NATURE

SATURDAY, JUNE 20, 1931.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Progress and Prejudice.

SIR ARTHUR KEITH'S rectorial address on "The Place of Prejudice in Modern Civilisation", delivered on June 6 to the students of the University of Aberdeen, bore challenge in its title and in its matter was boldly provocative. He was conspicuously courageous in attacking the gravest of the world problems of to-day—the future of international relations—from the point of view of the thorough-going evolutionist. Drawing on his studies of racial evolution from prehistoric times onward, he gave it as his considered opinion that race prejudice has to be given a recognised place in modern civilisation. He postulated a continuance of tribal rivalry and competition as an essential of progress in the future.

Sir Arthur's address teemed with phrases which almost charm acquiescence by their terse epigrammatic quality. "Without competition mankind can never progress; the price of progress is competition"; "Race prejudice . . . and national antagonism have to be purchased, not with gold, but with life"; "Nature keeps her human orchard healthy by pruning—war is her pruning hook". The last metaphor was not slow in moving criticism. A correspondent in the press at once pointed out that a pruning hook removes dead and useless wood while war does the reverse. Arboricultural experts may differ as to the exact function of a pruning hook: the biologist and the demographer will agree as to the function of war in helping to preserve the equilibrium of population, environment, and food-supply. The anthropologist, too, would be at no loss for examples to show that the abolition of tribal war under white administration has had an adverse effect in removing checks on an excessive growth of population, as in parts of South Africa, or by eliminating the zest of life and opening the way to racial decay, as in Melanesia. The price is undoubtedly heavy, and the results of the last war make it imperative that we should count the cost. In so doing, no side of scientific argument may be neglected. If Sir Arthur Keith's dicta, when torn from their context, seem needlessly ruthless, it is a ruthlessness which is due to the facing of facts; for Nature sacrifices the individual that the race may survive; and so in the long run does Society.

No one with any sense of history could have believed that the War was "a war that would end war". Yet a generation has grown up since 1918 of which a considerable section believes that war in future will be averted by the growth of public opinion. Another section, and that too very considerable and far from being entirely of the post-War generation, looks to internationalism to act as a preventive. Not the whole of this latter group rests its hope on a sentimental idealism. For some its end is to be attained through the application of scientific principles. They would weld the peoples of the world into a single tribe. But what does this imply? As Sir Arthur puts it, "To obtain universal and perennial peace—the price is the racial birthright that Nature has bestowed on them". All peoples, black, yellow, brown, and white, must pool their blood. In other words, intermarriage and the elimination of the present distribution of the peoples of the earth into races must produce a world populated by closely related hybrids, so closely related, in fact, that strife, in theory, becomes impossible.

Passing over the undoubted fact that members of the same family have been known to quarrel, we may point out that the facts of miscegenation in man are at present sufficiently obscure to warrant some hesitation at cross-breeding on such a colossal scale; especially as knowledge at the present moment does go so far as to suggest that some crosses, at least, do entail a certain amount of degeneration from the higher of two standards where there is any considerable difference between the two. But even granting that future research in such a subject, for example, as the distribution of the blood groups, should prove competent to suggest lines upon which cross-breeding might be practised on a large scale without the danger of wholesale deterioration, a long time would have to elapse before a scientifically directed control would be able to regulate marriage as efficiently as racial prejudice has succeeded in barring marriages by state legislation in the United States of America, when one of the would-be contracting parties can be shown to have a strain of colour inherited from even a remote ancestor of many generations back.

The colour problem is the most momentous of all those into which the question of race prejudice enters; and it is no exaggeration to say that the future of our civilisation depends upon its successful solution. Clearly, however, Sir Arthur Keith had more directly in view the urgent problem of the relations which are to subsist in the nearer future between the nations of western civilisation.

Whatever may be the ideals of the internationally minded, it is impossible to evade the fact that race prejudice is deep seated, and that, owing to its survival value, it has been, and will continue to be, paramount. As Sir Arthur phrased it, the prehistoric world in which man's tribal heart was fashioned was organised by Nature for the evolution of new and better races of mankind. The 'tribal heart' still beats to-day. It is the functioning of the strongest instinct which has been implanted in man, working through the group of which each individual is a member—the instinct of self-preservation.

It would appear that the evolutionist has but cold comfort to offer the apostle of peace who pins his faith to the obliteration of race prejudice and national antagonisms. On an evolutionary view of human progress, the attempt to form a League of Nations at the present juncture in the world's history is a break in an ordered advance. It departs from the line of racial evolution and social development alike. We must view race not as static but dynamic. In the conditions of human society the mingling of racial types produces endless variation. The nation represents a stage in racial evolution in which various racial strains—for anthropologists are agreed that there is now no such thing as a pure race—are being moulded so as to verge towards a common type, varying more or less widely in individuals, as in England, and closely bound by a common language and common institutions.

Yet it is evident that the world is becoming ripe for change. When we pass in review the history of humanity in the light of the teaching of social anthropology, it becomes manifest that there is in social institutions a regular progression and a constant movement to extend the feeling of solidarity over an ever increasing range from family to kin, from kin to tribe, and so forth, until we come to the nation and the Empire. Now we are approaching the battle of the greater units. For nearly a generation there have been movements in various parts of the world to burst the bonds of nationalism and to reach out to a greater unity in Pan-Turanian, Pan-Moslem leagues, and the like. The Union of Soviet Republics, not content with the bounds of the old Russian Empire, seeks in time to embrace the workers of the world. The League of Nations itself is symptomatic of this urge; but if the evolutionary view be right, it asks too much at the present stage of human development. If Sir Arthur Keith is correct in his view of the trend of racial evolution, in regarding the English speaking peoples as the future custodians of peace, so far as they represent an advance in the evolutionary scale, he has the support of science and of sentiment alike.

A Theory of Money.

A Treatise on Money. By John Maynard Keynes. Vol. 1: *The Pure Theory of Money.* Pp. xvii + 363. Vol. 2: *The Applied Theory of Money.* Pp. viii + 424. (London: Macmillan and Co., Ltd., 1930.) 15*s.* net each vol.

MR. KEYNES'S "Treatise on Money", the fruit of his study and reflection up to date on the part played by currency and credit in contemporary civilisation, is the most important work on monetary theory published since the War, certainly in England and probably throughout the world. Its two volumes, entitled respectively "The Pure Theory of Money" and "The Applied Theory of Money", are divided into seven books. The first book is concerned with essential definitions; the second investigates what the value of money really means, and how its fluctuations may best be measured; the third and fourth books—which contain the heart of Mr. Keynes's theory—deal with the factors which determine the value of money and the dynamics of changing price-levels; the fifth and sixth are taken up with a study of the statistical and non-statistical data bearing on changes in the quantity of money and its velocity of circulation, in the volume of production and trade, and in the rate of investment; while the seventh and last book contains Mr. Keynes's proposals for the practical reforms which he would like to see the ultimate monetary authorities of the world adopt in order to achieve the objectives at which, in his opinion, monetary policy should aim.

To state Mr. Keynes's theory both briefly and accurately is impossible. A technical subject demands technical terms whose precise definition cannot be short. But subject to the *caveat* that almost every expression used in the quotation which follows requires elaboration, the kernel of his doctrine is that "the price-level of output depends on the level of money-incomes relatively to efficiency, on the volume of investment (measured in cost of production) relatively to saving, and on the 'bearish' or 'bullish' sentiment of capitalists relatively to the supply of savings deposits in the banking system" (vol. 2, pp. 345-6). In this statement it is implied by Mr. Keynes's earlier chapters (*a*) that windfall profits or windfall losses (themselves highly complex concepts) are excluded from money incomes and from savings; (*b*) that investment represents real additions to the capital stock of the country or countries concerned; and (*c*) that savings deposits are true savings deposits and not merely the funds labelled by banks with this name for various extraneous reasons; while (*d*) 'bearishness' denotes the excess of the public's desire to hold liquid claims to cash rather than securities which are expected to decline in value over the amount of cash available for this purpose in the form of savings deposits, and 'bullishness' means the converse.

In at least three respects this new theory of money marks a distinct advance over the principal alternative theories which have hitherto held the field. First, it is excellent that so eminent an economist should have abandoned the arid rigours of the unabated quantity theory of money and exposed the barrenness of the algebraic identities in which that theory is usually formulated. In the second place, the emphasis placed on the importance of the relationship to the value of money between savings and investment on one hand and the volume of consumption and investment goods produced on the other, opens fertile and promising avenues to further investigation. Lastly, by demonstrating that modern banking plays a dual rôle, acting both as the supplier of current cash for depositors and as the purveyor of short loans mainly for working capital for industrial and trading borrowers, the new theory straightens out an old confusion and throws into relief an element which can and will be utilised in the course of time to guide and control economic activities much more successfully than they are guided and controlled to-day.

Nevertheless, Mr. Keynes's analysis as a whole appears to the present writer to be neither conclusive nor satisfactory, and to him at least it seems to break down in several vital places. For example, Mr. Keynes claims to have proved that if investment exceeds or falls short of savings, profits or losses (in his sense) must respectively arise in respect of output as a whole. At the crucial stage in his proof, however, he apparently abandons the analysis and formulæ he has taken pains to establish in the preceding pages, and tacitly introduces a new set of assumptions which either imply a novel (and wholly undeveloped) theory as to the relationship between new savings and dealings in existing securities, or else boil down to the doctrine that additional supplies of bank money injected into the economic system tend to raise prices, and conversely. The former alternative—a novel theory about savings and securities—is too embryonic to be susceptible of criticism; the latter alternative—the addition or withdrawal of bank money—assumes the conclusion in the premises, and is an obvious truism; but one which leaves the relationship which he alleges to exist between investment, savings, and profits (or losses) totally unproved. Although the exposition (cf. vol. 1, chap. 10, section (iii.), and particularly p. 145) is so inordinately obscure that it is practically impossible to arrive at Mr. Keynes's exact meaning, even the most sympathetic reader cannot escape the uncomfortable feeling that one of the corner-stones of the entire "Treatise" is insubstantial and the underpinning shaky.

Similar defects appear elsewhere, especially in Book iv., on the dynamics of the price-level. Here rigorous demonstration is impossible in the nature of things, and Mr. Keynes is thrown back on the several probabilities of various alternatives. The argument is extremely difficult to follow or to assess; but its upshot is a description of the genesis and development of a credit cycle which at best is ingenious and plausible but which can scarcely claim to be comprehensive or final. And when Mr. Keynes passes from his theoretical analysis to his practical conclusions, one feels that the reforms he proposes rest on far too uncertain an analytical ground-work for them to be acted upon without much closer and more careful examination by the practical men who would have to work them than they have yet received.

One further observation may perhaps be permitted. Here, devoting itself to the analysis of a subject vital to the very well-being of modern industrial civilisation, and backed, moreover, by a pen of superb literary skill and facility, is a mind as brilliant, as powerful, and as subtle as any mind that has ever been occupied with economic subjects. Yet the result of its labours, prolonged over years, is inconclusive and in many respects disappointing. Why should this be? Can it be that somehow Mr. Keynes, for all his gifts, has just overlooked the philosopher's stone? Or is it that there is no philosopher's stone at all, that the technique of quasi-mathematical analysis breaks down when applied to monetary affairs, that in its modern monetary studies the Cambridge school of economists, the most distinguished and honoured modern representative of which is before us, has been exploring not a broad highway but a blind alley? Mathematics, provided it is given the right abstractions to manipulate, has proved itself by results to be the most powerful instrument of thought mankind has yet devised. But if the mathematical method is to succeed, it must start off with the right abstractions; and if it begins with the wrong ones, then all that emerges is a will-o'-the-wisp pseudo-science such as astrology. Can it be that modern monetary theory has started off with the wrong abstractions? Or are the initial abstractions right enough so far as they go, but too fragile to support the towering fabric of theory which has been erected upon them?

By far the most interesting, freshest, and most instructive sections of Mr. Keynes's book are those in which he examines the too scanty existing facts which throw light on the actual movements of various monetary and non-monetary elements in economic life. Whatever answer different people may return to the questions just asked, there can be no doubt at all that what monetary science now requires is further and more intensive study of the facts now available, and, as Mr. Keynes earnestly pleads, more facts supplied by bankers and others for economists to study. Until the facts which are urgently needed have been supplied and analysed much more thoroughly than to-day, not even Mr. Keynes's genius can reduce the intricacies of this theory to the simple and (where possible) quantitative propositions which alone the common man can understand and utilise in the conduct of practical affairs. Jules Menken.

'Organismal' Conception of Development.

The Interpretation of Development and Heredity: a Study in Biological Method. By Dr. E. S. Russell. Pp. vi+312. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 15*s.* net.

In some branches of biology the relevant data can be pieced together without the aid of any very comprehensive conception of the structure or potentialities of the living organism. The study of animal development, on the other hand, constantly provides facts which require, for their interpretation, a definite conception of broad biological principles. The developing embryo has potentialities often only revealed in the laboratory, and not infrequently it exhibits, in a striking manner, the subordination of parts to the requirements of the organism as a whole. To state that the activities of an organism are something more than an integration of the activities of all its parts, is perhaps a truism, but in Dr. Russell's pages it is the central theme of an extremely interesting and careful argument which leads to the establishment of the organism as the only fundamental and valid unit in biology. If we accept this conclusion, we reach what the author calls the 'organismal' conception of development, which gives us "rules of method for the study of living things and their parts without implying any mysterious 'action of the whole' on those parts". We can "accept the simple facts of observation that the organism acts as a whole and that the activities of its parts are subordinated to and co-operate in whatever the organism as a whole is doing at the moment of observation. It is from this simple and objective point of view that we must regard the relation between the organism and its cells and energids."

The author's position is, in a sense, impregnable. All attempts to portray the facts of development against a background of physics and chemistry have so far failed, whilst the conception of developmental organisers has done much to strengthen the attack on current materialism. Dr. Russell develops the attack with vision and with vigour. He does not stand alone. We read, with a feeling of security, that "many of the necessary concepts of 'organismal biology' are in use by biologists especially of the older and sounder tradition"; they only require freedom from "any tinge of materialism that may cling to them". Those who feel that they are old enough and sound enough will read Dr. Russell's sentence of death on the 'gene' without a quiver of regret, whilst his rejection of the analytical principles which dominate the sciences of physiology and biochemistry will be a timely warning to irresponsible youth. All units, except the organism itself, must be swept away if we are to retain an adequate conception of development. Molecules, enzymes, genes, chromosomes, cells, and organs all play their part and all are legitimate objects of study by those who are not primarily interested in the most fundamental truths of biology: they are no more than the individual words of a sentence—the real meaning of which lies outside the individual components. Dr. Russell's argument is vigorous and stimulating; it is set forth with scholarly judgment.

Most biologists are probably willing to admit that some type of 'organismal' outlook provides a deeper insight into the problems of development than does any other theory; but it is not clear how this conviction leads to the discovery of new facts. Theories are ephemeral, facts remain, and it is as a working hypothesis that Dr. Russell's conclusions must stand or fall. In the meantime, his book will stimulate thought and suppress ultra-materialistic dogma, and this in itself is a very real contribution to biology.

It is not difficult to criticise adversely selected passages from a work which not only defines the point of view of its author but also of most of the more eminent biologists of the past. Some may think that the author's conception of the chomosome theory of inheritance is an inadequate representation of the established facts, and it may be that when Dr. Russell is most vigorous he is least sound. Others may be unconvinced that the analytical method is obsolete or unreliable. There may even be some who will fail to read the first three chapters without a yawn. Those, however, who are not unduly prejudiced in favour of materialism will read the whole book with pleasure, and congratulate its author with more than usual sincerity.

J. Gray.

A History of Elementary Mathematics.

Geschichte der Elementar-Mathematik in systematischer Darstellung: mit besonderer Berücksichtigung der Fachwörter. Von Dr. Johannes Tropfke. Band 1: *Rechnen.* Dritte, verbesserte und vermehrte Auflage. Pp. vii + 222. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 12 gold marks.

It is a remarkable testimony to the excellence of this work that a third edition should have been called for within nine years of the issue of the first volume of the second edition (1921). The first edition, in two volumes, appeared in the years 1902 and 1903 and contained about eight hundred pages. The second edition was published in seven parts or volumes (1921–24) and ran to nearly thirteen hundred pages in all, the increase being due to the incorporation of the results of new researches into the history of mathematics carried out in the meantime. The first part of the present edition contains 222 pages, as compared with the 177 pages of the first part of the second edition, which again shows that the author has included a large amount of fresh material.

The preface to the first edition described the plan and intention of the work. There were previously available three volumes of the monumental work of Moritz Cantor, the first attempt in recent times to concentrate in one book the vast material existing in earlier histories which had become antiquated (Heilbronner, Montucla, Kästner, Arneth, etc.), and in a multitude of scattered articles dealing with separate questions. But the great scope of Cantor's undertaking precluded him from entering into great detail; and one effect of its publication was to call forth a number of new works, some of which helped to fill up gaps, while others took the form of histories of separate subjects, for example, Braunmühl's "History of Trigonometry". The strict chronological order followed for the most part in Cantor's work constituted a great difficulty in the way of the reader who wished to inform himself on any particular point at short notice, since the information had to be laboriously gathered together out of a number of different chapters in the book, with the help of the index. For a reference book, therefore, which should enable a student to get light on this or that point without loss of time, a systematic arrangement according to subjects is infinitely preferable, and Tropfke's book is written from this point of view.

The seven parts of the second edition divide the subjects thus: (1) Calculation (numeral systems, whole numbers and fractions, arithmetical operations, etc.); (2) general arithmetic (including algebra, logarithms, theory of numbers); (3) proportions and equations; (4) plane geometry; (5) plane trigonometry, sphæric and spherical trigonometry; (6) analysis and analytical geometry; (7) stereometry, with indices to the whole work arranged (*a*) according to names and works, (*b*) according to subjects.

As the editor explains, there is no pretension to literary style; the account is summary, approximating to the brevity of a lexicon; the object is, above all things, to catch the eye and make the salient points stand out, as it were. References are given in the notes to the original authorities for the statements made; the fullness of these notes will be gathered from the fact that there are 1343 notes, of various lengths, to 218 pages of text in the volume before us. They are brought up to dates so late as 1929 and 1930: there are references to light-years as units of distance; to Eddington's calculation of the diameter of the universe, regarded as finite under the relativity theory; to the latest researches into Babylonian and Egyptian mathematics by H. Wieleitner, O. Neugebauer, T. Eric Peet, A. B. Chace, Kurt Vogel, and others; to B. Datta's papers on ancient Indian mathematics, and so on.

There are and must be omissions. We have not so far traced any reference to the 'Russian peasant' method of multiplication (by means of duplicating and halving only), which in effect comes to the same thing as the ancient Egyptian method. In citing other works, the author does not always refer to the latest editions. But, taken as a whole, the work is an invaluable, nay, indispensable, *Nachschlagebuch*; and we look forward with lively interest to the appearance of the remaining parts.

T. L. H.

Our Bookshelf.

Soviet Union Year-Book, 1930. Compiled and edited by A. A. Santalov and Dr. Louis Segal. Pp. viii + 670. (London: George Allen and Unwin, Ltd., 1930.) 7*s.* 6*d.* net.

The "Soviet Union Year-Book", which first appeared in 1925 as the "Commercial Year-Book of the Soviet Union", is a bulky and informative volume, concerned chiefly, as its origin would suggest, with matters of commercial interest. There are sections on the constitutional and political organisation of the Union of Socialist Soviet Republics and of its constituent republics; on the economic organisation and development of the Union, including a short notice of the Five-Year Plan; and separate sections dealing with agriculture, mineral resources, industry, transport, foreign trade, finance and currency, labour, and co-operation. There is also a legal section, dealing only with private law.

Of most interest to readers of Nature are probably the sections dealing with education and with health. Under the former heading we read that there were in 1928–29, in the U.S.S.R., 109 Workers' Faculties with 60,200 students, and 134 universities with 155,300 students. One would be grateful if subsequent issues of the "Year-Book" gave more information concerning these institutions; there is nothing here concerning their organisation, their method of recruiting students, their geographical distribution, or the subjects studied in them. In the same section are included the numerous scientific institutes that have been opened in the U.S.S.R. and where research is being done in problems of applied science likely to assist the industrial development of the country. A list of these institutes is given and, as a sample of their activities, a summary of the work carried out in the Chemical Institute. Since the summary only occupies a page and a half, our curiosity is aroused rather than satisfied.

The legal section includes an account of the Soviet Union laws on copyright, trade-marks, industrial designs, and patents, including the full text of the most important decrees and ordinances in the matter of patents.

Other interesting features are maps, showing the new political and administrative divisions of the Union and the progress of electrification; a list of the more important periodicals published in the Union, including several technical and scientific ones; and a "Who's Who" of scientific workers. The value of the "Year-Book" as a work of reference is increased by the presence of an index.

The Universe around Us. By Sir James Jeans. Second edition. Pp. x + 363 + 24 plates. (Cambridge: At the University Press, 1930.) 12*s.* 6*d.* net.

Comment on this well-known book is almost a work of supererogation; the remarkable popularity it has attained, which shows no sign of abating, makes praise superfluous and adverse criticism futile.

The second edition shows little modification of the original book. The size is increased by eleven pages, and a number of small alterations have been made, either in correction of errors of detail or as representing the superiority of second thoughts to first. The increase of size is due mainly to a discussion of three subjects, described in the preface as the new planet Pluto, the rotation of the galaxy, and the apparent expansion of the universe. It is an eloquent commentary on the present progress of astronomy that, in little more than a year, subjects of this magnitude and importance have either been born or experienced developments of fundamental character. There is only one point in the book to which we might profitably direct attention. The index includes, under the general heading " Quotations ", a number of well-known names, but reference to the corresponding pages often shows no obvious quotation. Presumably the reference to George Meredith in connexion with p. 283 arises from the occurrence there, without inverted commas, of the isolated phrases " dusty answers " and " hot for certainties ". A 'quotation' from Matthew Arnold, assigned to p. 5, eludes us. If phrases which have passed into current coin of the language are to be dubbed 'quotations', there will be no end to the acknowledgments necessary. One wonders, for example, why " new heavens and a new earth " on p. 331 is not ascribed to St. John, or even why the Psalmist is not given the credit for " down to the sea ", on p. 151. The point is a small one, but it is not beneath notice. It is a penalty of reaching a high standard of excellence that small blemishes become unduly conspicuous, and this may serve as a justification for mentioning one of them here.

Little America: Aerial Exploration in the Antarctic and the Flight to the South Pole. By Rear-Admiral Richard Evelyn Byrd. Pp. xvi + 422 + 58 plates. (London: G. P. Putnam's Sons, 1931.) 21*s*. net.

Aerial exploration has introduced a new kind of book on polar travel. The two-volume account of the daily routine of sledge journey and camp has gone. An aerial journey is so brief that there is little to say beyond comments on the behaviour of the machine. Admiral Byrd made several remarkable flights during his year in the Antarctic and discovered considerable areas of new land; yet the bulk of the volume is descriptive of preparations for winter quarters and the journeys to and from New Zealand. The flight to the Pole and back, which occupied nineteen hours, is described in a single chapter.

The limitation of usefulness of aerial exploration is clearly brought out in this book, and Admiral Byrd wisely supplemented it with ground work where possible. Thus Prof. Goold's examination of the Queen Maud range was one of the most important aspects of the work. Unfortunately, the new land east of King Edward Land was not examined. The expedition had its base at the Bay of Whales on the Ross Barrier, out of sight of land, so that the majority of the large complement of forty-two men never got a glimpse of Antarctic land. Another innovation in Antarctic exploration was the daily contact by wireless with the outer world and the inclusion of a press correspondent in the staff. The book contains little record of scientific results, which were considerable, but has much information about flying conditions.

Oxydations et réductions. Par René Wurmser. (Les problèmes biologiques, Vol. 15.) Pp. xix + 381. (Paris: Les Presses universitaires de France, 1930.) 95 francs.

Prof. Wurmser has produced a really excellent book on oxidation and reduction, of value not only to those interested in the physical and chemical aspects of biology but also to the general scientific reader as well. He commences with the principles of oxidative and reductive processes as illustrated by changes in valency, by electron transfer, and diminution in free energy. The various mechanisms of the operation of both photochemical and thermochemical processes of oxidation and reduction are then developed, and two chapters are devoted to a critical discussion of the hypotheses involving 'activation' of hydrogen and 'activation' of oxygen respectively. According to the author, these theories must not be regarded as rivals, but that processes of oxidation and reduction operate by one or the other mechanism. Attention is then directed to the determination of oxidation, reduction equilibria, including not only those readily reversible but also those which are only partially reversible in systems for which the evidence for reversibility is at present somewhat scanty. The volume concludes with a discussion of experimental technique and a summary of the results obtained in the study of intracellular oxidation-reduction potentials. The book is well written, in that it is a veritable mine of information yet at the same time eminently clear and readable. The printing and binding are both superior to the average text-book of French origin.

E. K. R.

Foundations of Biology. By Prof. Lorande Loss Woodruff. Fourth edition. Pp. xvi + 501. (New York: The Macmillan Co., 1930.) 3.50 dollars.

This is regarded in many universities as a standard text-book for the student's own reading. It gives the zoologist the necessary essentials of botany, and shows an understanding of the part played by unicellular organisms. The diagrams are simple and admirably selected, many being original. Technical terms are reduced to a minimum, and the student is helped also by an admirable glossary. The new edition is a great improvement, and the more adequate discussion of many themes will make them simpler to the student. The enlargement of the section devoted to human welfare is useful. We ourselves are rather tired of the evolution of the horse; in the next edition the author should explain what a horse is and how it is adapted to its environment, for his students will not know.

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.*]

Observations on the Penetrating Radiation in the Antarctic.

Observations upon the variation of intensity of the penetrating or cosmic radiation with latitude were carried out by the B.A.N.Z. Antarctic Research Expedition during the recent summer cruise of the *Discovery*, November 1930 to March 1931.

All observations during the voyage were made by Mr. A. L. Kennedy, physicist to the expedition. The apparatus employed was a Geiger-Muller electron tube counter, with single-stage amplifier, relay, and automatically recording chromograph. The tube-counter was contained in a Pyrex glass tube, into which tungsten leads were sealed and filled with argon gas at a pressure of approximately three centimetres mercury. The tube was mounted between lead blocks in such a way that, except for the holes through which the ends of the tube projected, four inches of lead surrounded the tube on every side.

