictions of membership, and started the gradual raising of the professional status of the analytical profession by making the essential qualifications more real. Hehner's appointment as examiner to the Institute in 1895 was the real commencement of a genuine test of knowledge in analytical chemistry, and to him also the foundation of the library of the Institute is due; he filled the office of vice-president on three separate occasions and was censor in 1901 to 1903.

Hehner held many appointments as public analyst;

and, indeed, was more proud of this title than any other. In almost every branch of the analysis of food and drugs he has left his mark. As a witness he was superb; in the box he told a plain unvarnished tale in perfect English (although he never lost his accent), and carried conviction. Before parliamentary committees also, he placed his wide knowledge, and there is no doubt but that his evidence had a distinct influence on legislation, and his expert advice was welcomed in many quarters.

During the War, Hehner devoted himself wholeheartedly to the country of his adoption; his expert knowledge of glycerin technology was placed at the service of the country without remuneration, and he served on various committees where his knowledge was invaluable. His reward was that some pettifogging local authorities removed him from his public appointments because of his German origin; how little they knew the man, who had given them such good service. Hehner was greatly hurt by this, and it affected his health; partly on this account, but chiefly to escape what he felt was an anomalous position, he went to South Africa in 1921, and though he came back, he paid another temporary visit, and died there on September 9 of a tropical fever.

Full of energy, kind-hearted and generous, especially to young men, a keen critic, and a strong fighter, but always in a fair and just manner, a firm staunch friend, a widely read philosopher, a genial companion, he had that strong personality and marvellous intuitive brain that marks a leader. H. D. R.

MR. J. BRITTEN.

THE sudden death of James Britten, fellow of the Linnean Society and for nearly forty-five years editor of the *Journal of Botany, British and Foreign*, occurred at Brentford on October 8. He was born at Chelsea on May 3, 1846, and became attracted to the study of plants from an early age. His earliest printed paper known to the writer is in the *Journal of Botany*, in the first volume of which, issued in 1863, is a short paper on "Rare and Exotic Plants at Kew Bridge." In 1865 he removed to High Wycombe, and the four years spent in that town gave him further opportunities for studying field botany.

Short papers came from Britten's pen quickly; then in 1869 he was appointed a junior assistant in the herbarium of the Royal Botanic Gardens, Kew. Two years later he was transferred to the Department of Botany, British Museum, then housed at Bloomsbury. In 1879 the senior assistant, Henry Trimen, proceeded to Ceylon, succeeding Thwaites at the botanical garden of Peradeniya, and Britten took his place as editor of the *Journal of Botany*, which he occupied until his death last week.

Britten's independent works were a quarto on "European Ferns," in 1881–82, a reprint of William Turner's "The Names of Herbes in Greke, Latin, Englishe, Duche and Frenche, 1548," with the identification of the plants, in 1881; a list of farming words, extracted from Wm. Ellis, in 1880; and the determinations of Banks's plants issued in folio by the Trustees of the British Museum, in 1900–1905. With Robert Holland he brought out "A Dictionary of English Plant Names," 1878–84; and with Prof. Boulger "A Biographical Index of British and Irish Botanists," 1893, with three subsequent Supplements to 1908; a second edition is understood to be ready for press.

Britten, however, was better known as a keen debater and critic, in his own journal, and the number of his essays, long or short, is great. He was quick to detect the weak side of an adversary, and unsparing in attack. For many years he took an active part in the work of the Catholic Truth Society, in recognition of which he was made a knight of the order of Saint Gregory in 1897, by Pope Leo XIII., and knight commander (K.C.S.G.), *con placca*, in 1917. B. D. J.

PROF. H. KRAEMER.

THE death on September 9 of Prof. H. Kraemer at Detroit, which has robbed pharmacognosy of one of its most brilliant exponents, will be much deplored by his colleagues not only in the United States but also throughout the scientific world generally. Henry Kraemer was born on July 22, 1868, and studied at the Philadelphia College of Pharmacy while still an apprentice in a pharmacy in that city. In 1889 he graduated in pharmacy there and afterwards took the degree of Bachelor of Philosophy in the School of Mines of Columbia University. He was then appointed professor of botany and pharmacognosy in the School of Pharmacy of the Northwestern University. He studied for an additional year in Marburg, chiefly under the late Prof. Arthur Meyer, and obtained the degree of Ph.D. Soon after his return to America he was called to fill the chair of botany and pharmacognosy in the Philadelphia College of Pharmacy, a position which he continued to hold until 1917, when he was transferred to a similar position in the University of Wisconsin.

From 1899 to 1917 Prof. Kraemer was the editor of the *American Journal of Pharmacy*. During this time he exhibited indefatigable industry, not only in his capacity as editor but also as research worker in the laboratory, mainly in the fields of botany and pharmacognosy. He also took an active part in the revision of the United States Pharmacopœia as chairman of the sub-committee on botany and pharmacognosy. In Great Britain he was best known by his "Scientific and Applied Pharmacognosy" and "Applied and Economic Botany," his ability receiving recognition by his appointment as honorary member of the British Pharmaceutical Conference. Prof. Kraemer exercised a widespread influence, particularly in America, by his industry and by the stimulus he imparted to others by the example he set. He was an independent thinker and gave fearless expression to his thoughts, a trait which made correspondence with him a sincere pleasure. His loss will be keenly felt.

WE regret to announce the following deaths:

Lord Abercromby of Aboukir and Tullibody, formerly president of the Society of Antiquaries of Scotland and honorary member of the Finno-Ougrian Society of Helsingfors and of the Finnish Archæological Society, on October 7, aged eighty-three.

Dr. W. B. Hemsley, F.R.S., formerly Keeper of the Herbarium, Royal Botanic Gardens, Kew, on October 7, aged eighty.

Current Topics and Events.

WE have received under the designation of "Commission F (Propaganda)" what is apparently a proposal emanating from the Twenty-third World Peace Congress to the Commission for Intellectual Co-operation of the League of Nations. We forbear to reproduce the language of this document, which has evidently been written under strong emotion. After an allusion to the fact that science often places its work at the service of war and destruction, a further allegation is made that science is frequently governed by a spirit of national hostility and narrow-mindedness, accompanied by the oppression and persecution of savants "who expressly profess another opinion." The wording of this document is not felicitous, but the meaning and purpose are tolerably clear. The Commission for Intellectual Co-operation will certainly have the goodwill of the British scientific world in its efforts to divest science from all its misuses by man, and in all efforts towards promoting international amity. We think, however, that the document before us greatly overstates the case and does much less than justice to the international sympathies that have existed and have been fostered in the scientific world. We certainly know nothing of international oppressions and persecutions following upon conflicts of opinion; we should rather have said that, before the War, the nations had nowhere reached a sense and condition of brotherhood more real than in the world of science. Not only was there a pooling of all new knowledge, but there were also numerous international organisations for co-operative scientific investigation and for deliberative and social intercourse. Few men of science in modern times have attained maturity without finding themselves linked by strong ties of friendship to a multitude of foreign fellow-workers. Certainly there are sometimes acute differences of opinion between two men of science, or it may be two schools of thought in different countries, but we have no knowledge of any oppression or persecution arising here any more than among men of the same country.

THE dictum that "for the chemist there are no waste products" is well illustrated by the exhibition which British Glues and Chemicals, Ltd., is holding in its research department at 19 Bedford Square, London, W.C.2. Although bones were used for many purposes by primitive man, and glue is said to have been first prepared from them by Papin in 1680, no industry of any importance based upon their utilisation was initiated until about a century ago. Since then the number of products made from bones has increased considerably and the quantity of bones consumed has multiplied almost beyond measure. In addition to the manufacture of glue and gelatin, the extraction and preparation from bones of calcium phosphate, in various forms and degrees of purity, is a great and growing industry. This substance is used as bone-ash in the ceramic industry, and as bone-meal, steamed bone-flour, raw bone siftings, "dissolved" bones in agriculture. Recently pure finely ground steam bone-flour, containing 65 per cent. tricalcium phosphate and 10 per cent. calcium carbonate, has come into prominence as a food for farm stock. Other useful products obtained from bones are fat for soap and candle manufacture, animal charcoal, bone oil and pitch, and ammonium sulphate. A large variety of substances and commodities is shown in the exhibition, and in many cases useful explanatory data are added.

AT the opening meeting of the new session of the Society of Chemical Industry (Manchester section), Mr. W. J. U. Woolcock, president, gave an address on the benefits that accrue from close co-operation of the scientific and industrial branches of chemistry. The impetus to co-operation given by the War has now passed, and we are in danger of retrogression. Lack of understanding between scientific worker and industrialist may be due to weaknesses on both sides. The former is apt to forget that common sense is often more important than scientific knowledge; the latter to regard pure and applied science as unrelated spheres of activity, and to consider research in pure science as wasted effort, particularly when times are bad. Members of both branches are prone to take on work for which they are not fitted by nature. It is to revolutionary discoveries, especially in pure science, that we must look for help. The Association of British Chemical Manufacturers has had an educative influence on the less enlightened manufacturers; in working for the advancement of chemical industry, it helps to open up better prospects and bring about better conditions of employment for the chemist, and by effecting successful co-operation among chemical firms, it fosters co-operation between the technical and non-technical branches of the same firm. The organisation of the chemical and other scientific exhibits at the British Empire Exhibition is a splendid example of the successful co-operation of scientific and industrial workers.

AN archæological discovery of the highest importance for Indian prehistory has been made at Mohenjo-Daro in Sind and at Harappa in the Punjab. Beneath strata belonging to the Kushan culture of the second century B.C. have been found remains of massive brick structures and a number of objects, including new types of pottery, plain and painted and both hand- and wheel-made, bangles of glass, paste, and shell, stone rings of unknown use, knives and cores of chert, and oblong bars of copper, assumed to be coins. A number of seals, of ivory, paste, stone, and steatite, are engraved with an unknown pictographic script and figures of unicorns and bulls, in a style unknown to Indian art. The absence of iron, except in the latest strata, and the scarcity of metal indicate an early date. Sir John Marshall, Director-General of Archæology in India, in describing the discovery in the *Illustrated London News* of September 20, points out the affinities of the script to pictographs from the Mediterranean area of Mycenean age; but he is of the opinion that this culture developed in the Indus valley without

serious modification by outside influence. Prof. Sayce, in commenting on the discovery in the issue of September 27, points out that the inscribed seals are practically identical with the Proto-Elamite "tablettes de comptabilité" found by de Morgan at Susa, and indicate intercourse between Susa and North-West India in the third millennium B.C. In the same journal on October 4, Messrs. Gadd and Sidney Smith of the British Museum described in detail, with numerous illustrations, the parallels to be found in the objects from both the sites and from Babylonia, their conclusion being that the makers of the seals were in close touch with the Sumerians and had borrowed their artistic style and the basis of their script from them somewhere about 3000–2800 B.C.

