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Purposes of University Education

IN the plea for devising an education which would secure for us representatives capable of co-operating intelligently with technical experts in constructive social enterprise and would also teach us how to choose them, which formed one theme of his Conway Memorial Lecture (see *NATURE* of July 25, p. 139), Prof. L. Hogben uttered a warning against the teaching of science for vocational purposes which deserves close attention. He raises essentially the same question regarding all education that was raised of university education by the recent report of the University Grants Committee (see *NATURE* of June 27, p. 1057), and the wider question should in fact be faced before we really formulate our answer to the question, what is the purpose of university education.

The valuable study of education for citizenship in secondary schools, issued early this year under the auspices of the Association for Education in Citizenship (London: Oxford University Press. 5s. to non-members; 3s. 6d. to members), directed attention to the inadequacy of indirect education for citizenship to-day. Experience has shown that a man with a good general education based on languages or science may be an excellent father, an excellent business or professional man and at the same time a bad citizen. The political world has become so complex and difficult that it is essential to train men just as consciously and deliberately for their duties as citizens as for their vocation or profession.

The monograph to which we have just referred proceeds to discuss how the direct teaching of citizenship may be achieved, particularly by linking it to the subjects at present taught in secondary schools. Prof. Doris L. Mackinnon, for example, suggests that it is a prime duty of the

teacher of science to let the pupil understand from the beginning what are the responsibilities in common life which the scientific discipline lays on all those who have once submitted to it. Moreover, the suggestions in regard to the teaching of clear and of accurate thinking made by Prof. G. C. Field and Dr. R. H. Thouless are scarcely needed more in any section of the community than in regard to the training of the scientific worker.

The present unsatisfactory position arises in fact from the growing tendency towards vocational education, and perhaps more particularly the teaching of science for vocational purposes. Already this has invaded the public and other secondary schools and spread far beyond the universities and technical colleges. In a highly organized society political administration must be the vocation of certain people. It is also true that intelligent citizenship is no longer possible without some understanding of the place of science in the everyday life of the whole nation; and the teaching of science needs to be adapted to such requirements rather than to those of assisting the few to gain a livelihood in a particular way.

If, therefore, we could re-orientate the teaching of science in both post-primary and secondary schools so that it would be taught as part of the equipment of everyone for living in a scientific age, and not as the first stage in preparation for a career in science, we should have taken one step to facilitate co-operation between the technical expert and the political administrator. If, further, by means of training for citizenship on the lines advocated by the Association for Education in Citizenship, we could ensure that those entering a university had received at any rate some equipment in this respect before embarking on their specialized studies, we should be in a much

sounder position to discuss the question of the quality and quantity of university education.

As the report of the University Grants Committee points out, the engineer, chemist, medical man or schoolmaster trained at a university is rightly expected to have received a sound technical training in the particular calling or subject he has studied. Whether he has also received that stimulation and enrichment of the whole mind which enable him to lead a fuller and more interesting human life, and to play more adequately his part as member or leader of the community, must depend at least partly on the way in which he has been prepared for the training he receives at the university.

If the tendency to specialize at a too early age, and particularly in the later years of school life, has had insidious consequences and needs to be resisted strenuously, at least it should teach us that there can be no hard and fast separation between secondary education and university education. One must be planned in relation to the other, and we cannot throw on the university stage the whole responsibility of training a man not only as a skilled worker but also as a member of society and a human being.

The special responsibilities of the universities in this field must of course be recognized. Industrial and commercial appointments are being thrown open to university graduates over an increasingly wide field. The growing extent to which leadership in commerce and industry, like that in national and local administration, is passing under the influence of professional men, means that the great majority of those who become leaders in the national life will continue to be drawn from those who have received a university training. No university can fail to recognize the opportunities of service in ensuring conditions of training which enable its students to go into the world with minds richly informed, unsleeping in the exercise of a critical intelligence and imaginatively alive to the human issues underlying the decisions they may be called upon to take.

The importance of giving due attention to these fundamental issues at the present time can scarcely be over-emphasized. Mechanization of thought is a peril in Great Britain as in other countries, and the suppression in the universities of several European and other countries of all independent thought and critical discussion of the principles of government, or of the meaning of life, throws a special responsibility upon British universities if

the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind.

Training for citizenship is a part of this wider question of training for life, but the two can scarcely be separated in any discussion of education to-day. Both the school and the university, each within its own limits, must endeavour to give its students a training for life, and this is even more important than training for a particular vocation or career. It is at last becoming more widely recognized that it is scarcely possible for a university to equip its students with the technical knowledge which might be expected to be of immediate use to them in any branch of industry they may enter on leaving the university. The detail of technical work can in fact be mastered only by practical experience after the student has left the university. The function of the universities in training scientific workers and technical men for industry is rather to give them such a knowledge of the principles of science and technology that they are able to bring trained minds to bear upon the understanding of practical problems which they encounter in their industrial or professional life.

The stimulation of thought, the widening of its horizons, the development of the faculty of judgment, and the evoking in its students of the energy of the soul in which Aristotle found the essence of true well-being, are the essential contributions to education which characterize the university rather than the schools. The dissatisfaction with many graduates of universities to-day is largely due to the fact that their primarily specialized training has robbed them of the essence of a university education and left them unequal to the demands which the major problems of life and industry make upon them when questions of value and judgment are involved. Moreover, specialization in itself is not so much criticized as premature specialization and the inadequate foundation upon which it is built, with the result that many of those completing long courses of study at a university in medicine or science, for example, are in danger of being uneducated persons.

Prof. Hogben showed convincingly in his lecture how ability to sort out the real issues, and to think clearly on the values as well as on the scientific and technical factors involved, are demanded to-day in our political leaders and in some degree in those who elect them. The professional aspects of after-life are to-day scarcely the major preoccupation of the universities, at least so far as they are

not linked up with the wider question of training in thought which they give to their students and of the linking of thought to action.

It is no part of the duty of a university to inculcate any particular philosophy of life. Never, however, was it more important than it is to-day that it should stimulate and train its graduates to think strenuously about the great issues of right and wrong, of liberty and government on which for the individual and for the community a balanced judgment is essential to a rational life. Without overlooking the place of research in the functions of a university or the desirability of upholding the value of learning for the sake of learning, the linking of knowledge to action is of such supreme importance at the present time that even the research activity of the universities needs to be re-orientated so as to secure that the advance of knowledge proceeds on a more even front. Only when our research effort is directed in some relation to the fundamental needs of society can we hope to redress some of the evils which the rapid advance in the physical sciences as compared with the biological or social has brought in its train.

An undoubted consequence of the redistribution of our comparative research effort between the physical and the biological and social sciences in the way urged by Dr. Julian Huxley or Prof. W. McDougall, for example, would be not merely the fertilization of thought in the social sciences and the breakdown of barriers between them but also the stimulation of thought generally in these fields. As in the physical sciences, we might witness

significant advances through the overlapping of traditional disciplines in several branches of knowledge.

Given this redirection of research effort and the stimulation of thought in social and biological problems, the training of men and women who will bring unprejudiced minds, critical powers and moral courage to bear upon the new and difficult problems which they must meet in this era of physical science should become much simpler. To some extent, the absorption of the graduate into industrial or other employment may become a simpler problem because he will be better fitted to take any place as an intelligent member of the community, though the warning of the University Grants Committee in regard to the limitation of the members of those entering a university needs to be kept in mind. Nor can we overlook the importance of that early training for citizenship which those entering a university should share with those whose school education finishes at the post-primary or secondary school education stage. There at least must be laid a foundation from which a university can fittingly start to impart, not a mere training for livelihood, but a training for life and for leadership, so that its graduates are distinguished by a sense of values, a wide vision and a capacity for the creative thought and judgment which require only the ripening of experience to enable them to bring a trained mind to bear on any of the problems with which they may afterwards be confronted in their professional, industrial or civic life.

Morphology of Muscles

The Cranial Muscles of Vertebrates

By Prof. F. H. Edgeworth. Pp. ix + 493. (Cambridge: At the University Press, 1935.) £5 5s. 0d. net.

IN this large, copiously illustrated and splendidly produced volume, Prof. Edgeworth has brought together the knowledge which has been gained in the last hundred and fifty years of the comparative anatomy and embryology of the cranial muscles (and their motor nerves) in vertebrates. The author is well equipped for this task. Though not a professional zoologist—he was for many years, until recently, professor of medicine in the University of Bristol—he has long been a

worker on this subject “so far as medical practice and teaching permitted”, and has become widely known from his many published observations which have added to our knowledge of the subject.

This memoir is a notable and important contribution to vertebrate morphology, and contains the most complete account which has been published of the homologies of the cranial muscles. Its scope may be indicated by mention of the principal subjects discussed in its chapters. They begin with a discussion of the embryonic head mesoderm and its segmentation, of the relation of the muscle plates of the head to the myotomes of the body, and of the number of the branchial segments. The

author finds that in the cephalic mesoderm, premandibular, mandibular and hyoid segments are followed by a "branchial region" in which the number of segments varies in different phyla, and, as he has found, among the genera of any one phylum. He puts forward the view that this variability occurs not by the intercalation or dropping out of segments but by "the separation of the branchial region as a whole into a greater or a lesser number of segments than is usual in their respective phyla".

The chapters which follow show the extensive range of the author's observations on the development and anatomy of the cranial muscles in the vertebrates from the Dipnoi to mammals. The subjects dealt with include the external ocular muscles, the palato-quadratus bar in Ichthyopsida and Amphibia, the mandibular muscles and the palato-quadratus bar in Sauropsida, and the palato-quadratus and mandibular muscles in mammals.

Separate chapters deal with the hypobranchial skeleton and the hyoid muscles, the superficial facial and cervical muscles of mammals, and the branchial muscles. Considerable space is devoted to the description of the Cucullaris muscle, and the author presents a condensed but valuable account of this muscle throughout the vertebrates. The first stage in its phylogenetic history is represented in the Dipnoi, in which a muscle, the "constrictor branchialis V", extends back as a broad sheet, "whose ventral edge is attached to the pectoral girdle and coraco-branchialis V. Probably generally in Holocephali and Selachians it is developed from the dorsal ends of all five branchial muscle plates. These extend forwards and backwards and fuse together to form a longitudinal muscle, the anterior end of which becomes attached to the cranium and its posterior end to the shoulder girdle. It is innervated by a branch of the 'R. intestinalis X', the fibres of which can be traced from the caudal, exclusively motor, fibres of the vagus or vago-accessorius.

"A cucullaris is present in most of the Amphibia and in the Reptilia. In birds there is no cucullaris—its function is taken over by the cranio-cervicalis, which also extends from the head to the shoulder girdle, but is innervated by a different nerve, the N. hypoglossus-accessorius. In mammals a cucullaris is present, developed from the most caudal branchial plate, and extends back to the limb as a single band."

The number and complexity of the cranial muscles is illustrated by the fact that thirty-eight pages are required merely for a list of the synonyms used by different writers for individual muscles, a list which the author states is "far from complete". This section is notable, not only from the

wide range of vertebrate forms, but also from the number of embryos at different stages of development which he has examined. Its value is enhanced by the number of illustrations given in corroboration of the facts stated in the text.

The author discusses at length some of the difficulties which arise in determining muscle homologies. The segment of origin of homologous muscles is in general constant from genus to genus and from phylum to phylum, but exceptions occur. Anatomists have long been accustomed to consider that the nerve supply to a muscle affords sound and reliable evidence of its homology, and this is generally the case, but again exceptions occur; the muscle plate of the mandibular segment is as a rule innervated by the fifth nerve, but in certain instances the seventh nerve may be the source of nerve supply, and this arises, according to the author, from the shortness of the first gill cleft.

The author has dealt more fully than is usual with the relation of nerve to muscle and not only with the peripheral pathway through which muscles are innervated, but also with the significance and the homologies of the groups of motor cells, spinal and medullary, from which the nerves are derived. Experimental evidence is made use of whenever possible to determine afferent from efferent fibres in different nerves, and a chapter is devoted to analysis of the groups of efferent cells in the "occipito-spinal motor cell column".

The aim of the author has been to ascertain what evidence the study of these muscles gives on the problem of the genetic relation of the vertebrate phyla "and so of the phylogenetic history of Man in the remote past". It may perhaps be doubted whether the material which he uses is capable of affording such information. The successive changes undergone by the developing embryo and its parts give only a general indication of phylogenetic history. The skeleton, the central nervous system and many of the viscera have been studied from this point of view, but have yielded no information of great significance on this problem. Where these systems have failed, it is scarcely to be expected that the study of muscles would be more fruitful, but the author's studies have led him to certain conclusions as to what were the characters of the ancestral forms from which the existing vertebrate phyla have originated, and these are given in detail in the final chapter.

No one who works, as the author has done, on broad problems of morphology can fail to have his interest excited in the significance of the whole embryological process and the variations in its details which occur in different forms. The author's

attitude towards this problem is best expressed by some sentences which may be quoted:

"The development of the cranial muscles gives much evidence of its purposeful character."

"In some unknown way the growing organism appears to foresee future needs, and sets to work with such material as it has to develop the necessary structures along the lines followed by its ancestors".

"Experimental embryology shows that the growing organism from the zygote upwards is a whole and not merely an aggregate of parts. Similarly, animals are psychological units, characterised by memory and purpose, by striving after ends in view. The variations in the development of homologous structures and in the structures by which the same functions are carried out show that this psychological factor is of great importance from the first."

"This immaterial, non-spatial, teleological factor, the mind, can initiate and inhibit physico-chemical processes. Life, development of individual organisms and evolution are primarily due to this power."

In view of the size and form of this volume and the wealth of illustrations—there are 841 figures, clearly drawn and reproduced on special paper, pp. 301–493—the price cannot be considered unduly high, though it may restrict its circulation. It is indispensable to workers in vertebrate morphology, and the author deserves the highest commendation for the care, the skill and the wide range of his inquiries, and is to be congratulated on the completion of a work which is a credit to British zoology.

DAVID WATERSTON.

A Study of the Ephemeroptera

The Biology of Mayflies:

with a Systematic Account of North American Species. By Prof. James G. Needham, Dr. Jay R. Traver, Prof. Yin-Chi Hsu, assisted by Specialists in certain Subjects. Pp. xvi + 759. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1935.) 7.50 dollars.

PROF. JAMES G. NEEDHAM, of Cornell University, the senior author of this book, has made a very valuable contribution to the knowledge of a little-known order, the Ephemeroptera. This biology has one outstanding feature of merit, it is original work. Prof. Needham has gathered around him a band of enthusiastic workers who have come forward and in their own words and under their own names, have told us of the results of their researches. Two of these workers appear with Prof. Needham as joint authors. The second author, Dr. J. R. Traver, has been responsible for nearly the whole of Part 2, the systematic description of the North American species, about five hundred pages, as well as a portion of Part I dealing with life-history and collecting. The third author, Prof. Yin-Chi Hsu, is responsible mainly for the chapters dealing with structure and anatomy. There are further chapters on anatomy under the pen of Dr. V. Knox.

This book is perhaps the most comprehensive that has ever been undertaken on the biology of the order. Pictet, in 1843, dealt with both anatomy and systematics in his "Histoire des Névroptères"; Eaton's classic monograph on "Recent Ephemeroptera" was mainly systematic; there have been sundry papers written by various authors since 1888, the date of Eaton's great work, scattered through entomological literature.

Prof. Needham's book will appeal, of course, mainly to the specialist, having regard to the fact that so large a proportion of its space is devoted to American systematic work; but the biology proper, consisting as it does of no less than 236 pages, has an interest not only for entomological workers but is also of economic value to all who are concerned with the study of the food of fishes, in Great Britain, more particularly the trout.

Chapter i deals with the life and habits of the Ephemeroptera or, as they are perhaps unfortunately called in America, the mayflies. It is unfortunate because the title is misleading. Not only do these insects appear on the wing during every month of the year—at least they do so in Great Britain—but also the name mayfly in the fly-fisher's world is restricted in its application to species of *Ephemera*, and the fly-fisher's popular nomenclature may be traced back for nearly five hundred years.

While, generally speaking, the life of an ephemeropteran is not quite so ephemeral as the name would suggest, Prof. Needham tells us of a species, *Callibaetis fluctuans*, the entire life of which in the winged condition is restricted to some forty-eight hours, during which it emerges from the water, changes from the subimago to the imago stage, pairs, oviposits and finally dies. The mayfly proper, the British species, *Ephemera vulgata*, on the other hand, has been observed by the writer, at least two months after emergence, having been so long on the wing as to have darkened to nearly black.

America is a country of extremes, and this trite saying applies even to the Ephemeroptera, for we read here that instances have been recorded of

these little insects swarming in such incredible numbers that camp fires have been extinguished beneath their corpses.

Several pages are devoted to the nymphal stages and then we come to Prof. Hsu's chapters on structure; not only are the external parts explained but the internal anatomy as well, with a final word which carries us through the insect's development moult by moult.

Dr. O. R. Smith contributes a chapter on the eggs and methods of oviposition. We learn that the females habitually fly against the breeze in order to maintain their position over a selected portion of the water: that some get rid of their eggs a few at a time, dipping over the surface; others drop them in a mass; and that others

again crawl down under water and lay their eggs on stones and rocks.

Passing to Chapter xvi, we find some useful information on the economic value of the Ephemeroptera; then there is a chapter on collecting, preserving and rearing them in captivity, and finally we come to Part 2, which deals with systematics. It suffices to state with regard to this branch of the subject, that the known North American species number 507 grouped in 3 families, 17 subfamilies and 47 genera. Useful keys and tables are included, and the whole plan of this part has been extremely well constructed.

We have no hesitation in stating that this book is a very fine contribution indeed to entomological literature.

MARTIN E. MOSELY.

Developments in Organic Chemistry

(1) Physical Aspects of Organic Chemistry

By Dr. W. A. Waters. Pp. xv+501. (London: George Routledge and Sons, Ltd., 1935.) 25s. net.

(2) The Chemistry of Natural Products related to Phenanthrene

By Prof. L. F. Fieser. Pp. xii+368. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 32s. 6d. net.

(3) Reactions of Organic Compounds

By Dr. W. J. Hickinbottom. Pp. x+449. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 16s. net.

(1) **A** TREATISE on the implications to organic chemistry of new conceptions of the atom is particularly valuable at this stage when the arbitrary ideas of the chemist have been largely justified. Electro- and co-valencies, and the semi-polar bond are now universally recognized, and the complex hypotheses of induced polarity and conjugation are receiving physical interpretation.

Just as the existence of polar and non-polar bonds has been admitted, it is now certain that both ionic and non-ionic reactions occur in organic chemistry. The latter resemble photochemical reactions, and include those like the pyrolysis of diazoamines, in which transient formation of free uncharged radicals must occur. Greater space is devoted to ionic reactions, which are induced by polar reagents, and generally involve carbonium anions and cations. Thus the properties of free radicals, which behave variously as non-polar radicals, or as cations, or as anions, receive an explanation. Molecular rearrangements result from the reconstruction of a carbonium cation, caused by an ionic reagent.

In dynamic isomerism, which involves an equilibrium between two forms, an ion wanders from one part of a molecule to another (prototropy or anionotropy) with consequent redistribution of valency bonds. The classical idea of tautomerism, that a single substance can react as if it had two structures, is revived in terms of wave-mechanical resonance, to which brief reference is made. The two structures differ only in electronic arrangement, neither representing the molecule, "but a hybrid intermediate between them, which cannot be represented by ordinary symbols, and has to some extent the properties of both" (Sidgwick). Conjugation and aromatic properties are discussed chiefly in terms of the theories of Ingold and Robinson, according to which an electromeric change may be induced in an aromatic derivative giving an activated molecule, the polarization of which determines further substitution.

The value of the book to students is enhanced by the use of the historical method of approach. In the more physical chapters, such as that on dipole moments, mathematical treatment is curtailed, but conclusions important to chemists are concisely stated.

(2) Structures containing polynuclear ring-systems based on the hydrogenated phenanthrene nucleus have been allotted to the morphine alkaloids, the sterols, sex-hormones and cardiac poisons. The dramatic manner of progress lends added interest to this monograph, which is a comprehensive interim report (the copious references include January 1936, and 70 per cent date from 1930) on a subject important alike to chemists and physiologists.

An account of the chemistry of phenanthrene itself is followed by a lucid treatment of the

morphine alkaloids and resin acids, which deals with their genetic relationships, their phyto-syntheses, and the problem of drug addiction. Throughout, relevant features of general or biological interest are described, so that the complex chemical side is put in its correct perspective. This is exemplified in the account of the cancer-producing hydrocarbons, which though not yet known as natural products are related to the latter, and generally contain a phenanthrene ring-system. That methylcholanthrene, the most powerful carcinogenic agent known, is a bile-acid degradation product has obvious significance, and points to metabolic derangement as a natural prelude to cancer.

Although Windaus and Wieland had seemingly settled the structure of the sterols, in 1932 Rosenheim and King, guided by the results of X-ray crystallography and by an observation of Diels, suggested an improved formulation. Since then organic chemists have not looked back, and the story of the elucidation of the structures of the sterols, bile-acids and sex-hormones forms the most fascinating part of the book. The cardiac poisons and the saponins are yielding their secrets too, and are already known to possess the same polynuclear system as the sterols, which has the most diverse distribution in Nature, and may fulfil the most manifold functions. Structures chemically similar have such different physiological properties as those of vitamin D, the sex-hormones, and the cardiac poisons!

The book may be recommended to all chemists interested in the subject; the author, who has

himself made worthy contributions, deals impartially with the work of many investigators in many lands, and frequently interpolates his own valuable suggestions where finality is still lacking.