The pressure of the argon was adjusted to give a counting-voltage between 450 and 500 volts, and a series resistance of the order of 1500 megohms consisting of a suitably proportioned mixture of xylol and alcohol in a hermetically sealed Pyrex capillary gave potential 'kicks' for each discharge through the tube. The whole apparatus was mounted in a small room on the deck of the *Discovery*, adjoining the wireless room. Of six tubes made in the physics laboratory of the University of Adelaide, only one survived the voyage. Fortunately, counts were obtained on this tube over a region ranging from Hobart to Adelie Land, that is, over a range of geographical latitude from 43° S. to 68° S.

Counts were made on thirty-four days during the voyage, and the total number of 'kicks' recorded was 28,350 in a total time of 4502 minutes, giving an average rate of 6·3 'kicks' per minute. Except on two occasions, when values of 7·5 and 7·2 were obtained, the variations from this mean are of the order due to probability variations, and both these high values occurred early in the voyage with values of a 'counting-voltage' higher than was usual. The counts for the two stations nearest to the magnetic pole, with the ship stationary off Adeliè Land, show values of 5·9 per minute and 6·3 per minute. There is thus no definite indication of variation with magnetic latitude.

Unfortunately, an overcast state of the sky was so general that no attempt at a correlation of electron counts with auroral intensity is possible. On the one occasion on which the log-book records the occurrence of a brilliant aurora, the count was, however, unusually low (5·6 per minute).

The mean value (6·3 per minute) of all counts on the voyage is identical within the limits of experimental error with the value (6·1) obtained for a count of four hours in the physics laboratory of the University of Adelaide.

The result of the observations thus tends to confirm those of Böthe and Kohlhörster in the North Atlantic (kindly communicated in a letter from Dr. Böthe), of Corlin at Abisko, and of Millikan at Churchill in Canada, in showing that the intensity of the penetrating radiation does not vary to any considerable extent with magnetic latitude even within 250 miles of a magnetic pole.

The accuracy of the observations probably does not exceed ten per cent at best, but it should be noted that they were taken in circumstances of exceptional difficulty, illustrated by the following extracts from the log-book: "Roll 40°." "Stopped. Radio transmission started." "Very big seas, stormy, rolling heavily . . . bottle P_2O_5 rolled on to instrument, putting it temporarily out of action."

Difficulties with regard to temperature, which affects the voltage of the H.T. battery, and humidity, which affects the insulation, were also formidable.

The former could not be controlled, but the latter was successfully countered by using sulphur as an insulating material and by surrounding the end of the Pyrex tube with a sleeve containing phosphoric anhydride.

The preliminary work of adjusting gas-pressure in the counting-tube, determining the counting-voltage, etc., was carried out by Mr. Iliffe, of the staff of the physics laboratory.

Kerr Grant.

University of Adelaide,
May 8.

The Nuclear Moments of Cæsium, Rubidium, and Indium.

In my work [1] on the hyperfine structure of the lines of the principal series of cæsium, I suggested that $\frac{1}{2}$ was the value of i, the quantum number of the rotation of the nucleus; but I pointed out that it might well be higher, it being impossible to determine it with certainty owing to the hyperfine structure of the P levels being too fine to resolve. In the meantime Schüler [2] has shown that the value of nuclear quantum number can be determined quite simply from the intensity ratio of the components of the hyperfine structure doublets. In cæsium the two components are of very nearly equal intensity; so that the value of i must be high: it may well be 9/2, or perhaps higher; in order to find the exact value, experiments are being made to determine very accurately the intensity ratio of the components.

I have also examined the structure of the lines $1S_{\frac{1}{2}} - 3\,^2P_{\frac{1}{2}}$ and $1S_{\frac{1}{2}} - 3\,^2P_{\frac{1}{2}}$ of rubidium. These possess a doublet structure with a separation of about 0·1 cm.$^{-1}$; but the intensity ratio of the two components is about 2 : 1; this corresponds to a value of 1/2 or 3/2 for i; the values of the intensity ratio being respectively 3 : 1 and 5 : 3 for these two values. The structure is probably affected to some extent by the isotope of higher atomic weight; but as this is only present to the extent of about 25 per cent, the value of i for the principal isotope must still remain within the limits given.

The value of i for indium [3] is given as one; this is almost certainly too low. It was calculated by Goudsmid's cosine law [4] from the separations of two very close levels. The ratio of these separations was found to be $0·072 \pm 006 : 0·045 \pm 006$; that is some value between 2 : 1 and 1·3 : 1. The corresponding value of i is between 1 and 7/2, if these limits of experimental accuracy are taken into consideration. But here again additional evidence is given by consideration of the intensity ratios of the fine structure components; this corresponds to a high value of i. It is therefore to be assumed that the upper limit of the range of values found by the cosine law, namely, 7/2, is the more probable.

The experimental results are of course in no way affected by this revised theoretical interpretation.

Goudsmid has suggested that my experimental results for the hyperfine structure of indium are uncertain, as they do not agree with some results obtained by McLennan.[5] A careful study of both works on the subject shows that the difference between McLennan's results and mine is just what is to be expected, if the lower resolving power with which McLennan worked is taken into consideration. The line 4101, I found to possess four components with separations 0·000, 0·281, 0·380, and 0·658 cm.$^{-1}$: now the component at 0·380 cm.$^{-1}$ is weak and very close to the component at 0·281 cm.$^{-1}$; consequently, except with very fine lines and high resolving power, it could not be observed and the line would appear to possess only three components, as McLennan observed. Similarly, in the case of the line 4511, I observe four components, while McLennan only observed two; now the separations of the four components are 0·000, 0·045, 0·204, and 0·276 cm.$^{-1}$: here the components at 0·000 and 0·276 cm.$^{-1}$ are weak and very close to the strong components at 0·045 and 0·204 cm.$^{-1}$; so that except with the highest resolution they escape detection and the line appears to be a doublet; which is just what McLennan observed.

In order to see the full structure of the lines, it is necessary to work with a resolving power of at least 500,000; this I achieved by using a reflecting echelon grating with a resolving power of about 800,000 and a light source which operated at the very low temperature of about 80° C. With any less adequate means it is quite impossible to observe the smaller separations.

D. A. JACKSON.

Clarendon Laboratory,
Oxford.

[1] *Proc. Roy. Soc.*, A, vol. 121; 1928.
[2] *Zeit. für Phys.*, vol. 67; 1931.
[3] *Proc. Roy. Soc.*, A, vol. 128; 1930.
[4] *Zeit. für Phys.*, vol. 47, p. 176; 1923.
[5] *Proc. Roy. Soc.*, A, vol. 128; 1930.

Effect of Fungi upon the Strength of Timber.

THE fact that fungal decay considerably lowers the strength of timber has long been familiar to all who employ this material for structural purposes, but practically no information has been available as to the actual amount of damage caused in any specific wood at various stages of decay. Recently it has been shown that almost imperceptible decay may render Sitka spruce timber unsuitable for use where high mechanical strength is required. An investigation carried out at Princes Risborough by the Forest Products Research Laboratory of the Department of Scientific and Industrial Research has now taken the matter a step further. The rate of loss of mechanical strength in pieces of timber exposed to the attack of a fungus growing in pure culture, with the chemical and other changes taking place in the wood, have been accurately followed.

The timber used in these experiments was Sitka spruce, one which is unusually homogeneous and therefore suitable for the mechanical testing and analysis of small samples; it is also a wood frequently used in structures such as aeroplanes where any deterioration of its strength may be a serious matter. Previous work at the Laboratory has shown that this timber in certain circumstances is very susceptible to decay, and the fungus *Trametes serialis*, chiefly responsible for the development of brashness in it, has been studied.[1]

A large number of small, carefully selected test pieces were inoculated with cultures of *Trametes serialis* actively growing upon agar medium in culture flasks in which a high humidity was maintained.

A number of test pieces were removed from the cultures after periods of exposure to the fungus varying from one to ten weeks, and tested for strength upon apparatus specially designed for the purpose; while at the same time matched control pieces, which had been kept sterile, were tested. The progressive loss in weight and chemical change by the fungus were also determined, and these results were correlated with the strength figures. Sections were cut from certain of the test pieces and examined microscopically.

Two sets of experiments were carried out and the results will shortly be published as a Forest Products Research Bulletin. In each series there was an extremely rapid fall in the strength values; after only two weeks in the second experiment the average value for the strength of the pieces had fallen to about 80 per cent of that of the normal sound pieces, and afterwards the mechanical strength continued to fall rapidly until after ten weeks less than 20 per cent remained.

This loss in strength could be closely correlated with the chemical changes brought about by the fungus. The curve for the change in alkali solubility 'shadowed' quite closely the curve for the strength values. It is of interest, however, to note that loss in weight of the specimens did not become significant until several weeks after the strength of the timber had begun to fall. The increase in alkali solubility of the wood substance preceded the loss in weight caused by the respiration of the fungus.

Examination of the sections of the test pieces showed that the hyphæ of the fungus rapidly permeated the blocks and penetrated the cell walls, but the amount of mechanical damage caused by the formation of small bore holes could not be considered as the chief factor responsible for lowering the strength of the wood, which should rather be looked for in the chemical changes in the material of the cell walls brought about by the fungus.

W. P. K. FINDLAY.

Forest Products Research Laboratory,
Princes Risborough, Bucks,
May 18.

[1] *Forest Products Research Bulletin* 4. K. St. G. Cartwright. "A Decay of Sitka Spruce caused by *Trametes serialis*." (London: H.M. Stationery Office.)

An Unusual Solar Halo Complex.

AN unusual halo complex was observed at Saskatoon, Canada, on April 16 between 8.20 A.M. and 9.15 A.M., 105th meridian time. Its appearance when the altitude of the sun was about 35° is shown in the accompanying diagram (Fig. 1). The significance of the various letters is as follows: *HH*, horizon; *Z*, zenith; *S*, sun; *aa*, halo of 22°; *ee'*, parhelia of the halo of 22°; *cc*, *c'*, upper and lower tangent arcs of the halo of 22°; *bbb*, portions of the halo of 46°; *d*, arc tangent to the halo of 46°; *mm*, parhelic circle; *pp'*, parhelia of 90°; *tt'*, parhelia of 120°; *h*, anthelion; *ss'*, narrow-angle oblique arcs of the anthelion; *rr'*, apparently portions of wide-angle oblique arcs of the anthelion; *gg'*, apparently secondary parhelia of the parhelia of 22°; *f*, arc vertically above, and concave towards the sun. Coloured halos and arcs are shown by a solid and a dotted line, the latter indicating the blue side of the halo.

Features which are worth noting in this halo complex are (1) the colour of the oblique arcs *r*, *r'*; and (2) the arcs *f* and *d*. When the arcs *r*, *r'* were observed first they were so faint that it was impossible to be certain of their colour, but shortly before the disappearance of the halo they brightened to such an extent that the red colour on the side next the horizon was very noticeable. The ends of the arc *f* appeared to merge into the upper horizontal arc *cc*, and the region enclosed by the two was much brighter than the surrounding sky. This arc appeared to have its centre at the sun, and was separated from the halo of 22° by an angular distance of about 3°. Its position with respect to the halo of 22° did not appear to change with time, although the intensity of the light from it decreased more quickly then than that from other parts of the halo. The arc d was not noticed

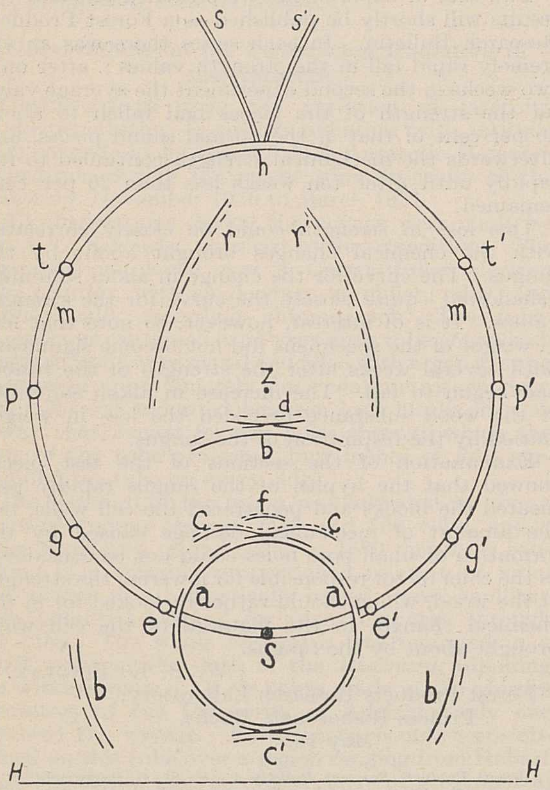


FIG. 1.

until several minutes before the disappearance of the halo, when it appeared as a short, brightly coloured arc, curved towards the zenith.

Although halos are an infrequent occurrence in western Canada, halos of varying degrees of complexity were seen almost daily during the second and third weeks of April. During this period of time there were two large dust storms, and it is suggested that small dust particles, carried to the level of the cirrus clouds, may have served as nuclei for the formation of ice crystals.

B. W. CURRIE.

University of Saskatchewan,
Saskatoon, Sask.

Arabic Source of Zadith's "Tabula Chemica".

THE basal texts of the alchemical knowledge of the Middle Ages in Europe are the "Turba Philosophorum" and the "Tabula Chemica" of Senior Zadith, son of Hamuel; but although both of them are obviously derived from Arabic sources, the latter have not hitherto been traced. Some twenty-five years ago an Arabic manuscript containing three of the works—two in verse and the other in prose—of the tenth century alchemist Muhammad bin Umail came into our possession from Lucknow, and the work in prose, entitled "Al-Mā'al-Waraqī wa-l-Arḍ an-Najmīyah" ("Silvery Water and Starry Earth"), was cursorily examined, as—being largely a compendium of quotations from older alchemical writers—it seemed likely to throw some light on a similar work (the "Shawāhid") of the well-known authority on alchemy, Muhammad bin Zakarīya ar-Rāzī, who died in A.D. 925. As, however, no connexion could at the time be established between the two works, and the Indian text was somewhat defective, the manuscript was put on one side until its collation with other manuscripts of the same work could be made.

This was not found possible until 1926, when the grant of a research scholarship by the Government of Bengal to Maulvi Turāb 'Alī enabled the work of collating the Indian text with photostat copies of two other manuscripts—one at Paris and the other at Leningrad—to be taken up. It was then noticed by one of us (H. E. S., while on leave in England in 1927) that the contents of the "Mā'al-Waraqī" were very similar to the treatise of Senior Zadith, and comparison of the Latin text in vol. vi. of Zetzner's "Theatrum Chemicum" (Strasbourg, 1659) showed not only the identity of the two texts, Latin and the first half of the Arabic, but also that both were a commentary on one of the poems contained in the Lucknow manuscript, and, partially, also in the treatise of Senior. The name of this poem is "Risālatu-sh-Shams ila-l-Hilāli", which appears in the Latin under the literal translation "Epistola Solis ad Lunam Crescentem". A portion of the Latin translation of the "Mā'al-Waraqī" was also found to be included in the compendium of alchemical treatises known as "Artis Auriferæ quam chemiam vocant" (1593 ed.; pp. 246-256) under the incorrect title "Rosinus ad Euthiciam". This last-named volume includes two versions of the "Turba Philosophorum", and it was next noticed that the latter work includes at least three passages that are to be found in the "Mā'al-Waraqī". Finally it was discovered that not only had the author of the "Mā'al-Waraqī" drawn some of his materials from both Ar-Rāzī's "Shawāhid" and another treatise by Ar-Rāzī's immediate predecessor, Mahrārīs, but also that the fourteenth century treatise of the Arabic alchemist al-'Irāqī, "Kitāb al-'Ilm al-Muktasab fī Zira'at adh-Dhahab" (edited and translated by Dr. E. J. Holmyard in 1923), was largely based on the "Mā'al-Waraqī".

A paper on the subject (which will include both Maulvi Turāb 'Alī's recension of the Arabic text as well as an edition of Senior Zadith's "Tabula Chemica") is now being published in the *Memoirs of the Asiatic Society of Bengal*, and an account of the recent discoveries, which throw much light on the history of chemistry, will be given at the Second International Congress of the History of Science and Technology that will be held at South Kensington at the end of June.

H. E. STAPLETON.

Writers' Buildings, Calcutta.

M. HIDAYAT HUSAIN.

Calcutta Madrasah,
April 14.

Two Modifications of Liquid Carbon Disulphide.

THE data of H. Isnardi [1] show that the dielectric constant of carbon disulphide undergoes at the temperature of $-90°$ C. a sudden change. This phenomenon appears at a considerably higher temperature than the freezing point of carbon disulphide ($-112°$); it is thus similar to ethyl ether. On the basis of our work on ethyl ether we may therefore suppose that the carbon disulphide undergoes at $-90°$ C. a transformation from one liquid modification into another one.

To confirm this assumption, we have made a study of the heating curve of carefully chemically purified carbon disulphide. The apparatus used in this study was the same as that used previously for ethyl ether and nitrobenzene.[2] Carbon disulphide was cooled to a temperature −93°; we then observed the change with time of the gradually increasing temperature of the substance, which was isolated from all external thermic influences. The observations of temperature were made in intervals of 10 sec. The observations, repeated five times, have shown that at −90·03° there appears a distinct break on the heating curve (see the part *AB* of the curve on the accompanying graph, Fig. 1). Both parts of the curve, above and below *AB*, are to a high degree of approximation straight lines, making appreciably equal angles with the axis of time. This shows that the specific heat of carbon disulphide does not undergo an appreciable change

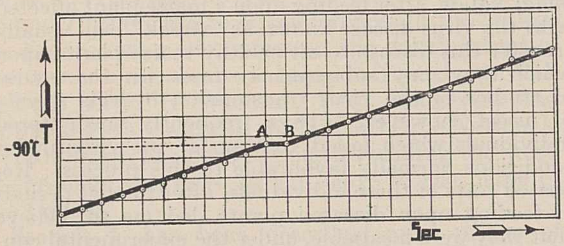


FIG. 1.

at the transformation point. Measurement of the value of the refractive index as a function of temperature shows also a break at this point.

It should be mentioned that the existence of two different liquid modifications of carbon disulphide could be distinctly observed during the cooling of the substance, because the two modifications do not mix together and so a sharp dividing line can be seen. This dividing line between the two liquid modifications can also be sharply seen during the slow heating of carbon disulphide. This phenomenon depends, of course, on the sharp change of the refractive index.

The heat of transformation, estimated roughly from the heating curve, is for carbon disulphide about 0·04 cal./gr., for ethyl ether 0·07 cal./gr., for nitrobenzene 0·14 cal./gr. All these values are of the order of the heat of transformation of helium I into helium II.[3]

The phenomenon reported in the present communication is the third case observed by us of the existence of two different liquid modifications of an organic substance.

M. WOLFKE.
J. MAZUR.

Physical Laboratory, Technical Institute,
Warsaw, April 19.

[1] *Zeit. für Phys.*, **9**, 153; 1922.
[2] M. Wolfke and J. Mazur, NATURE, **126**, 684; 1930.
[3] M. Wolfke and W. H. Keesom, *Comm. Leiden*, No. 190b.

Bridges' Genic Balance Theory of Sex Determination.

IN Bridges' table of sex indices,[1] in connexion with balanced intersexuality in *Drosophila*, the fact that the female intersex is a triplo IV and the male intersex a diplo IV is not expressed. The chromosomal difference between the two is not allowed for in the calculation of the series of sex indices. Since the addition of a IV chromosome to the male intersex chromosome relation converts it into a female intersex, the "IV chromosome must have a net female tendency similar to that of the *X* and different from that of the other autosomes". The following modification is, therefore, suggested:

X and IV represent the totality of female determining genes.

II and III represent the totality of male determining genes.

The addition of one IV chromosome to the chromosomal complex of the *male intersex* converts it into a *female intersex*. On the other hand, the addition of an *X* chromosome to the male complex converts the *male* into a *female*. The efficiency of the female determining genes on the IV chromosome must consequently be very much less than those on the *X* chromosome.

Assigning arbitrary values to the efficiencies of the two interacting components, male on the autosomes II and III, and female on chromosomes *X* and IV, the subjoined series of sex indices is obtained:

Let the efficiency of the female determining genes on the *X* chromosome be represented by $100 = f$, that on the IV chromosome by $10 = f'$, and the efficiency of the male determining genes on II and III chromosomes be represented by $100 = M$.

Chromosome Relation.	Gene determining Relation.	Sex Type.	Sex Index.
3X : 2A.	$3f + 2f' : 2M$	super female	1·60
4X : 4A.	$4f + 4f' : 4M$	4N female	1·10
3X : 3A.	$3f + 3f' : 3M$	3N female	1·10
2X : 2A.	$2f + 2f' : 2M$	2N female	1·10
1X : 1A.	$1f + 1f' : 1M$	1N female	1·10
2X : 3A.	$2f + 3f' : 3M$	female intersex	0·77
2X : 3A (−IV)	$2f + 2f' : 3M$	male intersex	0·73
1X : 2A.	$f + 2f' : 2M$	male	0·60
1X : 3A.	$f + 3f' : 3M$	super male	0·43

This table represents more accurately the genotypic differences of the various sex types, more especially the difference between the male and female intersexes, and can be applied to Bridges' suggestion that "by variation in the number of IV chromosomes, it is possible to have a fringe of minor sex types about each of the major types of sex difference".

H. ZWARENSTEIN.

Department of Physiology,
University of Cape Town.

[1] Bridges, C. B., *Amer. Nat.*, **59**, 127; 1925.

Forestry Research in Great Britain.

THE correspondence in NATURE and the leading article on "Forestry Research in Great Britain" in the issue for May 16 lay stress on certain points which need to be emphasised. It appears, however, that an even wider view of the problems must be taken if we are to make the most of our opportunities and of our obligations. Every schoolboy knows about the struggle for existence, the survival of the fittest, and similar phrases, but it is rare to meet a forester who has been trained to pay attention to the analysis of the factors as they occur either in natural woodlands or in plantations. This is not surprising, for intensive research in fundamental problems has been almost completely neglected in Great Britain.

Some attention has been paid to a few obvious diseases, but the results are almost negligible compared with what is known about fungal attack when timber has been worked, though these are often part of the same problems and should be treated as such.

The fungus-root (mycorrhiza) of trees is equally a subject which should be investigated seriously. Little or nothing has been done in Britain, and no one has been wholly engaged in its study. It does not seem to have been realised generally that casual identifications of woodland fungi presumed to be operative are worthless ; and moreover, that these fungi when they are not concerned with mycorrhizal roots have, nevertheless, an influence on the fertility of the soil, for the mycelium ramifies amongst leaves and obtains its nutriment from them.

The work that other fungi accomplish in the soil is also a matter for research ; it is certain that they are as important as bacteria, but I know of no work on them here or elsewhere.

The conditions overseas in natural forests are disturbing, when one considers both exploitation and replanting. On the last visit of the British Association to Africa I was told that it was of no use my going to a certain forest if I wanted to collect fungi ; I was repaid for my scepticism by the two best collecting days in twenty years' experience.

I have directed attention to the major activities of a single group of organisms, but even less is known about the more indirect ones of other cryptogams. We need still to keep cats and clover in mind.

With so many research problems crying out for attention, and the Breckland area within easy distance, it would seem that the Cambridge Forestry School might be saved from the fate which threatens it.

We have followed the German school more or less blindly and we should be unwise now merely to follow the Swedish school. Darwin first clearly pointed out the interplay between different organisms, and this principle applied with modern ecological methods of research would lead to the practical results by which the forester must, in the end, judge them.

J. RAMSBOTTOM.
British Museum (Natural History).

The Low Altitude Aurora of Nov. 16, 1929.

IN NATURE of May 2, p. 663, Dr. G. C. Simpson has compared the observation of an aurora in Abisko on Nov. 16, 1929, mentioned by me in NATURE of April 11, 1931, with an observation of an aurora made by him twenty-seven years ago. After a description of the last-mentioned aurora, he arrives at the following conclusion : " It is clear that these two experiences were practically identical, and there can be little doubt that what Mr. Corlin considered to be the thicker parts in the cloud covering were really breaks in the cloud through which the dark sky could be seen ".

There are, however, two important differences in the observations mentioned, which show that this conclusion cannot be valid, namely—(1) during the observation at Abisko the *cloudy structure* of both the thinner and the thicker strata could be easily seen, so that there is no doubt at all that they were clouds and not " the dark sky " : in addition, some few real breaks in the clouds elsewhere showed that the uncovered sky was light blue owing to the moonshine ; (2) the auroral ray observed at Abisko was apparently equally intense in front of both the thinner and the thicker strata with rather sharp limits, whereas the aurora observed by Dr. Simpson showed " bright and dark patches owing to the clouds ". Therefore the auroral ray at Abisko on Nov. 16, 1929, was either in front of the clouds or was far above the clouds, but had a greater intensity than the full moon.

Auroræ brighter than the full moon may possibly occur on rare occasions. An extremely bright aurora of possibly so high intensity was, for example, observed on Jan. 5, 1930, 3^h 30^m G.M.T., by the caretaker of the tourist station at Abisko, who awoke from his sleep and first thought that the tourist station was burning, but found that an aurora of extraordinary intensity was flashing all over the sky.

Therefore, I have not been ' convinced ' that the auroral ray on Nov. 16, 1929, was really below the clouds, but after reading later Mr. Cummings's observation of a low altitude aurora in Norwood, Canada, *on the same day* (NATURE, Jan. 17, 1931), I now find it more probable that a low altitude aurora (being thus a planetary phenomenon) really occurred on that day both at Abisko and at Norwood than that we should have by chance the same curious ' illusion ' on the same day at places so far apart.

AXEL CORLIN.
The Observatory, Lund,
May 23.

The Inheritance by a Leafhopper of the Ability to Transmit a Plant Virus.

LEAFHOPPERS of the species *Cicadulina* (*Balclutha*) *mbila* Naude, after feeding upon a maize plant affected with the virus disease known as ' streak ', will usually transfer this disease to all healthy maize plants upon which they may subsequently feed. In the course of studies of the virus transmission by this species of insect, however, I have frequently encountered individuals which failed to transfer the virus under conditions normally favourable to this process. Repeated tests of these individuals, after further periods of feeding upon diseased plants, led me to believe that they were incapable, under the experimental conditions, of acting as vectors of this virus.

I have recently studied the inheritance by this insect of the ability to transmit the streak virus by breeding successive generations from parents selected for this character. In this way I have obtained races which breed true for the character selected. Thus certain races, which may conveniently be called the ' active ' races, consist of hoppers, every individual of which will invariably transfer the streak virus under suitable conditions. On the other hand, ' inactive ' races have been raised in which every individual is incapable of transferring the virus. I have failed to find any morphological difference between the hoppers of these several races.