THE harbour at Esquimalt, B.C., was formerly well known as the North Pacific Naval Station, directly under the Admiralty, but is now under the Canadian Department of National Defence. The graving dock, built in 1887 by the Canadian Government, has been in constant use, but the need has been felt for something better able to cope with naval and merchant vessels of modern size, and the Federal Government decided in 1920 to construct a new dry dock. An illustrated account of this dock appears in *Engineering* for September 26, from which we learn that the dock will accommodate the largest class of ships, a depth over sill at high tide of 40 ft. being provided, while the maximum usable length will be 1150 ft. The width at the entrance at coping level is to be 135 ft. and on the sill level 107 ft. $1\frac{3}{4}$ in. To the west of the dock there is a landing wharf 800 ft. long. The main pumping plant will consist of three 42-in. centrifugal pumps direct-connected to vertical-shaft induction motors of 1000 horse-power. Eight capstans will be provided on the dock side and one at the end of the chamber. The former will have a full-load capacity of 25,000 lb. at 12 ft. per minute, and the latter a capacity of 65,000 lb. at the same speed. The construction is now well advanced and it is hoped to complete the undertaking this year. Whilst the Government Department will undertake docking and undocking, shipowners will make their own arrangements with repair firms for carrying out work on vessels while in dock.

FLOODS in India are rapidly subsiding, according to detailed information given recently in the *Times*. In northern India an improvement in the railway situation is reported, although some weeks must elapse before thorough working is restored; many important towns are entirely cut off from railway service. The roads have also been affected by the floods, and many railway bridges have been destroyed. In Delhi the floods are said to be unprecedented in living memory, and the records show that the Jumna at Delhi rose 2 inches higher than the level of the last great floods in 1906. In the Karnal district of the Punjab 200 villages are affected, and of these 60 are said to have been destroyed. The floods of the Ganges have done considerable damage in the district of Cawnpore, where the river level is higher than has ever been recorded. At the end of September the rainfall was excessive; in 2 days the amount reported was 15 inches at Mussooree and 13 inches at Meerut. At Simla continuous rainfall was reported for 72 hours, commencing at midday on September 27.

PROF. H. B. DIXON, honorary professor of chemistry in the University of Manchester, will deliver the inaugural lecture on "The Life and Work of Ludwig Mond," in the Chemistry Theatre of the University of Manchester on Monday, October 20.

APPLICATIONS are invited for an assistantship in the Technical Records Section of the Admiralty. Candidates must have a sound knowledge of modern physics and be able to read technical French and German and have some bibliographical experience. Applications must be sent by, at latest, November 10, to the Secretary of the Admiralty, C.E. Branch, Whitehall, S.W.1.

A DIRECTOR of the Laboratory of Microbiology and Pathology, Department of Public Health, Brisbane, is shortly to be appointed. Applications for the post are invited from holders of the diploma in public health with recent special laboratory experience in microbiology. The latest date for the receipt of applications, which should be sent to the Agent-General for Queensland, 409 Strand, W.C.2, is October 27.

TWO research assistants, a senior and a junior, are required by the National Federation of Iron and Steel Manufacturers, Caxton House, Tothill Street, S.W.1, for research work on blast furnace reactions at the Imperial College of Science and Technology, under the direction of Prof. Bone. Candidates must possess a good knowledge of physical chemistry, gas analysis and manipulations. Applications must reach the director of the federation by October 27 at latest.

THE new weekly journal entitled *East Africa* is devoted to the interests of east and central Africa. It makes a good start with an attractive number that contains several interesting articles, including one on cotton production in the Sudan and another on the pastoral and agricultural possibilities of the highlands of Kenya, Uganda, and Tanganyika. The journal promises to be of value to all interested in the development of the lands of East Africa.

THE Air Ministry has announced that the two-seater dual control light aeroplane competition, which concluded at Lympne on October 4, has resulted in the production of new aeroplanes and engines of great interest and value from a practical and technical point of view. The aeroplanes, which were all widely divergent in design, proved themselves to be thoroughly efficient and satisfactory, and the power plant showed itself capable of carrying out all the tests prescribed, including the ten hours' reliability test. On the other hand, it was found necessary to run the engines at such a high speed in order to secure the maximum competition performance, that trustworthiness suffered. The Air Ministry is therefore reviewing the whole of the engine position with the view of obtaining the necessary technical data,

free from the adverse conditions inherent in a competition of this nature.

THE Paris correspondent of the *Times* states that M. Callizo, the French airman, has created a world "record" for altitude by reaching the height of 11,841 metres (38,843 ft.) in a flight made on October 10. M. Callizo's barogram has been verified at the École des Arts et Métiers. The previous record was held by M. Sadi-Lecointe, who reached a height of 35,239 ft. at Villesauvage, France, on September 5, 1923.

THE "Cobb" lectures, which were delivered before the Royal Society of Arts in March and April of the present year by Dr. T. Slater Price on "Certain Fundamental Problems in Photography," are published in full in the Society's Journals for September 5, 12, and 19. The three lectures form a concise but comprehensive statement of the present state of knowledge concerning the gelatino-bromide photographic plate. Dr. Slater Price deals first with gelatin and especially its physical properties and matters related thereto. He passes on to the colour of silver deposits produced in gelatin films by photographic processes, the nature of the developable as well as of the printed out image, the theories of the nature of the action of light and the "centres" of sensitiveness in the grains, and other matters. Those interested in these things will find it a great help to have the various results brought together as they are here, with the valuable critical and comparative remarks of the lecturer.

THE latest catalogue of Mr. F. Edwards, 83 High Street, Marylebone, W.1 (No. 462, British Empire Series, No. 5), deals with books, engravings, drawings, and maps relating to Canada, West Indies, British Guiana, and Falkland Islands.

WE have received from Mr. W. H. Robinson, Nelson Street, Newcastle-upon-Tyne, a copy of his catalogue No. 11, 1924, of second-hand books. The catalogue, which is of a miscellaneous character, contains the titles of a good many works likely to interest readers of NATURE, *e.g.* a section is devoted to books illustrated by Thomas and John Bewick, and others to botany, natural history, folklore and archæology. The prices asked appear to be reasonable.

A NEW book by Prof. Ellsworth Huntington is announced by Charles Scribner's Sons. It is entitled "The Character of Races: their Formation and Modification by Environment," and is a study of the ways in which racial character is moulded and modified by environment. Another book in the same publishers' announcements is "Racial Realities in Europe," by L. Stoddard. In this volume the following subjects are dealt with: racial realities, kindred Britain, the Nordic North, composite France, the Mediterranean South, Alpinised Germany, disrupted Central Europe, the Alpine East, the Balkan flux, Turkey, Arab lands, and the new realism of science.

Our Astronomical Column.

COMETS.—Encke's Comet has brightened remarkably, and is now on the verge of naked-eye visibility. A photograph by Mr. G. Merton shows a short tail. It is 138 years, or 42 revolutions, since the comet was first seen, but the loss in brightness during that period is not noticeable, in spite of the small perihelion distance. Some thirteen years ago the late Mr. W. T. Lynn suspected that the comet was fading, but the loss of light, if present, was only temporary.

Dr. W. Baade succeeded in photographing Reid's Comet, 1924*a*, on September 27 with the Bergedorf reflector. It was of magnitude 16 as compared with the calculated magnitude 10, indicating great physical loss of light. The position was within 4′ of the Copenhagen orbit.

MARS.—*L'Astronomie* for August contains several drawings of the planet Mars, made during June and July. The southern hemisphere was then in its spring, the summer solstice being passed on September 30. The southern polar cap was large and showed much interesting detail. It was crossed by two large dark rifts, and the region Argyre on its edge was brighter than the rest of the cap.

M. Antoniadi, who has been observing with the 30-in. Meudon refractor, gives a series of measures of the size of the polar cap in the *Comptes rendus* of the Paris Academy of Sciences for September 22. Several years ago he contributed a paper to the Royal Astronomical Society indicating that the size and rate of melting of the cap vary with the solar cycle. The size is greater and the melting slower in times of sunspot minimum and diminished radiation. It is noted that the present results are in full accord with this, and that the late winter and spring of the Martian southern hemisphere appear to have been colder than the average.

THE SPIRAL NEBULÆ.—Dr. K. Lundmark contributes a paper to the *Observatory* for September, dealing with the radial velocities and proper motions of the spiral nebulæ. He includes some nebulæ of the class described by Reynolds as globular, since they share the high radial velocity. He finds the following values for the solar apex and motion:

(1) From the radial velocities of 43 spirals—

R.A. of apex	$20^h{\cdot}3 \pm 3^h$
Decl.	$+75° \pm 30°$
Velocity	651 ± 135 km./sec.

The large K term of $+793 \pm 88$ km./sec. is indicated.

(2) From the very small and uncertain proper motions of seven spirals—

R.A. of apex	$1^h{\cdot}7 \pm 5^h$
Decl.	$+63° \pm 46°$
q	$0{\cdot}0074'' \pm 0{\cdot}0055''$.

Deduced mean distance of spirals 61,000 light years.

No allowance has been made for proper motion of comparison stars, which were of about magnitude 16.

The two positions of the apex do not differ more widely than we should expect from the large probable errors. Both R.A. and Decl. are considerably larger than the values, 18^h and $+30°$, given by the nearer stars, suggesting that the whole group of stars round the sun is drifting relatively to the group of nebulæ.

Research Items.