(3) This text-book presents organic chemistry in a way making for closer liaison between theory and laboratory practice, but is recommended also as a reference book, not least for the large number of well-chosen references. Compounds are treated according to functional groups in eleven chapters, each of which has a summary and descriptive tables; reactions are dealt with fully, and a number of representative preparations is included.

Within the limits imposed by the author (for example, heterocyclic compounds and condensed nuclei are only referred to incidentally) the work is reasonably complete. The section on diazonium compounds might have included Nesmejanov's work on mercurials, and that on halogen compounds recent patent literature on sodium alkyls and aryls. On the other hand, the influence of structural factors, polar or steric, on the course of well-known reactions is usefully treated.

With journals so drastically abridged that reactions are referred to only by the names of their discoverers, the author might have named them so; and the absence of an author index makes it difficult to look up less-known reactions. Textual errors are rare, and generally of a minor nature. For the amount of information it contains, the book is low priced, and should prove invaluable to the student as a manual of organic reactions, and an aid in the identification of carbon compounds.

Mysore Tribes and Castes

The Mysore Tribes and Castes

By Diwan Bahadur L. K. Ananthakrishna Iyer. (Published under the auspices of the Mysore University.) Vol. 1. Pp. lxxii+502+68 plates. (Mysore: Government Oriental Library, 1935.) 15 rupees; 24s.

A PERIOD of more than thirty years has elapsed since the late Mr. Nanjundayya commenced a systematic survey of the tribes and castes of Mysore on the lines laid down by a former Census Commissioner for India, the late Sir Herbert Risley. In 1925, Mr. Ananthakrishna Iyer succeeded the original superintendent of the Mysore Survey. Three volumes have already appeared containing the Survey results, caste by caste, in alphabetical order; and we now welcome the appearance of vol. 1, which deals with the results as a whole.

It is not unusual for the authors of such works to invite a distinguished scholar to add a short introduction to his general volume; but Mr. Ananthakrishna has thought fit to enlist for this purpose the assistance of several well-known anthropologists, so that his book becomes more a compendium of essays than the mature conclusions of one writer. Thus, Dr. R. R. Marett commences with a short appreciation of the book, and some interesting reflections on the parts which East and West may profitably play in such inquiries. The late distinguished scholar, M. Sylvain Lévi, follows with some general remarks on the nature of caste. These are followed by a translation for use in India.

We then come to a lengthy and most important essay by Baron von Eickstedt, of Breslau. This is perhaps the most important feature of the book. Von Eickstedt, dealing in some detail with the

racial invasions of India in the past, and after allotting due influence to occupation and environment, presents the reader with an entirely novel classification of the population, for which he supplies some anthropometrical data. It will be remembered that most former writers on Indian racial elements have been disposed to assume an original Kolarian population of a very early type, displaced later, largely in the south, by a Dravidian immigration, upon which followed the arrival from the north-west passes of an Aryan-speaking people. Later bands of immigrants, such as the Scythians, Yuechi, and Huns, penetrated northern and western India between 100 B.C. and A.D. 600. Von Eickstedt, rejecting the existing terminology as savouring too much of linguistic instead of racial significance, evolves a threefold base for the Mysore population, namely, the Veddids, the Melanids, and the Indids. To each of these he allots sub-groups. A table giving anthropometric data for these will be found on p. 76.

The reader must be left to study for himself the exact significance of these new divisions. It is possible to convey a rough idea of them by explaining that the Veddids have much in common with the old Kolarian, the Melanids seem to be similar to Dravidian, and there is little to distinguish the Indid from the Aryan. In the special Ethnographic Appendix to the last Census of India, some doubt is thrown on the value of von Eickstedt's classification owing to the inadequacy of the anthropometric data on which it rests. It is, however, one that will repay careful examination; and it certainly possesses the merit of simplicity when compared with the almost incomprehensible formulæ of 'co-efficients of relative likeness' on which Dr. Guha proceeds in the Census of India volume.

Not content with the assistance of the three scholars referred to above, the compiler of this volume next offers the reader a chapter on the cultural geography of Mysore by a distinguished member of the Indian Civil Service, Mr. F. J. Richards. Writing with personal knowledge of the country, Mr. Richards gives us a thoughtful study of the history and cultural features of the population of Mysore which by itself would make Mr. Ananthakrishna's book a valuable possession. Interesting charts are added, showing the extent and distribution of various elements in the population, such as Marāthas Lingāyats and Jains. From these it can be learned by a rapid glance how the main castes and tribes are distributed throughout the State territories.

Following these more or less introductory essays, the reader will find chapters on caste, religion, taste in dress and ornaments, totemism, magic, animism, etc.; and here we meet for the first time

with an attempted summary of the various contents of the articles in the preceding volumes. The writer's survey takes him far afield; and we are even given specimens of the particular tattoo marks favoured by Hindu ladies, such as a picture of the temple of the god Shiva, accompanied by his attendant *Nandibail* (p. 438). Space does not, unfortunately, admit of a study of the significance of this material. A few words must, however, be devoted to the important Chapter vii, which deals with the practice of totemism.

Some recent investigations in the neighbouring Presidency of Bombay concerned with the same subject have tended to show that more prospect exists of arriving at the origin of the population by having regard to the practices of the people in this connexion rather than by measuring their heads and their noses. In the pages of the *Indian Antiquary* (61, 106-111; 1932) a list of some two hundred and twenty totem divisions identified in the centre and south of the Bombay Presidency will be found, and will repay most careful study. On p. 255, Mr. Ananthakrishna gives a list of a hundred and twenty-five such totems, which are classified as animals, trees and plants, and inanimate objects. Needless to say, the resemblance to the Bombay list is striking, the entries in many cases being identical. As was to be expected, the author of this work finds the system in many cases to be in a state of decadence; but it is none the less widespread among tribes and castes of non-Aryan origin. He shows that customs such as matriarchy, adult marriage, burial and totemism are a surer guide to the racial origin of a caste or tribe than most of the traditional accounts which are so readily forthcoming to mislead the investigator.

The chapters on animism and magic contain little that has not already been recorded in other works on the subject. On p. 237 *et seq.* reference is made to the curious custom known as the *covade*. Mr. Rice, in the *Mysore Gazetteer*, has already supplied evidence of confinement restrictions on the husband among the Kuravas. Little fresh material can be gathered from the present volume.

In conclusion, it remains to congratulate Mr. Ananthakrishna Iyer on the completion of his great task. The separate and final volume promised by him, which is to contain a bibliography and index, will be awaited in the hope that it may also find place for the missing synonyms of caste and tribal names which the previous three volumes should have included. The present work is signally free from misprints, though it may be observed that 'ironette' (p. 473) as a kind of dancing seems a somewhat novel form of movement. Are we really dealing with a 'pirouette'? There are numerous excellent illustrations.

R. E. ENTHOVEN.

The Land of Britain:

the Report of the Land Utilisation Survey of Britain. Edited by Dr. L. Dudley Stamp. Part 78: Berkshire. By J. Stephenson, with an Historical Section by W. G. East. Pp. 113. (London: London Utilisation Survey of Britain, 1936.) 2s. 6d.

THE publication of the first of the contemplated eighty-seven county reports on the utilization of the land of Great Britain gives an idea of the scope and value of the work. The report begins with a summary of the geographical background, geology, relief, soils and climate. Then follow accounts of the distribution of woodland, arable land and grassland, which are closely correlated with physical conditions and illustrated with distributional maps. Next comes the distribution of orchards and poultry farming and lastly the distribution of settlements and population in general.

The report brings out not merely the present use of the land but also indicates the changes that have taken place chiefly through the operation of economic factors. Thus to-day the arable land of Berkshire covers 26.5 per cent of the county, while in 1808, and for many years subsequent, it appears to have covered more than fifty per cent. The process of putting arable land down to grass is still continuing. On the other hand, arable farming would appear to be concentrating in the areas best suited to that use. This tendency is accentuated by better transport, which helps to nullify advantage of position, and uniform wages which reduce the ability of poor areas with low wages to compete with better land. Mr. Stephenson concludes by dividing the county into agricultural regions each with its own characteristics and potentialities, and he notes that Berkshire is in a transitional stage common to all counties near London. Price conditions are changing the aspects of farming, and growth of population and transport are making the east and south more and more into residential areas.

The report concludes with a valuable article by Mr. W. G. East on the utilization of the land about 1800.

Wild Flowers of the Wayside and Woodland

Compiled by T. H. Scott and W. J. Stokoe, based upon the Standard Work "Wayside and Woodland Blossoms" by Edward Step. Pp. 352+81 plates. (London and New York: Frederick Warne and Co., Ltd., 1936.) 7s. 6d. net.

THIS attractive book will prove very useful to the field naturalist rather than to the academic student of systematics. It is well produced, and is of a size convenient for the pocket. Such a book, well printed and beautifully illustrated, is just that type which helps the intelligent man to a truer appreciation of the country, while at the same time giving a valuable insight into the beauties of Nature. It should, therefore, give full satisfaction to the country rambler interested, if only mildly, in the surrounding flora. Apart from this, however, it will provide an excellent introduction to a later more serious study of systematic botany.

The book opens with a short description of the more common forms of leaves, and this is illustrated by two pages of line diagrams. Next follows a short dissertation on the forms of flowers, illustrated by a typical flower and line diagrams of the more common types of inflorescences. A short glossary of botanical terms helps the reader to follow more easily the descriptions in the greater part of the book.

An unusual and helpful feature then follows: forty pages are devoted to line diagrams of common flowers, grouped according to the colours, white or whitish, and shades of pink, red, yellow, blue, purple, lilac, green and brown.

The bulk of the book is occupied by a description of the most common plants in the British flora. This occupies about 250 pages, interspersed with eighty coloured plates each portraying about four types of flowers. There is an index.

This book is to be unreservedly recommended, and, in view of the amount of subject matter and coloured illustrations which it contains, it is excellent value for the price demanded.

The Heavens and Faith

By the Rev. M. Davidson. Pp. xv+162. (London: Watts and Co., 1936.) 5s. net.

THE impact of the science of astronomy upon the Christian faith is a topic which has been dealt with by a number of writers, but Dr. Davidson is better equipped than many, because he is at once a clergyman and an astronomer, Sir Frank Dyson testifying in a foreword to his competence in this science. But, what is not less important, Dr. Davidson has not only the requisite knowledge, but also the necessary candour, apart from which all discussion ends with foregone conclusions.

The problems set for religious faith by modern astronomy are threefold: (1) the apparent indifference of an incredibly vast universe to man and his destiny; (2) how to reconcile the three-storey universe of Creeds and Scripture with present scientific knowledge; and finally (3) what we are to make of the eschatological beliefs entertained not only by Paul and the primitive Church, but also, as is now recognized by scholars, by the Founder of Christianity himself. Most works of orthodox apologetic tackle (1) and (2) with varying degrees of success, but there is a widespread tendency to ignore (3) altogether, in spite of its vital importance. Dr. Davidson, however, does not evade this issue, nor seek to obscure the point that the ethic of the Sermon on the Mount had a very definite basis of apocalyptic belief which is no longer held. How far its validity may be thereby affected is a matter for serious inquiry and not for dogmatic assertions. As a matter of fact, if we believe that the world is soon to end and be replaced by a better, the ethic of the Sermon is mere common-sense, and not fantastic idealism, as it appears to most 'world-accepting' citizens to-day.

This book was very well worth writing, and will repay study.

J. C. H.

Out of the Night:

a Biologist's View of the Future. By Prof. H. J. Muller. Pp. 127. (New York: The Vanguard Press, 1935.) 1.50 dollars. Pp. 160. (London: Victor Gollancz, Ltd., 1936.) 4s. 6d. net.

EUGENICS is based very largely on genetics, and any technical or theoretical advance in the latter science has its effect on eugenical thought. Consequently, the considered views of Prof. Muller, well known as one of the leading geneticists of the day, on eugenical topics are very welcome.

Prof. Muller commences with a consideration of the evolution of man, illustrating his argument with novel and effective analogy. He then discusses the future of man and contrasts man's probable fate if conscious control of the occurrence of various genetical types is not exercised, with his possible achievements if such a control is successfully attempted.

The author next considers the measures which seem desirable for the purpose of such a control of genetical change in man. He favours the extensive use of a few chosen sires, by a technique involving the storage of gametes and artificial insemination. It is important to note that technically many of the proposals made are either possible at present or likely to be rendered possible by a relatively small amount of further research.

It is certain that Prof. Muller's views on the technique of human improvement will not be universally accepted. Some geneticists do not agree that the use of a few chosen sires is the best way of achieving rapid selection. It can be stated, however, that, in spite of possible disagreement on some points, the book will be of great interest to anyone concerned with the problems of eugenics, as it is both genetically and technically accurate.

K. MATHER.

L'Année psychologique

Fondateurs: Henry Beaunis et Alfred Binet. Publiée par Prof. Henri Piéron. (Bibliothèque de Philosophie contemporaine.) Année 35 (1934). Vol. 1. Pp. xix + 480. Vol. 2. Pp. 481-912. (Paris: Félix Alcan, 1935.) 120 francs.

THIS excellent annual publication becomes more and more an indispensable aid to the study of the ever-increasing production of works and memoirs on psychology. The research value of the "Année Psychologique" is shown not only in its original memoirs, but also and mainly in the useful classification and summary reviews of the current literature concerning psychology published during the year. Among the original memoirs published in the present issue, we should mention H. Piéron's "L'Evanouissement de la sensation lumineuse" and the two essays on psychological factors by N. Margineanu. The classification of the works reviewed occupies fourteen pages of the table of contents; which shows the reviewer's difficulty in making a satisfactory selection, and also the wealth of material which has been sifted and analysed by the editors of this important publication.

T. G.

The Monks of Athos

By Prof. R. M. Dawkins. Pp. 408 + 6 plates. (London: George Allen and Unwin, Ltd., 1936.) 15s. net.

PROF. DAWKINS, whose knowledge of the eastern Mediterranean now extends over more than thirty years, has long been known to students not only as an archaeologist, but also as a diligent collector of the folk-lore and legends current, or recently current, among the modern Greeks of the mainland and the islands. In the course of four visits to Athos, he has made a gathering of the legends current among the members of the remarkable monastic communities of the peninsula, to which he has added a gleanings from the literature relating to it. His purpose, however, has been inspired by a deeper motive than that of collection merely: his aim has been to test the value of folk-memory as preserved in these legends—a purpose for which Athos is better fitted than most localities. It is somewhat remarkable to find that, in communities which are notoriously anti-feminine, the Virgin Mary holds a place no less prominent than in other parts of the Mediterranean. It is also to be noted, the author points out, that theological controversy, which has raged here on more than one occasion, appears to have been forgotten almost immediately after settlement, and has left little or no mark on tradition.

Prof. Dawkins found that his main purpose would have been very inadequately served without some account of the geographical and cultural setting. In consequence, he has written a full description of the peninsula, which conveys its charm in a literary style no less felicitous than the subject matter demands.

Geologie von Asien

Von Prof. Dr. Kurt Leuchs. Band 1, Teil 1: Überblick über Asien, Nordasien. (Geologie der Erde, herausgegeben von Prof. Dr. Erich Krenkel.) Pp. viii + 236. (Berlin: Gebrüder Borntraeger, 1935.) 18.40 gold marks.

THIS addition to the "Geologie der Erde" series, published under the general editorship of Prof. E. Krenkel, is planned to comprise two volumes each of two parts, and, in its completed form, will fill a long-felt want in geological literature.

The first part of vol. 1 contains a general introduction including a summary of the physiography and geological structure of Asia as a whole. This is followed by the section dealing with north Asia, which includes a relatively detailed discussion of the stratigraphy and igneous rocks, the tectonic structure and the chief ore deposits of the region.

To some extent it covers the same ground as Obrutschew's "Geologie von Sibirien", published in 1925; but in the intervening years much new material has become available and is incorporated by Prof. Leuchs.

The chief value of this book lies undoubtedly in the fact that it summarizes and makes available a great body of obscure, and for all practical purposes, inaccessible Russian publications, and as such is a notable addition to geological literature.

Seventh International Congress of Refrigeration

By Dr. Ezer Griffiths, F.R.S.

THE Seventh International Congress of Refrigeration, organized by L'Institut International du Froid and the Netherlands Association of Refrigeration, opened at The Hague on June 16 and closed at Amsterdam on June 20. For the opening ceremony, about four hundred members of the Congress, including delegates of fifty nations and members of the Dutch Government, assembled at the historic Ridderzaal—the Hall of the Knights at The Hague. At this meeting, speeches of welcome were made by representatives of the Dutch Government and such preliminaries settled as the appointment of presidents and secretaries of sections, together with the procedure to be followed in the conduct of the meetings.

The work of the Congress was subdivided between four sections, and altogether about two hundred papers and reports came under consideration. Abstracts of the papers were printed in the language supplied, followed by translations in French and (or) English. The topics of these papers covered the whole field of low temperature work, and were of a varied character, ranging from paramagnetism to a new method of making ice rinks. The mass of material to be dealt with proved embarrassing, since in the limited time available full discussion was impossible.

There was a feeling that a more rigid process of selection would need to be followed in preparing the programme of the next Congress. In a congress of this character, adequate time for discussion is all-important, for sometimes ancillary information of considerable interest is brought out in the course of a discussion. For example, a paper was read describing the development of refrigeration in Japan; and, in answer to a question, an outline was given of the method employed in certain parts of that country for the cultivation of strawberries—a subject of general interest. A sunny slope is selected exposed to sea-breezes. The rocks are arranged with pockets of earth between, and in these the roots of the strawberry plant are planted. At night the rocks cool and condense water vapour which trickles down the rocks and is absorbed by the earth. By day the rocks warm up rapidly and afford a source of heat to the strawberry plant.

The majority of the papers dealt with that aspect of low temperature work which is concerned with methods for the preservation of perishable foodstuffs. The papers read at this Congress would perhaps suggest that the engineer is greatly in advance of the biologist in the science of refrigera-

tion, but this impression is probably due to the fact that biological workers as a whole failed to support the Congress to the same degree as their engineering colleagues. Much of the biological work recorded was more of a descriptive character than an attempt to get down to fundamentals as regards the chemical and structural changes taking place consequent on storage temperature and environments. There is great scope for investigation on the biological side, particularly in respect of tropical fruits, and it may be of interest to record that a resolution was passed at this Congress recommending that the question of tropical fruits should occupy a prominent place in the programme of the next Congress; such fruits afford interesting material for research, for it is possible to carry out, in the course of weeks, experiments which may be protracted over many months in the case of hard fruits.

Reverting to the engineering side, it was noteworthy from the papers submitted to the Congress that advances are being made in the production of temperatures considerably lower than those customary in cold-stores work, although of course much higher than liquid air temperatures. Here the question is not one of the mere attainment of low temperatures, but the economical production of temperatures of the order of -50°C . in large spaces. For example, ice-cream manufacturers prefer quick hardening of their product in wind tunnels at -40° to -50°C . to slow hardening at a higher temperature.

These developments in refrigeration have resulted in the evolution of special types of refrigerating machinery. For intermediate temperatures of, say, -25° to -40°C . the booster compressor of the rotary blower or piston type finds application in raising the pressure of low density vapour to densities at which it can be efficiently handled by compressors of standard design. Lower temperatures are obtainable by refrigerating equipment of the modern absorption type, in which temperatures so low as -76°C . can be economically obtained in commercial practice, using ammonia, in spite of that temperature being within one degree of the triple point of ammonia and the specific volume being twenty-five to thirty times as great as at ice-making temperatures.

The question may reasonably be asked what useful purpose does such a Congress serve. In the first place, it affords unique opportunity for workers in various countries to establish contact

and exchange views, and on this occasion the various nationalities came together with a common objective. Representatives from the Dominions Overseas appreciated to the full the value of the Congress as an opportunity to meet their colleagues. The Congress also demonstrated to those countries which are lagging behind in the encouragement of scientific work the benefits accruing from organized research.

During the period of the Congress, meetings of some of the commissions functioning under the auspices of the Institut International du Froid were convened. Commission No. 1 considered the question of temperature measurements down to liquid hydrogen temperatures. The temperature scale is defined by international agreement down to the boiling point of oxygen; beyond this there is no generally accepted standard scale. Even in the range covered by the International Scale, further work appears to be necessary, since some investigators have found that platinum thermometers constructed and calibrated according to specification differ by so much as 0.03° at about -140°C . To study this question, it was decided

to set up a committee composed of representatives of the various national laboratories and of those centres where low temperature investigations are in progress.

Commission No. 12 on land transport and Commission No. 13 on water transport held a joint session. As problems for further study, they decided that data should be collected as to the heat production of various types of fruit, this being a matter of interest to the marine engineer when dealing with fruit delivered to the ship without pre-cooling. It was also decided to consider methods for the control of the atmospheric conditions in the holds of ships carrying perishable produce requiring atmospheres of high carbon dioxide and low oxygen content.

These are subjects which will be studied by expert committees under the auspices of the Institut International du Froid and reported upon at the next Congress.

Thanks to the thorough planning of the executive committee, the arrangements worked smoothly and efficiently, and those participating will retain the most pleasant memories of a very useful meeting.