In the course of this pure line breeding it became clear that the character of ' activity ' behaved in inheritance as dominant to the character of ' inactivity '. Later study of crosses between the two pure-breeding races confirmed this conclusion and, furthermore, showed that the character was linked with sex. Thus the cross, active ♂ × inactive ♀, gave an F_1 progeny of inactive ♂♂ and active ♀♀. In the F_2 generation, active and inactive hoppers appeared in approximately equal numbers in each sex. The reciprocal cross, inactive ♂ × active ♀, gave an entirely active F_1 offspring, and segregation in the F_2 generation into active and inactive ♂♂ in approximately equal numbers, and only active ♀♀.

These results conform with the well-known *Drosophila* type of sex-linked inheritance.

H. H. STOREY.
East African Agricultural Research Station,
Amani, Tanganyika Territory,
April 22.

Molecular Combination of Aliphatic Iodides.

THE binary system hexadecyl iodide (m.p. 23·3°)–octadecyl iodide (m.p. 32·9°) has a eutectic point (19·3°) and a non-congruent melting point (22·3°), showing the existence of a compound of one molecule of each iodide. This appears to be the first example of combination of alkyl halides.

J. C. SMITH.
The Dyson Perrins Laboratory,
University of Oxford,
June 9.

Fourth Centenary of the Collège de France.

AMONG the great educational institutions of Paris the Collège de France, founded by Francis I. in 1530 as the Collège Royal, is one of the oldest and most famous, and this week (June 18–20) is celebrating the four hundredth anniversary of its foundation. The celebrations commenced with receptions in the Collège itself and at the Hôtel de Ville; on June 19 there was a gathering in the great amphitheatre of the Sorbonne, presided over by the President of the Republic; and on June 20 a visit is to be paid to the château of Francis I. at Fontainebleau, and a gala performance will take place at the Théâtre Français. During the forenoons of June 18 and 19 there are to be conferences in the Collège de France, when discourses on the development of the various sciences are being delivered by MM. Sylvain Lévi, H. Vincent, Paul Langevin, and Edmond Faral; while in the Bibliothèque Nationale an exhibition has been arranged recalling the work of the men who have added lustre to the name of the Collège.

Francis I. has been described as a prince of excellent abilities, kindly disposition, rash and generous, but licentious and without principles. Like many others, his reign, which began in 1515 and ended in 1547, was marked by long wars and much persecution. Yet it was also marked by an increasing interest in literature and art, and Francis is remembered as the protector of Rabelais, the patron of Leonardo da Vinci, and the friend of Erasmus. His age was that of the Reformation, the age of Luther and Calvin, which was likewise the age of Michelangelo, of Dürer, of Copernicus, of Vesalius, of Paracelsus, and of Georg Agricola. The sack of Constantinople in 1453 had made the treasures of the ancient world available for all mankind, learning in all its branches had received new impetus, and the founding by Francis I. of the Collège de France was but one outcome of a momentous movement. Inaugurated under the most promising auspices, free from clerical restraint, and devoted to all branches of knowledge, the Collège, like many similar institutions, has passed through periods of stagnation, and at one time its chairs were bestowed by ministers on their family doctors or tutors to serve as pensions, but during the later part of the eighteenth century it was reconstituted, and it has ever since played a conspicuous part in the intellectual life of Paris. When founded in 1530 the lectures were given in different colleges, but the present building near the Sorbonne was commenced in 1610 and was completed about 1778. Bearing over its doorway the inscription *Docet Omnia*, the Collège to-day possesses more than forty chairs, and all its lectures are public and free.

Not the least interesting feature of the Collège is its collection of busts and memorials which help to recall its history. Though some of its professors have left behind them little but their names, there have been many who by their writings, their discourses, their researches or discoveries, have added vastly to the spread and increase of knowledge. The first professor of mathematics, chosen by Francis himself, was Oronce Fine (1494–1555), the author of thirty-one works and the constructor of models which were still in existence at the time of the Revolution. Another mathematician was a far more famous man, Pierre de la Ramée (1515–1572), better known as Ramus, who fell a victim to the massacre of St. Bartholomew. His works on arithmetic, geometry, and algebra were the standard textbooks, and he was as distinguished as a philosopher as he was as a mathematician. Among his pupils was the almost forgotten Jean Pena, who translated Euclid's "Catoptrica", but who died at the age of thirty. Roberval (1602–1675), the opponent of some of the views of Descartes and the supporter of those of Copernicus, became professor of mathematics in the college in 1632, and in 1645 Gassendi (1592–1655) was made one of his colleagues. Picard (1620–1683), the astronomer, was first the assistant and then the successor of Gassendi, while a successor of Roberval's was La Hire (1640-1718). To Picard and La Hire belongs the credit of being the first to use the newly built Paris observatory for regular observations, and together they were employed by Colbert on the construction of a map of France. Duhamel (1624–1706), the first secretary to the Academy of Sciences; Sauveur (1653–1716), the partly deaf founder of the science of acoustics; and the mathematician Varignon (1654–1732), whose "Projet d'une nouvelle mécanique" appeared the same year as Newton's "Principia", were all associated with the Collège at the end of the seventeenth or the beginning of the eighteenth century.

It was soon after this that the fortunes of the Collège sank to their lowest ebb, when no one spoke of it, and its posts were bestowed as pensions. Under Louis XV. the tide turned; orders were issued for its reorganisation, and through Delisle, Lalande, and others its halls again became a centre of attraction. Delisle (1688–1768), the friend of Newton and Halley, had spent twenty years in Russia before he became a professor at the Collège de France; and Lalande (1732–1807), his successor, had likewise spent a short time at Berlin. As anxious to call public attention to himself as to astronomy, Lalande became the most popular exponent of science of his day, and he stands in the first rank as a professor and a writer. Succeeding Delisle in 1762, he held a chair at the Collège de France for nearly forty-six years. One of Lalande's best-known contemporaries was Darcet (1725–1801), a chemist known for his study of the manufacture of pottery. With Monge he was one of the earliest explorers of the Pyrenees, and his lecture in 1775 on his experiences was the first ever delivered at the Collège of Science in the French instead of the Latin language.

Surviving the Revolution almost unchanged, the Collège de France, under the Napoleonic era, like the Institut, the École Polytechnique, the École Normale, and the Jardin des Plantes, became one of the scenes of the activities of the brilliant group of men of science which made that era so memorable in the history of science. Never before or since, perhaps, has there been gathered together in one city so many of the world's greatest contributors to the advancement of knowledge as there were in Paris at the beginning of the nineteenth century, and it was but natural that the Collège de France, with its unfettered regime and its public lectureships, should become one of the homes of those who spoke with authority. One eminent man who held office during the Revolution was Daubenton (1716–1800), the collaborator of Buffon. When he died, his chair passed to none other than Cuvier (1769–1832), the founder of palæontology and comparative anatomy, whose last lecture was given in the Collège only a few days before he died. Contemporary with Daubenton and Cuvier were the chemist Vauquelin (1763–1829), the discoverer of chromium; Thenard (1777–1857), in whose favour Vauquelin resigned in 1804; and Biot (1774–1862), who in 1800, at the age of twenty-six, was appointed professor of natural philosophy.

No less distinguished were the successors of these famous men. In the realm of physiology there are few names better known than those of Magendie and Bernard. Magendie (1783–1855), who described himself as a "rag-picker of facts", and on his death-bed remarked to a friend, "You see me here completing my experiments", became a professor in 1831, the year he visited Sunderland to study cholera. To him in 1847 as an assistant came Claude Bernard (1813–1878) who succeeded to Magendie's chair in 1855. Bernard's life as a Master of Medicine was written by Sir Michael Foster. To the chair of experimental physics at the college in 1824 was appointed Ampère (1775–1836), the centenary of whose publication of the fundamental laws of electro-magnetism was celebrated at the Sorbonne ten years ago; and at his death, Savart (1791–1841), who for eight years had been curator of the physical cabinet, succeeded him. Savart in turn was followed by Regnault (1810–1878), who, like Faraday, after having obtained a reputation as a chemist, turned physicist. Regnault in 1854 was made director of the Porcelain Factory at Sèvres, and it was there, and not at the Collège de France, that his apparatus for the investigation of the expansion of gases was destroyed during the German occupation of 1870. Two years after this Regnault resigned his position at the Collège de France, and his chair passed to his deputy Mascart (1837–1908), afterwards destined to be director of the Central Bureau of Meteorology and president of the Paris Academy of Sciences. What Biot and Ampère and their successors did for physics was paralleled by the work of the eminent chemists who followed in the chairs of Darcet and Vauquelin. Pelouze (1807–1867), the successor of Dumas at the École Polytechnique, lectured for many years at the Collège de France, and in 1850 was succeeded by Balard (1802–1876), who had achieved fame at the age of twenty-four by his discovery of the element bromine. Balard was closely associated with many notable men of science. He owed much to Gay Lussac; it was in Balard's laboratory, at the École Normale, Pasteur in 1848 made his remarkable discovery with tartaric acid; to him in 1837 as an assistant came Berthelot; while his assistant in later years, Schützenberger (1829–1897), in 1876 became his successor. Almost the whole career of Berthelot was bound up with the Collège de France, where in 1865 a chair of organic chemistry was created for him. When he died forty-two years later it was said that France had lost her most eminent man of science. No one ever associated with the historic Collège was more convinced of the moral and practical value of scientific inquiry, and he once wrote "La Science domine tout".

Induced Malaria.

It is well known that, for some time past, malaria has been purposely induced as a remedial measure in persons suffering from general paralysis of the insane. The therapeutic value of this proceeding has been placed beyond doubt. Up to 1928, of 2499 patients in institutions in England and Wales so treated, 1188, or 47·5 per cent, were benefited sufficiently to be recorded as 'recovered', 'much improved', or 'improved'. Of 656 cases in 1929, 47·7 per cent came under the same heading. The 'discharged recovered' numbered nearly 12 per cent, and the 'discharged relieved' six or seven per cent. Thus nearly one-fifth of the cases treated by artificial infection with malaria benefit sufficiently to be discharged from hospital.

From a medical and a moral point of view, therefore, there is abundant justification for subjecting sufferers from one malady, grave and intractable, to the risks attendant upon infection with another which is controllable by drugs. At the same time, it has become apparent that the procedure affords a unique opportunity for the clinical study of malaria itself, a disease incomparably more important than general paralysis of the insane as a world problem, and one which is still beset by questions scarcely answerable in the uncontrolled conditions of the field.

Arrangements were therefore made at the suggestion of Col. S. P. James, adviser on tropical diseases to the Ministry of Health, whereby the Ministry, in consultation with the Board of Control, the London County Council, and Col. J. R. Lord of Horton Mental Hospital, Epsom, organised what is virtually a first essay in clinical investigation under strictly experimental conditions. Colonel James communicated a report on the first results to the Malaria Commission of the League of Nations in 1926, and communicates a record of the material which has since accumulated to the *Transactions* of the Royal Society of Tropical Medicine and Hygiene (**24**, 5, 477-538; March 1931.)

It is very difficult to find malaria patients who can infect *Anopheles maculipennis.* Of 305 mosquitoes dissected when sporozoites should have been present in the salivary glands, ten only were found with zygotes in the stomach and none with sporozoites in the glands. They were among eight batches fed, some of them as many as five times, upon the blood of patients with a high gametocyte count. Dr. P. A. Buxton suggests that a gelatinous sleeve, such as Schaudinn has described (perhaps present only at a certain phase in the process of digestion), arises from the chitogenous cells of the fore-gut and intervenes between the blood and the epithelium of the mid-gut of the insect, thus accounting anatomically for the heavy infection of some *maculipennis* and not of others. While the problem of insect infection needs further study, it has been ascertained that the condition of the gametocytes of *P. vivax* in the blood of patients who are 'good infectors of *Anopheles*' is such that the male forms of the parasite in thin blood films kept moist at 25° C. 'exflagellate' within fifteen minutes. With *P. falciparum* and *P. malariae*, even this indication of infectability for *Anopheles maculipennis* is uncertain. There are good and bad receptors of infection as well as good and bad infectors. But there is no positive evidence that a particular species of *Anopheles* is a better 'malaria carrier' than another.

If susceptible patients are bitten by mosquitoes which have sporozoites in their salivary glands, infection does not always result. This may be accounted for by non-injection of sporozoites. Excluding such cases and also cases in which there was doubt whether or not the patient had suffered from malaria previously, 18 per cent of the number of patients who certainly received sporozoites failed to develop malaria within the usual incubation period. These are held not to be attributable to the presence of 'immune bodies' in the patients' blood. Some are examples of 'latent infection'; others may be due to an anaemic or otherwise abnormal physiological condition of the blood.

Failure may also result from the fact of a previous attack, and some of Col. James's most suggestive results concern the course of malaria in cases treated by quinine. In cases of so-called 'spontaneous recovery' from benign tertian malaria the infection 'smoulders', and the blood picture and parasite findings assume features akin to those of the blood of native children in hyperendemic areas. Usually, between the eighth and tenth months after primary infection, there is a definite recurrence of fever and a reappearance of parasites in the blood, followed in a few days by recovery. A few small doses of quinine then secure freedom from further attacks and from parasites. Before the recurrence, the patient can be reinfected with the same parasite, but after 'spontaneous recovery' such patients are proof against reinfection. This condition of immunity is inhibited by quinine therapy. On the other hand, immunity to reinfection by *P. vivax* confers no protection against *P. falciparum* or *P. malariae*, and complete immunity to reinfection by one strain of *P. vivax* confers at best only a partial protection against another strain. As immunity has hitherto been studied only as a mass problem among natives races, Col. James suggests that the development of these findings should be carried out by field workers.

Cases are recorded in which the expected malarial attack was six months or more late. Since infection is desired early in malaria therapy, such cases are rare in induced malaria; but it has been possible to study twelve in which from 28 to 45 weeks intervened between infection and attack. In one of these the patient had been infected with quartan fever when, nine months after infection with tertian, the benign type developed unaffected by a long attack of quartan followed by a curative course of quinine.

If a distinction is made between the return of fever within eight weeks of recovery from a primary attack (recrudescence) the return between 8 and 24 weeks (relapse) and the return later than 24 weeks (recurrence), about half the patients infected by mosquito bite have one or other of these manifestations, the other half none. Recurrence was found to occur within 27 to 39 weeks of primary infection, and all of the cases which 'recurred' in the twenty-seventh week became ill on the 190th to 194th day after their blood became free from parasites after their primary attack. This relationship led the investigators to construct a graph representing the history of 107 cases referred to the same starting-point. The resemblance between this graph and representations of the seasonal clinical incidence of benign tertian malaria in northern Europe suggests that the 'spring rise', about which so much has been written, is due not to any climatic circumstance but to recurrences in persons who had their primary attack in September, with primary attacks in persons whose infection in September remained latent throughout the winter.

Observations on prophylaxis by quinine support those made by Yorke and Macfie. Quinine taken prophylactically will not prevent infection, but this is different from saying that it will not prevent clinical attacks. Whether persons who have to live in a malarious place would be better advised not to take a daily dose of quinine but to wait until they get a true malarial attack which would be adequately treated by quinine, or whether they would be better advised to take a daily dose suppressing the outward clinical manifestations of the disease in order to 'carry on' during periods of moderate fever and indisposition, are questions to be answered differently in different cases. The daily dose taker gains little or no immunity, and a period of exceptionally hard work is likely to determine a more severe attack than he usually suffers. Large doses (30 gr.) of quinine given at any time during the incubation period have no effect; a single dose of 5 gr. after five or six paroxysms stops the fever but permits a recrudescence within a fortnight; a small dose (5 gr.) given later and repeated daily for a few days cures 50 per cent of cases. Existing practice would be revolutionised by adopting the indications afforded by these facts, but it would be unjustifiable to withhold quinine in a case of malignant tertian malaria later than the first discovery of parasites in the blood.

Obituary.

Prof. W. D. Halliburton, F.R.S.

In a nursing home at Exeter, William Dobinson Halliburton passed away, peacefully, on the evening of May 21. With his death the physiological world loses one of its most outstanding personalities, King's College one of its most loyal friends, and those who knew him, one who occupied, in their affection, a place it will not be possible to fill. For Halliburton was unique. To many is given knowledge, to many also the power to impart it. A few have the intuitive faculty of investigating the fundamentals of their subject and of guiding the steps of others in the uncharted pathways of original research. How restricted is the number who combine these attributes with patience apparently unlimited, calmness in times of stress, encouragement when disappointments came, and never, by word or deed, acted other than in the spirit of reasonableness. Yet such was Halliburton.

Born in London seventy years ago, educated at University College School, trained under distinguished teachers at University College and Vienna, Halliburton graduated in medicine and became Sharpey scholar and assistant in the Department of Physiology under Prof. [now Sir Edward Sharpey] Schafer, following in this position MacWilliam, who until recently held the chair of physiology at Aberdeen. Further academic attainments followed; he obtained his M.D. in 1884 and his membership of the Royal College of Physicians twelve months later.

It was, however, four years after this that Halliburton's life-work began, for in 1889 he was elected to the chair of physiology at King's College, London, rendered vacant through the retirement of Prof. G. F. Yeo, an appointment he held until his illness at Christmas 1922, an illness which, unfortunately, caused him to relinquish his professorship in the following July. Since then his physical vigour has gradually failed and, while on holiday in his favourite Cornwall, a sudden relapse demanded his removal to Exeter, where he died.

The present Department of Physiology at King's College is a tribute to the organising ability of Prof. Halliburton. On taking up his duties, he found the physiological laboratory situated in ill-adapted premises in the basement. But it was there, though handicapped in many ways, that some of his finest work commenced, and shortly after his appointment a move was made to the present position, where under his guidance it grew and prospered. It was a source of gratification to him and to others that five years after his retirement, he was able to open extensions to his old department, extensions for which he had hoped and worked and, by his labours, justified.

In his choice of staff and colleagues in research, Halliburton was singularly happy—one has but to name Dr. [now Sir Charles] Martin, Sir Frederick Mott, T. G. Brodie, F. S. Locke, and Otto Rosenheim.

Despite excursions into other parts of physiology, it was the chemical side to which Halliburton always returned, devoting much attention to the problems connected with the properties of nerve, of muscle, and of protein. As an investigator his name is perpetuated in the pioneer work in these questions. Halliburton made physiological chemistry his own. It is largely to him that the present position of biochemistry is due. By his earlier work and by his writings he laid the firm foundations of his subject, and his researches are now part of the heritage of physiology.

Handicapped as he was in personal experimental work, his capacity for compiling and classifying information was little short of marvellous. His "Text-Book of Chemical Physiology and Pathology" (1891) is monumental; his "Handbook of Physiology" has completed nineteen editions; his "Essentials of Chemical Physiology" is now in its fourteenth. In addition to these labours, at the request of the Physiological Society he became, in 1916, editor of *Physiological Abstracts*, a task which involved the issuing of a monthly précis of papers on biological subjects appearing throughout the world. Almost unaided for five years, he not only edited and managed this journal, but also did the major part of the abstracting. Other publications include "The Chemical Side of Nervous Activity" (Croonian Lectures, 1901), "The Biochemistry of Muscle and Nerve" (1904); "Physiology and National Needs" (1919). As contributions to original work, there appeared from his laboratory some three hundred papers by himself and by others. He delivered the Oliver-Sharpey (1907), the Goulstonian (1893), and the Croonian (1901) Lectures of the Royal College of Physicians. He commenced and for several years compiled the invaluable section of physiological chemistry in the "Annual Reports on the Progress of Chemistry."

In 1891 Halliburton was elected a fellow of the Royal Society; the degree of LL.D. was conferred on him by the Universities of Aberdeen and Toronto. He was a fellow of both King's and University Colleges, senator of the University of London, member of the council of the Royal Society, and, in turn, vice-president of the section of Anatomy and Physiology at the meeting of the British Medical Association in 1893. Twice, also, he was honoured by being president of Section I (Physiology) of the British Association.

As a speaker Halliburton was supreme. He brought to King's not only a scientific knowledge possessed by few, and a command of his subject coveted by many, but a facility of expression envied by all. It was, indeed, a tragedy, in his later years of leisure, to see the gradual loss of this great gift.

Halliburton's whole life reflected his personality. Never physically strong, his ability to carry out the strenuous programmes that he did was due to the unflagging devotion of Mrs. Halliburton, who until the end was untiring in her watchful care.

(*Continued on p.* 945.)

Supplement to NATURE

No. 3216 JUNE 20, 1931

Habit: The Driving Factor in Evolution.*

By Prof. E. W. MACBRIDE, F.R.S.

NO subject is of such perennial interest as evolution, for evolution means the gradual growth of one type of an organism into another as the generations succeed one another. It is quite clear that if the possibility of this kind of growth be conceded for one type of organism it must hold good for all, since all, from the highest to the lowest, exhibit the same essential types of growth and reproduction. Therefore the problem of evolution is the problem of the growth of all animated Nature, of which we ourselves form a part.

One of the principal interests of zoology has been to endeavour to trace the course which evolution has actually pursued in the case of each particular group of animals. It is as fascinating a problem as a cross-word puzzle, with this great disadvantage, however, that it has been so far impossible to arrive at an agreement as to what is the correct solution.

When this was first fully realised, interest in the problem dropped off. In some quarters it was regarded as insoluble, and it was considered that the most contradictory solutions were equally likely. Yet if the problem were given up, zoology would cease to be a science and be reduced to a lumber-room of disconnected facts, as indeed was its condition during the eighteenth century.

It is quite clear, however, that the problem of evolution is a secular one. However it may have proceeded, its progress has been exceedingly slow and it is impossible to obtain direct evidence of the actual operation of an evolutionary process from observations made during the span of a human life. Zoology shares this disability with geology; but geology is in better case than zoology, for geological structure, affecting as it does our obvious material surroundings, is likely to find a place in our permanent records; but no one in past ages is likely to have left minute descriptions of our common animals with which we might compare descriptions of their appearance to-day. All evidence for the occurrence of evolution is therefore indirect, for direct observation of living animals yields very little but confirmation of the old maxim that 'like begets like'. Everything turns, therefore, on the validity and convincing power of this indirect evidence.

The evidence chiefly relied on during the nineteenth century was similarity in ground plan of structure. All animals possessing a back-bone, for example, are built on the same general plan. If all these animals had been evolved out of a common ancestor, this is what we should naturally expect to find, and these facts, although they do not prove evolution, are consonant with the theory that evolution has occurred. Of course, if fish, amphibians, reptiles, birds, and mammals all have grown out of one common stock, then the rule of 'like begets like' must have suffered exceptions, but this difficulty is got over by assuming a principle of 'variability', a principle which I shall discuss later.

Further research into comparative anatomy has shown, however, that 'similarity in ground plan' does not always imply community of descent. The muscles of fish and of the lower amphibia are divided into similar segments repeated in a line one behind the other, and so are the muscles of the common worms; but the view that worms and fish owe their similarities to descent from a common ancestor has now been given up by most zoologists. It was, however, passionately advocated for at least a quarter of a century by the late Dr. Dohrn, the founder of the Zoological Station at Naples. Its disrepute is largely due to the assumptions which it involves: if it be true, then worms must have given up their original mouth and invented a new one on the opposite side of the body in order to become vertebrates; and the main divergence between the supporters of this and rival theories of vertebrate descent depends on the view which their respective supporters take of the relative 'probability' that a new mouth would have been substituted for an old one, or that segmented muscles should have been evolved independently in two cases.

* Royal Institution Discourse delivered on June 5.

If variations occur sporadically in all directions 'by chance' for no assignable reason, if indeed, as the Bishop of Birmingham suggested in a recent address on "Heredity and Predestination", 'genes' come "aus der Ewigkeit" and evolution depends on the chance correspondence of one of these genes with the needs of the animal, then the question of the acceptability of one theory of a particular descent over another is ultimately a question of the powers of imagination and credulity possessed by the theoriser.

If, however, as most of us who have looked into the question agree, evolution, if it has occurred at all, has been slow, and structure has been modified in accordance with the demands of function, then we must look for evidence of a more satisfying kind than mere agreement in ground plan of structure. So far as I can see, there are three sources of evidence open to us, and only three. We shall examine them briefly in turn.

The First Proof of Evolution.

(1) A species of animal is defined as an assemblage of individuals resembling each other closely, except so far as differences connected with age and sex are concerned, and crossing freely with one another and producing fertile offspring.

Now if we examine wide-ranging species the members of which do not wander about much, we find that all such species are divisible into local races, each race inhabiting a circumscribed area. The members of each race differ from those of the next race in minute characters such as colour and the proportions of the limbs and trunk, etc. No one has ever questioned the assumption that these various races have been evolved or developed out of a common stock; even the theological opponents of Darwin, who assumed that the Almighty had created every species independently, admitted this. But subsequent research by naturalists has shown that there is no hard and fast line to be drawn between the differences that separate races and those that divide species. There is, for example, a squirrel ranging all over tropical Africa known as *Heliosciurus*. This varies a great deal in colour, and systematists had classified these colour varieties as distinct species. But Mr. M. A. C. Hinton, after the examination of an enormous amount of material, has come to the conclusion that all these supposed species are merely local races of the same widely distributed species. It is assumed, of course, that members of distinct species will rarely breed together, and that when they do so they produce infertile hybrids, but that when members of distinct races breed together they will produce numerous fertile offspring.

In very few cases has this test been applied, however; we *guess* that two assemblages are distinct species, because when they come into contact with one another in Nature they keep distinct from one another, and in those cases where the experiment has been tried they are often mutually infertile. But suppose we are dealing with two very similar groups of animals, one in Europe and one in America, and we regard each group as a distinct species, how shall we discover whether they are mutually fertile or not? In fact, it appears, especially from the researches of Dr. Goldschmidt, who bred together members of the different geographical races of the Gipsy-moth (*Lymantria dispar*), that there is no absolutely sharp division between sterility and fertility, but that there is every grade of fertility, with the zero limit at sterility.