Prehistoric Ivory Figurine from Egypt.—Among the more important objects discovered by the British School of Archæology at Qau in Egypt during the excavations of last season was a female figure rudely carved in ivory. It differs from any of the prehistoric ivories hitherto known. On the same site were found ripple pottery and a number of objects—a globular vase with four small handles, a long narrow palette, a flint dagger, and a small oval vase with cylindrical neck, all of types not previously known. It would appear that these finds represent a culture apart from the usual prehistoric Egyptian, though on much the same level and using the same materials but in a different way. The ivory figure is not of the steatopygous type. The arrow heads and other flint work point to a connexion with the makers of the Fayum desert flints, which are of Solutrean style. Sir Flinders Petrie in describing these finds in *Ancient Egypt*, 1924, Pt. ii., suggests that the culture may have originated in Central Asia, whence the Solutrean workers are supposed to have come. This civilisation, for which the name Badarian is suggested provisionally, from Badari, the district around Qau, would thus be the earliest of any known in Egypt, though not necessarily contemporary with the European Solutrean period.

Currency of the Gupta Dynasty in Eastern India.—In the course of some notes on the Gupta and later Gupta coinage in the Journal of the Asiatic Society of Bengal, N.S., xix., Pt. 6, Mr. N. H. Bhattasali discusses the origin of the so-called "Imitation Gupta coins." These coins are of base gold and approximate to a standard of 95 grains, considerably less than the Gupta standard. They were in circulation in Eastern India only. Although they cannot be attributed to the Gupta imperial dynasty, it is evident that they were issued by a family which had a veneration for Gupta traditions. It is also evident that the king who was responsible for their issue claimed paramount power in virtue of the performance of the horse sacrifice. This would point to the first king of the Gupta dynasty of Magadha, Aditya Sana Deva, who rose to power after the death of the last sovereign of the imperial line, with which he was connected, and is known to have celebrated the horse sacrifice. The fall of the Magadha dynasty was followed by a period of anarchy in which all knowledge of arts and crafts was lost, so that when the Mohammedans first entered Bengal they found that the only currency in use consisted of cowrie shells, no minted money having been struck for four centuries.

Prakrit and Sanskrit Linguistics.—Sir George Grierson has won for himself a world-wide reputation by a long series of masterly works upon the languages of Hindustan, culminating in the magnificent "Linguistic Survey of India" published by him for Government, and now happily almost completed. His latest contribution to these studies is "The Prakrit Dhātv-ādēśas according to the Western and the Eastern Schools of Prakrit Grammarians," published in vol. viii., No. 2, of the Memoirs of the Asiatic Society of Bengal. As is generally known, the modern Aryan languages of India are all derived from the ancient dialects represented in literature by the Vedic and Sanskrit. The intermediate links were the Prakrits or ancient forms of popular speech, which in their turn were cultivated for literary purposes and studied by many grammarians, whose surviving works, so far as they are known, fall into two classes, an Eastern school, deriving from Vararuci and his successors, and a Western school, based upon Hēmacandra. The present work deals with the verbal roots which are specifically recognised by the grammarians as used in Prakrit and as differing from the corresponding Sanskrit roots. It consists of two indexes: the first of these contains the Prakrit roots arranged alphabetically, in the order of their Sanskrit forms, in parallel columns showing the respective paradigms quoted by five leading native grammarians, while the second presents the roots arranged in their own alphabetical order with parallel columns showing the various meanings assigned to them by the same grammarians. It is rounded off by an introduction and an appendix containing the text of a chapter on the same subject from the Prākṛita-kalpataru, a Sanskrit grammar by Rāma Śarman, and altogether will be of the greatest utility to students of the ancient literary Prakrits and the modern vernaculars of India.

Control of Pests in Glass-houses.—The Annual Report for 1923 of the Experimental and Research Station at Cheshunt gives a record of steady progress and widening scope of activity. The variety and manurial trials with tomatoes have been revised to bring them more into line with present-day requirements, and valuable results are anticipated. A definite relation has been determined between manurial treatment and blotchy ripening of fruit, the proportion of blotchy fruit being heavy when the soil is deficient in both nitrogen and potash, and reduced when these substances are added to such soil. Experiments on the destruction of red spider by fumigation indicate that the action of gases and volatile liquids is ineffective owing to their rapid escape from the atmosphere in glass-houses and owing to the difficulty of keeping up a comparatively high concentration of the vapour sufficiently long to kill the spider. As recorded by Messrs. E. R. Speyer and O. Owen in Nature of June 7, p. 820, naphthalene, when heated, seems to be the type of fumigant best suited to the purpose, provided that, within broad limits, the amount of its vapour in the atmosphere can be controlled so that no injury is caused to the plant. Other tests show wood-lice can be controlled by the introduction of small quantities of phenol into the soil, but unless commercial phenol can be utilised, the method is too expensive for ordinary use. In view of the suggested fertilising value of increased quantities of carbon-dioxide in the air of glass-houses, continued experiments have been made to overcome the technical difficulties involved in the control of the concentration of the gas, and increased yields of tomatoes have been obtained in certain cases, encouraging further research on the subject.

Surface Tension of Spray Liquids.—In the control of insects by poisonous sprays, the power of the liquid used to wet and spread over the surface to which it is applied is as important a factor as its toxicity to the organism against which it is directed. Woodman (*Journ. of Pomology and Horticultural Science*, iv., No. 1) has now shown by carefully devised physical experiments that the surface tension of a spray liquid may be reduced to a certain critical value by the addition of small quantities of soap, under which conditions the surfaces of leaves are easily wetted and the maximum amount of spray liquid retained by them. Further reduction of surface tension increases the "spreading power" of the spray though not its "wetting power." Increases of viscosity by the

addition of gelatine at about 0·3 per cent. concentration causes the retention of much more of the spray fluid on account of the adsorption of gelatine by the leaves. Forcible spraying, when the drops pass rapidly through the foliage, also augments retention. By measuring the areas of spread of lenses of liquids on wax surfaces, it has been determined that the reduction of surface tension of the spray fluid below 32 dynes/cm. greatly increases the area of spread. This indicates the economic advantage of soap as a "spreader," owing to the very low surface tension of dilute soap solutions. The greatest spread is obtained with small drops applied with considerable force, which supports the advocated practice of mist-like spraying, though it is pointed out that reduction in the size of drops would lead to decreased "force" in passing the leaves and so to a lessened retention of the spray liquid.

WATER ABSORPTION BY COCO-PALMS.—The *Philippine Journal of Science* for July 1924 contains a paper by Messrs. R. B. Espino and J. B. Juliano dealing with the rate at which roots of *Cocos nucifera* (*in situ*) absorb three- or four-salt culture solutions. The solutions absorbed most rapidly are characterised by a rather high proportion of magnesium sulphate. In this respect the results resemble those previously obtained for rice, except that the latter apparently requires less concentrated culture media. Maximum absorption in the coco-palm takes place between one and two o'clock in the afternoon, and it is shown that variations in the rate of absorption correspond quite closely to variations in the rate of transpiration. The apparent width of the leaf pinnæ is inversely proportional to the rate of absorption. The fact that water absorption depends upon the evaporating power of the air leads the authors to suggest that successful cultivation of this palm is possible even in climates usually regarded as too dry, if soil moisture is supplied in sufficient quantity.

THE GENETICS OF TOBACCO.—While parthenogenesis has been known to occur in two varieties of *Nicotiana Tabacum* grown in England, various tests have shown that this process is almost unknown in North America. The question has been re-examined at Pusa by Messrs. G. L. C. Howard and Kashi Ram (Mem. Dep. Agric. in India, Bot. Ser. 13, No. 1), who were unable to obtain evidence of parthenogenesis in either of the varieties tested. Parthenocarpy, however, occurred in *N. Tabacum*, var. *Cuba*, this always being associated with white flowers and also with especially vigorous growth of the parent plant. The inheritance of characters in Indian varieties of *N. rustica* has also been studied by G. L. C. Howard, and the results are described in the same number of these memoirs. Neither parthenogenesis nor parthenocarpy were observed. The characters of the F_1 plants were intermediate between those of the parents, except that the average height was always greater than that of the taller parent. The difference between short and tall types appears to be due to a single factor which causes elongation of the internodes both of the stem and of the inflorescence. A frilled leaf margin is dominant to a smooth edge and is apparently associated with the presence of a single factor.

RAINFALL MAP OF SWEDEN.—Owing to the widespread distribution of rainfall stations in Sweden which has grown since the start of the Hydrographic Service in 1907, it has been found possible to produce a rainfall map of the country with much greater accuracy than of old. Nederbördskartor över Sverige by Axel Wallen appears as Band 2, No. 3 of *Meddelanden från Statens Meteorologisk-hydrografiska Anstalt*. It contains a map of the annual rainfall based on the figures from 1881 to 1920 and twelve maps of monthly rainfall. In the north, where stations are few, the records probably do not express the full value of the fall and they have been adjusted by data derived from the flow of rivers. In the north-east, such corrections should probably also be made, but the figures do not appear to be available. The paper contains a summary of the data employed and a discussion of the cartographic methods employed. The Swedish rainfall figures for 1923 are published by the same department in Aarsbok. 5. The volume includes rainfall maps for each month of the year 1923.

EXPERIMENTS ON A MERCURY ARC RECTIFIER.—In the *Zeitschrift für Physik* for August 8, Messrs. W. Schottky and J. von Issendorff describe experiments designed to elucidate the peculiar effect produced when different voltages are applied to the wall of a mercury arc rectifier. The current curve obtained with a probe electrode was quite similar to that with the rectifier; when the electrode was 12·2 volts above the cathode voltage, the current, I, flowing from the discharge into the electrode was zero; but it very rapidly increased, as the voltage diminished, towards a saturation value. The greater part of the rise of current took place between +12·2 and zero volts, after which down to −100 volts it rose very slowly indeed. To determine the nature of this current, the authors measured the heating effect produced by it in the probe electrode, by means of an auxiliary heating coil, insulated in such a way that the whole of the heat produced by it went into the electrode. In this way the watts required to give the temperature rises produced by the current I at different voltages were determined, and it was shown that, with constant current through the electrode, the connexion between the heat produced and the voltage was a linear one. The relation was such that, within the limits of accuracy of the measurements (about 20 per cent.), it can be stated that the subsidiary current is due entirely to the flow of positive ions into the electrode. There is therefore no secondary production of cathode rays in the region examined. There is a distinct dark space round the probe, which only vanishes when it is made the anode. The suggestion previously made, that measurements of potential in the mercury arc with a probe are several volts too low, is confirmed.