The Royal Research Ship *Research*

By Dr. H. Spencer Jones, F.R.S., Astronomer Royal

THE destruction of the non-magnetic ship *Carnegie* by an explosion, at Apia, Western Samoa, on November 29, 1929, brought to a sudden end the magnetic survey of the oceanic areas, which had been carried on for twenty-five years by the Carnegie Institution of Washington. The *Carnegie* had been specially designed and constructed for obtaining magnetic observations at sea. She was a hermaphrodite brig, built of white oak and pine, with copper or bronze fastenings, and with a displacement of 568 tons. She was equipped with an auxiliary engine, capable of giving a speed of about 6 knots in calm weather; the engine was of internal combustion type and, at first, used gas generated from solid fuel, but, as this proved not altogether satisfactory, petrol was substituted. Sufficient fuel was carried to give a cruising range of 2,000 miles at 6 knots. With the exception of cast-iron pistons for the cylinders of the engine and the steel cams necessary for operating the valves, amounting in all to less than 600 lb., no magnetic material was used in the construction of the ship.

In six cruises between 1909 and 1921, the *Carnegie* traversed 252,702 miles in 3,267 days

actually at sea. Her last cruise was planned to extend from May 1928 to September 1931 and to cover 110,000 miles. It was designed to determine the secular change of the earth's magnetism in all oceans, by making numerous intersections with the tracks of previous cruises. Nearly one half of this cruise had been completed at the time of her loss.

The results obtained by the *Carnegie* were placed freely and promptly by the Carnegie Institution at the disposal of the British and other Governments, for use in the construction of world magnetic charts. Successive issues of these charts were based to an increasing extent upon the data provided by the *Carnegie*.

The secular changes of the magnetic elements at any given place are not constant quantities. Extrapolation over long periods may therefore lead to considerable errors. The continual accumulation of observations is necessary in order to determine both the secular change and the rate of change of the secular change of each element. At the present time, the magnetic data are most uncertain in the Indian Ocean. The last cruise of the *Carnegie* in the Indian Ocean was in the year 1919. The

cruise on which she was engaged at the time of her destruction was to have taken her into the Indian Ocean in 1930 and 1931. In South Africa there has been a considerable decrease within recent years in the secular change of the magnetic declination, and in Western Australia there has been a considerable increase. There are no data available as to how the secular change is altering in the southern Indian Ocean between South Africa and Australia. The magnetic charts for this area are therefore based at present upon very uncertain extrapolations. In other areas, where the magnetic elements are known at present with reasonable accuracy, the extrapolated values would become less and less reliable in the course of time, in the absence of further observations, such as were provided by the *Carnegie*, to serve as a control on the changes in the secular variations.

In view of the fact that Great Britain is the principal maritime nation, the British Government has accepted the responsibility of providing accurate magnetic data at sea, and a non-magnetic ship is to be built, equipped and operated for this purpose by the Admiralty. The ship is to be known as the Royal Research Ship *Research* (R.R.S. *Research*), and she will fly the Blue Ensign and Jack with the yellow Admiralty anchor in the fly.

The plans for the new ship have been prepared at the Admiralty and it is hoped that the construction will be commenced shortly. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington not only placed at the disposal of the Admiralty all information with regard to the construction and the instrumental and other equipment of the *Carnegie*, but also generously gave the services of Mr. W. J. Peters as consultant, without charge. The experience and advice of Mr. Peters, who commanded the *Carnegie* on her first two cruises, have been of the greatest value in the design of the ship and of her equipment.

The R.R.S. *Research* will be somewhat larger than the *Carnegie*. She will have a displacement of 650 tons and will be brigantine rigged. She will be provided with a single screw Diesel engine and will carry sufficient oil fuel to give a radius of action of about 2,000 miles at 6 knots. Her cables will be of bronze, instead of the hemp rope used in the *Carnegie*, and to some extent brass or bronze will take the place of wood. She will carry a total complement of 31, including the commanding officer, three deck officers, three scientific workers, a surgeon (who will also be a scientist) and an engineer.

The work of the R.R.S. *Research* will not be restricted solely to magnetic observations. She will undertake observations of atmospheric elec-

tricity. Such observations are particularly valuable at sea, where the air is less contaminated by suspended impurity than it is on land. It may be recalled that it was by means of observations on the *Carnegie* that it was established that the maximum potential gradients are related to Universal Time and not to the local time of the place of observation. The *Research* will be provided with an oceanographic winch and motor for oceanographic work, will carry an echo depth sounding gear, and will also make meteorological observations, including upper air observations by means of pilot balloons.

The principal magnetic instruments for observations at sea will be a marine collimating compass for observations of declination; a sea-deflector, for observations of the horizontal intensity; and a marine dip inductor for observation of the dip. The collimating compass is a modification of the standard marine liquid compass. The magnet system carries four concave speculum mirrors, adjusted so that their optical axes are in the direction of the four cardinal compass points. A scale is mounted in the focus of each mirror. The four scales are carried on arms attached to the magnet system. The angle between the sun, when at low altitude, and one or other of the four compass points, as defined by the scale images, is measured with a sextant, the scales being viewed through windows in the compass bowl. This observation provides the means of calculating the magnetic declination. The compass will be mounted in such a position that it will have as clear a view of the horizon as possible.

The sea deflector consists of a marine compass, provided with permanent attachments, whereby a deflecting magnet can be mounted in a horizontal position and vertically above or below the compass magnet system. The bowl is rotated until the deflecting magnet is perpendicular to the compass magnet, as shown by the reading of the card. The angle of deflection is read on a graduated scale on the edge of the bowl. The deflector is mounted in an observatory adjacent to, and forward from, the chart room, in which is the standard compass. As the observer at the deflector reads off the angle of deflection, a second observer at the standard compass reads off the direction of the ship's head. The horizontal intensity is proportional to the cosecant of the deflection. The constant of proportionality is determined periodically by simultaneous observations ashore, with the sea deflector and land magnetometer.

The marine earth-inductor follows the general design of earth-inductors, but is provided with a special gimbal stand that is not affected by the rotation of the coils. It is important, for observations

at sea, that it should be driven at a constant speed, and a special tuning-fork controlled rotary converter, situated in the after part of the vessel and driving through an articulated phosphor-bronze shaft, will be provided to ensure this. Two galvanometers, one of the moving coil type, with short period, and the other of the string type will be provided and experience will be gained at sea of the relative suitabilities of the two types. The earth-inductor will be mounted in an after observatory.

Portable instruments for land observations, at fixed magnetic observatories and elsewhere, will

also be carried. The designs of the instruments have been based on the Carnegie Institution designs, with such modifications as were suggested by experience on the *Carnegie* or as seemed desirable for various reasons.

The magnetic observations on the R.R.S. *Research* will be made primarily in the interests of navigation. But they will provide at the same time valuable information about the earth's magnetism, which is needed for the investigation of such matters as the non-potential portion of the earth's field and the line integrals around closed contours on the earth's surface.

Body Orientation of the Lower Crustacea (Branchiopoda)

By John H. Lochhead, University Museum of Zoology, Cambridge

AMONG the Branchiopoda it is now well known that the Anostraca swim normally lying on the back, while the Notostraca swim with the back directed upwards. Orientation is also constant among the Cladocera, but there are here considerable differences between genera.

Four possible controlling factors have been suggested. These are the aeration of the water, gravity, the surface resistance of the animal, and light.

Lowndes¹ and Wertheim² hold that the limbs of Anostraca, which are doubtless respiratory, are normally directed upwards because the upper layers of water are best aerated. This view, however, cannot apply to the Notostraca. Nor could orientation be controlled in this way except perhaps very near the water surface, since the differences in aeration above and below a swimming animal must normally be too small to be detected. It is true, however, that both Anostraca and Notostraca often come up and beat their limbs just below the surface film, the Notostraca specially turning over on to their backs for this purpose. It has been widely stated that this occurs especially when the oxygen content of the water is low. It may thus well be a respiratory phenomenon, though Mathias³ has shown that the oxygen requirements of *Artemia* are surprisingly small. In any event, however, the habit is quite distinct from the more usual swimming of the animals farther below the surface.

Control of orientation by gravity may occur in two ways. There may be automatic control, the centre of gravity of the animal being so placed that a constant attitude tends to be maintained independent of muscular effort. The factor of the

resistance offered by the surface shape of the animal to the water may also play a part here. Or there may be nervous control due to the effect of gravity on special sense receptors, the position maintained by the animal being then not necessarily the stable one with respect to the automatic forces just mentioned.

Surface resistance is a factor of special importance in the Cladocera, because of the regular rest pauses which characterize their swimming. But in the Anostraca and Notostraca, considered for the sake of simplicity only when swimming or floating more or less horizontally, the effect of surface resistance on dorso-ventral orientation must be small. R. T. Müller⁴, however, has shown that for Anostraca the effect due to the centre of gravity may be important. It has long been known that in water the anostracan body sinks back downwards. This might be due to the position of the centre of gravity, or to surface resistance. Müller showed that it is due to both these factors. He placed both fixed and narcotized *Tanytastix* in sugar solution of the same specific gravity as that of the animals, and found that they then lay floating in the solution back downwards. This could be due only to the position of the centre of gravity. He then raised the specific gravity of the solution until the animals rose up fairly rapidly towards the surface; they did so back upwards, surface resistance overcoming the force exerted by the centre of gravity. Thus when an anostracan sinks in water, both forces tend to keep the back downwards. For the Notostraca, such careful experiments have not been done; but Seifert⁵ has shown that a dead *Apus* also sinks in water back downwards. Probably this is due to the same

forces acting together as in the Anostraca. If this is so, then *Apus* normally swims in an unstable position with respect to its centre of gravity, and if gravity plays any role in controlling orientation it must be by acting on sense receptors. But although *Apus* has been histologically well investigated, nothing in the nature of a statocyst has been found.

The effect of light on the dorso-ventral orientation of Anostraca and Notostraca may be very marked. But Müller⁴ gives much experimental evidence to show that in the anostracan, *Tany-mastix*, the responses occur only when phototropism has been awakened by other stimuli; the possibility that this may also be the case for the Notostraca has not been investigated. Both orders, however, respond to sudden changes in the direction of light, the Anostraca seeming always to try to keep the ventral surface facing the source of light, while Notostraca show the opposite response. This corresponds with the normal swimming positions of these animals when light is coming from above. When illuminated from below the animals turn over, though the fresh-water Anostraca seem to find difficulty in swimming in the unaccustomed and unstable position. Individuals of *Streptocephalus* observed by me repeatedly 'looped the loop' when illuminated from below, swimming slowly ventral side down when at the bottom of the loop and going rapidly, ventral side up, over the top of the loop. *Apus* when illuminated from below swims easily on the back, this being for it, as it is for the Anostraca, the presumably stable position with respect to the centre of gravity. In both Anostraca and Notostraca, control of orientation in respect to light has been shown by Seifert⁵ to be effected in the first place solely through the eyes. In the Anostraca he has shown⁶ that probably only the lateral eyes are concerned. In the Notostraca he has found⁵ the lateral eyes to play the chief part, assisted, however, to a small extent by the median eye.

It may be concluded that, while in fresh-water Anostraca control of orientation by light is probably secondary to that exerted by the centre of gravity, this is apparently not so for the Notostraca. Here the normal swimming position is perhaps in direct response to the direction of light, although the possibility that gravity plays a role is not excluded. Seifert⁵ found that *Apus*, in response to a change in the lighting, appeared to turn over more rapidly to the normal position with the back upwards than it did for the reverse change. He also found that when the normal habitat conditions are reversed, by lighting from below and placing a false bottom above, *Apus* does not behave towards this false bottom in the same way that it does towards a true one when

the light comes from above. But the tendency for the animal to sink rather spoils the significance of this experiment. Much more interesting should be the behaviour of the animals at night. I have found, in agreement with Müller, that fresh-water Anostraca continue to swim ventral side up at night, this being the stable position with respect to the centre of gravity. But for the Notostraca I have no observations on this point, and I can find only two brief notes by Seifert⁵. He states (p. 403) that animals swimming in the dark show some uncertainty in their orientation, and (p. 414) when allowing themselves to sink down after a period of swimming, do so back downwards. These observations, if they are correct, would seem to show that it is indeed light which controls the normal daytime swimming position of the Notostraca. In fresh-water Anostraca this control is probably more latent, being awakened, according to Müller, only by certain disturbing stimuli.

An interesting confirmation of the probable truth of these general conclusions is contained in the later paper by Seifert⁶. In this paper, Seifert compares a fresh-water anostracan, *Chirocephalus*, with the 'brine-shrimp', *Artemia*. For *Chirocephalus* his results are in close agreement with those of Müller on *Tany-mastix*. But he finds that in *Artemia* conditions have been reversed by the nature of the environment. *Artemia* swims on the back like other Anostraca, but Seifert finds that in the strong brine in which it lives, this is actually the unstable position, because its body is tending to rise rather than to sink. Correlated with this presumed instability of the normal swimming position, there is a much more constant orientation of the body with respect to light than has been found in other Anostraca. Probably Seifert would thus divide the Euphyllipoda into those forms which normally swim in a 'stable' position and respond to light only after suitable stimulation, and those forms which swim in an 'unstable' position, maintaining their orientation by a constant response to the direction of light.

Clearly other factors than light and gravity, such for example as the currents set up by the animal, may also play a part. But for the sake of simplicity I have not considered these here; nor have I more than briefly mentioned the Cladocera, because the large amount of work done on this group has already been well reviewed (*cf.* Wagler⁷).

¹ A. G. Lowndes, *Proc. Zool. Soc. Lond.*, p. 1093 (1933).

² P. Wertheim, *Zool. Anz.*, 108 (1934).

³ P. Mathias, *Ann. Sci. nat. Zool.*, (x), 17 (1934).

⁴ R. T. Müller, *Z. Biol.*, 69 (1919).

⁵ R. Seifert, *Z. vergl. Physiol.*, 11 (1930).

⁶ R. Seifert, *Z. vergl. Physiol.*, 16 (1932).

⁷ E. Wagler, *Branchiopoda*, in Kükenthal and Krumbach, "Handbuch der Zoologie" Bd. 3, H.I. (1926-27).

Obituary

Mr. A. H. S. Lucas

AUSTRALIAN science loses a notable and versatile votary by the death of Arthur Henry Shakespeare Lucas, on June 9. The son of the Rev. S. Lucas, he was born in 1853 at Stratford-on-Avon and educated at Kingswood School, Bath, and the University of Oxford, where he was an exhibitor of Balliol College.

Going to Australia as mathematics and science master of Wesley College, Melbourne, in 1883, Lucas later became tutor and natural science lecturer at Trinity, Ormond and Queen's Colleges of the University of Melbourne. From 1893 until 1898 he was headmaster of Newington College, Sydney, after which he joined the Sydney Grammar School as mathematics and science master, and headmaster in 1920. He was also for some time lecturer in physiography at the University of Sydney. Retiring from school work at the end of 1923, he acted for two years as professor of mathematics at the University of Tasmania.

One of the founders of both the Victorian and the New South Wales Naturalists' Societies, Lucas was president of both at different times. In 1907-9 he was president of the Linnean Society of New South Wales, and he was a councillor until his death. For many years he was curator of the Algæ of the Sydney Botanic Gardens, and the last twelve years of his life was devoted to active research and wide collecting of Algæ, from Western Australia to the Barrier Reef, usually spending the summer months—including the last—with his co-adjutors, Mr. and Mrs. Perrin, near Georgetown, Tasmania, in this work. His last paper, "The Marine Algæ of Lord Howe Island", was read at the Linnean Society of New South Wales in June 1935. His "Introduction to Botany", written in conjunction with Prof. Dendy, is a well-known textbook to Australian students. But botany, although his chief love, was but one of many studies. In his teaching life, one learned that his personal pupils in the Senior Public Examinations had won University medals in eleven different subjects—these including all branches of science and mathematics. Besides papers on Australian lizards, in collaboration with the late Dudley Le Souef, he published two books on the animals and on the birds of Australia respectively.

Lucas's passion for acquiring learning led him also into the study of languages. A sound classic and English scholar, he extended his range of modern languages beyond the usual French and German to Italian, Spanish and Russian, by way of holiday pastime. The present writer, spending a summer vacation with him at Twofold Bay, found him reading "Don Quixote" in the original, while during the Great War he was requisitioned to interpret Russian in a law court, in the cause of some Russian refugees. Italian was a necessary concomitant to the study of

De Toni's work on Algæ. Far beyond Dr. Johnson's conception of learning, Lucas earned the famous epitaph on Goldsmith "Nihil quod non tetigit; nihil tetigit quod non ornavit".

A great teacher, a humorous and lovable friend, Lucas's wide influence was attested by the large and representative gathering which—at the shortest notice—attended Roseville Church to pay the last honours to a rare personality. He leaves three daughters and three grandchildren. H. J. C.

Dr. J. D. Unwin

WE regret to record the death of Dr. J. D. Unwin, anthropologist and head of Cambridge House, the University social settlement in south London, which took place after an operation at the age of forty years.

Joseph Daniel Unwin was born on December 6, 1895, the son of Mr. F. D. Unwin of Chauntry House, Haverhill, Suffolk. He was educated at Shrewsbury School, and would have gone to Oriel College, Oxford, with a classical exhibition in 1914, had it not been for the outbreak of war. He served in the Northamptonshire Regiment and the Tank Corps, was twice wounded, and was awarded the Military Cross. After the War, he spent some years in Abyssinia. In 1928 he was elected a Fellow Commoner Research Student of Peterhouse, Cambridge. He then compiled a thesis in anthropology for the Ph.D., which was published in abbreviated form in 1933 under the title "Sexual Regulations and Cultural Behaviour". A fuller account of his research, with much additional material, was published as "Sex and Culture" in 1935. His theories of the relation of degrees or stages of culture and the intensity of sexual prohibitions, which was based upon evidence from no less than eighty tribes and peoples, attracted considerable attention and discussion. This book showed that Dr. Unwin had remarkable powers of analysing and marshalling cultural evidence. He had also engaged in research work for the Home Office on the subject of the imprisonment of debtors. The results of this research appeared in "Imprisonment for Debt" (1935). He also wrote "Notes on the Unwin Family" (1934).

Dr. Unwin's knowledge of social conditions and problems made his appointment as head of Cambridge House peculiarly suitable; and it was fully justified by his work for the settlement.

Miss Alice Balfour

MISS ALICE BLANCHE BALFOUR, of Whittingehame, who died on June 12, at the age of eighty-six years, was a naturalist born and bred, and her scientific interest in Nature persisted in spite of the social

distractions of her association with her brother, Arthur James Balfour, politician and philosopher. In her earlier days, her bent was shared and encouraged by a younger brother, Prof. F. M. Balfour, already a leader in zoology when he died at the age of thirty-one years. Later she paid particular attention to gardening, so that the garden at Whittingehame became famous for its beauty, and to the collecting of a full series of the butterflies and moths of East Lothian. Her knowledge of the specific characters and local distribution of these and of other living things was thorough, and her inquiries brought her often to the Royal Scottish Museum in Edinburgh, to which she left her natural history collections.

It would be misinterpreting Miss Balfour's life to regard science as dominating her outlook, for her intellectual interests were wide, and her chief activities were social, in the broadest sense, and personal; but it may be said that the sustained pleasure of her life depended upon her love of Nature. J. R.

WE regret to announce the following deaths:

Prof. Franklin D. Barker, professor of zoology in Northwestern University, an authority on Trematodes, on July 10, aged fifty-eight years.

M. Louis Bleriot, who made the first flight across the English Channel from Baraques, near Calais, to Dover, on July 25, 1909, in a monoplane having a three-cylinder engine of 22-25 horse-power, on August 1, aged sixty-four years.

Lieut.-General Sir Alfred Keogh, G.C.V.O., G.C.B., director-general of the Army Medical Service 1904-10 and 1914-18, and Rector of the Imperial College of Science and Technology, 1910-22, aged seventy-nine years.

Prof. E. J. Nanson, emeritus professor of mathematics in the University of Melbourne, on July 1, aged eighty-five years.

Dr. F. J. F. Shaw, director of the Imperial Institute of Agricultural Research, Government of India, aged fifty years.

News and Views

Dr. E. J. Allen, C.B.E., F.R.S.

ON July 30, a special meeting of the Council of the Marine Biological Association of the United Kingdom was held in the rooms of the Royal Society in order to appoint Dr. Stanley Kemp, former director of the "Discovery" expeditions to the antarctic, secretary of the Association and director of the Marine Biological Association at Plymouth, the appointment to take effect on October 1. The present director of the Station, Dr. E. J. Allen, retires at his own request on September 30 after forty-two years of arduous service to the Association. During this period, Dr. Allen has seen the Station grow from being a small and poorly equipped second-rate institution to becoming the premier marine biological station of the world. We propose to refer in a later issue to Dr. Allen's great services to zoological science.

Dr. Stanley Kemp, F.R.S.

DR. STANLEY KEMP is probably the leading authority on oceanography at present living. During the years which he spent cruising in the Antarctic, he finally elucidated the circulation of the water in that ocean and proved its bearing on the habits and life-histories of the various species of whale which go south during the brief Antarctic summer in order to feed and grow fat and during this period fall a prey to whalers. He discovered the amazing fact that the largest of them all, the Southern Fin-Whale, feeds practically exclusively on one small species of 'shrimp' about 2 inches long. The baby whale when born is 20 feet long; it grows to a length of 50 feet during its first year, and attains its full size (100 feet long) in less than five years. He showed further that each antarctic summer is characterized

by an enormous growth of diatoms on which these 'shrimps' feed and consequently a rich oxygenation of the sea-water due to photosynthesis. As this water flows north to the antarctic circle it sinks from the surface to an ultimate depth of about 600 fathoms and it takes approximately five years to reach the equator. The sequence of antarctic summers can be traced in the patches of oxygenated water which it contains, and the intensity of the oxygenation of each patch marks the degree of warmth of the corresponding summer. Dr. Kemp's appointment is therefore a happy augury for the future of Plymouth and for fishery science in general. It is becoming increasingly clear that the variations in British fisheries are connected with variations in intensity of a southward flow of arctic water carrying with it stupendous harvests of diatoms and shoals of the most sought-after edible fish. Oceanographic exploration based partly on Plymouth may be as fruitful in the endeavour to elucidate the life-histories of these fish as antarctic exploration has been in unravelling the life-history of the whale.