I have said that the division of the species into local races is only found in species which do not wander much. Where there are extensive migrations either in search of food or to accustomed breeding places, members of the species drawn from all localities mingle together and no local races are formed. Dr. Johan Hjört has shown that an adult cod in the North Sea may travel as far as 2000 miles in one year to and from its breeding place. No better example of the contrast between a stationary and a migratory species could be imagined than that between the so-called viviparous eel, which is a blenny, and the true eel. The true eel when fully grown is a fresh-water fish. Its ally, the conger eel, haunts the sea, but is only found in shallow water close to the shore. The true eel lives in rivers and ponds for several years, eating voraciously and growing enormously in size. When fully grown, the desire to migrate to the sea overcomes it. If it is in a river, it swims downwards to the mouth; if it is in a pond, it emerges at night and wriggles over the moist grass until it reaches the nearest stream and then resumes its journey to the sea. I once surprised an eel in this migration; it was wallowing in a mud puddle in a field a few yards from the edge of a Cornish sea cliff. No doubt as soon as darkness fell that same evening it would gain the edge of the cliff and make the great adventure. True eels are found in all the rivers of Europe and North Africa, from the White Sea to Morocco, and also in the rivers flowing into the Mediterranean. Yet if a sample of eels be gathered from any of these rivers and compared with a sample from any other, no difference can be observed between them. It is true that the individuals in each sample differ slightly from one another, some have a few more vertebræ in the backbone than others, but these differences are found equally in all samples.

The reason for this uniformity of type became clear when Johannes Schmidt discovered the life history of the eel. When eels reach the sea they all swim to the same breeding place, a spot situated in the Atlantic Ocean a short distance south of the Bermuda islands. There they spawn, the females shedding the eggs and the males the sperm into the sea at random, where their union is left to chance, and thereafter the adults die. Thus it comes about that the eggs of an eel from Morocco can be fertilised by sperm from a male from the North Sea; and if local conditions tend to produce local races, this tendency is neutralised by the constant crossing of the germ cells of individuals coming from different places. The fertilised eggs develop into flattened semi-transparent larvæ with white blood utterly unlike the parents, and they take three years to reach the streams from which their parents came.

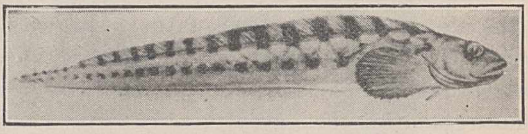
Contrast with this condition of affairs the habits and life history of the viviparous eel. In this fish, the eggs after fertilisation are retained inside the oviduct and there develop into little replicas of their parents, ready to take up the parental life as soon as they are born. They do not move far from their birth-place, but form communities which interbreed chiefly with each other, and these communities show slight differences in structure from each other, even when as in Denmark they are separated from each other by distances so small as fifteen miles. For example, a community living at the mouth of the Lym fiord differs slightly from one living farther up the fiord.

Now no one will maintain that these differences have been specially created; all agree that they have arisen out of something in the local conditions. The important point to note is that they are functional differences. The eels from the mouth of the fiord are longer and slimmer than those living higher up; this difference in shape is a difference in the organ of locomotion, namely, the tail, which makes up two-thirds of the fish (Fig. 1). The fish near the mouth of the fiord go out into the troubled waters of the North Sea for their food and have to swim more strongly than their sheltered neighbours in the fiord. Hence the difference in structure is correlated with a difference in habit. If, then, these minute differences are the first steps in secular evolution, we may say that they demonstrate that *habit is the driving force of evolution.*

The Second Proof of Evolution.

(2) The second type of evidence is derivable from the remains of extinct animals, that is, fossils. But only certain portions of this evidence are really convincing. It is possible to take a series of fossil fish of different ages gathered in different localities and to arrange them in a series in the order of their supposed ages, and then to say that the series proves that evolution has gone on in a certain way. It may be so, but it is always open to the objector to deny that the older members of the series are really the ancestors of the younger. Some palæontological theories are based on series like this, but I have always been extremely sceptical as to their value. I have harboured the suspicion that the younger fish in such series may have been

A



B

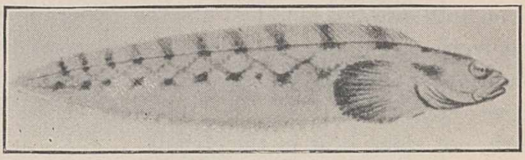


Fig. 1.—The viviparous eel (*Zoarces*). A. The long, slim, open sea form. B. Shorter fatter form from enclosed waters.

derived from fish contemporaneous with the older ones but as yet undiscovered.

There are, however, certain exceptional cases in which a whole series of rocks in one and the same locality is full of the remains of the same kind of animals from top to bottom, and where as we proceed from the older to the younger layers a slow modification in the structure of a particular animal can be seen, until, if we compare the youngest with the oldest layers, we seem to be dealing with quite a different species, though the difference between the specimens found in two contiguous layers may be so slight as to be inappreciable. In cases like this, no doubt is possible that we are dealing with the same race of animals, which is undergoing slow modification, and these successions are known as *lineage series*. The conditions for the preservation of such a lineage series are the persistence of a uniform deposition of silt in quiet waters in the same locality for vast periods of time. The best two cases of such series known to me are the rocks in the western States of North America exposed in the sides of the Grand Cañon, and the English Chalk.

In North America, the rocks are the beds of silt deposited by the annual floods of a great river which originated in a large inland lake like the present Lake Superior. Every year some of the animals grazing on the grass of the meadows bordering the river were drowned and their bones embedded in the silt. In this way the whole story of the development of the camel and the horse has been elucidated, and, comparing the remains of these animals found in the lower beds with those in the upper, we can see the ancestors of the camels changing from four-toed quadrupeds into creatures like deer and thereafter into the splay-footed modern camel. The teeth of the earlier forms are in a complete series and the back teeth are studded with cusps. Such teeth are found at the present day in animals which live on soft, succulent food. As time goes on the cusps become connected by longitudinal ridges and the teeth are thus converted into mills suitable for grinding the harsh herbage of the steppes. In the case of the horse we can begin with tapir-like creatures with four toes on the fore-feet and three on the hind-feet and pass by an infinite gradation of stages to creatures with a single toe on both fore and hind feet like the modern horse. The teeth pass from a condition with cusps to a condition in which the cusps are connected by ridges; but these ridges run obliquely across the tooth, not along it as in the camel.

Now all these changes, both in the camel and the horse, take place with great slowness and are correlated with changes in habit. The early ancestors walked on swampy ground as the tapir does now, ground where the spread of four toes was needed in order to give them adequate support. As the ground became harder and dried, more and more reliance was placed on the central toes, and the lateral toes dwindled. The tapir to-day lives on exactly the same kind of food as is indicated by the teeth of the ancestors of the horse.

The English Chalk originated as a deposit of calcareous mud in quiet sea-water a considerable distance from land, so that it was unpolluted by sand and mud borne down by rivers. In this mud lived and burrowed heart-urchins in most respects very similar to the modern heart-urchin, *Echinocardium*, which burrows in the sands of the Firth of Clyde. Our modern urchin constructs for itself a cave in the sand, the roof of which is supported by a crest of curved spines which the heart-urchin carries on its back. The cave communicates with the surface of the sand by a vertical shaft. The mouth is on the under surface of the animal, not in the centre but pushed towards one side. It is crescentic in shape, with a greatly projecting lower lip called the labrum. On the back of the urchin there are five impressions radiating from the centre which remind one of the petals of a flower (Fig. 2). These impressions are each composed of a double series of transverse grooves. On each groove sits a broad, flattened tentacle which acts like a gill: this tentacle communicates with the interior by two pores, one at each end of the groove. Through these pores, the tentacle communicates with an internal reservoir known as the ampulla. The right and the left series of grooves are separated by a median bare space. One of the petals is markedly different from the other four. It is more parallel-sided and the grooves are fainter and more numerous. From this petal are given off, not gills, but very long tentacles terminated by frilled discs. These tentacles are thrust forth two or three at a time through the vertical shaft on to the surface of the sand. Here they collect small animals such as baby mussels, pull them down the shaft, and transfer them to a ring of branched tentacles surrounding the mouth, the so-called buccal tentacles, by which they are pushed into the gullet, and so the heart-urchin feeds. The gills are continually bathed in a current of fresh sea-water, which is sucked down the shaft and made to flow over the gills by the action of certain ciliated spines.

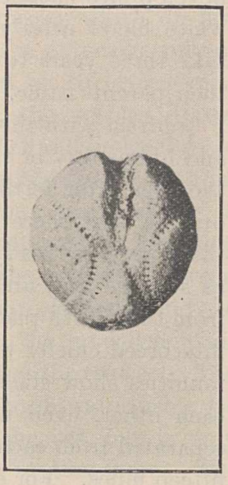


FIG. 2.—Denuded shell of the recent heart-urchin (*Echinocardium*), showing the upper surface. Note the grooved anterior petal.

Now when we examine the chalk sea-urchins which are known as *Micraster*, we discover that they occur in certain places in countless numbers throughout a great thickness of strata; and we find that they slowly change their characters as we pass gradually from the lower strata to the upper. The oldest *Micrasters* have the mouth circular in outline and entirely devoid of the projecting lip or labrum (Fig. 3). The petals are short and are not grooved, and the anterior petal is not markedly different from the rest. We interpret these features as meaning that these urchins, like the modern heart-urchin, *Spatangus*, were only partially buried; the gills projected freely into the sea-water, and the tentacles from the anterior petal were comparatively short. The roundness of the mouth suggests that food was sought all round it from the sand on which the heart-urchin rested. As we pass upwards, the mouth becomes more and more crescentic in shape; the labrum grows out over it and at the same time the anterior petal becomes more and more grooved. This grooving indicates the gradual coming into function of the long tentacles as food gatherers. Simultaneously the centre lines of the other petals between the two rows of gills become grooved of each petal becomes channelled out. Every change in structure is correlated with a change in habit.

For convenience, geologists pick out certain forms which occur at certain levels and constitute them types; thus we have the zone of *Micraster cor-bovis*. But if we collect enough specimens, we

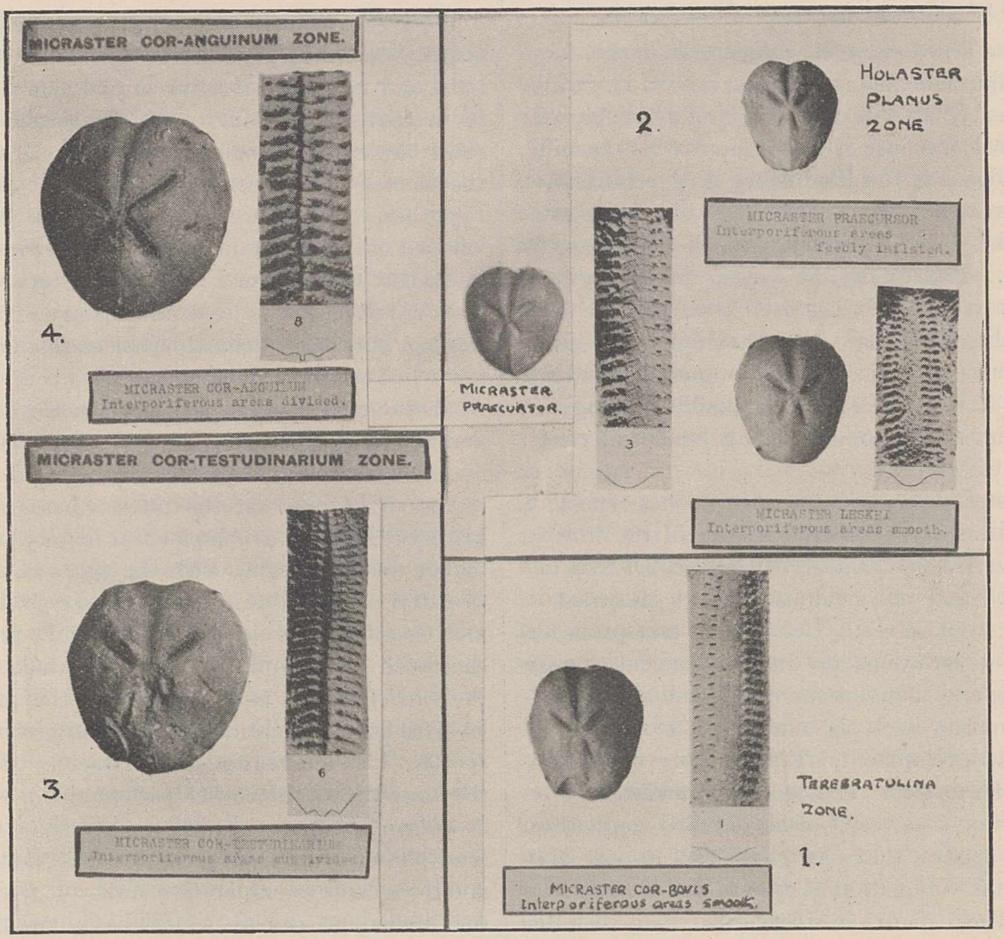


FIG. 3.—Four stages in the lineage-series of the cretaceous heart-urchin (*Micraster*). (1) is the oldest. All show the upper surface. (1) *Micraster cor-bovis*. (2) *Micraster præcursor*. (3) *Micraster cor-testudinarium*. (4) *Micraster cor-anguinum*.

Changes in the interporiferous areas.—On the upper surface of the sea-urchin are five petal-shaped tracts, each formed of two rows of plates, pierced by pores for the tube-feet. The middle region of each petal, between the rows of pores, is 'the interporiferous area'. In the lowest zone these areas are quite smooth, and the joints between the plates are not apparent. In the following zones the areas undergo gradual change, the successive stages being termed sutured, inflated, subdivided, and divided. Thus in the highest zone the plates are divided by a median furrow, and are swollen and granulated.

and a sharp crest or 'carina' is formed in the mid-dorsal line in order to carry the spines which support the roof of the cave.

All these changes are the result of a habit of burrowing deeper on the part of the sea-urchin. As it sinks below the surface of the mud, it becomes necessary to hold the mud away from the gills, and so the crest or carina carrying the fan of curved spines is developed. The buried gills require a more rapid current of clean sea-water over their bases and so the furrow in the centre find that these types are but arbitrarily chosen levels in an ever-varying population. Moreover, we find that the various characters, such as labrum, carina, grooved petals, do not change at the same rate in each individual. In one, the mouth may be more crescentic but the petals less grooved than in another. It is just as if the structure of each individual was responding to the change in its habits—but as if the different habits were not being modified at exactly the same rate in different individuals—in fact, as it has been dramatically expressed by one of our leading palæontologists, it is as if an individual could have a new collar but last year's pair of boots.

The evidence from lineage series thus confirms the conclusion derived from the study of local races that *change of habit is the driving force in evolution.*

The Third Proof of Evolution.

(3) The third class of evidence is much more disputable than the first two, but if it can be established that it is valid, it is of much greater importance, because it is far more wide-reaching. This evidence is the life-history of the individual, which, according to the so-called 'biogenetic law' of Haeckel, is a 'recapitulation' of the history of the race. This theory, at various times, has been heavily attacked. It has been asserted that there is no inherent reason why the individual in its development should rehearse its ancestral history, and that in many cases it is impossible to imagine a functioning adult animal at all similar in character to the embryo.

The assumption that the animal does repeat its ancestral history involves a theory of the time at which 'variations', that is differences between one generation and the generation which preceded it, manifest themselves. Geneticists are prone to assert that variations are due to chemical changes in the egg and that this changed chemical composition manifests itself as a changed growth at all stages in development. Eimer, however, the inventor of the term 'orthogenesis', maintained on the contrary, as a result of his detailed comparison of allied species, that new characters appear only towards the completion of growth and then first in males. The dispute has arisen, as so many disputes arise, from the confusion of two different types of phenomena. The geneticist is considering the abnormal, non-functional and monstrous deviations of growth shown by our domesticated animals; these are due to interferences either with the egg or with the very young germ; they often, but not always, show themselves at the beginning of development, and the individuals showing them are always physiological weaklings as compared with the typical animals. That these 'sports' or 'mutations', as they are called, are really due to chemical changes in the protoplasm, I am by no means ready to concede; the evidence available points rather in the direction of their cause being specific weakening of the powers of growth. It is a remarkable fact that when these weaklings are returned to normal conditions and still are able to survive, their offspring revert in a limited number of generations to the normal type. The systematic zoologist, on the other hand, deals with specific differences and Eimer is right when he says that these are manifested only at the end of growth; the youthful forms of allied species are notoriously so like each other as to be almost impossible of distinction.

If we compare two species belonging to the same genus, one of the generalised type common to the tribe and the other of a specialised type, it will be found that the youthful form of the specialised type resembles closely the generalised type. If we reject the doctrine of special creation and adopt the hypothesis that the two species have been developed out of a common ancestor, then it follows inevitably that the more specialised repeats, in its later development at least, the history of the race. We can only have definite proof of this biogenetic law when we have independent means of knowing what the ancestry of a particular species has been, and, as has already been pointed out, this is possible in only a few cases, and the knowledge thus attained throws light only on the latest phases of racial history. But the developmental history of all the higher animals begins with the egg—which in its essential structure is an amœba-like protozoon—and therefore this development should present in shortened and simplified form the whole story of the race from its emergence from the protozoon level to its culmination in the adult form of the species. We have no certain means of testing the accuracy of the earlier part of this record, but if we can bring strong evidence to show that the later phases do really represent ancestral structure, and if we can by comparative embryology elucidate the secondary causes which have modified the ancestral record, then I think we are justified in the faith that the whole development is a story of the evolutionary history of the race.

Larvæ and Embryos.

Now one of the most important things to notice is that the development exhibits two phases, both of which are always present but which are of very different relative duration in different species. These are the *embryonic* and *larval* phases. In the embryonic phase, the young creature is sheltered from the outside world; but in the larval phase, it leads a free life, seeking its own food and avoiding its enemies. The latest phases of development are always larval, for no animal is born exactly like the adult condition. The earliest phases, on the contrary, are always embryonic, because no egg is ever cast naked on the world ; every egg is sheltered for a longer or shorter time either inside an egg membrane or the mother's body.

Now it is easy to show that the larval mode of development is the primitive one, of which the embryonic is a secondary modification. For the organs of the larva are used, whereas those of the embryo are non-functional. Thus there is a toad called *Hylodes* which lives in the West Indies and frequents localities in the damp undergrowth which are far from water. This toad lays large eggs from which hatch out minute fully-formed toads. If, however, one of these eggs be opened about half-way through its development, there will be found therein a tadpole with fully developed tail and internal gills like those of the tadpole of the ordinary toad which lives in water. Therefore if we are seeking the original meaning of development, we must concentrate our attention on species with a long larval development.

When we do so, we find in many cases, notably in the life-histories of the Crustacea, that the larval phase is broken up into a series of sub-phases or 'instars', and that during every one of these the larva has a distinct set of organs and corresponding habits, so that the primitive type of development consists of the coming to the surface of a series of habits ; and when a species deviates from the habits common to the order in the last phase of development, it exhibits the habits typical of the order in its younger phases. Of this we may cite one example which is familiar to many. From the egg of the common shore-crab, *Carcinus*, there hatches out a small shrimp-like creature known as a *zoaea*. This larva has a rounded and shortened fore part of the body known as the cephalothorax and a long thin hinder part divided into six segments known as the abdomen. The cephalothorax has a spike projecting upwards from the centre of the back, and also one in front which is known as the rostrum. At the sides of the rostrum are two large stalked eyes, and behind these there are two pairs of short feelers. Beneath is the mouth and at the sides of this are situated three pairs of jaws or 'gnathites', which are practically identical with those of the adult crab. Behind these jaws we find two pairs of comparatively long forked legs, the so-called maxillipedes. This list comprises all the limbs which the zoæa possesses. By using the maxillipedes as oars it rows itself vigorously about, grasping at any food which comes within its reach by means of its jaws, and it employs its abdomen as a rudder.

Like all Crustacea, the zoæa is enclosed in a stiff horny cuticle or shell which impedes growth. Nevertheless, growth goes on ; small buds appear at the sides of the segments of the abdomen prefiguring swimmerets, and behind the maxillipedes other buds appear, the first indications of the normal legs of the crab. The zoæa moults four times, and after each moult comes a short period of unimpeded growth during which the leg buds increase slightly in length but the abdominal buds become fully developed swimmerets. Then comes a fifth and critical moult and the larva changes into a *megalopa,* which sinks to the bottom and has different habits. For now it has legs behind the maxillipedes with which it can crawl, and it takes on habits like those of the shrimp. Like the shrimp, it can still occasionally swim, using for this purpose, however, the abdomen with its swimmerets and not the maxillipedes.

After a brief period of this kind of life, the megalopa undergoes another moult from which it emerges as a creature with a broadened cephalothorax but a reduced abdomen, no longer used for swimming but tucked underneath it ; in a word, it has become a crab. But the crab has not yet attained the complete features of the adult crab. For one thing, the abdomen retains a full set of swimmerets. It grows older and bigger, undergoing a series of moults. At last, there comes a crisis when it assumes the full sexual characters of the adult. These characters are indicated by far-reaching modifications of some of the swimmerets. It might have been expected that as moult succeeded moult the swimmerets would gradually change into sexual organs. When the crisis arrives they are re-absorbed into the body ; their outer horny shells are cast off in the moult. Underneath the next shell they re-develop as buds, which grow into the shape of the sexual organs, and after the next moult they appear in their fully developed form.

This history shows clearly the stuff of which development is made ; we see a succession of 'powers of growth' coming into action one after another ; each set of growth powers gives rise to a corresponding set of organs, and each set of organs corresponds to a new set of habits. Development can thus be analysed into a superposed series of habits, and thus it affords another confirmation of the theory that *habit is really the governing factor in evolution.*

The Effect of Acquired Habit on Heredity.

We have yet to face the really fundamental question : How does habit govern evolution ?

Does habit change first, and do the changed habits produce the modified structure, or do structure and habit both 'vary' in all possible directions, and when the right habit and the right structure 'happen' to coincide in some fortunate individual, is this individual 'naturally selected'? In a word, does Darwin's theory of evolution by natural selection cover the case of correlated changes in habit and structure?

Now, in a sense, the theory of natural selection does cover this, and all other possible modes of evolution. For if evolution has gone on at all, the powers of growth of one generation must have become altered as compared with those of a previous generation, and this alteration is what is known as 'variation'. Again, if evolution has occurred, the individuals which have evolved must have continued to live, that is, they must have survived. To say that an individual has been 'naturally selected' is merely to say that it is there. Consequently the theory of evolution by natural selection is worse than a fallacy—it is a truism; it pretends to give an explanation which turns out on examination to be no explanation at all, but a mere form of words. It is obvious that the real problem is glossed over; it is hidden in the word variation or *change*. Until we have explained that, we have not really attacked the problem of evolution at all.

Darwin implicitly assumed that inheritable variations in all directions turn up 'at random', so that the right combination is always there to be 'naturally selected'. If this were really so, we should have to investigate the causes which produce these 'random' variations, for 'chance' or 'contingency' is no scientific explanation. But the so-called pure line investigations prove conclusively that Darwin's assumption is wrong. In phanerogamous plants, in Crustacea and in Protozoa, it has been proved that if we raise a brood from one parent only, either by self-fertilisation as in the case of the plant, or by parthenogenetic reproduction in the case of the crustacean, or lastly by the asexual process of fission as in the case of the protozoon, the members of the brood will differ from each other slightly in size and proportions, but the shorter individual will give rise to a brood of grandchildren as long as, or even longer than, those of the longer individual. These individual differences, or 'fluctuating variations' as they are called, are due to differences in nutrition and are not inheritable.

If we abandon, then, the theory of random variations, we have to face the only alternative left, namely, that change of habit produces change of structure. This is the theory of evolution put forward by Lamarck, as can be shown by quotation from his "Philosophie Zoologique": "Every fairly considerable and permanent change in the environment of any race of animals works a real alteration in the needs of that race. Every change in the needs of animals necessitates new activities on their part for the satisfaction of those needs and hence forms new habits. Every new need necessitating new activities for its satisfaction, requires the animal to make much more frequent use of some of its parts which it previously used less and thus greatly to develop and enlarge them. A more frequent use of any organ gradually strengthens, develops, and enlarges that organ; whilst the permanent disuse of any organ imperceptibly weakens and deteriorates it, and progressively diminishes its functional capacity until it finally disappears. All acquisitions and losses wrought by Nature on individuals through the influence of the environment in which their race has *long* been placed and hence through the influence of the predominant use or permanent disuse of any organ, all these are preserved to the new individuals by reproduction."

This theory is what is termed 'Neo-Lamarckism' in order to distinguish it from the full evolutionary theory of Lamarck, for Lamarck believed that the principal factor in evolution was a sort of urge towards perfection which was inherent in living things, and that this urge was modified and even diverted from its course by the effects of the formation of new habits. Now, in order to prove the truth of Neo-Lamarckism, it is necessary to bring evidence that the formation of habits in one generation affects the next generation. We must also try to show how this is possible, remembering that each member of the new generation begins its existence as a tiny germ cell, and that whatever influence is carried over from the previous generation must be somehow embodied in this cell. Of course, it is generally admitted that the formation of a new habit modifies the growth, and therefore the structure, of the generation by which it is formed. We are all familiar with the enormous arms of the prize-fighter, and the greatly strengthened legs of the professional dancer. But, to many people, it is difficult to believe that the strengthening of one particular organ should so affect the germ cell that in the new animal produced by it the same organ should be strengthed as was strengthened in the parent.

Perhaps the best piece of evidence so far obtained is that which emerges from the experiments of Dürkhen. These experiments lasted five years and the animal dealt with was the common white butterfly, *Pieris brassicæ*. Dürkhen discovered that if the caterpillars of this larva were reared in boxes provided with lids of orange-tinted glass, they would metamorphose into pupæ the pupal coverings of which, instead of being coloured dirty white as in the normal pupa, were transparent. Since the blood of the pupæ is coloured green, this blood shines through the transparent cuticle and the pupa appears to be green. The pupæ were allowed to live until the white butterflies escaped from them. These butterflies were carefully preserved in large cages exposed to the air and light but protected from the attacks of birds by a double belt of close wire-netting. They were fed on sugar and water, and after a week or two they paired and laid eggs, which were carefully preserved. Then these eggs were reared up into caterpillars. Half of these caterpillars were subjected to the same treatment as their parents, but half were reared in ordinary daylight. The results obtained were as follows. From the original generation of caterpillars 66 per cent of green pupæ were obtained; from the second generation reared under orange light 95 per cent green pupæ resulted. When the offspring of the first generation of green pupæ were reared in ordinary daylight, 34 per cent of green pupæ resulted. The normal percentage of green pupæ found in ordinary cultures where no coloured light was employed was 4 per cent. These experiments show clearly that when a habit is acquired by one generation, a second generation exposed to the same conditions acquires the same habit more quickly and thoroughly; and that when the offspring of a generation which has acquired a peculiar habit are returned to normal and typical conditions they still show the effects of the habits acquired by the parental generation.