THE EMISSION OF ELECTRONS CAUSED BY α-RAYS.—Dr. A. Becker has carried out a very comprehensive investigation on this subject, in which the phenomena were studied in high vacua. The α-rays were sent through foils of different thicknesses of aluminium, silver, and gold, and the movements of the electrons were controlled by fields of different signs and different intensities, produced between an electrode consisting of the preparation holder and foil and a surrounding electrode, or a parallel plate (*Annalen der Physik*, September). About ten electrons were produced per α-particle, when this had the velocity $1{\cdot}5 \times 10^9$ cm. per sec., and about twenty with half this velocity, using any of the three metals. It was shown that the emission requires no essential outside acceleration, so that the electrical method employed in determining the velocities of the electrons, or δ-rays, is good in principle. Using a central field (an outer spherical electrode with the preparation holder at the centre) the curve of velocity distribution is very similar to that of the electrons from an incandescent solid, but varies from this at high velocities, which are more

frequent in the first curve than in the second. Within the limits of experimental accuracy, the first curve agrees with the Maxwell law of velocity distribution. These results were confirmed by experiments using homogeneous fields between two parallel condenser plates. It is probable that the distribution of velocity is independent of the direction of emission, and that the distribution in different directions follows the cosine law. The distribution of velocity, and its absolute value, are independent of the nature of the metal employed and of the velocity of the α-rays. The "most probable" velocity corresponds to a potential drop of about two volts; higher velocities than those corresponding to about twenty volts cannot with certainty be shown to exist. The results make it uncertain whether the two kinds of electron emission mentioned can be regarded as due to the same fundamental mechanism.

SINTERED GLASS FILTERS.—The *Chemiker Zeitung* (1924, vol. 48, p. 693) contains an account of the tests carried out by Moser and Maxymowicz at the Technische Hochschule, Vienna, of the new glass-filters made by the well-known Jena firm of Schott und Gen. These filters are an improvement upon the asbestos pads of the Gooch crucible, since the glass filtering layer is fused into the glass crucible, the lower rim of which projects beyond it for protection. Various grades are made according to the fineness of the precipitates to be collected. Successful quantitative tests were carried out with silver chloride, lead sulphate, lead chromate, mercuric sulphide, cuprous thiocyanate, nickeldimethyl glyoxime, barium sulphate, calcium oxalate, etc. The calcium oxalate can be weighed as $(COO\,Ca)_2 \cdot H_2O$ and attempts are being made to estimate various metallic ammonium phosphates as such. The filters were found to resist the action of dilute and concentrated acids, including aqua regia, but are readily attacked by alkalis. Aqueous ammonia can, however, be used. The main disadvantage lies in the fact that variations of as much as 0·4 mgm. were found in the weighings unless the crucibles were allowed to stand for several hours in the desiccator.

CHEMICAL CONSTANTS.—In the April-July volume of the *Compte rendu des Séances de la Société de Physique*, of Geneva, the question of the calculation of the entropy of a gas from the point of view of the quantum theory is discussed by A. Schidlof. It is pointed out that the problem involves the quantification of the energy of translation of the gas molecules, and the difficulties arising out of this are mentioned. In the case of a gas consisting of N molecules in a volume V, the volume V/N may be taken as that in which the quantified motion takes place (Sackur), or, alternatively, the cube of the mean free path (Schrödinger). There is only one case free from ambiguity, namely, when the volume V contains only one molecule which can assume all the states of motion compatible with the conditions imposed. With this case, an expression for the entropy is found containing an additive constant, and it is claimed that neither Nernst's theorem nor the quantum theory allows of this constant being neglected. In the calculation of the chemical constant of a monatomic gas, the number N does not appear in the result, and the author shows that it is also unnecessary to introduce it into the deduction. The formula is that of Sackur, and differs from that found by Tetrode and by Planck.

THE COMPOSITION OF CHROMIC ACID.—The hydration product present in an aqueous solution of chromium trioxide has usually been supposed to be dichromic acid, $H_2Cr_2O_7$, on the basis of the colour of the solution and conductivity measurements combined with cryoscopy. In the August number of the Journal of the Chemical Society, Mr. H. T. S. Britton describes some measurements with the hydrogen and oxygen electrodes in solutions of chromic acid which lead to the result that the acid is H_2CrO_4, dissociating in two stages: $H_2CrO_4 \rightleftharpoons H^{\cdot} + HCrO'_4 \rightleftharpoons 2H^{\cdot} + CrO''_4$. The first stage is almost complete in dilute solutions; the second dissociation constant is very small, $4{\cdot}4 \times 10^{-7}$ at 18°. The use of the oxygen electrode as an indicator of both hydrogen ion concentrations and as end-points in titrations was made possible by comparison with the hydrogen electrode, and the method used appears to offer possibilities of application in other fields.

ATOMIC WEIGHT OF ALUMINIUM.—The June issue of the Journal of the American Chemical Society contains a description of the analysis of aluminium chloride by H. Krepelka, of the University of Prague. In a previous determination, with Prof. T. W. Richards, the value 26·963 was found as a mean of four analyses of aluminium bromide, the value given in the International Tables being 27·0. In the present research, pure aluminium chloride was synthesised from very pure chlorine and the purest obtainable aluminium. Eleven different fractions of the chloride, digested and repeatedly sublimed in nitrogen and in a vacuum, were analysed. The ratio $AlCl_3 : 3Ag$ was determined, with three different samples of standard silver. The mean of the eleven determinations is $Al = 26{\cdot}972 \pm 0{\cdot}001$, with $Ag = 107{\cdot}88$ and $Cl = 35{\cdot}458$. The most probable figure is considered to be the mean value of 26·963 and 26·972, namely, 26·97. It is remarked that, according to Aston, aluminium is a pure element, of mass 27, its nucleus being composed according to the scheme $4n + 3$. The new result confirms the previously accepted value of slightly less than the sum of the nuclear masses of helium (4·00) and hydrogen (1·008), and although the three hydrogen nuclei are satellites, the new value suggests a slight loss of mass due to the disturbing effect of electromagnetic forces within the nuclear system.

PSEUDO-EPIBERBERINE.—In the August number of the Journal of the Chemical Society, Buck and Perkin describe experiments which involve at one step the condensation of 1-homopiperonyl-6 : 7-dimethyltetrahydroisoquinoline with methylal, under conditions the same as those previously used by Pictet and Gams. Crystalline products, however, could not be isolated. When the methyl alcoholic solution was treated with formaldehyde, the formyl derivative separates as a gum, and on warming with hydrochloric acid, this is at once converted into the sparingly soluble salt of what was anticipated would prove to be tetrahydroepiberberine. It was proved conclusively that this was not the case, and that the mode of condensation assumed by Pictet was incorrect. The isomeric alkaloid produced is called tetrahydro-pseudoepiberberine. For example, when treated with sodium hydroxide, the substance decomposes into oxypseudoepiberberine and dihydro-pseudoepiberberine, a reaction exactly analogous to one previously investigated in which epiberberinium chloride is converted into oxy-epiberberine and dihydro-epiberberine. In the same journal, Haworth, Perkin, and Rankin show that a similar state of affairs exists with respect to berberine, and that the tetrahydroberberine described by Pictet and Gams is probably not that substance, but an isomeride.

International Mathematical Congress.

THE International Mathematical Congress at Toronto opened on Monday, August 11, with a speech of welcome to the assembled members by Dr. H. S. Beland, Minister of Soldiers' Civil Re-establishment and Health. Dr. Beland, who spoke in English and French, conveyed to the mathematicians greetings from the Premier of the Dominion of Canada, who unfortunately found himself unable to be present. Sir Robert Falconer, president of the University of Toronto, also gave a brief speech of welcome. Prof. J. C. Fields, chairman of the organising committee, and Prof. C. de la Vallée Poussin, president of the International Mathematical Union, addressed the meeting. Prof. G. Koenigs, general secretary of the International Mathematical Union, assisted by Prof. W. H. Young, read a list of delegates to the Congress. This list was only provisional, since much of the information with regard to delegations was not available at that time. The large number of delegates officially appointed to represent governments, learned societies, universities, and other institutions was a distinctive feature of this Congress in comparison with those previously held.

At the close of the opening session a general session was held for the election of officers. Prof. J. C. Fields was elected president of the Congress, and the following vice-presidents were elected: Prof. B. Bydžovský, Prof. F. M. Da Costa Lobo, Prof. L. E. Dickson, Senator F. Faure, Prof. H. Fehr, Prof. L. E. Phragmén, Prof. S. Pincherle, Prof. E. Schou, Prof. C. Servais, Prof. C. Störmer, Dr. W. Van der Woude, Prof. W. H. Young, and Prof. S. Zaremba. Profs. J. L. Synge and L. V. King were elected general secretaries.

The various sections held their opening meetings at 2.30 P.M. The following acted as introducers for the sections: Sect. I., Prof. J. C. Fields; Sect. II., Prof. J. L. Synge; Sect. III. (a), Prof. J. C. McLennan; Sect. III. (b), Prof. C. A. Chant; Sect. IV. (a), Mr. T. H. Hogg; Sect. IV. (b), Prof. T. R. Rosebrugh; Sect. V., Mr. Robert Henderson; Sect. VI., Dean A. T. De Lury. After the reading of papers before the sections the members of the Congress attended a garden party given by Prof. and Mrs. J. C. McLennan at the York Club. In the evening Prof. Carl Störmer of Christiania delivered a lecture on "Modern Norwegian Researches on the Aurora Borealis."

On Tuesday, August 12, the sections met at 9 A.M. In the afternoon Prof. F. Severi of Rome lectured on "Géométrie algébrique." After the lecture the members of the Congress were the guests of the Lieutenant-Governor and Mrs. Cockshutt at a garden party at Government House. In the evening there was a conversazione at Hart House, at which the members had an opportunity of inspecting this great centre of student social life in Toronto.

On Wednesday morning, after short sessions of the sections, M. E. Cartan lectured on "La théorie des groupes et les recherches récentes de géométrie différentielle." In the afternoon, at a special convocation of the University of Toronto, honorary degrees of Doctor of Science were conferred on the following members of the British Association and the International Mathematical Congress: Sir David Bruce, Prof. de la Vallée Poussin, Sir Charles Parsons, Profs. Koenigs, Stekloff, Severi, Sir Ernest Rutherford, and Sir John Russell. After the Convocation, the members were entertained by the University at a garden party. In the evening Prof. W. H. Young lectured on "Some Characteristic Features of Twentieth Century Pure Mathematical Research."