Archæological Investigations in Syria

SIR LEONARD WOOLLEY's report on the work of the British Museum's archaeological expedition to Suedia, near Antioch, immediately before closing down work for the season (*The Times*, July 31) records the completion of excavation in the reserved area of the harbour site and the cutting of trial trenches on and around the hill station at Sabounia, two and a half miles inland. At the latter point, while the existence of a walled town at least as early as the Mycenaean age is established, the fall of the walls through the disintegration of the sandstone cliffs, on the edge of

which they were erected, has effectually disposed of the possibility of profitable excavation. Here, however, a find of vessels of copper and implements of bronze and iron has afforded instructive evidence of agricultural practice in Syria in the Byzantine age. At Sheikh Yusuf al Gharib further evidence was afforded of the activity of the port in the second half of the fourth century B.C., in the form of merchants' magazines, which had been burned, but had preserved a detailed picture of trade. A lamp store was stocked with lamps of both the imported and the locally made varieties, lamp fillers and Syrian oil bottles copying Greek models, while the stock of painted Attic *aryballi* bore witness to a common origin in common characteristics which made it possible to trace a definite shipment by a single firm and to date it within a few years. Gold and silver beads and silver coins of Athens, copper ingots and loose quicksilver marked a jeweller's shop. Back to the ninth century this is the most important Greek colony so far excavated. The absence of evidence from the earlier Mycenaean age is to be attributed to the forces of Nature, which have washed away the earlier portions of the site. Yet there is a link in a local copy of a Mycenaean vase and a single sherd of fine hand-made burnished black ware, which alone would suggest an earlier date. Though no inscription has been found, it is suggested that this is the ancient Posidium, mentioned by Herodotus as founded before the Mycenaean age.

Bronze Age Burials in Scotland

A NUMBER of bronze age burials with some remarkable and unusual features, recently disclosed by building operations at Doonfoot, Ayr, and at Riccarton, Ferniegair, Lanarkshire, are described by Mr. Ludovic Mann in *The Scotsman* of July 20. At Doonfoot, no evidence of a cairn was discovered, but at Ferniegair, a structure of stone, of which the over-ground portion had been demolished, had covered a group of burials. Some eighty tons of loose stones, some water-rolled, formed an understructure in which horizontal layers of turf had filled the interstices and survived in the form of black carbonized matter. Both cemeteries have yielded pottery vessels of various types, assignable to successive phases of the bronze age and, therefore, pointing to an occupation covering a considerable period of time. The earliest form is a small squat hand-made food-vessel, with incised and impressed zonal ornament. Traces of carbonized cereal adhere to the interior. The bodies had been placed in the contracted position, looking toward the rising, or, in one instance, the setting sun, at Midsummer. Over one body at Ferniegair was sheeting made from the twisted and plaited stems of the Scottish moss, *Polytrichum commune*. Other examples of this textile material have been found at Mount Vernon, Glasgow, in a bronze age cairn near Stranraer, and a few weeks ago at Craignish, Argyll. Mr. Mann states that the dimensions of the stones of the tomb structures conform with an ancient linear measure, as do the interior dimensions of the chamber; and also that the position of the urn-fields, and other remains,

ancient roads and tracks, conform, in a geometrical convention, also based on a common unit. Both at Doonfoot and Riccarton, adjoining burials contained large cinerary urns, with cremated remains, inverted over squared stone slabs. These overlaid burials of the earlier inhumation period. At Doonfoot three burials were superimposed. A further find recorded is at Catacol, Lochranza, Arran, where a six-foot skeleton was found in the extended position in a long narrow chamber, constructed of small side slabs and heavy roofing stones. An iron object was found with the body.

The National Central Library

THE twelfth annual report of the National Central Library refers to anxiety regarding the financial position of the Library due to inability to replace from any other source the £4,000 previously received as an annual grant from the Carnegie United Kingdom Trust. Fortunately, the Treasury grant-in-aid has been increased from £3,000 to £5,000 for a period of five years from April 1, 1936, and as a result the Carnegie Trustees have renewed their previous annual grant for a similar period. The continuance of both grants is conditional upon an increase in annual subscriptions from libraries by at least £2,000 by March 31, 1938. In consequence of the financial situation, expenditure on books has been only £2,338 but in addition to 3,110 volumes purchased, 5,451 volumes have been presented. The total number of volumes lent during the year was 118,288 and there are now 158 outlier libraries containing 6,303,000 volumes from which 10,002 volumes were borrowed. Reference is also made in the report to the extension of the regional system to cover the counties of Cornwall, Devon, Dorset, Gloucester, Hampshire, Oxford, Somerset and Wiltshire. When this system is established, the whole of England and Wales will be covered in eight regional systems, in addition to the London Borough libraries inter-lending system. Volumes lent to university libraries increased by 97 to 2,506. The system was used by 53 university libraries and 1,201 of the volumes were supplied by the National Central Library, 77 by foreign libraries and 1,228 by other university libraries, 80.52 per cent of the inquiries being supplied. The books supplied consist mainly of highly specialized and expensive books, books out of print, foreign books, back numbers of periodicals, or unpublished university theses.

National Research Council of Canada

THE eighteenth annual report of the National Research Council, Dominion of Canada, covers the activities of the Council in 1934-35. During the year, the Associate Committees on Aeronautical Research and on Trail Smelter Smoke were re-organized and three important conferences were held, one on problems of the honey industry, another to formulate a programme of cold-storage investigations, and the third to investigate the potato situation and the utilization of a surplus. The work at the laboratory for laundry research conducted by the Council since 1930 has now led to the formation of a Canadian

Research Institute of Launderers and Cleaners. Reports from the various laboratory divisions summarizing work in progress refer to investigations on chemical weed killers, including a review of the literature, and on the biochemistry of rust resistance. The Division of Chemistry has devoted a considerable amount of attention to problems relating to carbon black, leather, paints and rubber. It has developed a method for plucking poultry which has received many favourable notices. A special wax has been prepared which can be used for removing the pen-feathers, and by its use poulterers can prepare birds for market which are cleanly plucked and attractive. Much work has been done on the conservation of Alberta's natural resources, while in the Fire Hazard Testing Laboratory of the Division of Physics and Engineering, the testing and listing of domestic oil burners has been studied and the drafting of safety codes has received attention. A joint Associate Committee with the Dominion Department of Agriculture has investigated field crop diseases while another such committee is concerned with grain research including the frost injury of wheat, methods of determining moisture in grain and the effect of carbon tetrachloride on the quality of damp wheat in storage. Other associate committees are concerned with the storage and transport of food, weed problems, wool, parasitology and engineering standards.

Organon

THE first number of a new international review, *Organon*, has just been published in Warsaw by the Mianowski Institute. It is printed in French and English although all the authors are Polish, in order that a wide public may become familiar with the progress of scientific thought in Poland. The general character of the new publication can be gathered from the first group of contributions—"The Science of Science", "La Science, la religion et l'art", "The Man of Action and the Student", "Documents sur la psychologie de l'invention dans le domaine de la science", "Science and Scholarship in Poland to the Close of the Sixteenth Century", "Copernic", "Organisation de la science polonaise" and "Marja Skłodowska-Curie". The term 'science' is used in the widest possible sense, so that the new review will not be limited to contributions dealing only with the natural sciences. Two of the four historical articles have for their subjects the best known of Polish scientific workers, namely, Copernicus and Mme. Curie. It will be observed that the international character of science is well illustrated by the life and work of Mme. Curie. Polish by birth and French by marriage, her great discoveries were made with material from Bohemia which had been put at her disposal by Austrian authorities.

The Science of Science

THE first contribution to *Organon* attempts to analyse the 'science' of scientific investigations. We are reminded that the problems of science can be grouped according to different principles. Thus, they may be classified as being connected with the

philosophy of science, with its psychology or with its sociology. Such groupings and others in which further subdivisions are made do not avoid overlapping but, according to Drs. M. and S. Ossowski, they do serve to indicate that there can be a 'science of Science'. Against this view it can be urged that these problems already have their positions in well-defined fields (psychology, sociology, the theoretical parts of the separate sciences, etc.) but the Polish authors argue that the scope of this 'science of Science' comprises investigations concerning very widely separated subjects and brings them into internal harmony. The problems are attacked by many different means, but even here new links can be forged to bring the whole of science into one harmonious whole. The growth of science requires an extremely wide and many-sided supplementary apparatus, and the building of this apparatus requires theoretical studies.

A Landmark of Horticulture

THE names of J. C. Loudon and his wife Jane Loudon will always be remembered gratefully by gardeners. Such exhaustive publications as the "Encyclopædia of Plants", the "Encyclopædia of Gardening", and the "Encyclopædia of Agriculture" led up to their culminating triumph, the "Arboretum et Fruticetum Britannicum". This was published in sixty-eight parts between January 1835 and July 1838, so that it is approximately one hundred years since this typographical monument was given to the public. Mr. W. Roberts, writing on "The Centenary of Loudon's 'Arboretum'" (*J. Roy. Hort. Soc.*, 61, Part 7, July 1936), gives some interesting information about the methods by which the extraordinary amount of knowledge upon trees and shrubs was brought together. About three thousand questionnaires were circulated, in the days before the penny post, and Loudon received a very gratifying number of replies, the originals of which have been consulted by Mr. Roberts. Many of them bear striking testimony to the popularity of the Loudons, for invitations to stay at country seats were very numerous. An application to the Duke of Wellington resulted in his lordship mistaking the word Beeches for Breeches, and the signature for C. J. London. This he interpreted as from the Bishop of London, and accordingly dispatched the famous Waterloo breeches to that puzzled gentleman. The "Arboretum" and the other publications contain a great deal of information which is still of the greatest use at the present time. It is inevitable that the march of knowledge should add considerably to these solid foundations, but one feels that the £10,000 which the Loudons paid in amassing the knowledge and publishing the text of the "Arboretum" are still bearing handsome interest for the horticultural fraternity.

Survey of India

THE General Report of the Survey of India for 1935 directs attention to the need for quicker revision of the maps of India. It was in 1905 that the Survey embarked on a scheme of 1 inch to 1 mile maps of

India, which was to be completed in twenty-five years and then revised every thirty years. Subsequent events led to a modification of the scheme. In 1913 it was realized that the allotted time was too short, and a smaller scale of map was sanctioned for the less populous areas. But the Great War and subsequent financial stringency still further curtailed the plan. By 1935 only two-thirds of the programme had been completed. Surveys are being carried out at the rate of about thirty-nine thousand square miles a year, and if this can be maintained the programme will be completed in about sixteen years. Meantime, the maps of a large part of India, except on a small scale, are much out of date and printed mostly in black only. The Report contains a key map showing the degree of obsolescence of various sheets. Maps of India, Burma and adjacent countries on the 'one million' scale are now practically complete and the sheets of the Carte Internationale are approaching completion. A separate publication of the Survey of India is an Index to Annual Reports, 1904-5 to 1926-27.

Discoveries in Antarctica

SOME valuable details of new discoveries in Antarctica accompanied by photographs are contained in an article in the *National Geographic Magazine* for July by Mr. L. Ellsworth on "My Flight across Antarctica". It will be remembered that in December of last year, Mr. Ellsworth reached the Bay of Whales in the Ross Sea after a flight from Dundee Island, Graham Land. This took him over an entirely unknown part of Antarctica to the Pacific side of the Pole. South of Stefansson Strait he discovered a lofty rugged mountain range with an apparent trend between north-north-west and south-south-east. Farther on, other peaks appeared, one rising to 13,000 feet. Mr. Ellsworth made several landings in about lat. 80° S. and found a plateau at an elevation of more than 6,000 ft. He gave the names Hollick-Kenyon plateau to this elevated country, and James W. Ellsworth Land to the whole area between Hearst Land and Marie Byrd Land. The photographs of the new mountains do not suggest the block faulted mountains of Queen Maud Ranges, but rather the Andean ranges of Graham Land which, from Admiral Byrd's recent discoveries, would seem to continue into Edward Land.

FURTHER light on this problem is shed by an article by Mr. W. L. G. Joerg in the *Geographical Review* of July on "The Topographical results of Ellsworth's Trans-antarctic Flight". Mr. Joerg has mapped the direction of the new ranges as far as available data allow, and his map appears to confirm the suggestion of R. Staub that the axes of the Antarctic Andes of Graham Land spread fanwise in Hearst Land. Each of the newly discovered ranges seems to be a continuation of one of the three-fold lines of Graham Land. The relation of these folds to the plateau land of Antarctica has still to be determined, and Mr. Joerg's suggested direction does not continue into Edward Land. Mr. Ellsworth's photo-

graphs also suggest that Stefansson Strait is narrower than previously supposed, or possibly that it is an embayment on the east of Graham Land and not a strait. Its eastern entrance lies mainly north of the seventieth parallel. The discoveries open a field for future ground exploration.

Recommended Values of Illumination

THE Illuminating Engineering Society has issued a list of the values of illuminations which are recommended for various purposes. It has been prepared by the Technical Committee of the Society, and copies of the full recommendations can be obtained from the Honorary Secretary, I.E.S., 32 Victoria Street, S.W.1, price 6d. Since the candle-powers of electric lamps are known and the distance of the lamps from the work bench can easily be estimated, it is not difficult to estimate the candle-power. The committee recommends that if the task requires both discrimination and response, the foot-candle value should be at least 50. For severe and visual tasks such as fine engraving, sewing of dark goods, and discrimination of fine details of low contrast, the foot-candle value should not be less than 25. For prolonged critical visual tasks such as proof-reading, type-setting, drawing, reading, fine machine-work, fine assembling and use in large stores, a foot-candle value between 15 and 25 is recommended. A foot-candle value of 8-15 would be suitable for visual tasks such as detailed office work, skilled bench work and sewing on light goods and for retail shops. For less-exacting visual tasks, such as general office, large assembly work and classrooms, 5-10 suffices. For work of a simple character not involving close attention of fine details, 3-5 foot-candles is suitable. For casual observation where no specific work is performed, 2-4 foot-candles is regarded as sufficient.

Streamlined Trains

PEOPLE who have travelled in the new lightweight high-speed trains may have wondered why this new development has not come into wider use, and look forward to the time when most passenger trains will be similarly streamlined. According to a report issued by Science Service of Washington, D.C., L. K. Silcox, the engineer of the New York Brake Company, discusses this point in a report to the American Society of Mechanical Engineers. He says that only about 20,000 route miles of the main lines of the railroads of the United States are fitted by their curves, grades and traffic to be usable for lightweight trains that can go at 100 miles an hour. This length of railway is only about ten per cent of the total mileage of railroads in the United States. It is well known that crowds will gather to see a passenger locomotive go by if it is fitted with a metal shroud that helps its streamlining or presents what the public thinks is a streamlined appearance. But this shroud adds 13,000 lb. to the weight of the locomotive. Another drawback is that the equipment has to be built very robust. Like motor-cars, the internal equipment has to be turned over and renewed every few years. In addition, any new railroad rolling stock

has to be designed so that it is in keeping with the older equipment. A large reserve of the old equipment has to be maintained to meet the changing traffic demands made on it. Some engineers are afraid that there may be a public reaction after the very pleasant boon which the railways afforded when streamlined trains were first used. There is evidence of dissatisfaction when the public learns that a 100-120 miles an hour train is placed in revenue service on a 50-60 miles an hour schedule. Even although the maximum speed has been attained *en route*, the public feels that it has been misled.

Agricultural Research Institutes in Great Britain

THE Ministry of Agriculture has now published the report of the work of the agricultural research institutes in the United Kingdom for 1933-34 (London: H.M. Stationery Office; 5s. net). Besides describing the investigations carried out at the forty-four principal institutes, the report deals with the work at various advisory centres and special State-aided researches carried out in different parts of the country. The problems concerned cover a wide field, including soils, plant nutrition, physiology, breeding and disease, dairying, animal nutrition, breeding, diseases and pests, food preservation and transport, and agricultural engineering. Should anyone desire further information, a list of papers published from each centre is supplied so that reference to the original source of the work is available, and inquiries may also be addressed to the director of the institute or person concerned, the names and addresses of whom are listed.

The American Amaryllis Year Book

THE American Amaryllis Society has issued vol. 2, its Year Book for 1935 (from the Editor, Dr. Hamilton P. Traub, Mira Flores, Orlando, Florida, U.S.A.). It is dedicated to Theodore L. Mead, in recognition of his pioneer work with hybrid *Hippeastrum* plants. Gardeners are familiar with narcissi, they bestow a rather occasional interest upon day lilies (*Hemerocallis* spp.), they cultivate *Alstroemeria*; but most horticulturalists have not yet realized the wonderful beauty displayed by the new hybrids of *Hippeastrum*. The Society has an international outlook, for a large part of the volume is devoted to regional activities in Australia, Kenya, Europe, and all parts of America. A section on "Description and Phylogeny" quotes *inter alia* from Dr. J. Hutchinson's recently published volume on the classification of monocotyledons. Robert F. Ruthruff contributes a paper describing the alkaloids found in various Amaryllidaceae, and the late Dr. David Griffiths directs attention to "Opportunities for Breeding with Daffodils". Two valuable papers by Miss Ida Luyten and Dr. Traub introduce new methods of vegetative propagation of amaryllids. Fifteen papers deal with culture, five with curing, storage and forcing, and a similar number with marketing. The editor has introduced the idea of quoting one or two abstracts from scientific papers relevant to *Amaryllis* culture, and though the index shows nearly sixty papers, no subject appears

to have inadequate treatment. Plans have already been made for publishing year books so far ahead as 1938; the Society occupies a position of great utility and high æsthetic value.

Early Photographs

THE June issue of the *Alumnus Chronicle* of the University of St. Andrews contains an article by Mr. J. H. Read describing a collection of prints by early photographers which illustrate the local development of the art and have been presented to the University by Mr. James Thomson of Inverness. The oldest photographs of the collection are of buildings in St. Andrews produced by the Calotype process about the year 1840. Portraits of St. Andrews worthies, for example, Sir Lyon Playfair and Sir David Brewster, by the process date from about 1850. The majority of the photographs are albumen prints from wet collodion plates taken during the next twenty years, and include portraits, scenery and reproductions of pictures. The article is illustrated by reproductions from paper negatives by Thomas Rodger of a St. Andrews fishing quarter in 1843, and a portrait of Prof. George Day, professor of medicine, 1850, both of which are remarkably good.

Films and their Utilization

THE current number of *Film Progress* is in two parts. It contains the usual supplementary bulletin to the National Encyclopædia of Films. In this section are noted a good number of films, both 35 mm. and 16 mm., of G. B. Equipments and Pathé. Silent films of Ensign and C.I.B.E.F. are also listed. The other section deals mainly with the educational value of the sound film. This is in effect a résumé of the arguments put forward by C. F. Hoban in a symposium on "Sound and Silent Films" held at the University of Chicago. The arguments are well stated, but the article reads too much like special pleading, seeing that the arguments for the silent film presented to the symposium are not mentioned. We hope that they will be stated in a future number.

Third World Power Conference

THE following official delegates have been appointed to represent the Government of the United Kingdom at the Third World Power Conference and Second Congress, International Commission on Large Dams of the World Power Conference, to be held concurrently in Washington, D.C., on September 7-12: Viscount Falmouth, Mr. N. G. Gedye, Mr. T. Hardie, Mr. J. M. Kennedy, Dr. F. M. Lea, Mr. Charles H. Merz, Sir Archibald Page, Mr. C. Rodgers, Dr. F. S. Sinnatt and Mr. E. T. Williams. The final time-table for the Conference has now been announced. The joint opening session will be held in Constitution Hall, Washington, on Monday, September 7, at 8.30 p.m. Business sessions will be held earlier on the same day and throughout the week. There will be an address by the President of the United States on September 11 at 2 p.m. followed by a garden party and reception at the White House.

Building Exhibition at Olympia, London

THREE HUNDRED AND FIFTY firms and associations have already booked space in the twentieth biennial Building Exhibition which is to be held at Olympia, London, on September 16-30. This number of exhibitors is in excess of the number which exhibited on the last occasion in 1934, and an increase of about 10 per cent in the total number may be expected. The Department of Scientific and Industrial Research is again to have a large exhibit, and this will cover not only the work of the Building Research Station, but also that of the Forest Products Research Laboratory, Princes Risborough, and the National Physical Laboratory, Teddington. The Building Research Station exhibit will deal with plastering materials; common types of failure caused by using unsuitable material or by faulty construction; concretes, with special emphasis on light-weight concrete; further work on the driving of concrete piles; the measurement of strain on masonry structures; and the weathering of building stone. The work of the Forest Products Research Laboratory illustrated in the Exhibition will deal with the correct moisture content of timbers for various purposes; wood-working, with special reference to new and difficult timbers; and wood preservation and protection against the death-watch and other beetles. The National Physical Laboratory's exhibit will deal chiefly with building acoustical problems, models being shown of typical quiet and noisy rooms. Short-length films are to be shown by the Department on its stands.