These experiments were repeated by Heslop Harrison on the allied species *Pieris napi*, the turnip white butterfly. In this species, the first generation of caterpillars reared under orange glass gave rise to 94 per cent green pupæ, whilst the second generation reared under the same conditions gave also 94 per cent green pupæ; thirty of these second generation caterpillars reared in daylight all gave green pupæ. The percentage of green pupæ found in normal cultures was, however, higher than in *Pieris brassicæ*, reaching 20 per cent.

Heslop Harrison carried out another series of beautiful experiments to show how an ingrained habit is inherited. There is a gall fly, *Pontania salicis*, which normally lays its eggs in a particular species of willow (*Salix andersoni*). Harrison found that by hatching the insects out of the galls of this species and letting them loose in his garden, they could be forced to lay their eggs on another species of willow (*Salix rubri*) when the first species was not available. During the first years there was a heavy mortality and only a few of the gall flies succeeded in establishing themselves on the strange willow; but when the experiment had lasted for five years Harrison reintroduced the original species of *Salix* into his garden, but the saw-flies continued to lay their eggs on *Salix rubri*, to which they had been accustomed. The acquired habit had therefore become hereditary.

Perhaps the best example of the inheritance and transmission of an acquired habit is afforded by the experiments of Metalnikoff on *Galleria*, a moth the caterpillars of which feed on beeswax. If the caterpillars of this species are reared in an incubator at a temperature of 30° C. they will pass through their entire development in a period of 6–8 weeks, so that as many as six or eight generations can be reared in a year. The caterpillars are extremely susceptible to attacks by the cholera bacillus; but, as is well known, a vaccine immunising against the attacks of this bacillus has been prepared, and if this vaccine is injected into the caterpillars when very young they resist the toxins produced by the bacillus. Metalnikoff began his experiments with a brood of caterpillars which were the offspring of a single female. He ' immunised ' half of these with the vaccine and then inoculated the whole brood with the cholera bacillus. After three or four days the survivors were counted and allowed to develop and become the parents of the next generation. The same procedure was adopted with the next generation. This generation may be called the first filial generation and its offspring is then the second filial generation. None of the unprotected members of the first or second filial generation survived, but of the third filial generation 30 per cent survived. In the sixth filial generation the proportion of survivors had risen to 42 per cent, and in the ninth filial generation to no less than 75 per cent.

Metalnikoff remarks that the reason why previous experiments designed to test the theory that acquired habits are inherited had given negative results was that the experimenter had been content to rear two or three generations only. " Time pays no attention to experiments in which she is left out of account."

Entomologists have long been familiar with what are termed biological races within the species. By this is meant races which nearly or entirely resemble each other in structure but differ in their habits, notably in the species of plant or animal which they attack. The same kind of races are encountered in other groups of animals. Dr. Goodey has described them in the case of nematode worms. Thus *Ascaris lumbricoides*, a worm about six inches long, is found both in the human intestine and in that of the pig. Nevertheless, if the eggs of the human *Ascaris* are eaten by the pig they fail to develop in its intestine. In Trinidad, a large proportion of the pigs are infected with *Ascaris lumbricoides*; but the pig-keepers, who are principally Negroes, suffer very little from this parasite, although, when one considers their habits, their food must be constantly polluted with the eggs of this worm.

Again, the nematode, *Heterodera schactii*, attacks beetroot. The male remains in the earth, but the female bores into the plant and swells up to the size of a lemon seed, which it resembles in shape and appearance. In Germany there is a race of *Heterodera schachtii* which attacks the potato. In this race the female when it swells assumes a spherical form. It is very difficult to get this race to live in the beetroot, but by planting beetroot for three years running on land infested with the potato parasite, this was finally accomplished. The females, although descended from the potato race, when they succeeded in maintaining themselves on the beet assumed the form of a lemon seed.

Goodey attributes the formation of these biological races to 'food-memory'. By this he means that the female transmits to its offspring some substance which induces them to seek out the same kind of plant as that in which it lived. He thinks that this is not quite the same as the inheritance of acquired characters. But it is inherited habit and, as has been pointed out, this is what Lamarck meant by the inheritance of acquired characters; habit changes first and structure follows only long afterwards.

Dr. Thorpe, in an article entitled "Biological Races in Insects" (*Biological Reviews*, vol. 5), has given numerous examples of these races. From his interesting article we select the following cases. The louse which infests the human hair (*Pediculus capitis*) differs slightly from that which hides in the clothing (*Pediculus corporis*) in colour and shape (Fig. 4). Nuttall bred the head-louse, *Pediculus capitis*, for two years in boxes and found that it was completely changed into *Pediculus corporis*. *Hyponomeuta*, the small Ermine moth, attacks the apple, the hawthorn, and the blackthorn. The forewings of the moth are said to 'vary' in colour from dark grey to pure white; but it appears that the 'varieties of colour' are correlated with the plant attacked; for the white variety was found most frequently on the apple and the dark-grey on the hawthorn. When larvae taken from the hawthorn were allowed to pupate in cases containing both apple and hawthorn, they laid 911 eggs on the hawthorn and 237 on the apple. Thorpe remarks that the offspring of a generation reared on one plant and forced to feed on another will produce a third generation which will prefer the second food plant to the ancestral one, but will not entirely pass over to it when offered a choice of plants, so that the change from one set of habits to another is progressive, not effected at once as it should be if it were merely a case of 'memory'.

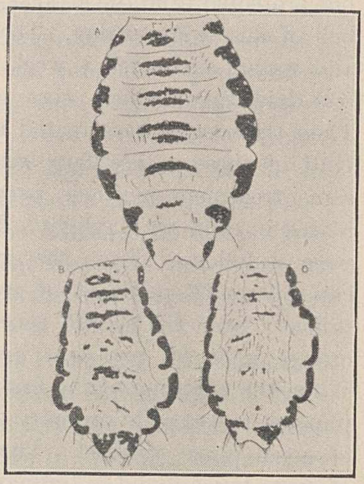


FIG. 4.—The abdomens of varieties of the human louse (*Pediculus humanus*). A. Body louse. B. and C. Head louse.

Another group of animals in which the production of new races by the formation of new habits is going on is the fishes which inhabit the torrential hill-streams of India. These fish, which have been beautifully described by Hora, have evolved modifications of the ventral surface which enable them to cling to stones and avoid being swept away by the current. We may select the carp-like fish *Garra rupeculus* for special description. Of this fish, Hora collected a large number of specimens of varying sizes. He found that when they were very small (13 mm.) in length the mouth was nearly terminal and was bordered by its proper upper and lower lips. As it grew larger, a so-called anterior labial fold made its appearance, which in its growth pressed the mouth downwards and backwards and the true lip inwards. Behind the true lower lip another fold, the posterior labial fold covered over with papillae, makes its appearance. This is crescentic, with the concavity turned backwards, and between the arms of the crescent a disc-like area of callous skin appears which the fish presses against the stones so as to act like a sucker. The lateral extremities of the true posterior lip grow backwards and form lateral borders to the sucker. A tuberculated ridge of skin forms its hinder margin. These stages, which Hora believes to be all growth stages of *Garra rupeculus*, are paralleled by the adult stages of other species of *Garra*. The differences in development of the sucker are correlated with slight differences in the velocity of the current, and hence in the efforts which the fish has to make to hold on to the substratum.

If we sum up all this evidence, we arrive at the conclusion that these biological races owe their origin to the inheritance of acquired habits, and in them we see the very first stages in evolution. I cannot sympathise with the remarks made by Dr. W. T. Calman in his address to Section D (Zoology) at the meeting of the British Association at Bristol in 1930. Dr. Calman stated that the cases adduced to prove the inheritance of acquired characters concerned characters so slight and fugitive that they could have played no effective part in evolution. Since, as all admit, evolution has been a very slow process, it could only be the very smallest steps in it which could be demonstrated during the period of observation open to a single observer. Many people appear to think that in order to prove the inheritance of acquired characters, it would be necessary to show that when a structure had been changed by the exposure of the animal to a new environment during one generation, the same structure should be inherited in full strength by the next generation when the new environment had been changed back into the old and typical one. This shows a complete misunderstanding of the real state of affairs. When a structure changes owing to the action of a new environment, this is because it responds to the change by a new rate of growth ; if the offspring are replaced in the old environment, this means that they come again under the influence of that environment, and their mode of growth tends, of course, to respond to the old and typical environment. To prove that the habits and mode of growth acquired in one generation do affect the next, all we require to show, and all we could expect to see, would be that there was an *intensification* of the effect when the exposure to the new environment was continued for several generations, and a *lag* in the resumption of typical characters when the offspring of individuals which had been exposed to the new environment were replaced in the typical environment. These expectations are amply borne out by Dürkhen's experiments on pupæ and Nuttall's experiments on the louse, to name only two examples.

The Mode of Transmission of Acquired Habit.

Even if we succeeded in showing that the characteristic features of allied species were correlated with the habits of each particular species, many people still feel a hesitation in admitting that the habits have caused the characters. To revert to the case which has just been considered, they would ask, how can the fact that the *Garra* fish in one particular place have to press their discs more tightly against stones, and thus enlarge them, so affect their germ cells that these, when they develop into little fish, will have larger discs ? Is a picture of the parent repeated in miniature in the germ cell ? Even if we could admit this, we might ask how the germ cell picture was altered when the parent was altered.

Now the study of embryology, and in particular of experimental embryology, affords, as it seems to me, a satisfactory answer to these conundrums. Whatever the embryo is, it is not a machine, that is, as Driesch expressed it ; it is not a constellation of parts in fixed relations to one another, and this is the only exact meaning that can be given to the word ' machine '. It begins as a single cell and this multiplies by division into a number of cells, and *in each cell slumbers the power of developing into the whole*. The nucleus, as is well known, is the centre of the growth powers of the cell ; but what a particular cell will develop into depends not on its inherent capacities but on its position in the whole. It is dominated by the whole, and this is what Driesch meant by ' entelechy '. The early development of sea-urchins affords beautiful examples of this. When the egg divides so as to form a blastula, a portion of this blastula can be cut off ; the remainder contracts so as to heal the gap and produces a small larva with all the organs developed but of reduced size. Further, when the egg has divided into a few cells, the mutual positions of these can be altered by pressure so that cells that should be in front lie at the sides and vice versa, yet it develops into a perfect larva. All the cells are equipotential. But this state of affairs does not continue. After a time the gastrula stage supervenes, when one pole of the blastula flattens and is pushed in like a finger, so that the rudiment of the gut is formed. If just before this stage supervenes the top half of the blastula is cut off, this top will grow into a new blastula, but will develop no further, whilst the bottom half will heal up and proceed with its development and form a perfect larva.

Later in development the front cœlomic pouch on the left side gives off a little bud which grows into the water-vascular ring-canal of the adult sea-urchin. From this canal all the beautiful tentacles of the adult grow out. This bud modifies all the tissues in its neighbourhood. The skin covering it gives rise to a crown of beautiful pointed spines. Where the posterior cœlomic vesicle is overlapped by the bud, this vesicle gives rise to the chisel-like teeth of the urchin. Under stimulation of the growth of the larva the front cœlomic pouch on the *right* side may also give rise to a water-vascular bud. When this takes place it transforms all the tissues of the right side of the larva, diverting them from their normal course of development and transforming into replicas of the tissues on the left side of the larva.

How have these changes come about? Since the nuclei govern the whole growth and metabolism of the cells, it can only be because the nuclei in a certain part of the embryo have emitted some new substance into the protoplasm which has altered its growth. So that we are confronted with the paradox that the nuclei, which are alike and all of which possess all the powers of developing into the whole, when once the development of the whole has started, develop only portions of their powers appropriate to their position in the embryo and produce these powers one after the other in a definite order. The most marvellous example of this has been described by Brachet. The egg of the frog, he found, can be entered by as many as seven spermatozoa. One of these unites itself with the egg nucleus—in a word, fertilises the egg—and then this double or zygote nucleus starts dividing and organising the protoplasm into cells. But the other spermatozoa start doing the same thing, and as they are only half the size of the double nucleus, the cells which they form are much smaller and easily distinguished from those formed by the zygote nucleus. Thus there may be no less than seven centres of cell formation in the egg; yet out of this medley is produced not a seven-headed monster but a single tadpole.

Just as the whole in development dominates and directs the growth of the parts, so, in reaction to the environment, the whole animal enters into the reaction and every part is co-ordinated with every other part. When, for example, a lion springs on its prey, every muscle in its body comes into action; some are contracted, others are relaxed, for it is not the individual organ which reacts to the stimulus but the whole animal. The reflex actions of excised muscles with which human physiologists have chiefly occupied themselves give no picture at all of what goes on in the intact animal striving under the influence of what Lamarck calls its 'inner feeling', and Rignano its 'affectivity', to escape from its enemies or to seek its food or a mate.

If we make the reasonable assumption that every such action has a reciprocal effect on the nuclei, and stores up something in them which is given forth when the action is repeated and accelerates and strengthens it, then we can make a provisional picture of the *modus operandi* of the inheritance of habit. For since all the nuclei are potentially alike, any one of them may become a germ cell if it finds itself in the proper position in the developing egg, and the nuclei of the germ cells will receive, like the nuclei of the other cells, the after-effects of the animal's actions. When the germ cells develop into the new generation, these deposits will become active at the corresponding period of growth of the embryo and will stimulate this growth. If the habit continues for many generations, more of the deposit will be formed every generation with an increasingly powerful effect on growth. The modified structure will be formed on ever slighter stimulus, until finally so much of the deposit is accumulated that the organ develops without stimulus at all, like the eye of the baby rabbit in the darkness of its mother's womb.

In the light of this hypothesis, we see why development should be ultimately analysable into a superposed series of habits, and why in the last resort *habit should be the driving force in Evolution.*

Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh.*

Church Cottage, their home in Marylebone Road, was open house to friends of all ages. In this oasis from London's rush, many sought both help and advice; none was refused. Free from worry over the more material aspects of life, his help to those in straitened circumstances was often more than words. Generations of students think with affection and speak with reverence of their old teacher and friend. Childless himself, *they* were his 'boys and girls'. When he came to King's, our College was enriched; by his death the whole scientific world is made poorer.

It is difficult to write truthfully about Halliburton without appearing to exaggerate. His character, his scientific accomplishments, his nature, his industry, his very life itself, make him one we can but mourn and do no more than try to copy.

J. A. HEWITT.

DR. RUDOLF MARLOTH.

WE record with deep regret the death of Dr. Rudolf Marloth, the distinguished botanist, who has been so closely associated with botanical work in the Union of South Africa. Dr. Marloth's profession was that of a consulting analytical chemist, but it is with regard to his botanical work that he is best known in the domains of science.

On the foundation of the Botanical Survey of South Africa, he was appointed a member in the year 1918, but before that time he had gained a reputation as a botanist with a wide knowledge of the flora of the Cape region. He was president of Section B of the South African Association for the Advancement of Science in Cape Town in 1903, and was president of the whole Association at Kimberley in the year 1914. He was also president of the Cape Chemical Society in 1913.

Marloth was the author of many botanical works and in particular "Das Kapland", which was published in 1908 and gives a general phytogeographical account of the vegetation of South Africa. This fine work is profusely illustrated, mainly from photographs taken by himself; for Dr. Marloth was, among other things, an expert photographer and an acute observer of biological factors in relation to plant life. Another monumental work is his "Flora of South Africa", planned to occupy four volumes, three of which have now been published; the first volume appeared in 1913, and this also was magnificently illustrated with both photographs and coloured plates. This is not a 'flora' in the strict sense of the term, as only a portion of the genera and species is dealt with and the Gamopetalæ have not yet been published. It is, however, a work which all those interested in the wonderful flora of the Cape region find indispensable for the proper study of the flowers of South Africa. He also published, in the year 1917, a "Dictionary of the Common Names of Plants of South Africa". In this volume, some two thousand records of common names of plants found in South Africa are given, and the list is particularly useful to the overseas visitor, since the Dutch have common names for most of the more conspicuous and generally distributed plants. One of his earliest works was his "Elementary Botany for South Africa", which was published in the year 1897.

Dr. Marloth travelled widely in Africa in the course of his duties as an analytical chemist, and had a wide circle of friends, particularly among the Dutch, who helped him considerably in his botanical studies. In connexion with his work on the Botanical Survey, he collected together a fine herbarium, which was remarkably rich in the Euphorbiaceæ and other succulent plants belonging to the Cape Province. The collection was rendered all the more valuable by the inclusion of photographs of these plants, giving their characteristic features in careful detail. Such photographs in the case of 'fleshy' plants are of very great value to the botanical student, and his herbarium, which will pass to the National Herbarium at Pretoria, will be invaluable to botanists carrying on researches on the flora of South Africa.

Dr. Marloth was a man of great energy and a delightful companion in the course of a botanical ramble. Having had an opportunity of spending some nine strenuous hours in his company on Table Mountain last November, one was able to realise the great extent of his knowledge of the Cape flora, and also his untiring energy as a walker; for, despite his age, he was able to outwalk many a younger man. His unexpected death will be a very great loss to botanical science, not only in South Africa but also to the world in general.

A. W. H.

PROF. JAKOB ERIKSSON.

JAKOB ERIKSSON, whose death, on April 26, we regret to record, was born in Hyllie, near Malmö, Sweden, in 1848. After a course of study at the University of Lund, he obtained his Ph.D. in 1874, and the same year was appointed lecturer (Dozent) in botany at the University. A year later he was called to Stockholm, where, besides teaching botany in one of the State colleges, he was engaged as plant physiologist at the experimental station of the Academy of Agriculture. In 1885 he became professor and director of the department of plant physiology of the Academy, a position which subsequently comprised the department of agricultural botany. Prof. Eriksson held this position until 1913, when he had reached the age limit, entitling him to a pension. He, however, continued his research work until shortly before his death, and published several books and monographs during his retirement. His primary interest centred on the study of the diseases of agricultural plants, more especially mildew, parasitic fungi, etc. It was very largely due to his energy and initiative that the plant physiological laboratory at Frescati, near Stockholm, was created.

Prof. Eriksson was a member of scientific academies in several countries and received numerous awards for his contributions to the knowledge of plant diseases and their treatment. A species of fungus in the Hysteriaceæ group has been named after him, and in 1923 an international prize for research in plant pathology was instituted at Wageningen in his honour. He represented Sweden at nearly all of the international congresses on horticulture and plant physiology, and devoted a large part of his time in the interest of the International Institute of Agriculture in Rome.

In addition to the work mentioned above, Prof. Eriksson took a keen interest in pomology, and for a number of years edited the *Journal of the Swedish Garden Association.*

WE regret to announce the following deaths:

Mr. W. F. Denning, a leading authority on meteors, discoverer of several comets, and of world-wide reputation as an astronomical observer, on June 9, aged eighty-two years.

Baron Kitasato, For.Mem.R.S., of the Imperial Pathological Laboratory, Tokyo, Japan, noted for his work in bacteriology, especially with reference to the artificial production of immunity to disease, on June 14, aged seventy-two years.

Dr. R. C. Macfie, Thomson Lecturer in the University of Aberdeen for 1929, and author of a number of notable biological expositions, as well as of volumes of picturesque verse, on June 9.

Dr. Warner J. Morse, director of the Agricultural Experiment Station, Orono, Maine, on Mar. 25.

Prof. S. W. Parr, emeritus professor of practical chemistry in the University of Illinois, known for his researches on fuels, on May 16, aged seventy-four years.

Mr. H. Tomlinson, F.R.S., formerly principal of the South-Western Polytechnic, Chelsea, on June 12, aged eighty-four years.

Mr. R. T. Wright, formerly fellow and tutor of Christ's College, Cambridge, and secretary of the University Press, on June 11, aged eighty-five years.

News and Views.

THE doctrine of the inheritance of acquired characters is by no means so dead as its opponents thought a generation ago. The effects of Weismann's knock-out blow are wearing off, and the heart begins to throb again, somewhat irregularly, but gaining strength all the time. In his Royal Institution Discourse of June 5, on "Habit: The Driving Factor in Evolution", printed in a special supplement this week, Prof. E. W. MacBride takes a strong stand on the side of the heritability of acquired characters. Dissatisfied with the evidence formerly adduced for the occurrence of evolution, he re-examines the question along three lines which he regards as the only possible approaches. These are: the line of racial differentiation amongst animals at the present day, the line of fossil evidences of past specific changes, and the line of embryonic and larval development. And each of these lines, traced to its end, leads Prof. MacBride to the conclusion, which would have delighted Lamarck as it will shock many adherents of orthodoxy, that habit or change of habit is at the bottom of the changes of structure which represent the difference between one species and another. The interesting examples cited in support of the thesis will be eagerly scanned, but whether all of them will satisfy the doubters is another question.

To take the case of the blenny or viviparous eel of the Lym fiord, the individuals of which at the mouth of the fiord are longer and slimmer than their relatives higher up, without direct proof it is unsafe to assume, and the argument is based on the assumption, that the difference is due to different habits. May it not be that the differences represent responses to physical differences in the environment, such as varied densities or salinities? Racial differences may be due to habitat as well as to habit, and until the one possibility has been eliminated the other cannot be taken for granted. In a similar way it is possible to imagine that the reversion of the spherical race of the nematode, *Heterodera schactii,* in the potato, to the lemon seed form when it feeds again on beetroot, may be due to physical or chemical properties of the juices it feeds upon—a physical rather than an organic reaction. But this sort of objection to regarding habit in every case as the initiator of structural change does not apply to other examples cited by Prof. MacBride, and we view with sympathy his championship of the directive force of the organism in the evolutionary race.

IN an article on "The Scientist and the Technologist in the Textile Industries", published in the *Journal of Textile Science,* Prof. E. F. Barker discusses co-operation between men of science and technologists and problems of their training. Prof. Barker points out that the technologist, or 'practical man', as he is frequently described in the textile industries, has attained his results much more by judgment and less by rule of thumb or haphazard methods than the man of science frequently imagines. Examples are quoted of textile problems faced and evolved along inductive lines of reasoning by the technologist, which indicate that some technologists at least may claim to be scientific workers within the sense of Sir Arthur Eddington's definition of science as "an attempt to set in order the facts of experience". The training of the technologist in the best of our technical colleges has been based largely upon system and not mere synopsis, and upon basic inductive methods. The technologist thus chiefly needs the cultural scientific training, based upon the extensive outlook or extensive "Science Discipline" suggested by Sir David Prain. The man of science, on the other hand, is essentially an analytical worker; and a fundamental defect of our present university training is that, while taught to appreciate facts, its graduates are frequently quite unable to assess values, especially human values. This defect has largely been responsible for the slightly contemptuous attitude towards industrial research once common in university circles, and makes the exclusion of the technologist from association with the man of science in the activities of the research associations catastrophic. Probably nothing would more rapidly ensure the provision of adequate support for such associations from the industries themselves than effective co-operation between the scientific worker and the technologist.

Prof. Barker urges that the man of science, having passed through the cultural scientific training, should proceed to the sterner discipline of an intensive training in which studying, as Sir David Prain suggests, "everything of something" evolves scientific, mental, and material tools, and the capacity to use them intensively, by means of which he may draw from Nature more of her riches for the service of mankind. The failure of scientific workers to attain greater success than they have hitherto attained is due to lack of appreciation of the problems which only broad co-ordinated enterprise can present for solution. The training suggested should assist the scientific worker to clarify or to reveal for the technologist the problems and factors with which he has to work, and if the technologist by taking the extensive "Science Discipline" as part of his course acquires the scientific outlook, the required co-operation between science and technology should easily be obtained. Such collaboration, and the twin advance of science and technology, are essential if both are to play their part in solving the world problems which they have largely created. The cultivation of a sense of values should, moreover, promote co-operation with art and humanitarianism—those other aspects of industry which have their part to play in the future as in the past in correcting the soul-destroying influences of mechanical work. The success or failure of Western civilisation may, as Prof. Barker suggests, depend upon the extent to which these aspects of industry function, not merely to serve the material interests of mankind by the secrets won from Nature, but to promote man's higher interests and the spirit of world fellowship.

Antiquity, thanks to a vigorous and courageous editorial policy, has attained a position in periodical literature which in Great Britain is unique. It has succeeded in maintaining its popular interest without thereby losing its attraction for more serious readers who wish to be kept abreast of the archæological movement in branches of study other than their own. Thus, in the June issue, Miss Caton-Thompson gives a brief preliminary account of the problems, such as the relation of palæolithic and neolithic culture to water supply, which the first season's work of the Royal Anthropological Institute's expedition to Kharga oasis is revealing for future investigation, while the series of air photographs by Lady Bailey are most valuable as indicating the nature of the terrain. In the same way, Mr. J. Leslie Mitchell's "Inka and Pre-Inka" is a useful summary of present theory for those who have not been able themselves to follow recent developments in South American archæology in detail. Mr. Cyril Fox's study of "Sleds, Carts, and Waggons" in Wales is not only a valuable record of the development and relation of types of vehicles which are now passing out of use, but is at the same time an instance showing how a highly specialised type which has developed in response to local conditions may survive for a considerable time even in the face of the standardisation of modern industry. We refer to Dr. Reisner's contribution on "Stone Vessels found in Crete and Babylonia" elsewhere, and must pass over other matters of moment in favour of a question raised by the editor in his "Editorial Notes".

In his "Editorial Notes" the editor of *Antiquity* directs attention to the "astonishing fact that . . . there exists no University Chair of what may be called Old English Archæology", meaning by that expression, the antiquities of the Saxon, Danish, and Norman periods. To those who are not acquainted with the circumstances, while this may seem a matter for regret, it may not appear of special urgency. There are other subjects of special study, of equal or even greater importance, which are without this provision. But, as the editor justly points out, not only have some of the most recent monographs on Anglo-Saxon antiquities been written by distinguished Continental archæologists, but also—and this is the more serious aspect of the matter—such knowledge as we have on the period, say, between A.D. 450 and 650, is concentrated in a few individuals whose numbers do not increase as time goes on, while for the period A.D. 700 to 1000 accurate scientific knowledge, based on proved fact, is almost entirely lacking. Yet there is ample material in Saxon and Danish earthworks, for example, upon which no work of excavation has ever been carried out. In view of the lack of encouragement given to these studies, there is a very real danger that research in this by no means uninteresting phase in our history may entirely die out. The modern standard of scientific excavation is too exacting to make it advisable to rely on private effort, however successful this may have been in the past in the initial stages of other branches of archæological investigation; while the endowment of a chair would at least give organised direction to investigation, and probably provide the stimulus of open discussion and criticism which is essential to progress in this as in other similar studies.