On Thursday, August 14, the members of the Congress crossed to Niagara and availed themselves of the kind invitation of the Hydro-Electric Power Commission of Ontario to inspect the generating plant at Queenston, being afterwards entertained at lunch as the guests of the Power Commission at the Clifton Inn, Niagara Falls. After viewing the Falls and the Rapids, the members returned by boat to Toronto.

On Friday, August 15, a general assembly of the International Mathematical Union was held for the election of officers. Prof. S. Pincherle, of Bologna, was elected president, and Prof. G. Koenigs, of Paris, general secretary. After this meeting, sessions of the sections were held, and in the afternoon lectures were delivered by Prof. L. E. Dickson, of Chicago, on "Outline of the Theory to Date of the Arithmetics of Algebras," and by Prof. S. Pincherle on "Opérations fonctionnelles." The members then attended a garden party at the Grange, given by the council of the Art Gallery, and in the evening the Hunt Club was kindly placed at their disposal.

On Saturday, August 16, the sections met at 9 A.M. At 2 P.M. a wreath was laid at the base of the Soldiers' Memorial Tower. At 2.30 P.M. Prof. J. Le Roux delivered a lecture, "Sur l'intégration des équations aux dérivées partielles par des intégrales définies." At 5 P.M. the closing session of the Congress was held. Prof. J. C. Fields, president of the Congress, expressed the thanks of the Congress to all those who by their generous hospitality or services had contributed to its success. Prof. S. Pincherle and Major P. A. MacMahon also spoke, and Prof. J. L. Synge, general secretary, reported on the membership of the Congress. The following resolutions were adopted by the Congress at the closing meeting: proposed by Prof. J. L. Synge (Toronto), seconded by Dr. B. Bydžovský (Prague), "That this International Mathematical Congress assembled at Toronto hears with pleasure that the Royal Irish Academy contemplates the publication of a collected edition of the works of Sir William Rowan Hamilton"; proposed by Prof. C. V. Raman (Calcutta), seconded by Prof. G. A. Bliss (Chicago), "That the best thanks of the members of the International Mathematical Congress are due to Dr. J. C. Fields and to all those mentioned by him as having contributed to the success of the Congress, and that this vote of thanks be communicated to them."

The members of the Congress and friends assembled for the last time at a dinner in Hart House on Saturday evening. Those members of the Congress who went on the western excursion with the British Association left Toronto on the night of Sunday, August 17.

Although the attendance suffered considerably from the fact that the Congress took place while many summer sessions in the universities of the United States were in progress, the registered membership was 386. This number does not include accompanying relatives. The membership was distributed by countries as follows: Argentine, 2; Belgium, 7; Canada, 67; Cuba, 1; Czechoslovakia, 3; Denmark, 3; France, 25; Georgia, 1; Great Britain, 39; Holland, 4; India, 2; Ireland, 3; Italy, 11; Mexico, 1; Norway, 5; Poland, 3; Portugal, 2; Rumania, 1; Russia, 5; Spain, 3; Sweden, 3; Switzerland, 4; Ukraine, 1; U.S.A., 189; Yugoslavia, 1.

The number of papers presented was very great—235 in all, exclusive of the lectures already mentioned. Of these papers, some, in the absence of the authors, could only be presented by title. On account of the desirability of affording the members an opportunity of seeing Niagara Falls, and also in view of the many entertainments so generously offered, the time available for the reading of so many papers was none too

long. It was found necessary, on some of the days, to have all the eight groups representing sections and subsections in operation simultaneously, and thus members had to make an invidious choice between the various groups at which papers of rival interest were being presented. In the circumstances, it was difficult to suggest a remedy for this state of affairs other than the expedient of cutting down the time allowance for individual papers so far as to detract seriously from their interest. The general maximum time allowance for a paper was twenty minutes, but in the case of certain communications, which might be regarded as lectures to individual sections, this allowance was increased up to one hour. Such sectional lectures were: Prof. J. Pierpont: Non-Euclidean Geometry from a Non-Projective Standpoint (Section II.); Prof. V. Bjerknes: Solved and Unsolved Problems in Dynamical Meteorology (Section III. (b)); Prof. J. B. Pomey: Sur les nouveaux appareils multiplex de télégraphie (Section IV. (a)); Prof. G. Puppini: Principe de réciprocité dans les sciences appliquées (Section IV. (a)); Sir Charles Parsons: Physics and Engineering (Section IV. (a)); Prof. J. G. Gray: Gyroscopic Stabilisers (Section IV.); General Charbonnier: Sur le balistique extérieur (Section IV. (b)); Prof. A. L. Bowley: Use of Mathematics in Economic, Social, and Public Statistics (Section V.).

The numbers of papers presented to the various sections were: Section I. (Algebra, Theory of Numbers, Analysis), 56 papers; Section II. (Geometry), 40 papers; Section III. (a) (Mechanics, Mathematical Physics), and III. (b) (Astronomy, Geophysics), together, 55 papers; Section IV. (a) (Electrical, Mechanical, Civil and Mining Engineering), and IV. (b) (Aeronautics, Naval Architecture, Ballistics, Radiotelegraphy), together 47 papers; Section V. (Statistics, Actuarial Science, Economics), 24 papers; Section VI. (History, Philosophy, Didactics), 13 papers.

The classification of papers into the various sections, a matter always arbitrary to a certain degree, was left almost entirely to the judgment of the authors themselves, who would naturally seek the most sympathetic audience. It will be seen that, as usual, the Section on Analysis had more communications than any other, being closely followed by the combined Physics and Astronomy Section. Section IV., embracing the various branches of engineering science, was a new development for this Congress. Although the number of papers in Section V. was not large, yet the meetings of this section were very successful, and recognition is due to the activity of Mr. Robert Henderson, of the Equitable Life Assurance Company of New York, in helping to stimulate American interest in this section.

In order to increase the interest of the meetings and to facilitate discussion, the organising committee had abstracts of the papers printed and ready for distribution among the members on registration. These abstracts were supplied by the authors. This was a very successful measure so far as it went, but many authors failed to send in abstracts although asked to do so in the preliminary circular. If funds permitted at future congresses, it would be a good plan to urge upon authors more strongly the desirability of furnishing such abstracts for printing and distribution during the meeting.

The place of meeting of the Congress which is due to be held in 1928 is not yet fixed. It is to be hoped that the political restrictions on the membership of the congresses will be removed before that date.

Miners' Flame Safety Lamp Gauzes.[1]

ALTHOUGH a period of 109 years has elapsed since Sir Humphry Davy gave to the world the first wire-gauze safety lamp, the mesh of the gauzes in use to-day is identical with that adopted in the original Davy lamp. In the near future, however, it is highly probable, as a result of the valuable researches conducted under the auspices of the Miners' Lamp Committee, that safety lamp gauzes will have 400 apertures per square inch (20 mesh) instead of 784 apertures per square inch (28 mesh).

These researches showed that two 20-mesh gauzes of 27 S.W.G. wire could be regarded as safe, and that this type of gauze, by affording increased ventilation to a lamp fitted with it, materially increased the candle power that could be obtained from it. Acting on the advice of this Committee, the Secretary for Mines arranged with the co-operation of leading manufacturers of flame safety lamps for comparative tests to be carried out at the Mines Department Lamp Testing Station of (1) lamp fitted with the present standard gauzes (28 mesh), and (2) similar lamps fitted with gauzes having 20 meshes to the linear inch. By the direction of the Secretary of Mines, the Superintendent Testing Officer's report on these tests has now been printed.

The tests carried out consisted in the main of (1) photometric tests; (2) tests in a still explosive atmosphere, and (3) gallery tests in a current of the most explosive mixture of petroleum, ether, and air.

The photometric tests which were made by a Bunsen disc photometer against a one candle-power standard pentane lamp yielded the following results:

AVERAGE CANDLE-POWER GIVEN BY VARIOUS TYPES OF FLAME SAFETY LAMPS.

Type of Lamp.	Candle-power with 28 mesh Double Gauzes.	Candle-power with 20 mesh Double Gauzes.	Average Increase in Candle-power.
			Per cent.
Marsaut	0·62	0·82	32·3
Marsaut with short inner metal chimney . .	0·70	1·01	28·0
Marsaut deflector . .	0·71	0·85	19·7
Marsaut deflector with short metal chimney .	0·77	0·94	22·1
Marsaut with inner metal chimney and inner glass	0·89	1·10	12·2
Bottom feed with bottom air admission ring .	1·05	1·20	14·3
Air feed from middle ring to below the wick .	1·80	1·85	3·0

From statistics published in the Final Report of the Miners' Lamp Committee it would appear that in the event of the new gauzes being adopted, approximately 402,000 Marsaut type lamps would obtain the benefit of an average increase of 32·3 per cent. in candle power, whilst 182,000 lamps of other types would benefit by an average increase of 16·1 per cent. in candle-power.

Although the Safety Tests were of a most severe character, none of the lamps submitted failed to pass the test satisfactorily, and Capt. Platt, the Superintending Testing Officer, is of the opinion that the factor of safety under test conditions is sufficiently great with the 20-mesh gauze.

[1] Report on Tests of Miners' Flame Safety Lamps fitted with Open Mesh Gauzes, carried out at the Mines Department Lamp Testing Station, Eskmeals, by Capt. C. B. M. Platt. (London: H.M. Stationery Office.) 3d.

The British Dyestuffs Corporation.

TWO important pronouncements regarding the present position of the British Dyestuffs Corporation appeared in the press last week. In a written reply to a question put in the House of Commons by Mr. Graham White, the President of the Board of Trade, Mr. Sidney Webb, said: "The Board of the British Dyestuffs Corporation have been informed that the Government would feel compelled to exercise their power of veto with respect to an agreement with the Interssen-Gemeinschaft on the lines suggested."

In making this decision, the Government has taken the only course consonant with national welfare and with the best interests of the textile industries. The question of the agreement has never been specifically before the shareholders of the Corporation, but it has been for some time abundantly evident that the views and policy of the directors and of the financiers who hold large blocks of shares were opposed to the considered opinions of all the important industrial and scientific organisations concerned.