Observations on Comets

A CONSIDERABLE number of observations of Peltier's comet are now available, and the Rev. Dr. M. Davidson has computed a new orbit, using observations from May 16 to July 15, the latter being made by Dr. W. H. Steavenson and independently by Mr. Will Hay. The period appears to be about 1500 years, but observations from the southern hemisphere, in which the comet can be followed up to October, will enable computers to obtain a more accurate period. The comet is rapidly moving south, and will not be visible in these latitudes after August 6. A comet of sixth magnitude was discovered by Kaho on July 17, and a number of observations have since been made at various observatories and also by members of the British Astronomical Association. The orbit given below was computed by Whipple and Cunningham, but as the observations used were very rough, the orbit is only approximate. Dr. Crommelin, having received more accurate observations, is now engaged in computing a general orbit. The comet is receding from the earth and sun and is fading rapidly.

Orbit of Comet 1936a (Peltier)
Computed by Rev. Dr. M.
Davidson

T	1936 July 8-95141 U.T.
ω	$148^{\circ} 28' 32.0''$
Ω	$134^{\circ} 02' 18.8''$
i	$78^{\circ} 32' 51.6''$
a	130.681
e	0.991584
q	1.099743

Orbit of Comet Kaho
Computed by Messrs. Whipple
and Cunningham

T	1936 July 13-700 U.T.
ω	$40^{\circ} 56'$
Ω	$262^{\circ} 02'$
i	$123^{\circ} 08'$
q	0.5220

The period is nearly 1,500 years.

Announcements

ROBERT ESNAULT-PELTERIE has been elected a member of the Division of the Applications of Science to Industry of the Paris Academy of Sciences in succession to the late Jean Rey.

At the quarterly meeting of the Royal College of Physicians held on July 30, the Weber-Parkes Medal and Prize were awarded to Sir St. Clair Thomson for his work on tuberculosis of the larynx, and the Moxon Gold Medal to Prof. Edward Mellanby for his work on the problems of nutrition. The Harveian Oration will be delivered by Sir Walter Langdon-Brown on October 19, at 4 p.m. Dr. Arthur Hurst has been appointed Harveian Orator for 1937 and Dr. E. A. Cockayne Bradshaw Lecturer for 1937.

THE Royal Academy of Belgium has made the following awards: Lefebvre Prize to MM. Wattiez and Sternon; Laurent Prize to M. R. Bouillenne; Van Beneden Prize to M. J. Brachet and grants from the De Potter Fund to M. A. Gardedieu, M. Capron, M. van den Bruel and M. Florin.

DR. GOTTLIEB HABERLANDT, emeritus professor of botany in the University of Berlin, has been made an honorary member of the Academy of Sciences of Vienna.

THE Austrian Society for Roentgenology will hold its annual meeting at Vienna on September 4-8. Further information can be obtained from Allgemeines Krankenhaus, Zentral-Roentgen Institut, Alserstrasse 4, Wien 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Junior assistants (physics or chemistry) in the Chemical Defence Research Department (War Department)—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (August 12).

A lecturer in electrical engineering in Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (August 15).

An assistant lecturer and demonstrator in civil engineering in University College, Cardiff—The Registrar (August 19).

A part-time assistant lecturer in the Department of Physics and Applied Physics in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (August 24).

An assistant director of the Plant Pathological Laboratory, Harpenden—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (August 31).

A senior assistant in the Department of Surgery of the Royal Veterinary College—The Secretary (August 31).

An assistant curator in the Royal Albert Memorial Museum, Exeter—The Town Clerk, Exeter (August 31).

A lecturer in physiology in the University of Western Ontario, London, Ontario, Canada—The Dean of the Medical School.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 250.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Energy of Formation of 'Cyclol' Molecules

ACCORDING to the cyclol theory of the structure of proteins¹—a *working hypothesis* recently put forward in these columns—the polypeptide, the essential unit in the molecule on the classical theory, is

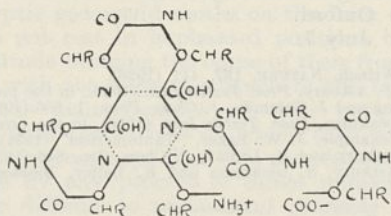
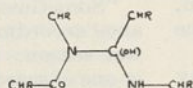
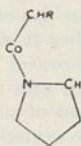


FIG. 1.

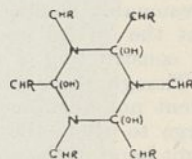
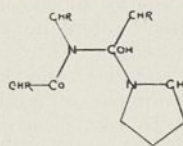
replaced by the cyclized polypeptide (Fig. 1): correspondingly the classical peptide links (joining one pair of C,N atoms) are replaced either by the double peptide links (joining two pairs of C,N atoms) or by the



Single peptide links.



Double peptide links.

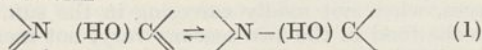


Triple peptide link.

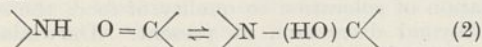
triple peptide link (joining three pairs of C,N atoms) (Fig. 2). The reaction

polypeptides \rightleftharpoons proteins

is thus regarded as a ring chain tautomerism², which takes the form



if the appropriate groups are in the imide form, and the form



if they are in the amide form.

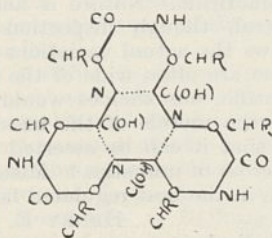


FIG. 3.

The precise data required for an estimate of the energy balance in the process of formation of cyclol molecules from polypeptides are not yet available, but we may consider cyclol 6 (Fig. 3) as an indication of the situation, in the hope of directing attention to the fact that certain data are urgently required.

The figures³ for heats of formation of various links, in kilogram calories, are as follows:

C=O	82.8 (alcoholic ethers)	C=N	119.6 ('estimated')
C=O	177.8 (ketones)	O-H	109.5 (H ₂ O)
C-N	61.5 (amines)	N-H	83.3 (NH ₃)

With these figures, the energy changes are as follows:
One amide to imide transformation,

$$(177.8 + 61.5 + 83.3) - (82.8 + 109.5 + 119.6) = +10.7.$$

One transformation of type (1),

$$(119.6) - 2(61.5) = -3.4.$$

One transformation of type (2),

$$(177.8 + 83.3) - (82.8 + 109.5 + 61.5) = +7.3.$$

According to these figures, the formation of cyclol 6 from a closed polypeptide consisting of 6 residues requires 21.9 kilogram calories if the polypeptides are in amide form throughout; if the three links concerned are already in the imide form, energy amounting to 10.2 kilogram calories is emitted. In these calculations, no allowance is made for resonance, which amounts to 20 kilogram calories for acetamide.

The calculation for the process of linkage (1) suggests that if the synthesis of proteins is a process of cyclization of polypeptides (or indeed if it is a process of polymerization of substituted diketopiperazine molecules), it is facilitated if the appropriate groups are in the imide form. The implication is that certain enzymes operate directly on the substrate by imposing on some of its (CO,NH) groups, the imide form -C(OH)=N- . This deduction from the cyclol hypothesis gains support from the researches of Bergmann and his co-workers on dipeptidase, which led them to assume⁴ that the "hydrogen atom becomes rearranged under the influence of the enzyme in such a way that the amide form of the dipeptide is changed to the imide form $\text{-CO-NH-} \rightarrow \text{-C(OH)=N-}$ ".

The implications of the calculation for the process of linkage (2) are explored in the accompanying letter by my colleague, F. C. Frank.

D. M. WRINCH.

Mathematical Institute,
Oxford.

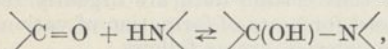
¹ D. M. Wrinch, *NATURE*, **137**, 411 (1936).

² See, for example, J. W. Baker, "Tautomerism" (1934), p. 38.

³ The figures of Pauling and Sherman given in *J. Chem. Phys.*, **1**, 606 (1933), calculated on the basis of the value of 208 kilogram calories for the heat of dissociation of N_2 , have been modified to take account of the revised value of 169 kilogram calories (see Mulliken, *Phys. Rev.*, **46**, 144 (1934); Herzberg and Sponer, *Z. phys. Chem.*, **B**, **26**, 1, though this modification is without effect on these calculations.

⁴ *J. Biol. Chem.*, **109**, 325, 329 (1935).

WRINCH¹ recently proposed that in monolayers or globular molecules of proteins, polypeptide chains are knitted into a fabric by the bonding process



which Frank² had shown to be required in keratin to make permissible the structure Astbury deduced for it by X-ray crystallography. It is desirable to estimate the energy balance of this process, which is chemically analogous to lactam-lactim tautomerism, or to the ring closure in sugars associated with mutarotation.

Taking link values of heat of rupture from Pauling and Sherman³, we find the process of linkage represented above is endothermic by about 7.3 kcal., while a lactam-lactim transformation is 10.7 kcal. endothermic, without allowance for resonance energies in either case. Resonance in the lactam form increases both these figures by some 20 kcal., if taken as the same as in acetamide: there must be a similar but presumably smaller resonance energy in the lactim, but the 'cyclol' molecule in itself offers no chance of constructing a resonant system.

Though these are not free energies, and in any event not very accurate, they appear certainly too large to allow the equilibrium to rest close to the right hand of the equation, as the theory requires, so that we must either abandon the theory or find some compensating source of energy. This is provided in the keratins by strain in the side-chain cross-linkages, which Astbury² and Speakman⁴ have shown to provide the main driving force of contraction from the β -form. In the proposed 'cyclol' monolayers, we have a similar source of energy which we may call a heat of crystallization, for the cyclization into a compact strainless form is evidently at the same time a process of two-dimensional crystallization; but this by itself cannot be sufficient.

An additional source is provided by hydration (or association through hydroxyl bonds generally), which is well known to stabilize lactims, non-chelate enols, and hydroxylic tautomeric forms in general⁵, a fact directly related to their superior solubility in water and other hydroxylic solvents. Not only the hydroxyls but also the nitrogens, which are more aliphatic in nature in the cyclized form, are available for hydration: protein hydroxyls can also associate with each other. Each hydroxyl bond formed may be supposed to provide energy of the order of half the internal latent heat of vaporization of ice, thus about 5 kcal., so that the whole may be a sufficient compensating source of energy, about 20 kcal.

Thus it appears that if the protein molecules are fabricated with the aid of this linkage, they can only be stable when hydrated. Any conditions tending to

dehydration will render the protein excessively liable to opening into chain forms, unless restrained by side chains or deprived of catalysts necessary for transformation. Mildly dehydrating conditions should be most effective because water is a catalyst for transformation as well as a stabilizer of one form. So long as the rings only occasionally open they can re-form in the same configuration, but as soon as the opening becomes too frequent this will cease to be the case and they will then re-form in altered structures, derived more directly from open chains. This conforms with all observations on the processes of degeneration and denaturation, including Astbury's X-ray studies of these processes^{6,7}. Thus what seems at first to be a destructive obstacle to the theory may be capable not only of reconciliation with it, but even of enhancing its effectiveness.

F. C. FRANK.

Engineering Laboratory,
Oxford.
July 7.

¹ D. M. Wrinch, *NATURE*, **137**, 411 (1936).

² See W. T. Astbury, *Proc. Textile Inst.* (1936), in the press.

³ L. Pauling and J. Sherman, *J. Chem. Phys.*, **1**, 606 (1933).

⁴ J. B. Speakman, *Proc. Textile Inst.* (1936), in the press.

⁵ See, for example, J. W. Baker, "Tautomerism" (1934), p. 38.

⁶ W. T. Astbury and R. Lomax, *J. Chem. Soc.*, 846 (1935).

⁷ W. T. Astbury, S. Dickinson and K. Bailey, *Biochem. J.*, **29**, 3351 (1935).

Insect Coloration

IN the article on the Oxford Congress of the South Eastern Union of Scientific Societies in *NATURE* of July 11, p. 88, reference is made to the address of the president, of which the main topic was the coloration of insects by natural selection. Prof. Hale Carpenter is reported as saying:

"Sometimes it pays an insect to change its appearance according to whether it appears in a dry or in a wet season. Poulton pointed out that a dry season is one of scarcity of food, and certain butterflies then remain inconspicuous and of skulking habits, whereas in a wet season they are conspicuously coloured, and they can afford to allow some of the species to be eaten by reason of their number."

Prof. Hale Carpenter referred to an African *Charaxes*, which is conspicuous in the wet season but in the dry assumes a dead-leaf-brown and deliberately hides itself among clusters of dead leaves. To assert that an insect *deliberately* hides, is going far. When bug hunting in Australia and Sumatra, it seemed to me that the butterflies all made for shade behind leaves, when not madly careering in the sun. May not the food in the two seasons vary, not merely in quantity but in quality? It certainly will. The temperature also. As we know nothing about the relation of coloration to quality of food, the subject is beyond discussion, at present. Darwinian discussion is largely on 'Alice' lines. No chemist can believe in change by any process of direct mimicry—nor even a MacBride. Nature is held under strict enzymic control, though inspection of any good collection shows the actual variations are very wide. Discussions too are often wide of the mark: if they were all scientific, our shelves would have an easy burden. Are the morals of the insect world on so high a plane that it can be asserted that there has never been a cross of mimetics? Mistakes, we know, are made even in the best regulated families.

HENRY E. ARMSTRONG.

55 Granville Park,
Lewisham, S.E.13.

PROF. ARMSTRONG'S criticisms are easily met. It is *not* going too far to "assert that an insect *deliberately* hides". The taking temporary shelter from sun is a different matter from assuming a position of complete rest in surroundings best suited to concealment for long periods. The case I mentioned was undoubtedly deliberate choice of a cluster of dead leaves, among others, by a *Charaxes*. I have repeatedly watched the Pierine butterfly *Eronia cleodora*, having been disturbed from undergrowth where it had settled late in the evening, deliberately settle again, after previously fluttering around, among the half-dead leaves from which it had been disturbed and with which its patchy yellow underside closely matched. The late Dr. G. B. Longstaff recounts the same experience on p. 194 of his book, "Butterfly Hunting in Many Lands", and gives a very accurate coloured plate to illustrate the point.

Has Prof. Armstrong never studied photographs of procrystic geometrid moths on the bark of trees, which do not rest in haphazard positions but take up an attitude bringing the edges of their front wings into line with the edge of a crack in the bark, and putting the main features of their pattern into harmony with the surface on which they rest?

Prof. Armstrong says that "No chemist can believe in change by any process of direct mimicry". It is a little difficult to understand precisely what is meant. Is he aware of the facts concerning *Papilio dardanus*? In this butterfly the light yellow pigment of the male, and the ancestral form of female like it, fluoresces in ultra-violet light, but in the mimetic forms of female the fluorescence has been lost: this surely implies a chemical change.

The last point raised by Prof. Armstrong is a form of the old and out-of-date argument that mimicry is merely an expression of affinity.

No one, I think, would venture to assert that the close mimetic likeness of a moth to a Hymenopterous insect such as an ichneumon-fly is due to hybridization! Would Prof. Armstrong account for the likeness of a moth or a beetle to a bird-dropping in the same way? Such a resemblance is of the same class as mimicry, and an explanation other than natural selection which accounts for both has yet to be found.

G. D. HALE CARPENTER.

University Museum,
Oxford.

Palaeozoic Seismicity

EVIDENCE of contemporaneous disturbances during the deposition of Ordovician strata has recently been collected at localities in the Irish Free State including Portraine, Balbriggan, Raheen Bridge and Tramore. This comprises breaking up and slumping of limestone beds, rapid alternations of shale and graded sand (greywacke sedimentation), breccia beds between sub-parallel undisturbed layers, and anti-dune wave-crests in mud. The cause probably lies in seismicity associated with the instability of the Lower Palaeozoic geosyncline.

It now seems possible to demonstrate that the 'crush-conglomerates' and 'thrust-conglomerate' distinguished by Reynolds and Gardiner¹ at Portraine are paene-contemporaneous effects, since the Portraine limestone contains unbroken layers intercalated between beds brecciated *in situ*, and 'landslip' masses (Fig. 1). North-west of Balbriggan, one has a repetition of several of the features which Henderson² at Girvan ascribed to seaquakes and tidal waves.

In County Waterford, greywacke beds with breccias have been examined on the coast north of Raheen Bridge. The shaly fragments in these remain so sharply angular that they must have become embedded in their present sandy matrix almost as soon as they were disrupted. The possibility of tsunamis, after earthquakes, carrying shore sand out to sea among disturbed shaly sediments, as suggested by Bailey and Weir³, must be carefully considered. In the Carrigaghalla Series of Reed⁴, on the north side of Doneraile Cove, Tramore, wave-crests of mud, in the anti-dune phase, have been discovered preserved in tuffaceous sand. The only explanation in this case seems to be that the sandy detritus was deposited by a tsunami, the swift passage of which induced the anti-dunes. Examination of one wave-crest about $\frac{3}{4}$ inch high, indicates that it is in no way a compressional structure due to pressure by an overlying column of sand differentially weighted, but shows loosening out of the muddy laminae.

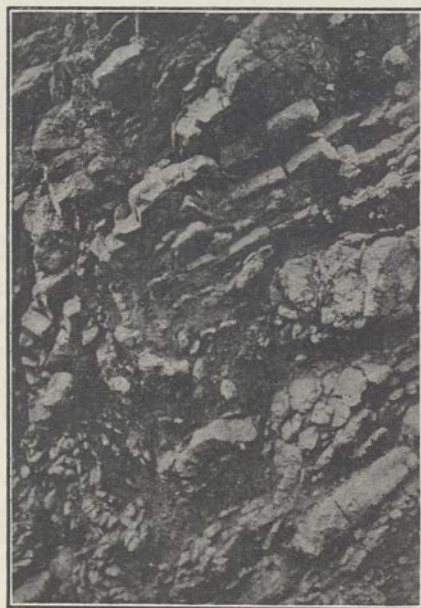


FIG. 1. Slumping of limestone beds in shale.
Height of section, about 8 feet.
Priest's Chamber, Portraine, Co. Dublin.

This work casts grave doubt on the views of Kilroe and McHenry⁵ regarding 'intrusive tuffs' in south-eastern Ireland. These anomalous clastic beds probably originated as water-laden sand which, under seismic conditions, might behave with the mobility of an igneous rock.

The Irish disturbances I have noted are of Caradocian age—the Portraine beds may be correlated with the Robeston Wathen limestone in Wales—and this epoch may be regarded as one of marked seismicity.

There is no doubt that seismic activity must have prevailed at many stages during the development of the Lower Palaeozoic geosyncline. Certain breccias in Arenig greywackes of the west of Ireland are unquestionably attributable to it. One example figured by Gardiner and Reynolds⁶ from Glensaul may be taken as typical. It occurs sharply bounded between undisturbed layers, the narrowness and unbroken nature of which exclude the contingency of

frictional brecciation. A similar interpretation seems to apply to the 'crush-conglomerates' described by Lamplugh⁷ from the Manx Slate Series. In the Lower Cambrian (?) of Howth, near Dublin, greywackes and shaly breccia—'sherd-schist'—appear to me to provide at a still earlier period an indication of contemporaneous disturbances.

As an example from another geosyncline, there are the graded sediments of the Middle Devonian of New South Wales. From these, Benson⁸ figures an example in which a claystone layer has two anti-dune wave-crests picked out in tuffaceous sand. He describes the latter as 'intrusive'. But it is more likely to have been carried into place by a tsunami. The specimen, I believe, has been figured upside down.

It may be added that a recurrence of seismic conditions in carboniferous times in the Dublin district seems to be indicated by anti-dune wave-crests in mud which have been found in beds of Yoredale age at Loughshinny. These beds show rapid alternations of shale and graded sand. Their evidence is corroborated by brecciation *pari passu* with deposition in D₂ limestone at Curkeen Hill quarry.

ARCHIE LAMONT.

Department of Geology,
University,
Glasgow.
June 25.

¹ "Crush-Conglomerates in Ireland", *NATURE*, **53**, 488 (1896); "An Account of the Portrairie Inlier (Co. Dublin)", *Quart. J. Geol. Soc.*, **53**, 527-534 (1897).

² "Ordovician Submarine Disturbances in the Girvan District", *Trans. Roy. Soc. Edinburgh*, **58**, 498-507 (1935).

³ "Submarine Faulting in Kimmeridgian Times: East Sutherland", *Trans. Roy. Soc. Edinburgh*, **57**, 449-454 (1932).

⁴ "The Lower Palaeozoic Bedded Rocks of County Waterford", *Quart. J. Geol. Soc.*, **55**, 728, 740-742 (1899).

⁵ "On Intrusive, Tuff-like, Igneous Rocks and Breccias in Ireland", *Quart. J. Geol. Soc.*, **57**, 482-489, and especially Figs. 3, 5, etc. (1901).

⁶ "On the Igneous and Associated Sedimentary Rocks of the Glensaul District (County Galway)", *Quart. J. Geol. Soc.*, **66**, 257, fig. 1 (1910).

⁷ "The Crush-Conglomerates of the Isle of Man", *Quart. J. Geol. Soc.*, **51**, 563-588 (1895); "The Geology of the Isle of Man", *Mem. Geol. Surv.* 1903, pp. 55-71.

⁸ "The Geology and Petrology of the Great Serpentine Belt of New South Wales. Part V. The Geology of the Tamworth District", *Proc. Linn. Soc. New South Wales*, **40**, 570, Fig. 11 (1915).

Density and Compressibility of Solid Hydrogen and Deuterium at 4.2° K.

It has been shown by Bennewitz and Simon¹ that the influence of zero-point energy on the properties of a condensed substance is very great for substances of low boiling point. The effect is most marked in helium², where it actually plays the chief part in determining the properties; but it is large, too, in hydrogen, a substance which is particularly interesting as it possesses two isotopes which have identical binding forces but very different zero-point energies.