The Empire Forestry Society has recently published a second issue of a most useful little work entitled, "The Empire Forestry Handbook". The handbook gives a list of office-bearers and members of the E.F. Association; a list of forest officers of the Empire (not without its value, but liable to get quickly out of date); a list of higher forestry educational centres in the Empire; a list of Empire research institutes; a list of departments and institutions dealing with imperial forestry—incomplete, since several universities which, apart from education, certainly deal with imperial forestry are omitted; data and tabular statements purporting to give the forest resources of the Empire, but inevitably, in the case of large areas of our tropical forests in as yet imperfectly known regions, based on the roughest of estimates; and finally a useful list of trade names of Empire timbers which it is hoped gradually to get established.

On the subject of forest research institutes in Great Britain the following comment may be made. Under these institutes the Forestry Commission is first mentioned, then the Imperial Forestry Institution, Oxford; and thirdly, the Forest Products Research Laboratory, Princes Risborough. This ends the list of centres said to be undertaking forestry research in Great Britain; but examples of such work being conducted in connexion with Empire forestry interests at other centres could be quoted. Perhaps the simplest for reference is furnished by Dr. Rayner's letter in connexion with forest research which appeared in NATURE of April 4. The paper alluded to, "Mycorrhiza in Relation to Tree Growth", was actually published in the *Empire Forestry Journal*, vol. 9, No. 2, 1930. As was pointed out in the leading article in NATURE of May 16, on "Forestry Research in Great Britain", if forest research work for the Empire is really to pull its weight, the Forest departments require to harness every centre which is able to undertake such investigation work. Dr. Rayner has shown that Bedford College for Women, London, is capable of performing such work. In the next issues of the Handbook it may be hoped that the editor will be able to find a place amongst his research institutes or centres, since the Forestry Commission, London, cannot be termed an institute, for the Bedford College for Women, and other places in Great Britain equally interested in Empire forestry research.

THE radio equipment of recently-built luxurious liners is now wonderfully complete. The new liner, the *Empress of Britain*, is furnished with both long wave and short wave installations. The latter waves enable telephone communication to be maintained over distances which are quite outside the range of the long wave transmitter. Hence telegrams can be exchanged directly with the country from which the passenger comes, and this effects considerable economies. Emergency and lifeboat radio equipment are also supplied. The ordinary cabin telephones are connected with the short wave transmitter, so that the service is as convenient as when on shore. London connects each cabin telephone with practically every telephone in Europe, and New York with Canada, the United States, and Mexico. The Marconi repeater equipment enables the ship's band to be heard in any part of the ship. There are eleven loud speakers for the decks and public rooms and two for private cabins. They can be used for making announcements. The loud speakers are mounted in the structure of the ship so as to harmonise with the decorations. A special type of radio receiver enables broadcast programmes to be heard when they become available. Gramophone records relieve the orchestra when necessary, and supply dance tunes. Four large cabins are devoted exclusively for the radio apparatus. The Marconi direction finder is installed in the chart-room for the convenience of the navigating officers. The radio equipment was installed by various companies acting on behalf of the Marconi International Marine Communication Co., Ltd.

ON the occasion of the recent opening of its central laboratories, the British Non-Ferrous Metals Research Association has issued a pamphlet entitled "Ten Years of Research for the Metal Industries", which provides, in a convenient form, an account of the work done by the Association since its formation in 1920. The main features of this work have been described on many occasions, and attention is now particularly directed to the efforts made, largely at the suggestion of the Director, to bridge the gap which undoubtedly exists between the solution of a problem in the laboratory and its general application in industry. Even where, as in this case, the interest of the principal firms in the industry has been secured, the time lag which occurs between the issue of a laboratory report and the news that the report has had an actual influence on practice is so great as to disappoint those who have been most eager to promote industrial research. The Association has done its best to diminish this time lag, first by an intelligence service which enables its members to keep abreast with work that is being done all over the world, and next by a Development Section, with its own trained staff, the duties of which will increase in importance as time goes on. The new aluminium brass condenser tubes, the improved materials for locomotive firebox construction, and the ternary alloys of lead for the sheathing of cables are among the chief practical results of the work of the Association, and each of these calls for special effort in securing their general adoption by members.

WHERE there are no civic regulations to the contrary, modern buildings in cities are ever growing taller. In Europe, ten- and twenty-storeyed buildings are getting not unusual, and in the United States there are buildings with fifty storeys. In order to let sunlight reach the streets underneath, the buildings are made narrower near the top. This makes the problem of providing shafts for the requisite lifts very difficult. In the *Westinghouse International* for April, an interesting account is given of a method that has been adopted in an eleven-storey office building in East Pittsburgh for increasing the transport facilities up and down the building. There are two shafts in the building and each shaft has two cars. At first sight it seems dangerous to operate two cars in the same shaft and on the same set of rails. The difficulty has been overcome by running the cars to a fixed schedule. Both complete their trips upwards before either of them starts on the return journey. They thus always operate in the same direction. The limits for the lower car are the bottom of the shaft and the upper car, and the limits of the upper car are the lower car and the top of the shaft. For the dual control, the car is automatically slowed down and stopped before it catches up the other car. In addition, a set of signals is displayed within the car, so that the passengers and operator know at once why their car is slowed down or stopped before it reaches its destination. The control panel shows at each instant the location of each car and also illuminates three signal lights. The green light indicates full speed, the yellow light slow speed, and the red light indicates a stop.

CONSIDERABLE attention is being paid at present to the part that wireless will play in the future in the growth of international communication. Many believe that it is only a question of time until it will become the universal medium for communication, and that wire and cable systems will become obsolete. On the other hand, some believe that the future of wireless is very limited, and that it will be mainly confined to broadcasting and communication with and between mobile stations. It is quite possible that wireless will be displaced eventually from the broadcast field for local areas by the use of wire broadcast systems. In a paper published in *Electrical Communication* for April, H. H. Buttner discusses this question fully. He concludes that in the future development of international communication there will be a definite use for both wire and wireless systems. Short wave systems for long-distance communications are generally the more economical. But if the traffic is heavy, or if some is picked up on the main route, it is probable that the cable system would be the best commercially. Owing to atmospheric interference, wireless circuits can rarely give continuity of service over the twenty-four hour day. Cable circuits can also be interrupted by natural causes, possibly over a long period. Wireless can transmit to several stations at once, but the secrecy of cable systems is of great importance in war time. To a large extent, wireless and cable services are complementary to one another. Those services where wireless is essential, such as broadcasting, trans-oceanic telephony, meteorological and direction finding services, should not be hampered by being allocated too few air channels. The extension of wire and cable communication systems to localities not formerly served owing to economic reasons will release valuable wireless channels for the development and pioneering of new services where the use of wireless is essential.

THE Mineral Resources Department of the Imperial Institute has recently issued a most valuable survey under the title "Mineral Position of the British Empire" (1931, pp. 121, price 2*s*. 6*d*.). The mineral production of 1928, as compared with that of 1913, shows that the Empire has fallen back as compared with the world as a whole ; but the chief cause of this is the extraordinary increase in petroleum production, to which the Empire contributes only a very small proportion. Otherwise coal and iron ores are the two chief mineral needs of industrial civilisation, and, in these, the Empire has enormous reserves, which should secure for it a high place in the world's industries for some centuries to come. The future outlook as regards supplies of copper and the other base metals, as well as the iron-alloy metals, can also be regarded as promising. Minerals which the rest of the world imports largely from the Empire are asbestos, china clay, chromite, diamonds, gold, mica, nickel, and tin. Minerals for supplies of which the Empire depends almost entirely on foreign countries are antimony, bismuth, borates, petroleum, potash, pyrites, quicksilver, sulphur, and radium. Of all other important minerals, the Empire has ample supplies and great resources, and in many cases an exportable surplus. The position thus disclosed as regards independence in the matter of mineral supplies is one with reference to which the Empire need not fear comparison with the rest of the world. The survey is of great interest and importance, and will prove to be an invaluable mine of information to a wide range of appreciative readers.

IN conformity with the decision of Marshal Lyautey, Commissioner of the International Colonial Exhibition to be held in Paris this year, the Seventh International Congress of Aquiculture and Fisheries is to be included in the programme of the Exhibition. The Congress will be in session from July 20 to 25 inclusive. According to details available in the preliminary syllabus now issued, it will be constituted in three groups, the first dealing with marine fisheries and allied industries, the second with river fisheries, and the third with overseas fisheries. Each of these main groups will be further divided into numerous sections and subsections, each of which will consider and discuss in detail some particular branch or aspect of the general theme. The findings of sections will be communicated to the main groups at combined meetings specially convened. In addition to purely technical work, members of the Congress will join in visits to the Colonial Exhibition and take part in certain of its deliberations. At the end of the meeting, a tour will be arranged to all the principal fishing ports of northern France, including Boulogne, St. Malo, Brest, Belon, and Lorient. Any further information regarding the Congress can be supplied by the General Secretary, 28 Rue Serpente, Paris.

IN a short paper in *Scientia* (vol. 49, p. 335; 1931) Prof. Paola Enriques, of Padua University, endeavours to find a way of conciliation between the apparent contradictions of heredity and evolution. Heredity, to put it broadly, is concerned with the conservation of the species, while evolution, on the other hand, is concerned with the transformation of the species. In the old days, observation of the relationships between parents and children left open a way for evolution, since children, however much they resembled their parents, in some characters were different. But genetics suggests that all the hereditary patrimony of the child can be decomposed into definite and known elements, so that no room is left for the evolutionary novelty. Enriques emphasises the significance of the fact, well known to systematists, that there is amongst related species or groups of species a combination of characters associated with the characters betraying affinity. Further, one set of characters may vary independently of the other. Experimental heredity shows also the possibility of variations in hereditary factors; so that there may be deduced a common law ruling both heredity and evolution, the law of "independent variability"—"hereditary factors may vary independently of one another, and it is from the independent variations that the formation of new species is derived". So enters the possibility of evolution.

FUNGI form excellent objects of study for the amateur naturalist armed with the microscope, and the March issue of the *Journal* of the Quekett Microscopical Club contains two interesting papers in which different aspects of fungus study are discussed especially for the microscopist. The president of the Club, Mr. J. Ramsbottom, of the Natural History Museum, discusses some of the more interesting of the aquatic fungi, including in his account brief descriptions of some little-known groups in which the English forms, in particular, would well repay intensive study. Mr. B. F. Barnes, of the Department of Botany of Birkbeck College, London, discusses quite a different phenomenon. By modern technique, using sterile solid media, fungi can be grown in pure culture for years and, thus cultivated, remain as constant in form and in the structure of their reproductive bodies as more highly organised plants. It has thus been possible to recognise the fact that variable forms, which sometimes remain distinct in culture whilst in other cases they revert with time to the normal, may be produced from the stable normal types by special treatment. Mr. Barnes describes the variations he has induced in three different species by heating the spores from which sub-cultures are afterwards made.

During the last ten years great improvements have been made in photoelectric cells and in valve amplifiers. In a lecture to the Royal Society of Arts on Feb. 25, W. G. W. Mitchell showed how these improvements have been of the greatest value in the development of television. Comparing this art with that of picture telegraphy, where the tones of a photographic print are transmitted over a wire or wireless circuit and reconverted at the receiver end into a permanent record, he pointed out that with television, eighteen complete pictures must be sent out per second, and that the actual speed of transmission must be a hundred times quicker than in picture telegraphy. The discovery by Baird that infra-red rays could be used instead of the light from a powerful arc lamp made the process of being televised quite comfortable to the subjects. The method of two-way television over the telephone developed by the American Telephone and Telegraph Company was successful. It is very expensive to install, and it has the great drawback of using up some fifteen ordinary telephone conversation channels. A two-way 'conversation' by this method was successfully carried out in New York over a distance of two miles between two deaf mutes. The conversation was maintained solely by reading lip movements. The main difficulty that lies in the way of developing purely electrical methods such as the cathode ray method is the high voltage at present required for operating the necessary tubes. The next big development will probably be the production of a picture of the size and brilliancy of the cinema screen picture of to-day. This will probably be done by using zone methods of scanning in conjunction with wired transmitting circuits. Television should prove a better aid to salesmanship than picture telegraphy. It has already been found useful in connexion with researches on the Kennelly-Heaviside layer. Mr. Mitchell expressed the hope that litigation on patents will not hold up the development of television as it did radio communication.

The April issue of the *Scientific American* has a short description, with diagrams, of a sonic altimeter produced by the General Electric Company which has been used successfully by the Army Air Corps of the United States. A high frequency whistle mounted in a megaphone pointing downwards sends out short blasts at regular intervals, the power being derived from a gas supply tank fed from one of the engine cylinders. At each blast a pointer begins to travel round the dial of the altimeter and the pilot reads the position at the instant he hears the echo of the blast by reflection at the surface of the ground. He is provided with a stethoscope connected to a second megaphone pointing downwards, mounted in the tail of the aeroplane. An acoustic filter in the connecting tube reduces the engine and other aeroplane noises, and it is found that altitudes so low as 50 ft. and so high as 1000 ft. can be accurately measured even in the densest fog.

Typhus fever in the Old World is transmitted by the body louse. Recent *Daily Science News Bulletins* of Science Service, Washington, D.C., report that Drs. Dyer and Badger, of the U.S. Public Health Service, investigating typhus fever in Baltimore, have obtained evidence incriminating a rat flea as the agent transmitting this form of typhus fever, which may be a type slightly different from European typhus fever. It is probable that there are several typhus-like fevers, for there are forms of typhus fever in the East which are transmitted by ticks. It is of interest to recall that Prof. Matthew Hay, of Aberdeen, in 1907, before the mode of transmission of typhus fever was known, suggested on epidemiological evidence that the flea might be the agent.

Messrs. Bellingham and Stanley have recently issued a new illustrated catalogue of their spectrometric apparatus. The general feature in the design of their instruments is the increasing departure, which is now fairly general, from the old conventional type based upon the rotating telescope and collimator. Even where the Littrow principle of mounting is not applied, the instruments tend to be made in more compact and mechanically sounder forms, and, occasionally, to be constructed with interchangeable optical systems. One spectrometer of rather special interest which has been built specially for the study of the Raman effect, but would be of use in the investigation of any feeble visible source when high dispersion was not required, is a large aperture instrument of aperture $F/2$; with a single prism and a lens of 16 cm. focal length, the spectrum between 8000 A. and 3400 A. occupies a length of 16 mm. Among other instruments listed is a polarising photometer for use in the visible and ultra-violet regions.

The New Physics Building of the National Physical Laboratory will be opened on June 23 at 2.15, by Sir F. Gowland Hopkins, president of the Royal Society, and chairman of the general board of the Laboratory. Other speakers will be Sir Richard Glazebrook, chairman of the executive committee, who will give a short account of the history of the building, and Sir J. J. Thomson, chairman of the research committee of the Laboratory. At 3 o'clock the president of the Royal Society will proceed to the Main Aerodynamics building, to receive other visitors to the Laboratory.

The Bakerian Lecture of the Royal Society will be delivered at 4.30 on Thursday, June 25, by Prof. S.

Chapman. The subject will be "Some Phenomena of the Upper Atmosphere".

THE latest addition to the series of catalogues of Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, is No. 538, devoted mainly to "Voyages and Travels before 1750".

THE author of the article on "The Nature and Origin of Ultra-Penetrating Rays" in NATURE for June 6, p. 859, writes that the following errors (present in his MS.) were overlooked by him in the proof: "At the end of the first paragraph '$3{\cdot}7 . 10^9$ ε-volts' should read '$1{\cdot}9 . 10^9$ ε-volts'. This error is repeated fourteen lines later. Again, the same error appears in that at the bottom of the first column on p. 860, 'At present this limit is about $4 . 10^9$ ε-volts' should read 'At present this limit is about $2 . 10^9$ ε-volts'."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A laboratory assistant for the medical unit laboratories of the Welsh National School of Medicine—D. Brynmor Anthony, University Registry, Cathays Park, Cardiff (June 22). Two munitions committee research fellows at the University of Liverpool (Faculty of Engineering)—The Registrar, University, Liverpool (June 22). A lecturer in mathematics (with physics as subsidiary subject) at the Handsworth Technical College—The Principal, Technical College, Handsworth, Birmingham (June 23). A head of the Evening Building Department of the School for Building, Ferndale Road, S.W.4, and a full-time instructor of plumbing for day and evening classes at the same institute—The Education Officer (T.1), County Hall, S.E.1 (June 24). An assistant lecturer in commerce at University College, Leicester—The Registrar, University College, Leicester (June 27). Two visiting teachers for chemistry and physics at the Norwood Technical Institute—The Education Officer (T.1), County Hall, S.E.1 (June 27). An assistant lecturer in the Department of Political Economy of University College, London—The Secretary, University College, Gower Street, W.C.1 (June 30). A demonstrator of physics at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S.E.1 (June 30). A lecturer in physics in the Egyptian University, Cairo—The Dean of the Faculty of Science, c/o Egyptian Education Office, 39 Victoria Street, S.W.1 (July 1). Seven chemical assistants in the Public Health Department of the London County Council—The Clerk of the L.C.C., County Hall, S.E.1 (July 6). A tutor of women students in the University of Leeds—The Registrar, University, Leeds (July 6). A half-time assistant lecturer in botany at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (July 7). A demonstrator in physics in the University of Leeds—The Registrar, University, Leeds (July 13). A reader in organic chemistry in the Aligarh Muslim University (candidates restricted to Indian-born subjects of the King)—Prof. R. F. Hunter, Box 114, c/o NATURE Office. A lecturer-in-charge of the Building Department of the Norwich Technical College—The Principal, Technical College, Norwich.

Our Astronomical Column.

Calendar Reform.—A note in this column on June 6 referred to the widespread opposition to any break in the continuity of the seven-day week. An article by Mr. L. C. W. Bonacina in the *Evening Standard* of May 29 goes too far, however, in the opposite direction in resisting all reforms. One of his main points is the sentimental association of certain old traditions with the present months. But it may be pointed out that many of these associations have already been broken by the change of style. Before the change the hawthorn flowered early in May; now it seldom does so till after the middle of the month. Again, the old rhymes:

Barnaby bright; the longest day and the shortest night:
Lucy light; the shortest day and the longest night,

are no longer true. The dates of the feasts are June 11 and Dec. 13. The strongest argument for a change is, however, the utterly illogical arrangement of the length of the months. Since the average length of a month is almost 30½ days, it is clear that all months should have either 30 or 31 days. The abnormal shortness of February is due to the pride of some Roman emperors, who wished their months to have 31 days. It is strange that mankind has tolerated the anomaly for nearly two thousand years.

Different methods of improvement are possible. The simplest is to make the lengths 30, 31, 30, 31, etc., with the final 31 changed to 30, except in leap year. Another arrangement is 31, 30, 30; 31, 30, 30, etc., with an additional 31 at the end; this has the advantage that the first three quarters are each exactly 13 weeks. The leap day should be placed at the end of the year, so that it does not alter the interval from one calendar date to another in the same year. It is clear that there is room for improvements, and the prospects of carrying them out are rendered brighter if they are not too drastic. It would be wise to drop all tampering with the week; such a change excites strong opposition.

A Very Massive Double Star.—A *Daily Science News Bulletin*, dated Washington, May 20, reports that another very massive double star has had its mass determined, by Dr. J. A. Pierce, at the Dominion Observatory, Victoria, B.C. It will be remembered that the greatest star mass hitherto measured was that of the spectroscopic binary in Monoceros known as the 'Plaskett Star', since it was detected by Dr. J. S. Plaskett, director of the Observatory at Victoria. That consists of two stars of nearly equal mass, each at least 80 times as massive as the sun; since eclipses do not occur in that star, the exact masses cannot be given, but must be somewhat greater than the above. Curiously, the bulletin omits to give the name or position of the newly measured binary, which is one of the most important items in an announcement of this kind; it is stated that its binary character was detected at Mt. Wilson between 1920 and 1924; but it has been the subject of more exhaustive study with the 72-inch reflector at Victoria; since the report mentions "spectroscopic and other photographs", and also gives exact values for the masses (not merely minimum values), it may be concluded that eclipses have been detected. The period of revolution is 56 days, and the masses of the components are respectively 134 and 50 times that of the sun. The centre of gravity is receding from the sun at the rate of 8 km./sec.

Research Items.

Chronology and Archæology.—In *Antiquity* for June, Dr. G. A. Reisner examines the method of dating by means of objects from Egypt with special reference to stone vessels found in Crete and Mesopotamia, and incidentally lays down certain principles for its employment. (1) Conclusions have often been reached on the dating of single objects found in Egypt and little attention has been paid to its range. It is, therefore, necessary to know the whole range of time during which the object occurs in Egypt and the variations in form which it assumes in that time. (2) An Egyptian object found abroad must be identical in form, material, and technique with a type of known range in Egypt. It must be remembered also that most objects in Egypt pass through two stages of development, an earlier stage of practical use and a second in which more or less degenerate examples are made for burial purposes only. Taking the history of stone vessels in Egypt, it would appear that the period during which we might expect an export is that from the time of Zer (third king of Dynasty I.) to the end of Dynasty III.; but the export as gifts, especially royal gifts, might have taken place down to the end of Dynasty V. or even VI. Examining the evidence from the royal site at Knossos, it would appear that there is no object which can be dated with safety to the predynastic period or even Dynasties I.-II. Sir Arthur Evans's correlation of Early Minoan III., Middle and Late Minoan, with the Egyptian periods is correct in all essentials, but some modification is required for the correlation of the Cretan Neolithic and Early Minoan I. and II., as the history of Egyptian stone vessels has progressed considerably since the studies upon which he relied. Taking the material from Ur, so far as published, while the technique has some similarity to the most usual form of Egyptian technique—the boring with a stone—none of the vessels reported from Ur is of Egyptian origin, and they serve no useful purpose in the correlation of the early Sumerian and Egyptian periods.

The Development of the Thyroid.—Ernst Marcus (*Die Naturwiss.*, 27, Feb. 1931) gives a brief account of the development of the thyroid glands in Amphibia, based on his two recent papers on this subject in *Zool. Jahrb.* (Anat. Ontog. 52; Allg. Zool. u. Physiol. 49). Investigation of the ingrowing nervous layer of the ectoderm in all three orders of Amphibia—Gymnophiona, Urodela, and Anura—shows that the thyroid arises from this layer without participation of the endoderm. Implantation of oral ectoderm and mesoderm in the ventral region of the young larva results in the development there of thyroid; the turning of the presumptive oral ectoderm through 180° results in the development of a thyroid lying dorsal to the gut. If a piece of ectoderm the dorsal margin of which borders the ventral half of the presumptive oral region be turned, the portion of the nervous layer which remains in its natural position gives rise to a normal thyroid directed obliquely ventrally away from the endoderm of the gut, while the other portion of the nervous layer produces a thyroid directed obliquely dorsally and without relation to the endoderm.

Axolotls in Captivity.—Number 8, volume 4, of the *Aquarist and Pond Keeper* (May-June 1931) includes several references to the axolotl. In "Notes from the Brighton Aquarium", Mr. George W. Weller describes both black and white varieties. In the "Readers' Records", Mr. John Gray notes that an axolotl had tried to eat a stickleback, which choked and killed it; and Mr. W. E. Teschemaker makes the very interesting statement that a pair of axolotls living in an out-of-door pond have spawned and that the eggs are on the point of hatching. The parents have found their own food since last May, when they were first placed in the pond. The same observer has already reared the young axolotls in the open from the age of about six weeks or less, so that it is quite possible for the whole of the breeding and rearing to take place out of doors at low temperatures.

The Great Crossbill Movement of 1927.—In the summer and autumn of 1927, as many records in the British Isles witnessed, there occurred an important migration of crossbills (*Loxia curvirostra*). The movement, summarised by Ad. S. Jensen, extended over the greater part of Europe from mid-Russia to western France, Ireland, and Iceland, from Finmark to mid-Italy and the Ukraine, and even to the southern parts of western Siberia (*Det Kgl. Danske Vidensk. Selsk., Biol. Meddel.*, **10**, 1; 1930). It was noticeable that the crossbills showed themselves earliest in the most easterly countries visited and progressively moved westwards. The origin of the flight, therefore, must be sought in the east, indeed in the northern parts of Russia and Siberia, where the great pine-forests form the particular habitat of these birds. When explaining the migration, it must be remembered that in the summer of 1927 the pine-trees in these parts made extremely poor growth and the pine-seed harvest was a failure, so that the crossbills, deprived of their staple food, were compelled to wander to fresh feeding-grounds.

Biological Control in Mauritius.—Mauritius, like many other sugar-cane growing countries of the world, suffers severely from the ravages of Lamellicorn beetle larvæ. The species *Phytalus smithi* appears to have been accidentally imported into Mauritius from Barbados, some time prior to 1911, when it was first recorded as a pest. Good work has been achieved by various artificial methods of control, and this has been augmented by the application of biological measures. In 1916, the solitary wasp, *Tiphia parallela*, was introduced from Barbados and has now become well distributed over the whole region of infested cane. The present-day position of the problem is described by Mr. D. d'Emmerez de Charmoy, in the issue of the *Bulletin of Entomological Research* for March. He points out that since the *Phytalus* has been well established in Mauritius, some twelve or fifteen years before the introduction of its parasite, the latter is, for the time being, at a disadvantage from the economic point of view. Years must elapse before it can increase to the point where it will exterminate a sufficient proportion of the host population to yield the desired degree of control. At present the *Tiphia* destroys up to 30 per cent of the *Phytalus* and its work is being augmented by a second parasite, *Elis thoracica*, which was imported from Madagascar in 1917. At the present juncture, it may be said that artificial measures of control are required to be rigidly prosecuted so long as the biological method remains only very partially efficacious.

Tea in India.—Dr. Harold H. Mann's lecture, published in the *Journal of the Royal Society of Arts* of April 3, upon the scientific aspects of the Indian tea industry, was an interesting historical résumé, by one qualified to speak, of the progress in tea cultivation under Indian conditions. Dr. Mann went to India in

1900 as the first scientific officer of the Indian Tea Association. When tea plants were first cultivated in India, early in the nineteenth century, plants were introduced from China, but the discovery of indigenous tea plants on the borders of India and in Assam directed attention to the suitability of certain districts, especially Assam, for tea cultivation, and in 1839 the Assam Company was floated to take over and extend two-thirds of the Government plantations in the province. In those days, only Chinese experience and Chinese methods of cultivation were available, and Dr. Mann suggests that the Indian industry has only thrived since it has been broken away from these methods and developed its own. Tea is a crop with special requirements; it thrives on acid soils and deteriorates upon liming; the crop required is not flower or fruit, but the young leaf, so that a special pruning and cropping technique is required in order to encourage the continual succession of young leafy shoots suitable for plucking.