In view of the Government veto, other methods of dealing with the present unfortunate position of the British Dyestuffs Corporation must be necessarily explored, and definite alternative proposals are not lacking. In his recent address as chairman of the Colour Users Association, Mr. Sutcliffe Smith made proposals for the reconstruction both of the financial and management sides of the Corporation, and, speaking before the Society of Dyers and Colourists in Bradford on October 9, Dr. Herbert Levinstein, who has been engaged in dyestuff manufacture all his life and is also probably the largest individual shareholder in the British Dyestuffs Corporation, subjected the position of the Corporation to a critical examination.

According to the *Times*, October 10, Dr. Levinstein said: "Last April, at the annual meeting, the chairman stated that the board would resign if they were not encouraged to complete the agreement as outlined. The colour consumers, the customers of the company, through the chairman of their association, have definitely stated that they disapprove of the agreement, that they will prevent it if they can, and will welcome an entire reorganisation of the management. Further, the agreement, the headings of which have become known, is opposed by every one of the organised bodies in Great Britain representing pure and applied chemistry, including the Association of British Chemical Manufacturers. Thus it appears that the policy of the board and the constitution of the board are disapproved by the whole of the chemical world and by their customers, the colour-using interests. Out of much that is obscure this much is certain. The agreement has not been approved. The situation contemplated by the chairman and his colleagues has arisen. The board have not been encouraged to complete the arrangements with the I.G. in which they put their faith, and they will no doubt tender their resignations." At the annual meeting of the Corporation last April, several speakers, men of high standing in the City of London, who represented substantial financial interests in the company, supported both the board and the agreement. The public flotation of the Corporation was not a success, a large proportion of the shares remained, and apparently still remain, with the underwriters, and Dr. Levinstein viewed with concern this divergence of views between colour users and those who represented the underwriters.

The position is one of great gravity as regards the future of the British Dyestuffs Corporation. The problems imposed on the directors by inherent difficulties of the position have not been solved by their proposals, and it has been shown once again that the special conditions involved in chemical manufactures in general, and in dyestuff manufacture most particularly, cannot efficiently be dealt with by a board which bases its policy on financial, rather than on technical requirements. The improbability of the success of any dyestuff concern managed on these lines was predicted by Lord Moulton and others, and strong but unavailing appeals were made in NATURE and elsewhere that the directorate should contain a strong technical element.

The solution of the present lamentable position appears to be a drastic reorganisation of the British Dyestuffs Corporation's finances and policy, coupled with an all-British, instead of a German-British, agreement. It is stated that British firms outside the Corporation are at present supplying three or four times as much dyestuff to British consumers as does the Corporation, and are, in fact, its chief competitors.

WALTER M. GARDNER.

University and Educational Intelligence.

BIRMINGHAM.—The following appointments have been made: Mr. Robert H. Kinvig to be reader in geography; Mr. Launcelot P. Timmins to be lecturer and demonstrator in oil production in the Department of Oil Mining; and Mr. W. J. Shearer to be lecturer in coal mining and mine rescue work. Dr. Beatrice Webb has been appointed medical officer to the Women's Training Department in the place of Mrs. Olive Elgood Turner, who has resigned.

Under the title "Careers to which subjects may lead, and other information," the Faculty of Science has issued a booklet "for the guidance of those who intend to enter the Faculty of Science of the University, and for the information of Heads of Schools, Parents and Guardians concerned." This publication, for which there is already a considerable demand, sets forth the qualifications desirable in any one about to enter the Faculty of Science, great stress being laid on the necessity of a sound knowledge of English. Some knowledge of physics is regarded as essential in all subjects, and an acquaintance with German is strongly advised. An indication is given of the careers which are open to successful students in the various departments, and the pamphlet should be of great value in enabling intending undergraduates to decide upon the subjects to which they can most advantageously devote their time at the University.

BRISTOL.—An agricultural chemist is shortly to be appointed to assist in advisory work in the Bristol province under the advisory scheme of the Ministry of Agriculture. Particulars may be obtained from the Registrar of the University. Applications for the post should reach the Registrar not later than October 25.

CAMBRIDGE.—The new year finds the colleges busily occupied with the drafting and passing of statutes to meet the recommendations of the recent Royal Commission and the requirements of the Statutory Commissioners. So far the University has not been asked to devote much time and labour to the task of drafting statutes and ordinances, save for the new pension statutes, which will bring its future staff, and, so far as possible, its present staff, within the Federated Superannuation System for universities. It would, however, seem inevitable that when

the Commissioners come to grips with the detailed requirements of the Faculty Scheme, the provisional outlines of which have been already reported in these columns, the co-operation of the resident teachers must be sought. University and college officers alike look forward to a busy year, which will, in many matters, be of vital importance in the history and development of the University.

One department of the University which looks forward to immediate development is that of pathology, owing to the generous endowment for a new laboratory by the Rockefeller Trustees and Mr. Ernest H. Gates. Building is also to be done for the Animal Diseases Institute and for an extension of the School of Agriculture. New college buildings at Clare and Sidney Sussex Colleges will also soon be completed, the former being occupied this term. From all accounts the number of students is to remain at the same high level as in recent years, and the pressure on laboratories and on college accommodation is to remain very heavy.

Dr. T. M. Cherry and Mr. J. H. Quastel, research student, have been elected to fellowships at Trinity College.

LONDON.—The final report of the Royal Commission on University Education in London was dated March 27, 1913, and it is suggested that some modifications of its provisions may be desirable. The president of the Board of Education has therefore appointed a committee "to indicate what are the principal changes now most needed in the existing constitution of the University of London and on what basis a Statutory Commission should be set up to frame new Statutes for the University." The committee is constituted as follows: Lord Ernle (chairman), Sir Robert Blair, Dr. H. L. Eason, Mr. H. B. Lees-Smith, Sir Henry Miers, Prof. A. F. Pollard, Sir Amherst Selby-Bigge, Bt., Miss K. Wallas, and Mr. S. H. Wood as secretary, to whom all communications should be addressed at the office of the Board of Education, King Charles Street, Whitehall, S.W.1.

At an extraordinary meeting of the Senate held on October 9 to consider a communication, dated September 15, 1924, from the president of the Board of Education with reference to the appointment of a Departmental Committee on matters connected with the University, the following resolution was unanimously carried: "That the president of the Board of Education be respectfully reminded that the Senate was not consulted as to the reference to the Haldane Commission, nor represented upon it, nor gave evidence before it; and that, having regard to the successful progress of the University since the report of that Commission, the Senate is of opinion that such changes in the organisation of the University as are necessary may be more readily effected by amendments promoted by the University than by a statutory revision of the University as constituted by the Act of 1898; but that the Senate will be prepared to furnish through its officers and appropriate Committees any information desired by the Departmental Committee, and trusts that the various bodies and interests represented on the Senate will receive a full opportunity of putting individually or collectively before the Departmental Committee their views on the matters under consideration."

The Semon lecture for the present year will be delivered at the Royal Society of Medicine, 1 Wimpole Street, W., at 5 o'clock, on Thursday, November 6, by Dr. D. Guisez, of Paris, who will speak (in French) on "Malignant Disease of the Gullet." A course of four lectures on "Enzymes" will be given by Prof. J. Mellanby on November 6, 13, 20, and 27 at St. Thomas's Hospital Medical School at 4.30 each day. No tickets will be required either for the Semon lecture or the course on "Enzymes."

ST. ANDREWS.—At a meeting of the Court held on September 7, it was unanimously resolved to appoint Mr. J. N. Wright, at present assistant in the department of logic in the University, to the lectureship in logic and psychology in University College, Dundee, and the United College, St. Andrews, which became vacant upon the appointment of Prof. Morrison to the chair of moral philosophy. Mr. Wright, who is a graduate of the University of Durham, has been assistant in the department of logic in the University since 1920.

At a meeting of the University Court on September 29, Dr. O. R. Howell was appointed lecturer in chemistry in University College, Dundee, in succession to Dr. J. S. W. Boyle, lately appointed headmaster at Prestonpans. The following nominations of assistants were approved: botany (St. Andrews), Miss C. I. Kean; chemistry (Dundee), Mr. C. A. Kerr; mathematics (Dundee), Miss Mary C. Simpson; chemistry (St. Andrews), Mr. G. J. Robertson. Mr. G. B. Steele was appointed lecturer in civil engineering and structural design, University College, Dundee.

It was intimated at the meeting that the arrangements are now complete for carrying on in Dundee a course of lectures during the coming session in railway geography, intended for the staffs of the railway companies, the lecturer being Mr. D. E. I. Innes.

The degree of Ph.D. has been conferred on Mr. G. J. Robertson for a thesis entitled "Investigations on Cellulose," and on Mr. R. S. Vaidyanathaswamy, of Madras Province, for a mathematical thesis entitled "Contributions to the Theory of Apolarity."

SHEFFIELD.—The following appointments have been made: Miss Alice Garnett, to be assistant lecturer in geography; and Dr. R. Platt and Dr. C. W. A. Lister, to be demonstrators in physiology.

ACTIVE efforts are being made to raise the sum of 20,000*l.* for necessary extensions of Queen's College, London. The chairman of the general committee is Lord Askwith, and a distinguished body of patrons is supporting the appeal. Donations amounting to 7000*l.* have already been received, and it is hoped that the remainder of the sum required will be forthcoming from old students of the College or benefactors interested in the higher education of women. The Duchess of York has graciously consented to visit the College on Saturday, November 1, and to receive purses collected for the extension fund. Queen's College was established in 1848 and incorporated by Royal Charter in 1853. It was the first college for women, and remains as independent to-day as it was when first constituted by F. D. Maurice, R. C. French, Charles Kingsley, Sterndale Bennett, D. T. Ansted, Edward Forbes, and other leaders in different departments of progressive thought. For some years the work of the College has been carried on without adequate accommodation or equipment, yet its record for scholarship and inspiring teaching is remarkably high. There should not be much difficulty in securing the relatively modest sum required to enable the College to maintain a worthy place among institutions for the higher education of women. Contributions to the appeal fund should be sent to the hon. treasurer, Sir James Williamson, or to Mrs. Allport, at the College, 47 Harley Street, London, W.1.

Early Science at the Royal Society.