Certain of the properties of the solid phases have been measured already, by Simon and Lange for hydrogen³ and by Clusius and Bartholomé for deuterium⁴, among them being the specific heats at constant pressure, the heats of evaporation and melting, and the molar volumes at the triple points. Clusius and Bartholomé have discussed in their very interesting paper the influence of zero-point energy by comparing the properties of the two isotopes. Nothing was hitherto known, however, of the compressibilities. These are of special interest because the zero-point energy gives rise to a pressure $p^{(0)}$,

and its variation with volume to a compressibility² $K^{(0)}$, which, as a preliminary estimate shows, will be an important part of the total compressibility. At the same time, a knowledge of the molar volumes at the boiling point of helium will give us very nearly their values at absolute zero, and, using the known values at the triple points, the mean thermal expansions.

For obvious reasons, we had to use a pycnometer method. The only substance available as a filling liquid is liquid helium, and since its compressibility is very much greater than that of solid hydrogen, the method cannot be one of high accuracy. But as hitherto even the order of magnitude was not known, we thought it worth while to carry out the experiment.

A vessel of known volume (about 4 c.c.) was attached to a helium liquefier of the expansion type; it was nearly filled with condensed hydrogen (or deuterium), and when this was solid, completely filled with liquid helium at a pressure of about 100 kgm./cm.². By letting out successive amounts of helium and measuring them as a gas at room temperature, and afterwards measuring in the same way the hydrogen, the density of the solid hydrogen at each pressure could be calculated. The results are given in the accompanying table.

	Hydrogen	Deuterium
Density (gm./cm. ³) at 1 kgm./cm. ² and 4.2°	0.0890 ± 0.0004	0.2059 ± 0.0010
Molar volume (cm. ³) at 4.2°	22.65 ± 0.1	19.56 ± 0.1
Compressibility (cm. ² /kgm.) at 4.2° (average from 1 to 100 kgm./cm. ²)	(5.0 ± 0.5) × 10 ⁻⁴	(3.3 ± 0.7) × 10 ⁻⁴

As to the compressibilities, it may be remarked that the curve of volume against pressure is, as expected, not a straight line. In the above table, however, only the mean compressibility between 1 and 100 kgm./cm.² is given, since it is known more accurately than the compressibility at any given pressure. But it may be noted that the compressibility at 100 kgm./cm.² is for both isotopes roughly half that at 1 kgm./cm.². For the thermal expansion, assuming for a rough estimate that it is proportional to C_p , and combining the molar volumes at 4.2° with those at the triple points, we find that at a given temperature the expansion coefficient of deuterium is about half that of hydrogen.

We intend to publish a more detailed account of these experiments, and will postpone until then the theoretical discussion of our results, which we hope to consider also from the point of view of F. London's treatment of helium². Here we should like to point out only that, for hydrogen, $p^{(0)}$ amounts to about 1,000-2,000 atm., and $K^{(0)}$ accounts for a very great part of the total compressibility.

Our sincere thanks are due to Dr. N. Kürti for his constant help in carrying out the experiments.

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F. SIMON.

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July 10.

¹ *Z. Phys.*, **16**, 183 (1923).

² F. Simon, *NATURE*, **133**, 529 (1934); F. London, *Proc. Roy. Soc., A.*, **153**, 576 (1936).

³ *Z. Phys.*, **15**, 312 (1923).

⁴ *Z. phys. Chem.*, **B**, **30**, 237 (1935).

Quantum Relationship of the Light-emitting Process of Luminous Bacteria*

WE have studied the relation between the oxygen consumption and the light intensity of a suspension of luminous bacteria (*Photobacterium phosphoreum*) by measuring simultaneously, at different concentrations of potassium cyanide, the oxygen consumption by the ordinary Warburg method and the light intensity with the aid of a photometric method.

It could be shown that the oxygen consumption consisted of two main parts: one of which was inhibited completely by about 0.001 mol. potassium cyanide, whereas the other decreased slowly with increasing concentration of the cyanide and in proportion to the light intensity.

In plotting the light intensity against oxygen consumption, the lower part of this curve was a straight line, giving the percentage of oxygen consumed in the light-emitting process. This proved to be 19 per cent of the total amount of oxygen consumed.

As the light emission could be measured in absolute units, the number of molecules of oxygen consumed per quantum of light emitted could be computed. At 16° C. the mean value obtained was 500 molecules of oxygen per quantum.

It seems remarkable that, whereas the percentage of oxygen consumed in the light-emitting process proved to be constant under different conditions and at different temperatures, the light intensity varies a great deal. It must be concluded, therefore, that the efficiency of the light-emitting process is dependent on various, as yet unknown, factors.

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July 16.

* Preliminary communication from the Rockefeller Biophysical Research Group under the direction of Prof. L. S. Ornstein (Utrecht) and Prof. A. J. Kluyver (Delft).

The Lower Regions of the Ionosphere

IN our recent letter to NATURE¹, we did not mean to infer that reflections from the 60 km. level had not been found before. So early as 1930, Appleton² noticed reflections of this type. In 1935, Mitra and Syam³ recorded reflections from this level using the pulse method of Breit and Tuve. The only addition we made to existing knowledge was that this high level forms the top of a region extending from 40 km. to 55 km. and that there is a lower region from 5 km. to 30 km. high. Practically the same discovery was made in England by Watson Watt and his co-workers⁴. In accordance with Mitra's suggestion⁵, we propose to call these the *D* and *C* regions.

The following observations may be of interest. The height of the lower boundary of the *C* region is less in summer than in winter; it rises slightly during the night. The *C* region is so strongly reflecting in the summer months that it weakens the reflection from the *D* layer. Hence the *D* layer is usually found in the winter season. When thunderstorms or strong winds are present, the *C* region is very turbulent.

On April 22, 1936, a violent magnetic disturbance was recorded at Cheltenham, Md. On the same day, we observed that the *C* region was fluctuating violently (Fig. 1) and its lower edge approached very close to the earth's surface (1–5 km.). At that time no signals were received upon the 20-metre transmission band from any distant stations.

When the U.S. stratosphere balloon *Explorer II* passed through the 60,000 ft. level, its signals became weak⁶. Our explanation of this phenomenon is that

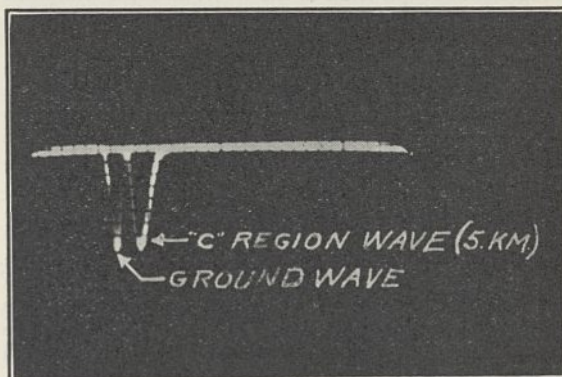


FIG. 1. Ground pulse and its reflection from the *C* region. On this scale, the *E* layer would appear about three inches and the *F* layer about six inches to the right.

the balloon was actually above the top of the *C* region; hence the signals, which had been reflected back to the earth when the balloon was in the *C* region, were later reflected out into space.

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June 22.

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A. W. FRIEND.
N. I. HALL.
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¹ NATURE, 137, 782 (1936).

² Appleton, *Proc. Roy. Soc., A*, 126, 542 (1930).

³ Mitra and Syam, NATURE, 135, 953 (1935). Syam, *Ind. J. Phys.* 10, Part 1, 13 (1936).

⁴ Watson Watt, Bainbridge-Bell, Wilkins, Brown, NATURE, 137, 866 (1936).

⁵ Mitra, NATURE, 137, 867 (1936).

⁶ Stevens, *Nat. Geog. Mag.*, 59, 693 (1936). NATURE, 137, 896 (1936).

Stereoisomeric Nature of Oxidation and Fermentation

I HAVE investigated with the aid of the Warburg technique the action of optically isomeric nicotines upon alcoholic (*Torula utilis*, *Saccharomyces exiguus*) and lactic (*Bacterium Delbrücki*) fermentations of glucose dissolved in the external solution; upon oxidation of exogenous glucose by *T. utilis*, *S. exiguus*, *Oidium lactis*, *Bacillus subtilis*, *B. mycoides*, *Sarcina lutea* and *Bacterium Schützenbachii*; upon oxidation of lactate by *O. lactis* and of ethyl alcohol by *B. Schützenbachii*; and upon respiration of stored glycogen in *T. utilis*, *S. exiguus* and *B. subtilis*. It was found that in these microbes all fermentations are more strongly depressed by *l*-nicotine than by *d*-nicotine, but all oxidations are, conversely, more strongly depressed by *d*-form.

I have also investigated the action of optically isomeric nicotines upon the metabolism of slices of

mouse tissue. The respiration of the stored glycogen in the liver of the mouse proceeds in two linked phases, the first of which (anaerobic) is more sensitive to nicotine poisoning and accounts for the fact that *l*-nicotine inhibits the whole respiration more strongly than *d*-nicotine. The oxidation of exogenous glucose and of lactate in the slices of starved liver are direct, and therefore more sensitive to *d*-nicotine. Glycolysis of the grey substance of the brain in mice is *l*-sensitive to nicotine and of the same order of magnitude as the endogenous respiration in the liver, and it is therefore probable that lactic acid production is the limiting anaerobic link in the latter case.

An extensive comparative investigation has further shown that in green Algae (*Rhizoclonium fontanum*) and Protozoa (*Palamecium candatum*, *P. Cursaria*, *Euglena viridis* and *Eudorina elegans*) oxidations are direct and *d*-sensitive to nicotine poisoning. At the same time, in the flatworm (*Polyulis nigra*) and in livers of adult pike (*Esox lucius*), frog (*Rana temporaria*), green linnet (*Chloris chloris*), and fowl (*Gallus domesticus*) oxidations are coupled with fermentations, and are more sensitive to the action of *l*-nicotine. It is also interesting that the liver of the chick (3 days old) appears to be primitive in the sense that its oxidation is *d*-sensitive to nicotine and therefore direct.

The precision of the results obtained in the analysis of oxidation and fermentation with the aid of optically isomeric nicotines may perhaps be due to the fact that both the pyridine and pyrrol groups of nicotine enter into the composition of enzymes catalysing carbohydrate breakdown¹ which are therefore in some way specifically destroyed by the nicotine.

A complete account of these investigations will be published shortly.

G. A. GAUSE.

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June 9.

Warburg et al., *Biochem. Z.*, **282**, 157 (1935).

Interaction of Heavy Nuclear Particles

SOME time ago, it was suggested that the interaction between neutrons and protons goes on via particles of small mass—electrons (positrons) and neutrinos—somewhat in the same way as electromagnetic interaction (compare Coulomb's law) is transferred by photons¹. After a recent discussion of the problem by Heisenberg², who pointed out the necessity for changing the r^{-5} law to one involving r^{-7} or r^{-9} , it seems desirable to perform the calculations for the magnitude of interaction in the most simple manner.

Indeed, the most essential point proves to be the fact of energy transfer by a pair of particles, and not by a single photon as in the usual electromagnetic case. For the magnitude of the interaction at the small distances which are of interest, even the statistics of the transferring particles is not important, or even the kind of partners implied (electron and neutrino, or two neutrinos). We have worked with simple scalar equations of wave type, or of the type of Schrödinger's second order relativistic equation. Starting with Fermi's assumption for the interaction between heavy particle and neutrino-electron field ($g \varphi_1 \varphi_2$), or with a more general expres-

sion $\left(g \frac{\partial^n \varphi_1}{\partial t^n} \frac{\partial^m \varphi_2}{\partial t^m}\right)$ and applying the elegant method of Dirac's quantum electrodynamics, we get for the magnitude of interaction expressions proportional to $\frac{g^2}{r^5} I_1(r)$, or $\frac{g^2}{r^{2m+2n+5}} I_2(r)$. The integrals $I(r)$ are equal to 1 for $r \ll \hbar/mc$ and vanish at great distances. Thus we get the remarkable result that the interaction depends chiefly on the presence of two particles, just as does the probability for β -decay³. If needed, one can introduce the relativistic equations for heavy particles and work with an interaction formula which is very similar to Breit's, but not identical with it.

So far as the order of magnitude is concerned, we can compare the interaction at the distance r_0 , equal to the radius of a heavy particle, with the self-energy μc^2 . For $r_0 \sim 10^{-13}$, which is assumed to be the most reasonable, the best choice is the energy expression, proportional to $\frac{g^2}{r^{11}}$ or $\frac{g^2}{r^{13}}$, which results from that

form of the interaction between heavy and light particles and is that found to be the best for the purposes of β -decay theory³.

We may note that until now no classical analogy for the field of two particles has been found, so that the above considerations rest on essentially non-trivial results of quantum electrodynamics.

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A. SOKOLOV.

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June 13.

¹ Ig. Tamm; D. Iwanenko, *NATURE*, **133**, 981 (1934).

² W. Heisenberg, *Zeeman's Festschrift*, 1935.

³ E. J. Konopinski and G. Uhlenbeck, *Phys. Rev.*, **48**, 7, 107 (1935).

Dependence of the Herschel Effect upon the Surrounding Gas Medium

THE Herschel effect—the weakening of the latent photographic image by means of light—is observed, as a rule, in the red and infra-red region of the spectrum. Recent investigations, however, show that under certain conditions the Herschel effect is observed in regions of the spectrum, where usually a normal photographic effect prevails. If, then, the Herschel effect is stimulated by the parallel reaction which accompanies the main photographic process, it is reasonable to suggest that the surrounding gas medium is involved in the reaction.

It was suggested to me by Prof. Narbut that an investigation of the influence of the gases oxygen, nitrogen, hydrogen and carbon dioxide and also of a vacuum upon the Herschel effect would repay investigation. Diapositive plates of the "Photo-Khim-Trust" works of Moscow and Kiev were used. The Herschel effect was obtained by red light (a photographic lamp of 25 candle-power).

Investigations were carried out with seven series of plates, with the following results:

- (1) In oxygen, the Herschel effect is much more intensive.
- (2) In nitrogen and carbon dioxide, the Herschel effect has almost disappeared.
- (3) In hydrogen, the red light gives but a normal photographic effect—additional darkening of the plate. Hence the medium is apparently essential in

the mechanism both of the normal photographic effect, and also the Herschel effect.

Further work with other photographic materials is in progress.

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A. VNUKOVA.

Ozone as a Heating Factor in the Atmosphere

THE vertical distribution of temperature in the upper layers of the atmosphere as affected by ozone has been carefully calculated. Taking the vertical distribution of ozone as found by Götz, Meetham and Dobson, and using new absorption coefficients, it was possible to derive the energy absorbed in the course of one day. Four days were selected to show the yearly change.

The solar radiation below 3000 Å. was assumed to be a black-body radiation of 5,910° K.; for all the other wave-lengths, the values given by Abbot were used.

Secondly, the nocturnal radiation has been studied. For each layer the absorption of radiation from the earth and from all the other layers, and the re-radiation of this layer have been calculated. The atmosphere was divided into six layers.

Value of the Acid Silver Nitrate Reaction as a Test of Ascorbic Acid

SZENT-GYÖRGYI observed that the suprarenal cortex reduces silver nitrate, and attributed this property to the ascorbic acid (vitamin C) which it contains¹. Many workers have observed that this reaction disappears in scurvy and comes back if ascorbic acid is given to the scorbutic animal²; the reaction was also used for histological detection of vitamin C, and, the specificity of silver nitrate being increased by acidification with acetic acid, an accurate cytological study of its repartition could be made³.

The value of the silver nitrate reaction as a test of ascorbic acid has been questioned. Harris and Ray⁴, noticing that the liver and the suprarenal medulla, though rich in ascorbic acid, failed to be coloured by silver nitrate, concluded that the absence of this reaction was very little guide as to the presence or absence of vitamin C. Many investigators consider the reaction valueless^{5,6}. For example, in a recent review of the question⁷, King says: "Silver nitrate staining is not reliable qualitatively or quantitatively as an index of vitamin C in tissues."

In order to clarify this question, we have to consider:

(1) *The occurrence of a reaction with acid silver nitrate.* The reduction of this reagent, without any action of light or heat, is a very specific test of ascorbic acid for the following reasons: the marked reductions are observed only in the organs which by the chemical and biological methods appear to be rich in ascorbic acid (suprarenal cortex, corpus luteum, interstitial cells of the testis and anterior pituitary). In these organs, the cells appear filled with the granules of reduced silver. In organs poor in ascorbic acid, a slight reaction, frequently with a deposit of the silver precipitate at the Golgi apparatus (suprarenal medulla, epididymis), or no reaction except along the walls of the blood vessels, is observed.

When large quantities of ascorbic acid are given to a guinea pig, new reactions appear in the epithelial cells of the intestine, and in the convoluted tubules of the kidney, corresponding chiefly to the increase in absorption and elimination which can be demonstrated by chemical methods.

If guinea pigs are given a diet without ascorbic acid, the reactions disappear quickly, so that after ten days none can be observed in their organs. Biological experiments confirm the absence of ascorbic acid in these conditions.

If ascorbic acid is injected into a guinea pig which is scorbutic and therefore depleted of its reserve, all the reactions reappear within a few hours after the injection.

It may be concluded that all the reactions observed after action of acid silver nitrate are due to ascorbic acid, and, as the histological localizations of the reactions are exactly the same in the animals which, like the rat, are able to synthesize ascorbic acid and

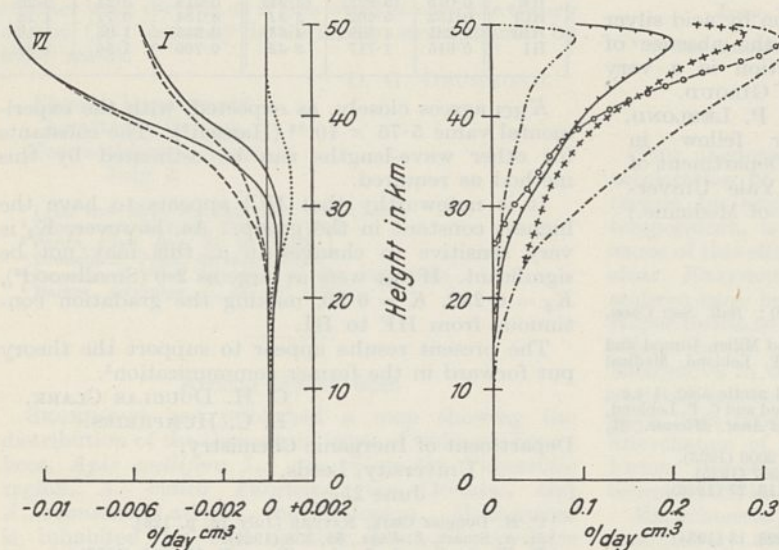


FIG. 1. Left: Cooling effect as affected by long-wave radiation. Two examples for different temperature distribution in the stratosphere are shown. Nocturnal radiation ———, Ozone radiation — — —, Terrestrial radiation Right: Heating effect as affected by absorption of solar radiation. March 21 + + + + June 22 — — — — September 23 — — — — December 22 — Ultra-violet absorption only (for June 22) — o — o — o

The results are shown in Fig. 1. It is seen that the heating effect is about ten times the cooling effect at a height of 50 km. Below 25 km. no remarkable influence could be found. Despite the fact that the centre of gravity is situated at 25 km., the maximum lies at 50 km. This demonstrates the importance of an exact determination of the ozone concentration in the highest layers. The maximum corresponds to many assumptions on the constitution of the upper atmosphere.

The results summarized here will be published elsewhere in a more detailed account of these and other phenomena concerning atmospheric ozone.

Geophysikalisches Institut,
Leipzig. July 4.

R. PENNDORF.

therefore cannot be depleted of it, it is logical to assume that in these animals, too, these reactions are caused by ascorbic acid.

However, there is one exception: the melanin granules in the Langerhans cells and the Malpighian layer of the skin show a reaction which may not be attributed to ascorbic acid, since it persists after methyl alcohol extraction, and does not disappear in the scorbutic guinea pig. This single exception ought not to cause confusion because of the easily recognizable pigment granules.

(2) On the other hand, the absence of reaction with acid silver nitrate may indeed be observed in some tissues rich in ascorbic acid (suprarenal medulla, liver . . .), so that a negative result must not be necessarily interpreted as indicating the absence of ascorbic acid.

The chief reason for this failure to reduce silver nitrate is the presence in the organs of factors inhibiting the reduction of ascorbic acid; these 'inhibiting factors' have been described by Huszak⁸ in the suprarenal medulla and by de Caro and Giani⁹ in other tissues.

In short, the absence of a coloration by acid silver nitrate does not necessarily mean the absence of ascorbic acid, but a positive reaction is a very specific test for this substance.

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¹ A. Szent-Györgyi, *Bioch. J.*, **22**, 1387 (1928); *Bull. Soc. Chem. Biol.*, **25**, 694 (1933).

² Harris and Ray, Quick, Hamilton, Siehrs and Miller, Giroud and Leblond, Galvao and Carvoso, quoted in C. P. Leblond, *Medical Thesis*, Paris, 1934.

³ The formula of the reagent used is: Glacial acetic acid, 1 c.c.; Silver nitrate, 10 gr.; Water up to 100 c.c. A. Giroud and C. P. Leblond, *Arch. d'Anat. Microsc.*, **30**, 105 (1934); *Arch. d'Anat. Microsc.*, **31**, 111 (1935).

⁴ L. J. Harris and S. N. Ray, *Biochem. J.*, **27**, 2006 (1933).

⁵ M. Dann and G. R. Cowgill, *J. Nutrition*, **9**, 507 (1935).