Flora of Lancetilla Valley, Honduras.—In compiling an enumeration of lowland Honduran plants of the region about Lancetilla Valley and the port of Tela, P.C. Standley (Field Museum of Natural History, *Botanical Series*, vol. 10, Publication 283, Jan. 1931) has made available a botanical work which will be equally useful for study purposes anywhere in the lowlands of Central America, as the area is typical of the wet lowlands of the whole Atlantic coast of that country. Almost all the area which is not devoted to the cultivation of bananas, which is the principal industry and furnishes the chief article of export from Honduras, is covered by dense forests, wooded swamps, or marshes. A general botanical description of the different types of vegetation, with accounts of the climate, geography and inhabitants, economic plants of the district, the relationships of the flora, vernacular names, and previous botanical exploration of the region, precede the descriptive flora. Both flowering plants and cryptogams are included, though the list of the latter is very incomplete. Many of the commoner plants are well illustrated.

Permian Insects.—In part 13 of his series of papers on "Kansas Permian Insects", Dr. R. J. Tillyard (*Amer. Jour. Sci.*, 21, p. 232; 1931) deals with a small group which at first sight appear to be true Coleoptera (or beetles), but a study of the venation and method of folding of the hind wing shows that there is no close relationship between these two groups. For these Permian insects Dr. Tillyard proposes a new order, the Protelytroptera, which he regards as the ancestral group from which the existing Dermaptera (or earwigs) have been derived.

Fossils of the Upper Rhine Valley.—W. Salomon-Calvi ("Oberrheinischer Fossilkatalog," Lief. 1, Berlin: Gebrüder Borntraeger, 1931; 35 gold marks) has edited a catalogue of the fossils found in the upper Rhine valley extending from Basel in the south to Hunsrück and the Taunus in the north. Under each species references are given to the works in which it is recorded or described, to the locality and horizon, and to the museum in which specimens may be seen. The part now published is divided into five sections: 1, "Palæozoic Animals" by M. Pfannenstiel; 2, "Triassic Vertebrates" by W. Scheffen; 3, "Jurassic Invertebrates" by W. Deecke; 4, "Triassic and Jurassic Vertebrates" by M. Pfannenstiel; 5, "Palæozoic and Mesozoic Plants" by K. Frentzen.

Ionic Wind Voltmeter.—One of the earliest effects noticed when a pointed conductor was connected with a source of high voltage was the electric wind produced at the point. The wind is produced by the ions colliding with the uncharged molecules and giving them velocities. The effect is observed at both the high tension and the earthed pole. When the latter is enclosed in an insulating vessel and a bent wire is used as an electrode, it is found that the wire is cooled by the alternating component of the wind according to definite laws. This phenomenon is used in the ionic wind voltmeter described by Prof. W. M. Thornton, W. Waters, and W. G. Thompson in the *Journal of the Institution of Electrical Engineers* for April. By making the earthed electrode part of a hot wire, bridge readings are obtained from which the voltages can be determined. The readings are due to the applied field upsetting the balance of the bridge. Indoor forms of voltmeters are made to indicate up to 300 kilovolts, and outdoor forms up to 132 kilovolts. In addition, portable forms from 3 to 150 kilovolts are made for general testing and X-ray work. The authors describe also a thermo-electrostatic relay which should prove a help in maintaining uniformity of voltage on the grid, a problem of considerable importance in distribution. If a fault or an excess load causes the line voltage to vary, the device actuates a warning signal. The authors state that the researches they made during their investigation on electrical discharge of gases have disclosed a new method of comparing molecular ionising potentials.

Fibre Structure.—An illustrated pamphlet of eighteen pages, issued by the University of Leeds, gives an account of the research work done there during the session 1929-30 with the aid of a grant from the Clothworkers' Company. It includes a five-page summary of the advances in our knowledge of the atomic structure of fibres by the X-ray analysis work of Messrs. W. T. Astbury and H. J. Woods. Wool in its natural state is built up of a number of molecular chains folded into a series of hexagons, and when the wool is stretched these hexagons break up into long zigzag lines the length of which may be double that of the series of hexagons. On the withdrawal of the stretching force, the original hexagonal form is resumed. Natural silk, on the other hand, behaves as would wool already stretched, and has not the long range elastic properties of natural wool. While steam has little effect on the properties of natural wool, it deprives stretched wool of its elasticity, and when the stretching force is removed the wool remains set in the extended state. This fact has important bearings on the dyeing and conditioning of wool and on other textile processes. The Government Grant Committee of the Royal Society granted £200 last year for the furtherance of these researches.

Rotation of Molecules in Crystals.—It has been suggested that in many cases there may be complete rotation of the molecules in crystals at temperatures below the melting point, and the transitions involving considerable absorptions of heat which have been found for solid hydrogen halides may be explained as due to the taking up of rotational energy by the molecules. The transition of solid hydrogen chloride is perfectly isothermal at 98·36° abs. and requires 284·3 cal. per mol. This explanation would require that the solids should have high dielectric constants, and for hydrogen chloride, for example, the dielectric constant of the solid should increase considerably at 98·36° abs. Cone, Denison, and Kemp, in the April number of the *Journal of the American Chemical Society*, show that this is the case. A temperature range of 85° to 165° abs. was used. At 98·4° abs. the dielectric constant changes isothermally from 3 to 10. Thus the theory of the rotation of the molecules in the crystal is supported.

The Ross Institute and Hospital for Tropical Diseases.

THE twenty-fifth anniversary in 1923 of Sir Ronald Ross's epoch-making discovery of the transmission of human malaria through the bite of anopheline mosquitoes was the occasion of an appeal for the foundation of an institute for research upon, and for the treatment of, tropical diseases which should serve as a lasting monument to Ross's achievement.

As a result of this appeal, initiated by Sir William Simpson and Sir Aldo Castellani and supported by many influential signatories in all parts of the world, funds were contributed by Indian princes, colonial governments and municipalities, city companies, rubber, tea, oil, and other trading companies, and private individuals, a house and grounds were acquired on Putney Heath, London, and the building was adapted partly as a hospital for the treatment of patients suffering from tropical diseases and partly as laboratories for research. This constitutes the present Ross Institute and Hospital for Tropical Diseases, of which Her Grace the Duchess of Portland is president.

The Institute is administered by a council of which Sir Charles Campbell McLeod is chairman and Major Lockwood Stevens, secretary. The staff includes Sir Ronald Ross himself as director-in-chief; Sir William Simpson, director of tropical hygiene; and Sir Aldo Castellani, medical director, with Sir Malcolm Watson in charge of the Malaria Department. The annual Report for 1930, recently issued, surveys at some length the activities and research work of the Institute. An increased number of patients were treated in the hospital during the year, the total number being 85.

Sir Ronald Ross has continued to write upon malaria and its control, Sir William Simpson is investigating the longevity of the plague and other bacteria, and Sir Aldo Castellani has published several papers on minor and other ailments of the tropics and upon fungi which attack the skin. Dr. Shaw-Mackenzie is continuing his studies of the blood-changes that occur in cancer and on the diagnosis by blood-tests and treatment of this disease. In the malaria laboratory, observations have been made on the influence of cold upon the larvæ of the British tree-breeding anopheline, *A. plumbeus*, showing that they hibernate and resist even freezing in the water in the tree-holes. A lengthy survey is given of the activities of the Anti-Malaria Advisory Committee of the Institute in the control of mosquitoes and malaria abroad; this work was referred to in NATURE of Jan. 31, p. 173.

Courses of instruction have been given to planters and others interested in the control of malaria. Unfortunately, the income for the year shows a decrease of £1500, partially counterbalanced by a reduction in expenditure of £628 on 1929. The financial position of the Ross Institute is unsatisfactory, as at present the Institute is entirely dependent upon voluntary contributions, and an appeal is made for funds to create an endowment fund.

In a series of appendices, the malaria policy of the Ross Institute is outlined and the results of malaria-preventive measures summarised. Mr. Jackson Clarke, a veteran worker in cancer research, is arranging his collection of slides and photographs for exhibition in the laboratories.

Bi-Centenary of the Foundation of the Royal Dublin Society.

THE bi-centenary of the Royal Dublin Society will be celebrated in Dublin on June 23–26. The history of the Society is in many respects remarkable. As regards the scope of its activities it is probably unique. The first meeting of the Society was held on June 25, 1731, in the rooms of the Philosophical Society in Trinity College, Dublin. The earliest definition of its objects is expressed as follows:

"It was proposed and unanimously agreed unto, to form a Society, by the name of the Dublin Society, for improving Husbandry, Manufactures and other useful arts."

A few days later, on July 1, at the second meeting, it was agreed that the words "and sciences" should be added after "arts" in the title of the Society.

Among its earliest members the name of Thomas Prior appears. He had graduated in Trinity College, Dublin, in 1703. He acted as secretary of the young Society for twenty years, and is by many regarded as its founder. Several distinguished names appear as early members: among others, that of Dr. John Madden, whose son, Samuel Madden, D.D., became a member in 1733 and proved to be one of its most loyal, able, and generous supporters. He became known as 'Premium Madden' because of his wise policy of offering premiums for methods of tillage, etc. He was influential in obtaining for the young Society its first charter.

Among the earliest members many other noteworthy names appear, including that of Sir Thomas Molyneux, a fellow of the Royal Society, who was a friend of Robert Boyle, of Sir William Petty, of Newton, Evelyn, Dryden, and Locke. Molyneux's scientific interests were wide; he first gave a rational account of the origin of the Giants' Causeway, and wrote a scientific report on the Irish elk. In general, however, matters of a practical character engaged the attention of the young Society: such as Prior's paper on "A New Method of Draining Marshy and Boggy Lands".

The foundation of local branch societies in the principal towns and cities of Ireland, which should establish communication with the Dublin Society, was promoted. There is no doubt as to the practical and directly beneficent character of the work of the young Society, and, at the same time, of its interest in the promotion of applied and general science.

This was in the days of that brilliant but unhappy genius, Jonathan Swift. A very extraordinary, anonymous book, printed in Dublin in 1753, and written "By a Friend to the Peace and Prosperity of Ireland", is in the possession of the present writer. It purports to be "A Dialogue between Dean Swift and Thos. Prior, Esq., in the Isles of St. Patrick's Church, Dublin, Oct. 9, 1753". The shades of the two defunct speakers, rising at midnight from the grave, discuss the economic conditions of Ireland and how best they can be improved. The constructive ambitions of Prior are in general exposed to the caustic satire and pessimism of the Dean. But in the end both agree on the necessity of reforms. The dialogue, covering 134 pages, is brilliant throughout.

In the first century of the Society's existence, systematic works, not only of economic and practical nature, but also in many cases of considerable scientific interest, were published by the Society. The now well-known 'Spring Shows' of the Society were inaugurated in 1831, and the stated meetings of the scientific members of the Society began some three years later.

It has been said that most of the good which has been done for Ireland has been done by this great institution. To its initiative and labours Dublin owes its beautiful Botanic Gardens at Glasnevin; its Museum of Art and Natural Science; its National Gallery and School of Art; its National Library; and its College of Science now amalgamated with the National University. The Irish Fishery Department is largely due to its initiative and early support. Its great agricultural shows and horse shows are known over the world.

More recently, the Irish Radium Institute came into existence as one branch of the Society's beneficent work. Its fine pioneer work in advancing radiotherapy, mainly due to the late Dr. Walter Stevenson, is widely known. The functions of this Institute extend to all parts of Ireland.

The support of science, pure and applied, in all its branches has been one of the Society's principal functions in recent years. Its *Transactions* and *Proceedings* include some of the most important writings of Fitzgerald, Stoney, Preston, Trouton, among others. The Society supports a liberal fund for the prosecution of research by the purchase of scientific instruments which are supplied on loan to the investigator, or by money grants when a hopeful investigation is involved. In its great hall, seating 1600 persons, scientific lectures suited to a youthful audience or, again, to an audience of adults are delivered annually by recognised scientific authorities. Still more advanced lectures and demonstrations are delivered periodically in a smaller apartment.

From remote times the Society has promoted the fine arts, as already mentioned; and offers to young artists annually a valuable prize upon the result of competitive work. The prize is of sufficient value to enable the winner to go abroad for the study of art, if he so desires. Nor has the cultivation of music been neglected. Throughout each session eminent musicians perform for the benefit of the members and of the general public.

The membership of the Society to-day numbers 9000, and a long waiting list exists. The great educational value of its membership is recognised by all.

In the celebration of its two-hundredth birthday, every effort will be made to recall its earlier history, as well as to show by contrast the advance between then and now. Early scientific instruments of historic value will be shown. Recent instruments for research devised by members of the Society will be on view. Works of art from Irish painters or sculptors which have arisen out of the Art School long ago established by the Society will be brought together. A period ball on June 26 will close the celebrations. In this, efforts to reproduce the costumes of the past will be encouraged.

June 23 is the opening day. A conversazione, and reception by the president, will be held on the evening of that day.

The North Sea Earthquake.

LATER reports on the North Sea earthquake of June 7 add little, if anything, to our knowledge of its distribution. Several of the cracks in the Chapter House of Lincoln Cathedral were found to be widened, and the shock was felt so far to the south as Paris. The former city lies within the area of slight damage as previously traced, the latter within the boundary of the disturbed area. The course of that boundary towards the east and north remains uncertain, in the absence of records from western Germany and Denmark.

An unusual feature of the earthquake is the great extent of the sound-area. In Great Britain, the sound was heard at several places not more than fifty miles within the boundary of the disturbed area. The double nature of the shock was also observed over a wide area, and even at places so near the boundary as Elgin and Bristol.

It is remarkable that some of the earthquakes most widely felt in Britain should be of submarine origin. The earthquake of 1852—the only one felt in all four divisions of the British Isles—disturbed an area of not less than 56,000 sq. miles. The exact position of the epicentre is unknown, but it was probably submarine and not far from the coast of Ireland. The shock so generally felt in eastern Scotland four years ago was connected with a centre to the west of the Norwegian coast. A centre lying a few miles east of Jersey has been responsible for several shocks felt over the south of England and even in London. The disturbed areas of the Jersey earthquakes of 1878 and 1889 contained about 68,000 sq. miles, while that of the earthquake of 1926 cannot have been much less.

So far as we know, the focus of the recent North Sea earthquake has not been in action for several centuries. The injury to the Chapter House at Lincoln suggests, however, that a strong earthquake in the year 1185 may have been connected with the same centre. The shock is briefly described in several monastic and other chronicles. According to Holinshed ("Chronicles", vol. 2, pp. 188-189), "On the mondaie in the weeke before Easter, chanced a sore earthquake through all the parts of this land, such a one as the like had not beene heard of in England sithens the beginning of the world. For stones that laie couched fast in the earth, were remooued out of their places, stone houses were overthrowne, and the great church of Lincolne was rent from the top downwards."

C. DAVISON.

University and Educational Intelligence.

CAMBRIDGE.—Dr. S. Goldstein, of St. John's College, and Mr. J. M. Whittaker, of Pembroke College, have been appointed University lecturers in the Faculty of Mathematics.

Dr. N. J. J. M. Needham, of Gonville and Caius College, has been reappointed University demonstrator in biochemistry.

The Appointments Committee of the Faculty of Biology 'B' invite candidates for the post of University demonstrator in experimental psychology to send in their names to Prof. Bartlett (at the Psychological Laboratory), together with such evidence of their qualifications as they think fit, not later than Oct. 1, 1931. An appointment will be made early in the Michaelmas Term 1931. The salary of the demonstrator will be £160 per annum.

The Benn W. Levy research studentship in biochemistry is vacant. Applications for its tenure should be addressed to Sir F. G. Hopkins at the School of Biochemistry, before July 1.

The title of Professor Emeritus has been conferred on Sir R. H. Biffen upon his retirement from the professorship of agricultural botany.

The General Board has been authorised to re-appoint Sir Horace Lamb, of Trinity College, to the Rayleigh lectureship in mathematics.

The Vice-Chancellor; Prof. Seward, Master of Downing College; T. Knox-Shaw, of Sidney Sussex; Prof. Debenham, C. F. Cooper, of Trinity Hall; Sir E. H. Young, of Trinity College; J. M. Wordie, of St. John's College; and R. E. Priestley, of Clare College, have been appointed a Syndicate to prepare a scheme for the erection of a building for the Scott Polar Research Institute.

Prof. G. H. Hardy, Savilian professor of geometry in the University of Oxford, has been elected to the Sadleirian professorship of pure mathematics, in succession to Prof. E. W. Hobson, who has resigned.

Applications are invited by the Director of Agriculture, Punjab, for the Maynard Ganga Ram Prize of the value of 3000 rupees, which will be awarded for a discovery, or an invention, or a new practical method tending to increase agricultural production in the Punjab on a paying basis. Applications must reach the Director of Agriculture, Punjab, Lahore, by, at latest, Dec. 31, 1932.

The Council of the Institution of Electrical Engineers offers a Ferranti Scholarship of the annual value of £250 and tenable for two years, for whole-time research or post-graduate work. Candidates must be less than twenty-six years of age, and nominations must be received by Aug. 15. Particulars of these scholarships can be obtained from the Secretary of the Institution, Savoy Place, London, W.C.2.

The following have been appointed to Commonwealth Fund fellowships tenable by candidates from the British Dominions: Mr. Ernest Beaglehole (New Zealand and London) to Yale University, in psychology; Mr. N. S. Grace (Saskatchewan and London) to the University of California, in chemistry; Mr. Bernard Notcutt (Stellenbosch and Oxford) to the University of California, in philosophy. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: Mr. T. G. G. Beck (Public Works Department, Government of New Zealand) to the University of California, in civil engineering; Mr. B. J. Dippenaar (Department of Agriculture, Union of South Africa) to the University of Wisconsin, in agriculture; Mr. A. R. B. Edgecombe (Public Works Department, Government of India) to the University of California, in electrical engineering; Mr. H. R. Knowles (Department of Agriculture, Union of South Africa) to the University of Wisconsin, in agriculture; Mr. E. H. Samuel (Civil Service, Government of Palestine) to Columbia University, in economics; Mr. George Stark (Native Development Department, Government of Southern Rhodesia) to the University of North Carolina, in education.

In the Report for the year 1929–30 of the University of Leeds, prominence is given to the development, actual and prospective, of the University's residential accommodation for students. Devonshire Hall, begun in 1928, already accommodates 140 men and is one of the largest hostels in a modern university. The plans of the building make provision for further expansion, but the extent to which this shall take place will depend not only on funds becoming available but also on the solution of the problem of how many students can appropriately be associated within a single hostel. Another important addition to the University's buildings is the mining block, finished during the summer. Here accommodation is reserved for members of the scientific staff of the Department of Scientific and Industrial Research engaged on a chemical and physical survey of the coal resources of West Yorkshire, which is part of a survey of the coal resources of Great Britain being carried out by the Government. Statistical tables annexed to the report show a substantial increase in the number of day students, both full-time (from 1385 to 1434) and part-time (from 144 to 219). Evening classes, chiefly textile and fuel (industrial), show a falling off from 223 to 144.

Birthdays and Research Centres.

June 20, 1861.—Prof. Sir F. G. Hopkins, Pres. R.S., Sir William Dunn professor of biochemistry in the University of Cambridge.

My department is engaged upon a variety of biochemical problems, but of late years we have given the most attention to a study of the catalytic control of biochemical reactions and especially of oxidations in the living cell. We are endeavouring to apply such studies widely in the biological field; not to mammalian tissues alone, but to every form of living cell. I think that very significant knowledge can be won by studying the metabolism of living organisms; not a little has come to light as the result of work by my colleagues in Cambridge.

I have myself returned lately to a study of the functions of glutathione in tissue respiration, and find that, in some tissues at any rate, it plays a real part in the organisation of events. I am also following up certain lines of vitamin research.

June 22, 1864.—Sir Daniel Hall, K.C.B., F.R.S., Chief Scientific Adviser, Ministry of Agriculture and Fisheries, and Director of John Innes Horticultural Institution.

So far as my personal work is concerned, I am endeavouring to clear up certain points in the taxonomy of tulip species, which has taken on a new aspect since the discovery of polyploidy in the genus by the late Mr. W. C. F. Newton. Tulips present various other problems of great significance in general botanical theory, but they can be resolved only by breeding experiments. Since six years are required on the average to bring a tulip seed to the flowering stage and two or three generations are necessary, I am trusting to some successor eventually to work out the material I am initiating.

Herein lies the great value of a research foundation like the John Innes Horticultural Institution; it can embark with some confidence upon a scheme of work that may require a long term of years for its completion. The genetics of fruit trees affords a case in point; a generation is rarely less than seven years with apples, plums, and cherries, and although Mr. Crane has already obtained results of prime importance, they still open up fresh vistas of more extended work.

Considering the magnitude of British interests in the tropics and the fact that all progress in the improvement of tropical crops like copra, rubber, tea, coffee, etc., depends upon genetical work, it is lamentable to see how little recognition the subject still receives either in our universities at home or in our experimental stations overseas.

June 22, 1887.—Prof. Julian Huxley, honorary lecturer in zoology at King's College, London.

I am myself especially interested in various lines of work bearing directly or indirectly upon the relation of hereditary constitution to adult characters: such problems as the effects of individual genes during development, the study of changes in relative size of organs with growth, and the systematic study of gene-expression under different environmental conditions.

I am also much interested in the species problem, and wish that a concerted attack could be directed upon it by a team including general zoologists as well as systematists, students of distribution, ecologists, biometricians, and geneticists. I believe that a careful organisation of research in this field would be extremely fruitful.

June 23, 1859.—Lieut.-Col. A. W. ALCOCK, C.I.E., F.R.S., I.M.S. (retired), formerly professor of medical zoology in the University of London.

Since my retirement from the London School of Tropical Medicine under the statutory age-limit, my efforts have been confined to supporting, under the auspices of the Tropical Diseases Bureau, what I hope may never be neglected, namely, the old and fruitful connexion between natural science and scientific medicine. Authors of papers treating of animals specifically hurtful to the human frame, and zoological papers throwing light on causes, or suggesting means of control and prevention, of specific diseases of mankind, provide most of the material of this useful though non-spectacular work.

As a medico-zoological subject for extremely promising study, I would direct attention to the wolf-reared children—one of whom I have seen—that occasionally come to light in northern India. There is evidence that such children, having in infancy been carried off by wolves, have survived, have lived among the wolves, and (if by after-chance rescued by capture) behave as wild animals. But to what extent the germs of their human and intellectual endowment have been annulled or aborted in their aberrant wolfish environment is a subject that has never been precisely investigated. It is plain that such exact investigation by a company of medical mentalists and biologists might be enormously instructive, in many directions, where confusion and fallacy now are somewhat prevalent.

June 25, 1859.—Prof. SYDNEY J. HICKSON, F.R.S., emeritus professor of zoology in the University of Manchester, honorary fellow of Downing College, Cambridge.

During the last three years the subject of my investigation has been the species-problem in certain groups of Cœlenterata. With this in view, I have completed a study of the Gorgonacea from the Panama region and of the Xeniidæ from the Barrier Reef. In some genera there are apparently clearly defined discontinuous groups probably of the character of Linnean species, in others there seems to be complete continuity between the so-called ‘species’. Satisfactory results as regards continuity can only be obtained when considerable numbers of specimens of a genus from one locality, or of species from several localities, are submitted to detailed investigation.

The main object of this research is to throw light on the origin of species in a group of radially symmetrical and sedentary animals.

June 26, 1894.—Prof. P. KAPITZA, F.R.S., fellow of Trinity College, Cambridge, and assistant director of magnetic research in the Cavendish Laboratory.

The general line of our research is the study of the influence of strong magnetic fields on solid substances. It is possible to trace the influence of the magnetic field on nearly all the known physical properties of substances. We devote our attention mainly to studying the magnetisation of the substance itself, to the influence of the magnetic field on the binding forces between the atoms (magnetostriction) and to the disturbing effect of the field on the motion of free electrons in the crystal lattice (galvanomagnetic phenomena).

It appears that all these phenomena are strongly influenced by the physical state of the substance, and are much simplified if they are studied in undisturbed crystals. The presence of foreign atoms, plastic deformation, and temperature agitation all seem to disturb the symmetry of the crystal lattice and hinder the appearance of the more simple laws which govern the phenomena in a perfect crystal lattice. Should these laws be established they would probably have a more simple theoretical interpretation, since the crystal lattice is the most regular and symmetrical of all aggregates of atoms known in Nature.

Societies and Academies.

LONDON.

Royal Society, June 11.—M. L. E. Oliphant: Electron emission from Langmuir probes and from the cathode of the glow discharge through gases. It is found that for potentials above about 600 volts the rate of increase of current to the probe is greater than that predicted by the original theory of Langmuir and Mott-Smith, and this is ascribed to electron emission from the electrode, which increases with the energy of impact of the positive ions. The energy delivered to the probes as heat has been measured by a compensation method which eliminates all corrections. From this energy and the potential of the probe relative to the surrounding space the positive ion current i_p can be obtained. It is found that the ratio of electron to positive ion current is independent of the energy of the positive ions up to that corresponding to a potential of 600 volts, and thereafter increases. The results are then discussed from the point of view of the angle of impact of the positive ions on the electrode surface, and it is pointed out that there must be an emission of electrons produced by agencies other than the impact of positive ions.—**H. E. Watson, G. Gundu Rao, and K. L. Ramaswamy:** The dielectric coefficients of gases, I. The dielectric coefficients of the five inactive gases and hydrogen have been measured at 25° and at $-190°$ or $-78°$ and compared with that of carbon dioxide. None of these gases except argon has an electric moment detectable by the method of measurement employed, $0{\cdot}05 \times 10^{-18}$ being an upper limit for krypton and xenon. For argon the figure appears to be $0{\cdot}03 \times 10^{-18}$, but this is probably a spurious result. For the remaining gases it is not more than $0{\cdot}015 \times 10^{-18}$. Further investigations of possible sources of error have been made, and an approximate method of determining condenser distortion with pressure is described.—**G. D. Bengough, A. R. Lee, and F. Wormell:** The theory of metallic corrosion, IV. The effect on the corrosion of zinc of faster and slower rates of oxygen supply than those used for previous papers has been studied, and some comparisons made with the corrosion of mild steel. Complete curves are given showing the effect of concentration of potassium chloride and of potassium sulphate on the corrosion rates of zinc in tranquil conditions. The influence of depth of immersion between limits of 0·35 mm. and 100 mm. has been ascertained. An explanation has been found for the departure from linear corrosion rates after prolonged immersion in potassium chloride solution. A micrographic study of the form and distribution of corroded areas has shown that very highly purified zinc yielded characteristic etch pits, but no preferential crystal boundary attack; less highly purified zinc rarely showed etch pits of definite shape, but marked preferential attack on the crystal boundaries.