October 19, 1664. Dr. Merret brought in his catalogue of trades, which was read and approved of; and it was ordered, that the amanuensis should fairly transcribe it against the next meeting, and that then it should lye exposed, at the time of the meeting of the society, for the several fellows to look it over, and to choose what trade they would give or procure the history of.—Mr. Hooke said he had observed, that upon the fall of the mercury wet weather followed.—Sir Paul Neile renewed his former motion of observing the figure of the sun at his rising and setting, both at Whitehall and Greenwich. Sir R. Moray was desired to observe it at Whitehall, and to recommend the observation of it at Greenwich to Mr. Marre.

1674. Mr. Hooke acquainted the council, that Sir Jonas Moore had been with him at Chelsea College, and made an overture of engaging a gardiner, a sufficient man, to take a lease of the house and land about it, and paying a yearly rent; allowing withal to the Society to make hortulan experiments there; as also to build an astronomical observatory, which latter Sir Jonas Moore would undertake to do at his own charges, to the value of an hundred and fifty or two hundred pounds.

October 21, 1669.—A Latin letter from Signor Malpighi was read acknowledging the favour of election, and in causing his discourse on the silk-worms to be printed.—Thomas Willisel the botanic traveller, employed by the society, brought in his collection of plants gathered in several parts of England and Scotland, together with some rare Scottish birds and fishes.—The lord bishop of Chester acquainted the society, that his Majesty had expressed a desire of having the measure of a degree of the earth determined, and expected the assistance of the society in it.

October 22, 1662. Dr. Merret mentioned, that live worms are sometimes found in the stomachs and guts of salmons. He was desired to make some observations in those and other fishes. This gave occasion of discoursing upon what is called equivocal generation.—Dr. Charlton brought in his papers, in which he had reduced birds into certain families, in Latin and English; which papers were ordered to be kept; and the doctor was desired, in conjunction with Dr. Merret, to reduce fishes into the like classes.

1668. There was presented from Mr. Hevelius his "Cometographia," wherein he takes particular notice of the society in his address to the reader.

October 24, 1666. It was moved that the materials for building, and the several sorts of earth for making brick and tile, might now be considered by the society; who were desired to think upon it against the next meeting.—A paper communicated by Sir Theodore de Vaux was read concerning several ways of making cheap and sweet fires of coal-balls wherein sea-coal is by the mixture of other combustible bodies both sweetened and multiplied.—Sir Robert Moray presented the society for the repository with some stag's tears.

1667. The method of transfusing blood into a man, as it was contrived by Dr. King was read and ordered to be registered.—It being moved, that the experiment might be made accordingly, as it had been done already in foreign parts, Sir George Ent suggested, that he thought it most advisable to try it upon some mad person in the hospital of Bethlem. This being seconded by divers other physicians of the society, Dr. Lower [and others] were desired to speak with the physician to Bethlem, about the execution of this trial.

Societies and Academies.

MANCHESTER.

Literary and Philosophical Society, October 7.—Miss Laura **Start**: The significance of some Iban textile designs.—J. **Walton**: On the existence of liverworts as fossils in the Carboniferous rocks of England. Dr. Lucy Wills has described some small dichotomously branched thalloid plants in shales of Upper Coal Measure Age in Staffordshire and suggested that they might possibly be fragments of a Bryophyte. Some clayey shale from the Middle Coal Measures of the Denbighshire coal-field yielded thalloid plants of a similar type of organisation, some with rhizoids attached. In addition, two fragments of a plant which cannot be other than a foliose liverwort were isolated by treatment of the same shale. This latter plant is distinctly dorsiventral. There are two rows of leaves, one on each side of the somewhat stout axial part of the shoot. The members of the two series alternate. On the under (or the upper?) surface of the axial part are two rows of smaller leaf-like appendages, each in definite relation to one of the larger leaves and lying close to it. Thus it is now clear that there were both thalloid and foliose forms of liverworts in existence in Carboniferous times.

PARIS.

Academy of Sciences, September 15.—M. Emile Roux in the chair.—Henry **Le Chatelier**: The viscosity of glass. A discussion of the experiments of E. Washburn and E. Shelton on the viscosities of soda lime glasses. These authors give their results in graphical form, but it is shown that the results of these measurements can be very exactly represented by the double exponential formula: Log (log η) $= -Mt + P$, in which η is the viscosity, t the temperature, and M and P constants. Exterpolation to the annealing temperatures, 500° C. to 600° C., gives results not in agreement with earlier work, and it is suggested that glass, like sulphur, exists in two allotropic states.—W. **Abbott**: The breaking up of the southern polar cap of Mars. A description of the changes in the shape and appearance of the polar cap between May and August 14 of this year.—L. **Dunoyer** and P. **Toulon**: The interpretation of the sheath phenomena in arc relays.—H. **Robert**, P. **Vernotte**, and A. **Jeufroy**: The measurement of the heating of the brushes of electrical generators. The advantages of using a thermocouple instead of the conventional mercury thermometer are demonstrated: the differences are magnified when the size of the dynamo is reduced.—E. **Hultén**: The origin of the band spectrum of mercury. There is some evidence, not quite conclusive, that the bands are due to the formation of some compound of the metal with hydrogen. The bands are more intense when a current of hydrogen at low pressure (1 mm.) is passed through the tube, whilst a current of air has the opposite effect.—P. **Vaillant**: The conductivity of solid salts at high temperatures. The conductivity of solid sodium chloride first increased, then fell sharply. At 150° C. there was a rapid increase to the highest temperature employed (420° C.). On reheating, the initial rise and fall were not repeated, but the increase from 150° C. was the same as on the first heating. Potassium sulphate and chloride behave similarly.—P. **Loisel**: The radioactivity of the granites from Guérat, near Bagnoles-de-l'Orne. Study of emilium. The study of the gases dissolved in the water of a certain number of springs in the Bagnoles-de-l'Orne region led the author to conclude

that these gases contained, in addition to the radium emanation, a new emanation (period 22 minutes). The granites, treated by the method of Strutt and Joly, gave a gas the curve of which differed from the characteristic curve of the radium emanation.—H. **Gault** and A. **Funke**: The alkylidene-dibenzoylpyruvic esters.—A. **Němec** and K. **Kvapil**: The composition of forest soils. Analyses of soil layers at different depths in forests of epicea, oak, and pine, the data including acidity, organic matter, and nitrogen.—**Lesné** and **Vagliano**: The production of cow's milk with antirachitic properties. The addition of cod-liver oil to the food of a cow modifies the composition of the milk and butter. The butter is rich in lecithine and the growth vitamin. The antirachitic factor present in the butter is not identical with vitamin A.—G. **Mouriquand**, Paul **Michel**, and M. **Berheim**: New researches on the sensibilisation of the guinea-pig to C-avitaminosis. After an attack of experimental scurvy, the guinea-pig is more sensitive to a second attack. This condition is not permanent, and slowly disappears. It is not fundamentally a true sensibilisation, and is closely connected with the long persistence of lesions only capable of detection by histological methods.—M. **Parat** and J. **Painlevé**: Constitution of the cytoplasm of a glandular cell: the cell of the salivary glands of the larva of the Chironome.—Auguste **Lumière**: The mechanism of anaphylactic shock. Reply to the criticisms of M. Bordet, maintaining the adequacy of the author's flocculation theory.

ROME.

Royal Academy of the Lincei, June 15.—V. Scialoja in the chair.—M. **La Rosa**: The ballistic principle and the velocity of light, and recent investigations by Rudolph Tomaschek.—A. **Piutti** and Pasquale **Badolato**: Action of light on solutions of certain organic substances in chloropicrin. Although chloropicrin is stable in the dark, it undergoes decomposition when exposed to light, and the products thus formed exert on dissolved compounds either a chlorinating, an oxidising, or a substituting action; in some instances the nitro group is reduced to the ammonium group, which separates as chloride or oxalate.—Gaetano **Rovereto**: Tectonic conditions of the Circean Promontory [of the Apennines].—Francesco **Tricomi**: Numerical resolution of Fredholm's integral equations.—Gina **Zanoni**: Extension of Hadamard's equation for the functional derivatives of Green's function to elasticity.—Luigi **Amoroso**: Mathematical theory of annuities.—Bruno **Finzi**: A noteworthy class of fluid motions.—Emilio **Adinolfi**: Hall's effect in bismuth in the case of weak fields. In the case of bismuth, the value of Hall's coefficient varies linearly with the strength of the magnetic field and exponentially with the temperature.—Vasco **Ronchi**: Study of optical systems by means of the biprism and Fresnel's mirrors.—Mario **Amadori**: Hydrated active tartaric acid. At temperatures below about 5°, tartaric acid separates from aqueous solution in a monohydrated form, which crystallises in blunt prisms belonging to the rhombic system and gradually changes to the ordinary anhydrous crystals at temperatures above about 10°.—L. A. **Herrera**: Imitation of nervous and cellular tissue by means of potassium hydroxide, silica and alcohol.—C. **Mazzetti** and F. De **Carli**: Reactivity of boric anhydride in the solid state with metallic oxides. The borates of various metals may be obtained by heating the corresponding oxides with boric anhydride at temperatures below those at which the respective mixtures undergo fusion.—G. R. **Levi** and A. **Ferrari**: The crystalline lattices of the rhombohedral carbonates of divalent metals.—S. **Ranzi**: Increase of the surface and increase of the volume during the development of the otocysts of Bufo. In the development of these otocysts, the increase in the surface does not always proceed *pari passu* with the increase in the volume. At certain periods of the embryogenesis there is predominance of the former, expressed by demarcation of the parts and by slight wrinkling of the walls, whilst at other periods increase of the volume, indicated by disappearance of the demarcation and by a tendency of the organ to become spherical, assumes ascendancy.—G. **Fadda** and I. **Schiacchitano**: The significance of the polar groove in relation to that of the diameter of the fertilisation membrane.—M. **Topi**: Existence of various species of vine Phylloxera, and the susceptibility of American vines to Phylloxera. Like Arizona vines suffering from Phylloxera, infected roots of Italian vines seem unable to impart this disease to American vine varieties.—G. **Cotronei**: The phenomenon of contraction in relation to sexual maturity and to senescence in Petromyzon. Although these organisms persist sexually immature for several years, the senescent phase, expressed by a profound atrophy, occupies only about a month, during which period the animal is used up by the activity of the reproductive elements.—C. **Artom**: Variation in the radio-sensibility of the cellular elements in pecilothermic organisms. The results of Packard's recent work on the susceptibility of cells to radium emanations fully confirm the conclusion drawn by the author from his experiments on *Paludina vivipara*: that in cold-blooded organisms the radio-sensibility of the cellular elements varies considerably with the temperature and that such organisms therefore constitute excellent material for determining the exact relationship between temperature and cellular radio-sensibility.—C. **Verdozzi**: Modifications of certain internal secretory glands (suprarenal capsule, thyroid, ovary, spleen) during lactation.