⁶ G. R. Biskind and D. Glick, *J. Biol. Chem.*, **113**, 27 (1936).

⁷ C. G. King, *Physiol. Rev.*, **16**, 238 (1936).

⁸ S. Huszak, *Z. Physiol. Chem.*, **222**, 229 (1933).

⁹ L. de Caro and M. Giani, *Z. Physiol. Chem.*, **228**, 13 (1934).

Kerr Constants of the Hydrogen Halide Gases

ON the basis of a recent note dealing with the polarization ellipsoids of the hydrogen halide gases¹, it becomes possible to calculate their Kerr constants (Na-D line, 20° C., 760 mm.), numbers which should be directly capable of experimental verification.

We take the Boltzmann constant $k = 1.371 \times 10^{-16}$ erg per degree per molecule, $T = 293^\circ \text{K.}$, $\pi = 3.1416$, $N = (6.064 \times 10^{23} \times 273)/(22,414 \times 293) = 2.522 \times 10^{19}$, and $\Delta n_{\text{HX}} = 0.0119$. Further experimental and estimated constants, different for the four halides, are taken as follows:

Di-atom	n_D	n_∞	μ	b_1	b_2
HF	1.000140	1.000136	1.58×10^{-18}	0.96×10^{-24}	0.72×10^{-24}
HCl	1.000446	1.000435	1.06	3.07	2.30
HBr	1.000612	1.000594	0.80	4.19	3.14
HI	1.000919	1.000883	0.41	6.24	4.68

The following relations are applied²:

$$K_1 = \frac{2\pi N}{15kT} \left[(b_1 - b_2)^2 \frac{n_\infty^2 - 1}{n_D^2 - 1} \right] = 2.629 \times 10^{32} \left[(b_1 - b_2)^2 \frac{n_\infty^2 - 1}{n_D^2 - 1} \right] \quad (1)$$

$$K_1 = \frac{3\Delta}{2\pi kNT(6-7\Delta)} (n_\infty - 1)(n_D - 1) = 9.477 \times 10^{-8} (n_\infty - 1)(n_D - 1) \quad (2)$$

$$K_2 = \frac{2\pi N}{15k^2 T^2} \mu^2 (b_1 - b_2) = 6.545 \times 10^{48} \mu^2 (b_1 - b_2) \quad (3)$$

$$K = K_1 + K_2 \quad (4)$$

where the symbols have their usual significance.

The value of K_1 by (1) is probably more accurate than by (2), and is independent of the result $\Delta n_{\text{HX}} = a$ constant. As an approximate check on the theory by which these numbers are derived, however, the value of K_1 by (2) is substituted in (1) to obtain a calculated value of $b_1 - b_2$, for comparison with that derived from the estimated b_1 's and b_2 's given above. Comparison of the last two columns of the following scheme shows the general run of the numbers to be in agreement.

Di-atom	K_1 by (1), K_2 , $K (\times 10^{18})$			K_1 by (2)	$b_1 - b_2 (\times 10^{24})$	
					est.	calc.
HF	0.015	(3.922)	(3.94)	0.018	0.24	0.26
HCl	0.152	5.662	5.81	0.184	0.77	1.18
HBr	0.281	4.399	4.68	0.345	1.05	1.16
HI	0.615	1.717	2.33	0.769	1.56	1.96

K_{HCl} agrees closely, as expected, with the experimental value 5.75×10^{-18} (Hansen³). The constants for other wave-lengths can be estimated by this method as required.

It is noteworthy that HCl appears to have the highest constant in the group. As, however, K_2 is very sensitive to changes in μ , this may not be significant. If μ_{HF} were as large as 2.0 (Smallwood³), $K_2 = 6.282$, $K = 6.30$, making the gradation continuous from HF to HI.

The present results appear to support the theory put forward in the former communication¹.

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June 25.

¹ C. H. Douglas Clark, *NATURE* [July 18, p. 126].

² H. A. Stuart, *Z. Phys.*, **55**, 358 (1929).

³ H. W. Smallwood, *Z. phys. Chem.*, **B**, **19**, 242 (1932).

The 2.73 μ Absorption Band in Fused Silica

LYON and Ellis in a recent note¹ refer to the absence of the 2.73 μ infra-red absorption band in specimens of fused silica examined by them, and suggest that the band found at this wave-length by previous investigators may be due to an impurity, possibly CO_2 or H_2O .

It is certainly unlikely, as I have previously pointed out², that it can be due to vitreous SiO_2 , since the absorption coefficient at the centre of this band was widely different in specimens examined by Parlin³

($K = 0.52$), Dreisch⁴ ($K = 0.33$) and me⁵ ($K = 0.03$) and, further, crystalline quartz shows no trace of such a band whilst every other band in fused silica between 1 and 7.5 μ has its counterpart in the crystalline quartz spectrum.

Fused silica, in the course of manufacture, comes in contact with hot carbon and reacts with this with the evolution of gas. This makes contamination with CO_2 seem likely, and the band in question does fall in the centre of the region of CO_2 absorption at about this wave-length⁶. This suggestion is open to the criticism that the next strong CO_2 band, that at 4.28μ , is definitely absent from the fused silica spectrum and that the 2.73μ band is single and broad while the corresponding structure for gaseous CO_2 appears as two doublets under similar resolving power. Nevertheless, solution of CO_2 in a solid may radically modify its absorption spectrum.

Another possibility is that the band may be due to another crystalline modification of silica, that is, a cristobalite or tridymite. This seems unlikely as in readings taken on the same set of specimens during one or two years no ageing effect was detected, and further, of specimens cut from one initial melt, some were used immediately without additional heat treatment while one was re-melted to improve its optical homogeneity without any significant difference being introduced in the intensity of this band in the material. A very slight difference was observed between different initial melts in this respect. It would be of interest to know whether the specimens examined by Lyon and Ellis were prepared without contact with carbon, as if this was the case the theory of the CO_2 impurity is decidedly strengthened by their result.

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Armstrong College,
Newcastle upon Tyne.
July 3.

¹ Lyon and Ellis, *NATURE*, **137**, 1031 (1936).

² Drummond, *NATURE*, **134**, 739 (1934).

³ Parlin, *Phys. Rev.*, **34**, 81 (1929).

⁴ Dreisch, *Z. Phys.*, **42**, 426 (1927).

⁵ Drummond, *Proc. Roy. Soc., A*, **153**, 328 (1936).

⁶ Barker, *Astrophys. J.*, **55**, 391 (1922).

African Honey Bees

SKORIKOW¹ has published a map showing the distribution of the three main types of ordinary honey bees, *Apis mellifera* L., occupying the Palaearctic region, *A. indica* Fabricius, the Oriental, and *A. adansonii*, Latreille, the Ethiopian. Madagascar is inhabited by still another form, *A. unicolor* Latreille. Alpatov, of the University of Moscow, has published statistical studies of South African honey bees, separating two races, called *A. adansonii* and *A. unicolor*, the latter being the form with black abdomen and scutellum. But his *A. unicolor* came from near Cape Town, and were surely not the true *unicolor*, but the race which Buttel-Reepen (1906) named *intermissa*. This insect differs from *A. unicolor* in having bands of tomentum on the abdomen, these being usually conspicuous, but sometimes not evident, when the specimens are worn, or the abdomen is much contracted.

I have just examined the honey bees of the 1933-34 expedition by Mr. and Mrs. J. Ogilvie to South Africa, and I find eight *A. adansonii* (from Bot River, Belmont, Kirstenbosch, Upington and Seeheim) and fifteen *A. adansonii intermissa*, from Lions Head, Cape Town and from Bot River, but the majority from an uncertain locality, owing to a mistake in labelling at the British Museum. From the expedition of 1931, I find four specimens from Victoria Falls, which I

had overlooked. Three are ordinary *A. adansonii*, but of two collected by my wife on Livingstone Island, one is *A. adansonii*, and the other, abruptly different, is to all appearances *A. unicolor*, though the surface of the abdomen is duller than in a specimen from the Seychelles Islands.

No doubt the African bees are being crossed with different forms of the European species, introduced by man; hence it is desirable that material should be collected as soon as possible in all parts of Africa and deposited in the British Museum or elsewhere, where it will be available for minute statistical studies, such as those of Alpatov. Enderlein, in his revision of *Apis* (1906) distinguishes the African forms by the smaller size (body 10-12 mm. long, $3\frac{1}{2}$ mm. broad, front wings 8-9 mm. long) and then divides them into those with black abdomen (*unicolor* and *intermissa*, as just given, and also a form *friesei*, Buttel-Reepen, differing from *intermissa* by the average smaller size and the yellowish-brown scutellum), and those with a largely fulvous or yellow abdomen, the true *adansonii*, closely resembling the familiar Italian race. The variety *friesei* comes from Mombasa, East Africa.

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June 29.

¹"A New Basis for a Revision of *Apis*", 1929.

Vernalization

THE phenomenon of 'vernalization', namely, the acceleration of ear formation in winter varieties of cereals by exposing the germinating seed to low temperature, is now well known¹. The underlying cause of this effect of low temperatures is by no means clear. Enzymatic changes in the fruit external to the embryo have been postulated by Richter and others. Experiments to test such possible changes or hormone effects have been performed by Krasnosel'skaja-Maxomova in which endosperm of winter and spring varieties has been interchanged. Similar experiments have been repeated by Sereiskii and Sluckaja, and interchange of embryos has also been tried. The former investigator claims positive results which, however, the latter investigators failed to substantiate.

Experiments recently carried out by us have shown conclusively that excised embryos separated completely from the endosperm and grown on agar containing 2 per cent glucose and mineral nutrients alone can nevertheless be vernalized in the same way as complete 'seeds'. Such separated embryos kept at 1°C. for six weeks and then planted out produced normal plants earing ten weeks later, whereas similar embryos kept at 18°C. until they had reached the same stage in development (coleoptile developed, but first leaf not emerged) showed no signs of 'shooting' after a further ten weeks of growth.

It would appear therefore that the 'cause' of vernalization by low temperature is entirely inherent in the embryo, and is not dependent in any way on the metabolism of the endosperm or aleurone layer.

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¹Vernalisation and Phasic Development of Plants. Bull. 17 Imperial Bureau of Plant Genetics.

Points from Foregoing Letters

In further development of her working hypothesis of protein structure, according to which a network ('cyclic') structure is postulated in place of the branched chain ('polypeptide') structure, Dr. D. M. Wrinch calculates the approximate energy of formation of 'cyclol' molecules from polypeptides. The calculations suggest that the process of linkage is facilitated if the appropriate groups are in the imide form, —C(OH)=N— , a state which may be brought about by the action of certain enzymes. F. C. Frank, commenting on Dr. Wrinch's theory, estimates the energy balance in the process and, to account for the deficiency in the necessary energy, postulates the existence of an additional source of energy similar to that provided by the strain in the side-chain cross-linkages found in keratin. He further points out that hydration also provides part of the necessary additional energy, and helps in explaining certain properties of the proteins, observed in 'degeneration' and 'denaturation'.

Criticizing Prof. Hale Carpenter's description of the behaviour of the African insect *Charaxes*, Prof. H. E. Armstrong states that an insect cannot *deliberately* hide itself, and suggests that 'mimicry' may be caused by changes in food, temperature, or by hybridization. In reply, Prof. Hale Carpenter gives further examples of *deliberate* action and of mimicry which cannot be explained by the factors suggested by Prof. Armstrong.

Indications of the occurrence of earthquakes and of accompanying seismic sea-waves (tsunamis) in Ordovician times (Caradog age) are described by Dr. A. Lamont, from observations of strata in the Irish Free State. These may involve revision in the interpretation of certain features, such as crush-conglomerates and intrusive tuffs, the origin of which has hitherto been ascribed to other agencies.

Miss H. D. Megaw and Prof. F. Simon have determined the approximate values of the density, compressibility and thermal expansion of ordinary and heavy hydrogen (deuterium) in the solid state (at 4.2°K.), by comparison with helium, in order to show the influence of the 'zero point energy' (inferred from Planck's second quantum theory) on those properties.

Part of the oxygen consumed by certain luminous bacteria (*Photobacterium phosphoreum*) is apparently directly connected with the amount of light emitted. K. L. van Schouwenburg and J. G. Eymers find that, at 16°C. , about 500 molecules of oxygen are used per quantum of light emitted, but the efficiency of the light-emitting process varies with conditions.

Some further notes on the behaviour of and variations in the ionized *C* layer of the atmosphere (5–30 km. high) are given by Prof. R. C. Colwell, A. W. Friend, N. I. Hall and L. R. Hill. The authors explain the weakening of the radio signals from the stratosphere balloon *Explorer II*, when it passed through the 20 km. level, as due to its having reached the top of the *C* layer; a portion of the radio waves would then be reflected outwards into space, instead of being reflected towards the earth.

Of the two optically active forms of nicotine, Dr. G. A. Gause finds that the *lævo*-form has a greater inhibition power upon the fermentation of glucose by various microbes than the *dextro*-form.

Oxidation processes on the other hand are more strongly inhibited by the *dextro*-rotatory nicotine. The author also finds differences in the action of the two optically active nictines upon similar processes taking place in green *Algæ* and in various animals.

Formulae for the magnitude of interaction between neutrons and protons (via particles of small mass—positrons and neutrinos) have been worked out by D. Iwanenko and A. Sokolow, with simple scalar equations of the type of Schrödinger's second order relativistic equation. The process is supposed to be somewhat on the lines of electromagnetic interaction.

Mrs. A. Vnukova finds that the antagonistic action exerted by light of certain wave-lengths, which weaken the latent image on a photographic plate ('Herschel effect'), is more effective in the presence of oxygen and becomes negligible in nitrogen or carbon dioxide.

From the difference between the energy absorbed by ozone from sunlight during the day, and that lost by radiation during the night, allowing for the absorption of radiation from the earth and from other layers, R. Penndorf calculates the heating effect due to the presence of ozone in various layers of the atmosphere. The calculations indicate a maximum heating effect at a height of 50 km. where the heating is about five times the cooling effect.

Having investigated the conditions under which silver nitrate can be relied upon as a test for vitamin C (ascorbic acid), A. Giroud and C. P. Leblond conclude that while the absence of a coloration by acid silver nitrate does not necessarily mean the absence of ascorbic acid, a positive reaction, with few exceptions, is a specific test for this substance.

In a test of the theory of the polarization ellipsoids of the hydrogen halide gases, Dr. C. H. Douglas Clark and Dr. E. C. Humphries have estimated the constants *K* for these gases occurring in the Kerr (magneto-optic) effect. These numbers are capable of experimental verification, and appear to confirm the theory.

In explanation of the origin of the absorption band (wave-length 2.73μ) in the infra-red spectrum of certain specimens of fused silica, Dr. D. G. Drummond favours the suggestion that it is due to the presence of carbon dioxide, with which the silica may readily become contaminated during the process of manufacture.

With reference to the various forms of African bees described, Prof. T. D. A. Cockerell records several specimens of *A. adansonii* and *A. adansonii intermissa*, and one specimen of *A. unicolor* in the British Museum collection. He directs attention to the desirability of collecting further material for genetic studies before the African bees become crossed with different forms of European bees introduced by man.

Dr. F. G. Gregory and O. N. Purvis have carried out experiments with embryos of cereals separated from the rest of the seed and grown on agar (containing 2 per cent glucose and mineral salts) kept near the freezing point (1°C.) for six weeks and then planted out. They find the same subsequent acceleration in the ripening process (vernalization) as in the case of whole seeds similarly treated, which indicates that the cause of 'vernalization' is inherent in the embryo.

Research Items

Physical Characters of the Bedouin

DR. WILLIAM M. SHANKLIN, of the American University of Beirut, in the summer of 1934 made an expedition into the Syrian desert with the object of studying the members of the Rwala tribe, who appear to conform to the definition of a Bedouin as "a nomad who breeds and keeps camels and . . . able to trace his descent from certain recognized pure-bred Bedouin tribes". The Rwala are a subdivision of the Al-Glas, one of the major branches of the Anazeh nation, who are found more especially in the Hejaz and Syrian deserts. In recording his results (*J. Roy. Anthropol. Inst.*, 65, Pt. 2; 1935), Dr. Shanklin summarizes the evidence of the blood-groups, published more fully elsewhere, as showing a high percentage of blood group *O*, indicating that the Bedouin belong to a race of very considerable antiquity. The American Indians also belong to the blood-grouping *O*. The Rwala in their physical characters have retained features which are regarded as having characterized the primitive Mediterraneans; but elsewhere in the Near East, Egypt, Arabia, etc., this type has been overrun by the brachycephalic element, to which observers have directed attention. Thus among their average measurements are: head-length, 191 mm., breadth, 144 mm.; cephalic index, 75 (range 67 to 82); nasal height, 55 mm., nasal breadth, 35 mm.; bizygomatic breadth, 130 mm.; bigonial breadth, 106 mm. They are white, but have brown, or brunet skin, straight black, or brown, hair, brown eyes and high, straight, narrow noses. If the view that holds that the agglutinogens *A* and *B* are of relatively late origin is accepted, the evidence of the blood-groups would corroborate the evidence of physical character in showing that the Bedouin may well be representatives of the primitive Mediterranean race, who have preserved their racial character over a long period. On the other hand, the earliest known skulls of the American Indians, as pointed out by Hooton, are also dolichocephalic, and this, with their blood-grouping, accepting the conclusion of their Asiatic origin, may point to the fact that they and the Bedouin are the descendants of a remote, but common, primitive stock.

New British Bird

THE rather remarkable number of scarce American birds that have appeared in the British Isles in the past two years—yellowshank, American pectoral sandpiper, and others—is further increased by the recent addition to the British list of Audubon's little shearwater (*Puffinus assimilis-lherminieri* Leason) which J. J. Harrison describes in the July issue of *British Birds* as of the West Indies form. The bird was found alive on the beach at Bexhill-on-Sea by Mr. W. E. Dance on January 7, being mobbed by gulls. When taken home it soon collapsed and died. The record is of importance because Gould recorded a specimen from Dover, but owing to insufficient verification it was never accepted, and he himself excluded it from his later works on British birds. It was in the April issue of *Ibis* that Mr. W. P. Lowe described another new British bird, the Franklin's gull, which was watched among a flock

of herring and black-headed gulls on Exmouth beach, Devon, on January 19, 1936. The British razorbill has recently had its status as a separate sub-species established owing to comparisons of British with Swedish and Greenland skins showing that the British birds are definitely smaller in measurements than the Continental ones and that the Faroe birds belong to the British race; hence the alteration in nomenclature to *Alca torda britannica*.

Periodicity in Algæ

IN certain districts of India, the regularity of the seasonal changes, especially as regards temperature and rainfall, offers an opportunity for the study of algal periodicity which would never arise under the variable conditions of the English climate. M. S. Randhawa (*Proc. Indian Acad. Sci.*, 3, No. 5, 1936) has now followed the periodicity of the freshwater Algæ in the Saharanapur District over the greater part of two years, and has obtained some very definite results. Many of the Algæ rest through the hot dry summer months in the form of thick-walled oospores; these germinate with the rain of the Monsoons and continue to grow vegetatively through the cooler autumn and winter months. With the rise of temperature in the spring a period of sexual reproduction sets in, ending with the production of thick-walled oospores. The gradual rise in temperature after a long period of vegetative growth is evidently particularly favourable to sexual reproduction, which is apparently strikingly prolific. Under these more consistent climatic conditions, the Algæ fall into step with the seasons and thus show marked periodicity, which is masked in more variable climates by small changes which affect the algal growth. It is of interest that the filling up of the ponds and streams by flood waters after the dry season is accompanied by a peak in the development of Myxophyceæ, an effect which has also been recorded in British Lake District waters when much debris is carried down by heavy rain.

Electric Heating of Garden Frames

A PAPER by Dr. J. Grainger and T. F. Armstrong (*Gardeners' Chronicle* of June 13 and 20) shows that the use of soil heating by buried electric cable is quite satisfactory for raising seedlings of green crops such as lettuce and endive, for the forcing of special crops, as mint and rhubarb, but not for root crops such as radishes, which tend to flower rather than to swell their roots in heated soil. A valuable table showing detailed consumption of electricity for raising the soil temperature by varying amounts is given. Heating cables have also been used to heat the air within deep propagating frames, and although this was successful from a horticultural point of view, it requires an average of 1.06 units of electricity per cubic yard per day to raise the temperature 10°–15° F. above that outside the frame. With electricity at 1½d. per unit, this works out about twice the cost of heating similar structures by a coke fire in a hot-water system. The paper also shows that heating the soil may aggravate the effects of crown rot disease of rhubarb, during forcing.

Autopolyploidy

THE evolutionary significance of autopolyploidy, based on the numerous cases now investigated, has been considered by Dr. A. Muntzing (*Hereditas*, 21, 263). About one hundred species are now known to show intra-specific variation in chromosome number, autotetraploidy being the most common condition. Such tetraploids usually show *gigas* characters, being generally stouter and slower in development. Both morphological and physiological changes result from the larger cells, but hexaploids frequently and octoploids generally show dwarfing, indicating that the optimum chromosome number has been exceeded. Intra-specific tetraploids are also ecologically different from the diploids, and they usually have a different geographical distribution, being generally, but not invariably, more northern. Such polyploids appear to be generally more hardy and adapted to a northern, alpine, xerophytic or coastal habitat, into which the corresponding diploid does not extend. Experimentally induced autotetraploids show essentially the same features as natural ones. Chromosome association at meiosis is the same in both, ranging from almost complete bivalency to almost complete quadrivalency. Wild autopolyploid races are usually fertile, while experimentally induced ones generally show poor fertility. This difference may be accounted for by the effects of natural selection. The perennial species in a genus have a higher average chromosome number than the annuals. Autopolyploidy has played an important role in the evolution of higher plants.