Geological Society, May 20.—A. A. Fitch: The geology of the country between Ivybridge and Buckfastleigh, Devon. The area described consists of a strip of the granite margin, the metamorphic aureole, and some rocks beyond the influence of the granite. The physical geology is discussed and the presence of a relic of the 700–500-foot platform demonstrated by planimetric measurements. The rocks are described stratigraphically. The petrology and petrogenesis of the resulting rocks are discussed in detail, and some aspects of two-way migration considered. The mineral assemblage of the aureole is not of much diagnostic value for the provenance of the sediments of the South of England. Superficial deposits do not afford matter of great interest. Economic aspects of the geology are dealt with.

DUBLIN.

Royal Irish Academy, May 11.—**J. J. Nolan** and **P. J. Nolan**: Observations on atmospheric ionisation at Glencree, Co. Wicklow. The equilibrium of atmospheric ionisation was examined under conditions of wide variability of concentrations of condensation nuclei. Certain diurnal variations of the concentrations of ions and nuclei were found. The relation between ions and nuclei cannot be represented by a recombination equation of the ordinary type. An empirical equation formerly proposed, involving the square root of the nucleus concentration, appears to fit the results better. Both the ratio of positive to negative ions and the rate of production of ions appear to have a diurnal variation corresponding to that of the earth's field.—**T. McHugh**: A pair of circular cubics generated by two rigid quadrangles. When one plane moves upon another in such a way that a fixed quadrangle in the first plane is always in perspective with a fixed quadrangle in the second plane, the centre of perspective describes a circular cubic in each plane. The relations and properties of these cubics are discussed and degenerate cases are examined.

EDINBURGH.

Royal Society, May 19.—**A. D. Peacock** and **R. A. R. Gresson**: Male haploidy and female diploidy in *Sirex Cyaneus*, F. (Hymen). The work of Peacock and Sanderson on the more generalised Hymenoptera, the Tenthredinidæ, in which cells of connective tissue, blastoderm, embryo, and gonad have been examined, shows that the parthenogenetically-produced male is haploid (8) and the bi-sexually-produced female is diploid (16). Further work, by Peacock and Gresson, on the wood-wasp *Sirex cyaneus* F., supports the same view, for the spermatogonia and second spermatocytes are haploid (8), there is an abortive first maturation division, and the oogenia are diploid (16). Shortage of material has precluded study of the somatic cells. Fuelgen's ' nuclealreaktion ' is negative when applied to the large chromoid body and the cytoplasmic granules seen so prominently in spermatogenesis by the iron hæmatoxylin technique; their nature remains to be discovered.—**Jessie A. R. Wilson**: Some new facts about the structure of the cuticles in the Russian paper-coal, and their bearing on the systematic position of some fossil Lycopodiales. With a note on the absence of eligulate heterosporous Lycopodiales in the fossil-record by **J. Walton**: A reinvestigation of the plant-cuticles extracted from the ' paper-coal ' from the Lower Carboniferous of the Moscow Basin has confirmed that the plants from which these cuticles have been derived were in possession of a ligule and must be classed amongst the ligulate lycopods. Since there is no evidence of leaf-cushions having been present on the older stems the cuticles are to be referred to the genus *Bothrodendron*. A critical consideration of the known facts about the living and extinct Lycopodiales makes it clear that there are no known examples of eligulate heterosporous types.—**A. H. R. Goldie**: The electric field in terrestrial magnetic storms. Magnetically disturbed days magnify a peculiarity that is present in the diurnal variation of magnetic force even on quiet days, the magnification increasing with proximity to the auroral zone. Using mainly the data of Lerwick, Eskdalemuir, and Abinger observatories, computations are made of the position, direction, and strength of electric currents capable of producing the displacements recorded during storms. The heights found in individual cases range from less than 100 km. to above 500 km.; strengths are of the order of 500,000 amperes. Midwinter and quiet years are characterised by currents low in strength and in altitude and considerably inclined to the W.-E. direction; summer and equinoctial seasons and disturbed years by the opposite features. A chart is given of the electric current system in northern latitudes. This system is derivable from currents generated mainly in the illuminated regions of the globe.—**T. M. MacRobert**: Fourier integrals. This paper gives proofs, by the method of contour integration, of Fourier's double integral and of the Fourier-Bessel integral. Two new Fourier-Bessel integrals are then established, and also a Fourier-Legendre integral.

PARIS.

Academy of Sciences, April 27.—**Gabriel Bertrand** and **V. Ciurea**: Lead in the organs of animals. In a previous communication regarding the occurrence and distribution of tin in animals it was mentioned that the sulphide precipitate contained other metals besides tin. One of these is lead, and figures are now given for the amounts of lead found in various organs of the ox, horse, and sheep. Generally, the distribution of lead and tin in the organs of these animals is similar, except in the case of the brain, which, in proportion, contains more lead.—**L. Cayeux**: The core-in-core structure in schists. Of the two hypotheses suggested for the explanation of the core-in-core structure, crystallisation and a pressure effect, the latter is found to accord best with the results obtained by the author from his examination of the Ordovician schists of Cabrières.—**Ch. Achard** and **M. Piettre**: The proteins of the articular effusion.—**Paul Helbronner**: A text of the third circular letter of Pascal relating to the cycloid (Dec. 7 and 9, 1658).—**S. Winogradsky**: New researches on the micro-organisms of nitrification: a description of a modified silica gel culture method, in which the gel is coated with a layer of an insoluble carbonate of an alkaline earth; the production of nitrate is accompanied by solution of the carbonate and consequent formation of translucent spots which can be counted.—**A. Buhl**: The curvilinear propagation of invariant integrals. The case of double integrals. Corpuscular propagation.—**D. Wolkowitsch**: The utilisation of Culmann's ellipsoid of inertia for the representation of an empirical law by an approximate formula with several parameters.—**André Fouillade**: A general theorem of iteration.—**Arnaud Denjoy**: Co-ordinated ensembles.—**Paul Montel**: Pairs of polynomials the zeros of which are inter-related.—**Edgar Baticle**: The equilibrium curves of wires the elements of which are submitted to central forces.—**P. Dupin** and **Teissié-Solier**: The alternate vortices of Bénard-Karman and Reynolds's law of dynamical similitude.—**S. Choubine**: The possible anomalies of resistance at low temperatures.—**L. Goldstein**: The quantic mechanics of atomic shocks.—**Drzewiecki**: The application of Bernoulli's formula to the expansion of gases.—**R. Perrin** and **V. Sorrel**: An induction furnace with a ferromagnetic muffle and self-regulating temperature. The muffle is made of ferrocobalt (30 per cent cobalt) and is surrounded by a closed conducting envelope (nickel) not magnetic at the working temperature. With currents varying from 40 amp. to 120 amp. the temperatures varied only from 946° C. to 972° C. The range of special steels now available permits self-regulating furnaces of this type to be made to work at any temperature between 150° C. and 1100° C.—**A. Sesmat**: The hypothesis of the curve of pursuit and Michelson's experiment.—**A. Kastler**: The structure of the Raman bands in liquids. In the passage from the gaseous to the liquid state, the Raman bands are displaced in the direction of lower frequencies.—**Ch. Féry** and **Reynaud-Bonin**: A non-sulphating accumulator with high output. A modification of the arrangement suggested in 1924, in which the access of oxygen to the negative plate is prevented. The results of comparative tests on the commercial scale with ordinary and modified accumulators are given, and show clearly the advantages possessed by the latter.—**P. Brenans** and **K. Yeu**: Symmetrical halogenated phenols.—**M. G. Filipesco**: The siliceous rocks of organic and chemical origin from the Oligocene of the Carpathian mountains.—**Albert Michel-Lévy**: The conditions of deposit of the Perrier conglomerates (Puy-de-Dôme).—**C. Arambourg**: The longevity, in northern Africa, of the genus *Rhinoceros* during the Quaternary period. Evidence from various sources tends to prove that the rhinoceros survived in North Africa up to a relatively recent date.—**Maurice Villaret, L. Justin-Besançon**, and **Jean Camus**: The application of perfusion methods to researches of experimental hydrology concerning vaso-motricity.—**Albert Nodon**: Observations on atmospheric detonations preceding solar and terrestrial disturbances.—**Ernest Esclangon**: Remarks on the preceding communication.—**Mlle. V. Bossuyt** and **G. Chaudron**: Contribution to the study of the structure of textile fibres.—**Pr. Merklen, Mlle. E. Le Breton**, and **A. Adnot**: The influences of the lipoids of serum on the precipitation and estimation of the serum globulins. The lipoprotein complexes of the serum exercise a hindering action on the precipitation of the globulins either by carbon dioxide or by neutral salts.—**G. Tanret**: The trehalose of yeast. Trehalose is found in high fermentation yeast to the extent of 2 per cent, but is not present in low fermentation yeast.—**M. A. Machebœuf** and **R. Wahl**: Biochemical researches on the serum of patients suffering from lipoid nephrosis.—**Marcel Labbé** and **F. Nepveux**: The sulphydric compounds of human blood in the normal and in pathological states.

ROME.

Royal National Academy of the Lincei, Nov. 16.—**Maria Pastori**: General expression for isotropic tensors.—**V. Hlavatý**: Geodetic co-ordinates. Various considerations concerning Fermi's theorem on the geodetic co-ordinates along a curve in n-dimensional space are discussed.—**G. Krall**: Critical velocities of heavy masses on a binary.—**N. Sakellariou**: A class of central movements.—**A. Masotti**: The electrical condenser formed by a rectilinear wire between two parallel planes. The general case, in which the wire is not equidistant from the two planes, is discussed.—**R. Brunetti** and **Z. Ollano**: The Raman effect in pure water and in certain solutions.—**V. Puntoni**: Morphological differentiation of certain species of Actinomycetes confused under the name *Actinomyces bovis*. By a study of the process of formation of aerial mycelia, and of the sporification, differential characters have been established between *A. sulphureus*, *A. albus*, *A. chromogenus*, *A. albido-flavus*, and *A. carneus*.—**M. Mitolo**: The material metabolism of the central nervous system (3): The elimination of the cholesterol. The complete elimination of cholesterol by surviving central nervous tissue is a phenomenon which may be established experimentally and is intimately connected with the metabolic processes of the tissue.

Official Publications Received.

BRITISH.

Forestry Commission. Bulletin No. 12: Forest Gardens. Pp. 116+25 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

The Journal of the Royal Agricultural Society of England. Vol. 91. Pp. 8+342+clxxv+12+xvi. (London: John Murray.) 15*s*.

Territory of Papua. The Species of Tobacco grown in New Guinea. By J. S. L. Gilmour. (Anthropology, Report No. 11.) Pp. v+10+7 plates. (Port Moresby: Government Printer.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 413, May. Pp. 557-672+xxviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Records of the Botanical Survey of India. Vol. 13, No. 1: A Census of Indian Mosses, with Analytical Keys to the Genera referred to in the Census as well as all the Genera dealt with in the second edition of Prof. Brotherus' Account of the Musci Veri in Engler and Prantl's "Pflanzenfamilien". By P. Brühl. Pp. 135. (Calcutta: Government of India Central Publication Branch.) 2.6 rupees; 4*s*. 3*d*.

Proceedings of the Society for Psychical Research. Part 119, Vol. 39, May. Pp. 419-447. (London.) 2*s*. 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 5: Observations on the Photo-electric Measurement of the Radiation from Mercury Vapour Lamps and from the Sun, and on the Effects of such Radiation upon the Skin. By Dr. W. R. G. Atkins. Pp. 49-66. 1*s*. 6*d*. Vol. 20 (N.S.), No. 6: Some Experiments on the Accuracy obtainable with Gas-filled Photo-electric Cells. By Dr. W. R. G. Atkins. Pp. 67-73. 6*d*. Vol. 20 (N.S.), No. 7: A Method of distinguishing certain Strains of New Zealand Perennial Ryegrass (*Lolium perenne*, L.) by examination of Seedlings under Screened Ultraviolet Light. By P. A. Linehan and S. P. Mercer. Pp. 75-83+1 plate. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Board of Trade. Report of the Departmental Committee on the Patents and Designs Acts and Practice of the Patent Office. (Cmd. 3829.) Pp. 104. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Imperial Institute. Annual Report, 1930, by the Director, Lieut.-General Sir William Furse, to the Board of Governors. Pp. 55. (London.) 2*s*.

Horticultural Education Association. Reports on some Aspects of Horticultural Education. Pp. 27. (Lewes.) 6*d*.

The Linen Industry Research Association. Report of the Council, 1930. Pp. 26. (Lambeg.)

British Honduras. Report of the Forest Trust, 1929. Pp. 15. (Belize: Conservator of Forests.)

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Tenth Annual General Meeting on May 20th, 1931. Pp. ii+94. (London.)

Union of South Africa: Department of Mines and Industries: Geological Survey. The Geology of the Country surrounding Nkandhla, Natal: an Explanation of Sheet No. 109. By Dr. Alex. L. Du Toit. Pp. 111+3 plates. (Pretoria: Government Printing Office.) 5*s*. (including Map.)

The Committee for Legalising Eugenic Sterilization. Psychiatric Indications for Sterilization. By Dr. Ernst Rüdin. (Abridged translation.) Pp. 10. (London: The Eugenics Society.) 6*d*.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1930. Pp. 19. (Hong Kong.)

Survey of India. Map Publication and Office Work, 1929 to 1930, from 1st April 1929 to 31st March 1930. Pp. vii+19+5 maps. (Calcutta.) 1 rupee; 1*s*. 9*d*.

Proceedings of the Royal Society of Victoria. Vol. 43 (New Series), Part 2. Pp. 101-262. (Melbourne.)

Canada: Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1929. (No. 719.) Pp. ii+69+5 plates. (Ottawa: F. A. Acland.)

Proceedings of the Royal Society of Edinburgh, Session 1930-1931. Vol. 51, Part 1, No. 6: The Genus *Lyginorachis* Kidston. By Dr. R. Crookall. Pp. 27-34+3 plates. 1*s*. 6*d*. Vol. 51, Part 1, No. 7: On Charlier's New Form of the Frequency Function. By A. C. Aitken and A. Oppenheim. Pp. 35-41. 9*d*. Vol. 51, Part 1, No. 8: Some Noteworthy Examples of Parallel Evolution in the Molluscan Faunas of Southeastern Asia and South America. By Dr. B. Prashad. Pp. 42-53. 1*s*. Vol. 51, Part 1, No. 9: The Classification and Development of Carbonaceous Minerals. By Prof. Henry Briggs. Pp. 54-63. 1*s*. Vol. 51, Part 1, No. 10: On the Identity of *Sacculina triangularis* and *Sacculina inflata*. By Dr. H. Boschma. Pp. 64-70. 9*d*. Vol. 51, Part 1, No. 11: Electromagnetic Phenomena in a Uniform Gravitational Field. By Dr. D. Meksyn. Pp. 71-79. 1*s*. Vol. 51, Part 1, No. 12: Further Numerical Studies in Algebraic Equations and Matrices. By A. C. Aitken. Pp. 80-90. 1*s*. Vol. 51, Part 1, No. 13: On the Operational Solution of the Homogeneous Linear Equation of Finite Differences by Generalised Continued Fractions. By L. M. Milne-Thomson. Pp. 91-96. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

FOREIGN.

University of Washington Publications in Anthropology. Vol. 4, No. 2: A Sketch of Northern Sahaptin Grammar. By Melville Jacobs. Pp. 85-291. (Seattle, Wash.: University of Washington Press.) 2 dollars.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 30, Part 2: On the Change of Barley Protein in Storage and Germination. By Eiji Takahashi and Kihoshi Shirahama. Pp. 119-161. (Tokyo: Maruzen Co. Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 297: Propagation of Wireless-Waves. By Hantaro Nagaoka. Pp. 169-188. 30 sen. No. 298: Experimental Studies on Form and Structure of Sparks, Part 8. By Torahiko Terada, Ukitirô Nakaya and Ryûzô Yamamoto. Pp. 189-217+plates 10-22. 90 sen. Nos. 299-301: X-Ray Diffraction by Incandescent Carbon, by Morisô Hirata: Über die Bandenspektren des Zinkhydrids, von Mitsuharu Fukuda; An Apparatus for Detecting Defective Insulators, by Takeshi Nishi. Pp. 219-250+plates 23-24. 50 sen. (Tôkyô: Iwanami Shoten.)

Smithsonian Institution: United States National Museum. Bulletin 155: The Birds of Haiti and the Dominican Republic. By Alexander Wetmore and Bradshaw H. Swales. Pp. iv+483+26 plates. (Washington, D.C.: Government Printing Office.) 1 dollar.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 83. The Orthoptera of Kansas. By Morgan Hebard. Pp. 119-227. The Fishes obtained by the De Schauensee South African Expedition, 1930. By Henry W. Fowler. Pp. 233-249. The Grootfontein, Southwest Africa, Meteoric Iron. By Samuel G. Gordon. Pp. 251-255. The Geographical Forms of *Polihierax semitorquatus*. By W. Wedgwood Bowen. Pp. 257-262. (Philadelphia.)

The American Museum and the University: Sixty-second Annual Report of the Trustees for the Year 1930. Pp. viii+208+8 plates. (New York City.)

Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1930. (Chemical Section, Publication No. 63.) Pp. iii+32. (Khartoum.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 73: Untersuchungen an Salmoniden mit besonderer Berücksichtigung der Art- und Rassefragen. Teil 2. Von H. Henking. Pp. 122. (Copenhague: Andr. Fred. Høst et fils.) 5.50 kr.

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 82, 1930. Pp. 450+37 plates. (Philadelphia.) 6.25 dollars.

The Academy of Natural Sciences of Philadelphia. 1930 Year Book. Pp. 77. (Philadelphia.)

Smithsonian Institution: United States National Museum. Bulletin 154: A Study of the Teiid Lizards of the Genus Cnemidophorus with Special Reference to their Phylogenetic Relationships. By Charles E. Burt. Pp. viii+286. (Washington, D. C.: Government Printing Office.) 80 cents.

R. Osservatorio Astrofisico di Catania. Annuario 1931. Pp. iv+37. (Catania.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 14, No. 2, March. Pp. 43-78. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.00 yen.

Anales del Museo Nacional de Historia Natural Bernardino Rivadaria, Buenos Aires. Tomo 36. Pp. x+519+88 láminas. (Buenos Aires.)

Cornell University Agricultural Experiment Station. Bulletin 516: Dry Skimmilk in Ice Cream. By Walter V. Price and Randall Whitaker. Pp. 37. Bulletin 517: Celery Production on the Muck Soils of New York. By J. E. Knott. Pp. 37. Bulletin 518: A Statistical Study of Milk Production for the New York Market. By M. P. Catherwood. Pp. 126. Memoir 135: A Gene in Maize for Supernumerary Cell Divisions following Meiosis. By G. W. Beadle. Pp. 12+3 plates. (Ithaca, N.Y.)

Carnegie Institution of Washington. Publication No. 413: Papers from Tortugas Laboratory of Carnegie Institution of Washington, Vol. 27. i. A Cytological and Biochemical Study of the Ovaries of the Sea-urchin *Echinometra lucunter*, by D. H. Tennent, M. S. Gardiner and D. E. Smith; ii. Observations on the Formation of the Egg of *Echinometra lucunter*, by Ruth A. Miller and Helen B. Smith; iii. Studies on the Coral Reefs of Tutuila, American Samoa, with Especial Reference to the Alcyonaria, by Lewis R. Cary; iv. Formed Components and Fertilization in the Egg of the Sea-urchin *Lytechinus variegatus*, by Esther C. Hendee. Pp. ii+105+22 plates. (Washington, D.C.: Carnegie Institution.)

Proceedings of the United States National Museum. Vol. 78, Art. 19: Notes on the American Bats of the Genus Tadarida. By H. Harold Shamel. (No. 2862.) Pp. 27. (Washington, D.C.: Government Printing Office.)

Carnegie Institution of Washington. Publication No. 414: Contributions to Embryology, Vol. 22, Nos. 126 to 133. No. 126: Focal Deficiencies in Fetal Tissues and their Relation to Intra-uterine Amputation, by George L. Streeter; No. 127: Human Tubal Ova, related Early Corpora Lutea and Uterine Tubes, by Edgar Allen, J. P. Pratt, Q. U. Newell and L. J. Bland; No. 128: Phagocytic Activity and Morphological Variations of the Ciliated Epithelial Cells of the Trachea and Bronchi in Rabbits, by Marian W. Ropes; No. 129: Observations on the Development of the Human Female Genital Tract, by Richard H. Hunter; No. 130: Ontogeny and Phylogeny of the Nasal Cartilages in Primates, by I. Chuan Wen; No. 131: A Human Embryo with 14 Pairs of Somites, by Chester H. Heuser; No. 132: Area vitellina of Chick Blastoderm in Tissue Cultures, by Z. Grodzinski; No. 133: On a Series of Placental Stages of a Platyrrhine Monkey (*Ateles geoffroyi*) with some Remarks upon Age, Sex and Breeding Period in Platyrrhines, by George B. Wislocki. Pp. iii+192+40 plates. (Washington, D.C.: Carnegie Institution.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1930. Pp. 23. (Batavia.)

Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1928. Pp. iv+164. Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1929. Pp. iv+170. (Zinsen.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 5. Pp. 133-154. 0.40 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 3. Pp. 131-183. 1.20 yen. Section 4: Zoology. Vol. 2, Part 3. Pp. 141-224. 1.30 yen. (Tokyo: Maruzen Co., Ltd.)

República Argentina: Ministerio de Agricultura de la Nacion. Anales de la Dirección de Meteorología, Tomo 19. Conteniendo las observaciones practicadas en el año 1928. Vol. 1: Resultados de las Observaciones Aerológicas effectuadas con Globos-pilotos en el Observatorio Regional Buenos Aires (Villa Ortuzar). Pp. 21+54 graficos. (Buenos Aires.)

CATALOGUES.

Rare and Interesting Works on Entomology and Arachnology. (New Series, No. 25.) Pp. 80. (London: Wheldon and Wesley, Ltd.)

Voyages and Travels before 1750, with a few Early Atlases, Books on Navigation, Mathematics and Kindred Subjects. (Catalogue 538.) Pp. 66. (London: Francis Edwards, Ltd.)

A Catalogue of Books on Philosophy. (No. 1458.) Pp. 28. (Cambridge: Bowes and Bowes.)

Diary of Societies.

FRIDAY, JUNE 19.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 3 and at 5.15.—Discussion on Audition to be opened by Dr. C. S. Myers.—Dr. E. D. Adrian: The Microphonic Action of the Cochlea in Relation to Theories of Hearing.—Dr. R. T. Beatty: Auditory Mechanisms.—Dr. A. W. G. Ewing: High-frequency Deafness.—Dr. F. Allen: The Perception of Intensity of Sound in Normal, Depressed, and Enhanced States of Aural Sensitivity.—Dr. E. G. Richardson: The Dynamical Theory of the Ear.—Sir Richard A. S. Paget, Bart.: Audition in Relation to Speech, and the Production of Speech Sounds by the Human Vocal Apparatus, by Acoustic or Electrical Resonators, and by Musical Instruments.—Dr. E. W. Scripture: The Nature of the Vowels.—Dr. E. Meyer: The Analysis of Noises and Musical Sounds.—Dr. C. V. Drysdale: Acoustic Measuring Instruments.—Dr. H. Banister: The Basis of Sound-localisation.—Dr. A. H. Davis: The Measurement of Noise.—Dr. F. Trendelenberg: Objective Measurement and Subjective Perception of Sound.—Dr. G. Waetzmann and H. Heisig: The Measurement by Resonance Telephone of the Threshold Sensitivity of the Ear.—Major W. S. Tucker: The Localisation of Sound Derived from Observations of Intensity.—Prof. E. M. von Hornbostel: The Time Theory of Sound-localisation. A Re-statement.

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section), at 5.—Special General Meeting.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Prof. F. J. Browne: The Zondek-Ascheim Reaction in Chorion-Epithelioma.—Dame Louise McIlroy and Dr. Gladys Hill: Pregnancy Complicated with Diabetes.

ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8.30.—Special General Meeting.

SATURDAY, JUNE 20.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—A. Walker: Interim Report of the Support of Workings in Mines Committee.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section) (at Oxford).

MONDAY, JUNE 22.

ROYAL GEOGRAPHICAL SOCIETY (Annual General Meeting), at 3.—Sir William Goodenough: Presentation of Royal Medals and other Awards of the Society; delivery of Presidential Address; Annual Report of the Council.

TUESDAY, JUNE 23.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Gossip Meeting.

WEDNESDAY, JUNE 24.

ROYAL SOCIETY OF ARTS, at 4.—Annual General Meeting.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 11 Chandos Street, W.1), at 8.30.—Dr. A. R. Redfern, Dr. Sybille Yates, and Dr. J. C. Young: Symposium on Phobias. Discussion to be opened by Dr. E. Miller.

THURSDAY, JUNE 25.

ROYAL SOCIETY, at 4.30.—Prof. S. Chapman: Some Phenomena of the Upper Atmosphere (Bakerian Lecture).

ROYAL SOCIETY OF MEDICINE (Urology Section), at 5.30.—The Treatment of Inoperable Carcinoma of the Bladder.

FRIDAY, JUNE 26.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Oxford).

SATURDAY, JUNE 27.

BRITISH PSYCHOLOGICAL SOCIETY (at Reading University), at 3.15.—Papers on Oscillation:—Miss M. I. Dunsdon: Reversible Perspective and the Effect of Conation.—Mrs. H. W. Oldham: Oscillation in Sounds of Low Intensity.—Demonstrations of Apparatus by D. F. Vincent: (*a*) A Mirror Tachistoscope Without Moving Parts; (*b*) An Apparatus for Producing Sounds of Predetermined Wave-form.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Oxford).

PUBLIC LECTURES.

TUESDAY, JUNE 23.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, W.2), at 5.—Prof. H. Hartridge: The Theory of Hearing.

FRIDAY, JUNE 26.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir Thomas Legge: Industrial Poisonings.

BI-CENTENARY.

JUNE 23 TO 29.

ROYAL DUBLIN SOCIETY (Bi-Centenary Celebrations) (at Ball's Bridge, Dublin).

Tuesday, June 23, at 8.30.—Conversazione.

Wednesday, June 24, at 11 A.M.—Scientific Proceedings.

Thursday, June 25, at 11 A.M.
At 3.—Anniversary Stated Meeting.

Friday, June 26, at 11 A.M.

Saturday, June 27, at 2.

Monday, June 29, at 8.30.

SUMMER MEETING.

JUNE 22 TO 24.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Harrogate).