SYDNEY.

Linnean Society of New South Wales, August 27.—Mr. J. J. Fletcher, vice-president, in the chair.—T. **Steel**: The nectar of flowers. Direct observation of the disappearance of nectar from protected flowers shows that, when not removed by birds or insects, this secretion is soon re-absorbed by the plant, apparently going to nourish the growing ovary. This may be the original purpose of nectar secretion in general. There are great differences between the densities of nectar as it occurs in flowers, and of honey in the comb. In the flowers examined the total sugar in the nectars varied between 9·05 and 41·20 per cent. Each species appears to have a fairly constant nectar density.—T. Harvey **Johnston**: An Australian caryophyllæid cestode. The paper describes the structure and relationships of the first caryophyllæid cestode to be described outside Europe, Asia, and North America, making the eighth species known in the family. A new genus is proposed to receive it. The parasite is noteworthy as being the first member of the family known to parasitise fish other than cyprinoids, its host being the jewfish, *Tandanus tandanus* Mitchell, a siluroid, from Queensland rivers.—J. R. **Malloch**: Notes on Australian Diptera. No. iv. Notes on the families Drosophilidæ and Chloropidæ, eight species being described as new in the former, and two genera and six species as new in the latter.—P. D. F. **Murray**: The motor nerve-endings of the limb muscles of the frog (*Rana temporaria*) and of the muscles of the pectoral fin of the dog-fish (*Squalus acanthias*). The nerve-endings were impregnated by the Bielschowsky method. Two kinds of motor nerve-endings are

described in the limb muscles of the frog, one coarse, one fine; the latter may be the sympathetic innervation. In connexion with the motor nerve-endings in the muscles of the pectoral fin of *Squalus acanthias*, at least two types of periterminal network are described, and another terminal organ in the sarcoplasm under the end-ring, which seems not to have been described hitherto.—J. M. Petrie: Studies in plant pigments. Part ii. The red pigment induced by insect injury in *Eucalyptus stricta*. Leaves of *Eucalyptus stricta* were found to be injured by a microscopic mite, and, as a result, great fasciation had taken place, and a bright red colour produced. The colouring matter of these red fasciated leaves was isolated and examined chemically. No trace of anthocyanin could be identified, but instead, the pigment was proved to be a catechol tannin red. It was obtained in red non-crystalline flakes, and soluble in alcohol and alkalies. The red pigment is probably one of the first anhydrides, or soluble phlobaphenes, of a catechol tannin.

Official Publications Received.

Proceedings of the Royal Society of Edinburgh, Session 1923-1924. Vol. 44, Part 2, No. 20: The Magnetic Quality of very Pure Nickel. By Ada M. Malcolm. Pp. 206-210. Vol. 44, Part 3, No. 21: The Law of Recurrences and Decay of After Images. By Winifred J. Smith. Pp. 211-217. (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.) 9*d*. each.

A Verbatim Report of a Meeting of the National Advertisers Dept. of the International Advertising Convention held at Conference Hall No. 1, Palace of Industry, British Empire Exhibition, Wembley, on July 15th, 1924. Subject: Truth about Circulation. Pp. 36. (London: Incorporated Society of British Advertisers, Ltd., 134 Fleet Street.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 503: Surface Water Supply of the United States, 1919 and 1920. Part 3: Ohio River Basin. Pp. vi+257+2 plates. (Washington: Government Printing Office.) 25 cents.

University of London, University College. Calendar, Session 1924-1925. Pp. lxviii+10+441+lxix-clxxx. (London: Taylor and Francis.)

Diary of Societies.

SATURDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Archibald E. Garrod: Harveian Oration.

PHYSIOLOGICAL SOCIETY (at Guy's Hospital), at 4.—E. D. Adrian: The Reflex Electric Response of Antagonistic Muscles.—Ff. Roberts: The Short-circuited Circulation.—J. Mellanby: The Action of Digestive Enzymes on the Red Cell.—J. F. Fulton: Alterations in the Size of the Electrical Responses of a Muscle Fibre produced by small Alterations in Tension.—D. T. Barry: Some Points in the Formation of a V-wave in the Venous Pulse.—R. J. S. McDowall and B. L. Worsnop: The Effect of Histamine on the Aorta of the Living Animal.—J. Barcroft, C. A. Murray, and I. Sands: The Effect of Splenectomy on Coal-gas Poisoning.—I. Sands: Self-oxidation in the Blood of the Earthworm.—J. M. H. Campbell, G. O. Mitchell, M. S. Pembrey, and A. T. W. Powell: The Effect of Muscular Work upon Digestion.—M. S. Pembrey: The Weight of the Heart in Different Conditions.—A. N. Drury: The Spread of the Excitatory Process in Auricular Muscle subjected to Pressure.—A. N. Drury and E. C. Andrus: The Influence of Hydrogen Ion Concentration on the Mammalian Auricle.—Demonstrations.

BIOCHEMICAL SOCIETY (at Cambridge).

MONDAY, OCTOBER 20.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Queen's Hotel, Leeds), at 7.—Annual General Meeting.

JUNIOR INSTITUTION OF ENGINEERS (North-western Section) (at 16 St. Mary's Parsonage, Manchester), at 7.15.—G. E. Blyth: Powdered Fuel.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court, S.W.), at 8.

TUESDAY, OCTOBER 21.

ROYAL HORTICULTURAL SOCIETY, at 4.—Lecture.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting of Fellows.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of June, July, August, and September.—Prof. H. M. Lefroy: Exhibition of lantern-slides illustrating the life-history and habits of the Death-Watch Beetle.—R. I. Pocock: The External Characters of the South American Edentates.—Rev. Dr. F. J. Wyeth: The Development and Neuromery of the Fore-brain in Sphenodon.—H. C. Abraham: Some Mygalomorph Spiders from the Malay Peninsula.—Joan B. Procter: Unrecorded Characters seen in Living Snakes and Description of a new Tree-Frog.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Sir James Kemnal: Present Tendencies in Steam Generation.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at the College, Loughborough), at 6.45.—F. W. Nicholls: Realisation of Heat Units in Steam and Electric Power Plant.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. A. Tipping: Old English Country Homes.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Coventry) at 7.15.—Dr. W. R. Ormandy: Research (Presidential Address).

INSTITUTE OF CHEMISTRY AND SOCIETY OF CHEMICAL INDUSTRY (Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh).—W. F. U. Woolcock: Opening Address.

WEDNESDAY, OCTOBER 22.

FARADAY SOCIETY, GEOLOGICAL SOCIETY, AND MINERALOGICAL SOCIETY (at Geological Society), at 3.—Dr. J. S. Flett: Introductory Address.—Dr. G. W. Tyrrell: Review of Recent Work on the Origin and Differentiation of Igneous Rocks.—Prof. W. E. S. Turner: The Physical Properties of Silicate Glasses.—A. F. Hallimond: The Formation of Eutectic and Similar Structures in Silica Melts.—Prof. J. W. Gregory: Magmatic Ore Deposits.—Dr. J. W. Evans: Proposed Researches in the Chemistry and Physics of Igneous Magmas Rocks.—Prof. C. H. Desch: The Theory of Crystallisation in Rock Magmas.—Dr. A. Scott: Equilibrium of Igneous Rocks and the Influence of Certain Factors on it.—Prof. P Niggli: Homogeneous Equilibria in Magmatic Melts and their Bearing on the Processes of Igneous Rock Formation.—Dr. W. A. Richardson: Some Ultimate Problems in Petrogenesis.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.—A. Hamilton: Crankless Engines.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at 244 Deansgate, Manchester), at 6.30.—Dr. W. R. Ormandy: Research (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Grand Hotel, Birmingham), at 7.—W. Lawson: Chairman's Address.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.30.—J. E. Barnard: The Elementary Principles of Microscopical Illumination—(1) Transmitted Light.—Dr. R. H. Greaves: Supersaturated Solid Solutions.—H. Wrighton: New Photo-micrographic Apparatus for all purposes.

THURSDAY, OCTOBER 23.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Engineers' Club, Coventry Street, W.C.), at 5.—H. Griffiths: Crystallisation.—T. V. Barker: The Development and Formation of Crystals.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W. B. Woodhouse: Inaugural Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Centre) (at Luton), at 7.—G. L. Ensor: Positive Valve Control.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Essex Street, W.C.), at 8.—Dr. Marie Stopes: The Present Position of the Birth Control Movement (Presidential Address).

INSTITUTION OF WELDING ENGINEERS (at Engineers' Club, Coventry Street, W.), at 8.—E. A. Atkins: Steel Wire: its Manufacture, Properties, and Uses for Welding and other Purposes.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Sir Malcolm Watson: Observations on Malaria Control with special reference to the Assam Tea Gardens.

FRIDAY, OCTOBER 24.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—D. Gunnaiya and G. Subrahmaniam, with Demonstration by D. J. Blaikley: Underblown Pipes.—W. Mandell and J. West: The Temperature Gradient in Gases at Various Pressures.—J. F. S. Ross: Vectorial Dimensions.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Anatomy and Malformations of the Heart (2). Specimens illustrating the common kinds of Congenital Malformation.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. E. Saunders "Close-ups" at the Zoo.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. F. Evans: Powdered Fuel.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Institution), at 7.30.—J. McGovern: Address.

PUBLIC LECTURES.

SATURDAY, OCTOBER 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Dewey: Cornish Scenery and its Causes.

MONDAY, OCTOBER 20.

KING'S COLLEGE, at 5.30.—Prof. E. W. Scripture: Prose and Verse analysed by the Newer Methods.

TUESDAY, OCTOBER 21.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. H. Piéron: La Douleur, au point de vue des fonctions affectives et perceptives (in French). (Succeeding Lectures on October 22, 24.)

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry (Gresham Lectures). (Succeeding Lectures on October 22, 23, 24.)

SATURDAY, OCTOBER 25.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. Balfour-Browne: Social Life amongst Insects—(1) Ants, Bees, and Wasps.