Tokyo Earthquakes in 1935

WE have received the last of the quarterly *Seismometrical Reports* for 1935 issued by the Earthquake Research Institute. These refer only to earthquakes that were sensible in Tokyo. After the great earthquake of 1923, a system of eight seismological stations was founded in and around Tokyo. During the year 1924, 60 earthquakes were felt in Tokyo, and the records obtained were sufficient to determine the epicentres of 52 and the focal depths of 42 earthquakes. In 1935, the number of stations had risen to thirteen, the number of sensible shocks was 78, the epicentres of all and the focal depths of 67 earthquakes were ascertained. In Tokyo itself, most of the shocks (55 in number) were just perceptible, and none at any station reached even semi-destructive strength. The mean depth of the foci was 28 miles, the greatest depth measured being 75 miles.

Oxidation-Reduction Potential

COMPARATIVELY few accurate measurements of the potentials of oxidizing-reduction systems have been made, one of the main difficulties being the ease of hydrolysis usually observed with the higher valency ion. One of the best investigated systems is that of the thallic and thalious ions, Tl^{III}/Tl^I , which was investigated in 1905 by Abegg and J. F. Spencer. Later investigators showed that the potential appeared to vary considerably with the nature of the anion, doubtless owing to the formation of anion complexes. Two recent investigations of the electrode, by J. R. Partington and H. I. Stonehill (*Trans. Faraday Soc.*, 31, 1357; 1935) and by A. A. Noyes and C. S. Garner (*J. Amer. Chem. Soc.*, 58, 1268; 1936), have included precautions to avoid this effect. The former investigators used the sulphates in sulphuric acid solution, and the latter the nitrates in nitric and perchloric acids. The two values for the

normal potentials, 1.20–1.22 volts, and 1.230 volts, respectively, are in satisfactory agreement. Since there is little likelihood that complexes are present in the nitrate and perchlorate, the results show that the formation of sulphate complexes by thallic sulphate is not very extensive. An interesting feature of the work of Noyes and Garner was the use of ozonized oxygen for the oxidation of the thalious to the thallic salt in concentrated nitric acid, thus avoiding the introduction of extraneous substances into the solution.

Experiments with Neutrons

C. H. COLLIE and J. H. E. Griffiths (*Proc. Roy. Soc., A*, 155, 434) have investigated the absorption of fast and of slow neutrons using an arrangement in which the effect of mere scattering was largely eliminated. The absorption cross-sections for fast neutrons were nearly the same ($1-1.5 \times 10^{-24}$ cm.²) for a number of elements tried. The experiments with detectors sensitive to slow neutrons showed an increase in activity when the absorber was put in, and this probably means that new slow neutrons were produced by collision of the fast neutrons with the absorber nuclei. S. Kikuchi, H. Aoki and K. Husimi (*Proc. Physic. Math. Soc. Japan*, 18, 115) have studied the production of γ -rays from numerous substances bombarded by fast neutrons (2×10^6 e.v.). Slow neutrons were excluded from the specimen. The cross-sections calculated for γ -ray production vary unsystematically with atomic number, the absolute values are of the order 5×10^{-25} cm.², and it seems that γ -ray production is responsible for a considerable part of the absorption of fast neutrons by many elements. The γ -ray energies seem to be fairly similar in all cases, but they are not monochromatic. The γ -rays excited by slow neutrons appear to be of a different type, they are usually harder, and are to be ascribed to the capture radiation associated with nuclear transformations.

Statistical Research Memoirs

THE first volume of a new publication entitled *Statistical Research Memoirs* appeared in June of this year, edited by Prof. E. S. Pearson and Dr. J. Neyman, and published by the Department of Statistics at University College, London. The *Memoirs* will contain only papers prepared in that Department. The series will not be strictly periodical, but it is hoped that a volume of more than 150 pages will be issued about once a year. The price is 15s. a volume, or 12s. 6d. to those who signify in advance their intention to purchase the next volume. The *Memoirs* are intended to advance the general theory of statistics, which at present is not yet on firm foundations. It is the ambition of the Department to contribute towards the establishment of a theory of statistics on a level of accuracy which is usual in other branches of mathematics. The present volume contains seven papers, two by J. Neyman and E. S. Pearson, and the others by P. P. N. Nayer, B. L. Welch, P. O. Johnson and J. Neyman, P. V. Sukhatme, and R. W. B. Jackson. All of these deal with closely related subjects, connected with the well-known methods of Neyman and Pearson for testing statistical hypotheses. The *Memoirs* will, as a general rule, be restricted to the general theory. Papers dealing with the applications of statistics serve their purpose best when they appear in journals devoted to the particular fields of application.

Forestry in Kenya

THE annual forest report for 1934 for the Colony and Protectorate of Kenya (Nairobi: Government Printer, 1935) is of interest on the subject of reservation of forests. The total reserved forest area in 1921 was 3,207 square miles; in 1934 it amounted to 4,711 square miles. During this period, some areas of reserve forest have been given up.

From the report, the reasons for giving up areas of forest already reserved is not clear. The common reason for such returns to the Civil Department is that the land is required, and can be more profitably used for, agriculture. This is not given as the reason in Kenya. The Conservator writes: "In making these excisions from the forest very careful consideration is given to each case, and no land that is thought to be of value to the forest, climatically or commercially, is given up". It is somewhat difficult to visualize the uses to which land of no value to the Forest Department can be put. In spite of this statement and the admission that there is a certain amount of anxiety in the Colony as to the adequacy of the forest area, "and a feeling that this area is being seriously diminished by constant excisions", the report states that, during the year, the Kenya Land Commission recommended that approximately 13,500 acres should be excised from forest reserves in settlement of various claims. The Department considers that "little real damage was done"; but the Commission itself records in its report that "We agree with the conclusion that the items shown in the schedule [that is, the land that was surrendered] should be regarded as the limit of sacrifice which the forest should be required to suffer".

This appears to be strange reading. In the administration of a country, nowadays, a clear understanding of the position played by the forests, both economic and climatic, should be possible and form part of the policy of governance. Either the forest is required to fulfil these vital interests of the population or it is not. Once the maintenance of the water

supplies of a country, provision for local requirements of the population, and such commercial interests as may be considered advisable to provide for have been arranged, the rest of the forests may be sacrificed, in other words, felled and suffered to disappear with equanimity in the interests of other and more serviceable utilization of the land. But such disposal of the land does not and should not entail "the limit of sacrifice which the forest should be required to suffer". It would appear in Kenya that, for some reasons not apparent in the report, land previously forming forest reserves is being alienated at some danger to the maintenance of a correct proportion of forest, even though there appears to be some 800-1,000 square miles still to reserve, lying mainly within the native reserves of Meru, Masai, Cherangani and Marakwet.

The cuts in expenditure account for much during the last few years; but in view of the fact that there has been an expert forest service in Kenya for some considerable period, it is depressing to read that "it was still impossible to detail an officer or officers for the special work of enumerations and compilation of working plans; divisional staffs cannot be expected to make much progress in such important work".

The chief work in connexion with regenerating the forests is by exploiting the forest produce indigenous to the areas it is desired to plant, and then, by means of controlled shifting cultivation or *toungya*, replanting suitable trees in regular plantations. In such work, as the report states, definite plans are required. But plantations will not replace square miles of indigenous forest, even if they are putting back a greater potential tonnage than that of the present annual cut. To know what is standing in the forests should be the vital factor antecedent to exploitation. Until this factor has been ascertained, it appears irrelevant to consider markets available for export.

Rural Custom in Civilized Communities

IT is an interesting coincidence that the claims of ancient custom and conservatism in civilized communities as worthy of observation and record should be urged almost simultaneously from three different sources, of which one is far removed from the other two—England, France and South Africa.

Mr. R. U. Sayce in *Man* of April, emphasizing the importance for anthropology of the study of civilized, as well as uncivilized, peoples, refers as a case in point to the remarkable variety shown in British agricultural implements in response to local conditions and requirements. Not all, indeed, are of British origin. Some have been introduced by foreign workmen, as, for example, the implements used in cutting peat near Manchester and the implements of the sugar-beet industry, both of which are of Dutch origin. The bill-hook affords an interesting example

of this variation. Mr. Sayce figures no less than forty-eight distinct varieties of the bill-hook, all of which are now manufactured, and are in use, in different parts of England and Wales. That Mr. Sayce is not entirely ploughing a lonely furrow is indicated by the fact that in the same month of April a collection of implements illustrating the changes in agriculture during the last hundred years was presented to the Colchester and Essex Museum.

Apart from its cultural value, the study of traditional types of agricultural implements may have a distinctly practical bearing on the work of the archaeologist in affording a clue to the character and purpose of a find of unusual or previously unknown type. This latter function of the study is stressed by M. L. Franchet in an introductory sketch of agricultural ethnography (*Revue des Sciences*, 111, April

11, 1936), in which he dwells on continuity in type as a regional characteristic. Analogies to archaeological finds, he points out, have been sought among primitive peoples, geographically remote, and often have led to erroneous results; whereas investigation in the area in which they were found, among the people of to-day, would have revealed in many instances the identical type, or a derivative, in everyday use. M. Franchet himself has interpreted his archaeological finds by this method with illuminating effect, and he has also traced modern implements back to their origin in the bronze age. His researches in the forest of Montmorency find an ancestry for certain implements which leads back to the stone age, while the equipment of viticulture and wine-making goes back, with the industry, to Gallic times, though, of course, not all the implements in use are of an equally remote origin. There is a pregnant reminder that the conversion of the sword into a ploughshare is more than a rhetorical trope in the observation that in primitive conditions the weapons of war do become the implements of peaceful occupations when hostilities cease.

A legitimate pride of descent and a half-humorous, but wholly determined, practice of traditional ways of doing certain things is attributed to the Cape population of Dutch descent in a record of surviving customs by Eric Rosenthal ("Old Time Survivals

in South Africa"). Government Printer, Pretoria, 1936. Pp. 38). The survival of so much that, on a superficial view, is obsolete may seem remarkable in a community that is now essentially up to date, and of which some of the industries are highly mechanized. To some extent this may be due to a racial pride and race consciousness; but the real explanation lies deeper. It is part of an enduring environmental adaptation. The clue is afforded by the survival of the old ox-wagon, virtually unchanged since its first introduction from Holland by Jan van Riebeck in 1632, except for the addition of a brake in the eighteen-sixties, yet of which there are more than a hundred thousand in use in South Africa side by side with the automobile. This apparent anomaly may be explained by the fact that the ox wagon has been the efficient cause in the development of the characteristic South African civilization. When built in the traditional way and from the traditional materials, it is still the best, and indeed the only, means of transport which is fully adapted to the geographical conditions and the social and economic needs of the country. One useful feature of ox-wagon travel, the 'outspan' for night camping, still found in every community, serves both the old and the modern need in a country where distances are great and hotel facilities few.

Empire Surveys

FORMERLY it was difficult for surveyors, more or less isolated in the Dominions and Colonies, to keep in touch with the advances in technique which are constantly occurring both as regards instruments and methods, cut off as they are from their fellow surveyors.

The institution of periodical conferences, held in the heart of the Empire, under the auspices of the Colonial and War Offices, has changed all this. Surveyors from different parts of the Empire meet and get in touch with each other as they never did before. Nothing but good can result from this. There has also been established a quarterly journal, the *Empire Survey Review*, devoted to survey technique and the discussion of matters of interest to the surveyor. At last year's conference, all the Dominions (except New Zealand), India and Colonies possessing survey departments, were represented, as well as many British scientific societies and universities.

At the conference, the report of which has lately been published*, some forty papers bearing on all branches of surveying and dealing with the latest instrumental developments were read and discussed. Of these, no less than eight dealt with matters connected with air survey, showing the importance now attached to this branch of the subject.

From such a mass of matter it is not easy to single out for notice particular subjects. Major M. Hotine has an interesting paper on signals for triangulation. Sufficient attention is not always paid to signals where accurate work has to be done. As the author points out in the case of opaque signals made of wood, it is very necessary in order to avoid warping

and the movement of the signal due to the drying of material after erection, that they should be made of seasoned timber, instead of, as is usually done, from wood cut on the spot. Incidentally, Major Hotine points out that if primary triangulation is undertaken at all, it should be of first-class order and not "only good enough for immediate purposes". Someone is sure to want to extend it in the future, in which case it may have to be done all over again. Therefore every precaution should be taken with the observations, the best instruments should be used and suitable signals well centred over the marks, or the work will not conform with first-class triangulation. A new type of electric night projector is being brought out by Messrs. Cooke, Troughton and Simms, Ltd., which can be worked by a 12-volt accumulator such as is carried on a motor car. We understand it is being used by the Ordnance Survey in the retriangulation of Great Britain now in progress.

Many papers are read chiefly with the view of encouraging discussion. For example, a new instrument is experimented with; it is of considerable advantage to know what the experience of others has been with an instrument of the kind. When we consider how grudgingly money is allotted for survey purposes in Great Britain, it is astonishing to read that more than £6 per acre is spent on the survey of Georgetown and Malacca in the Federated Malay States. The value of survey out there is evidently known and appreciated.

Perhaps one of the most remarkable papers read before the conference was by Lieut. E. H. Thompson, R.E., on "An Automatic Plotting Machine for Air Photographs". This machine is from the designs of Mr. Fourcade, who has been working at this difficult problem for some years. Lieut. Thompson has

* Conference of Empire Survey Officers 1935. Report of Proceedings. (Colonial No. 111.) Pp. vi+377+36 plates. (London: H.M. Stationery Office, 1936.) 20s. net.

constructed a most ingenious model from Meccano to illustrate the working of this complicated instrument. Without something of the sort, it is very difficult to understand how it functions.

Brigadier MacLeod pleads for the co-ordination of African surveys. He points out that some kind of arrangement should be come to among the various nations possessing African territory with the view of adopting uniformity of scales and projection of maps, before it is too late. So far, this has been achieved only in the case of the International "Carte du Mond" on the 1/1,000,000 scale. He also urges the adoption of the metric unit. The progress of aviation has made this necessary since the airman passes so quickly from one territory to another. Unless something is done, Africa of the future will be saddled with a multiplicity of scales, styles and projections. As no other nation is likely to adopt the British

units of measurement, unless we change to the metric system, yet another complication will be added to the map difficulties of the airman.

Before the conference terminated, resolutions were passed recommending that a central pool of survey instruments should be formed from which Dominions and Colonies could borrow on certain terms; that the *Empire Survey Review* should be continued notwithstanding some loss, as a means of keeping up the standards of surveying technique; a resolution emphasizing the necessity for basing all categories of survey on a proper geodetic foundation; a resolution recording the opinion of the conference as to the value of its proceedings for the discussion and interchange of views on the improvement of survey technique. The conference also decided that it is desirable to hold triennial conferences lasting for two weeks.

H. L. C.

Electrical Interference with Broadcasting

THREE years ago the Institution of Electrical Engineers appointed a special committee to consider the trouble caused by the interference of various kinds of electrical devices with radio reception. This nuisance has been gradually getting worse owing to the growing sensitivity of modern receivers. The report has now been published (Inst. Elec. Eng., Savoy Place, W.C.2. 6d. post paid) and was commented upon in NATURE of August 1. The committee was fully representative of all sections of the industry on both the radio and engineering sides.

A method of measurement of interference has been agreed upon, and instruments have been developed capable of indicating with sufficient accuracy the amount of interference caused by much of the electrical apparatus which causes trouble. The technical position has been cleared up, and it is considered that no undue extra expense will be involved in the design and construction of apparatus that will bring the interference caused within an acceptable standard. The apparatus which is likely to cause the most interference is classified as follows: (1) lifts in buildings; (2) trolley-buses and trams; (3) household electrical appliances; (4) small electric motors; (5) 'neon' display signs; (6) certain rectifiers for power plant and (7) electro-medical apparatus. In an appendix to the report, a brief account is given of the researches undertaken in connexion with these seven groups.

In addition, although there is at present little interference with ordinary broadcast reception due to the ignition systems on motor-vehicles, it is probable that, unless corrected, it will interfere with the television reception of the future. There are other causes of radio interference such as electric signalling gear on railways, but at present they produce only minor effects. Real progress has been made in finding the most effective methods of correction in each of the seven groups given above. As a result of Post Office activity, a considerable amount of radio interference correction has been taking place during the last few years.

The first case where radio interference correction was in effect made compulsory was that of traffic signals. The Ministry of Transport now requires all

traffic signals to be fitted with components which effectively prevent interference. This was achieved without much difficulty. The second case was that of trolley-buses, where much practical progress has been made. It is now clear that the various technical aspects of the problem are approaching solution, and it is necessary to consider whether compulsory powers should be conferred on some authority so that radio interference may be suppressed in those cases where it can only be done with the help of such an authority. The manufacturers of appliances and plant definitely support the view that there should be some recognized 'mark' which could be affixed to all portable apparatus as a guarantee that the apparatus complies with non-interference requirements. They consider that the sale of appliances which do not meet those requirements should be prohibited. It is essential that imported articles should be subject to the same regulations as home-produced articles and should bear the 'mark'. It is only through legislation that this question can be dealt with successfully. As a rule, it is not the man who buys and uses the apparatus, but his neighbour, who suffers from the resulting interference.

In view of the fact that it is generally cheaper to incorporate suppression devices in the original design of the equipment than to fit them after installation, it is recommended that compulsory powers should be conferred on some authority. It is anticipated that there will be only a small number of owners of interfering equipment who will refuse to apply remedial measures. It is recommended that the Electricity Commissioners should be the authority to issue regulations regarding both new and existing equipments and that the Post Office be charged with enforcing them. British Standards Specifications have already been issued giving the standard ratings for condensers, 'resistors', inductors and similar apparatus for incorporation in suppression devices. The specification for a standard interference-measuring instrument will cover the characteristics and performance requirements recommended by the Special International Committee on Radio Interference. It will include a detailed design for a portable instrument which will enable manufacturers to

ascertain what values of components should be used to reduce interference within the prescribed limits.

In a statement made by Mr. C. C. Paterson, the chairman of the Committee, concerning the report, he points out that should the regulations be put into force, the normal procedure would be very much as

at present. There would not be an army of inspectors searching out for trouble. Action would only be taken by the Post Office on receipt of a complaint of interference, and these complaints would become fewer in number as new apparatus bearing the 'mark' came into use.

Industrial Development in South Africa

THE Department of Commerce and Industry of the Government of the Union of South Africa has published a review of the material, scientific and educational progress made in connexion with the development of industry during the twenty-five years up to 1935*. Primarily, its purpose is to give an accurate picture of the conditions and prospects in what are described as the secondary industries, for agriculture and mining are otherwise dealt with and are only referred to in so far as they have a bearing on the other and less firmly established industries. The information it contains as to the conditions, facilities, costs, etc., in various districts and the progress of the numerous industries which have been established will also be found to supply a valuable scientific interpretation of the facts for the use of those who are or may become interested in the industrial future of the country.

In round numbers, the following figures give a picture of the expansion that has taken place in the twenty-five year period—employees have increased from 66,000 to 195,000, horse-power from 140,000 to 1,400,000, and total wages from 4 to 27 million pounds. The classes of industries dealt with and analysed statistically include fuel industries, iron and steel production, heavy chemicals and food production (sugar, wines and fisheries), together with other important developments which are taking place in connexion with the introduction of such manufactures as cement, pottery, clothing and textiles.

In these changes, the importance of research appears to be fully realized, and it is being fostered as an aid and guide in obtaining the best results. At Mount Edgecombe, the sugar industry has, at a cost of £13,000, established an experimental station, which is run at an annual charge of about £9,000. On the agricultural side, its main function is the search for new canes of superior sugar content and of higher resistance to disease. There are also a chemical side, dealing with manufacturing methods and processes, and an engineering section to investigate mechanical problems.

The Union Government conducts research in connexion with the fisheries, investigating life-histories and the intensity of operations and engaging in technological research on canning, smoking and other processes. Marine biological work is carried on in the specially designed research ship *Africana*, which took over the duties in 1931, while shore investigations in this department are conducted at the Laboratory and Aquarium at St. James, near Cape Town.

In a country making rapid advances towards industrialism, and possessing rich stores of natural wealth, much special research is necessary in order

to ascertain the best methods of making use of and adapting its resources to its own needs and that of export trade. Such work is being done on the coal supplies, the phosphates, the clays and other materials offering scope for increased usefulness. The use of gas, for example, might be greatly increased and developed.

The value of standardization has been recognized, and the editor takes the opportunity of impressing on his local readers its importance in eliminating ambiguous and misleading descriptions, in preparing dimensional standards and in specifying physical and chemical properties of materials, methods of testing, and safety codes. The South African Standards Institution, which is associated with the British Standards Institution, is conducted by a main committee representative of Government departments, technical societies and trade and industrial bodies, and there are five sectional committees dealing with mechanical, electrical and civil engineering, chemical and fuel matters respectively. In any work undertaken, the initiative lies with the interests concerned, and after tentative standards have been prepared they are submitted to the associated institutions, and those chosen are circulated for comment and recommendation. It is claimed that in this way the final standards approved should meet local conditions and requirements and then the industry or trade concerned may, if it desires, adopt them in its daily policy and practice.

It is to be noted also that a comprehensive scheme of training and technical education is now in being. The adoption, in 1922, of the Apprenticeship Act, marked the beginning of a new era in industrial legislation, and since then, 15,000 lads have completed their apprenticeships in accordance with its provisions and under the supervision of the committees of employers and employees which assist in its administration. The Act is operative in twelve groups of industries, and the general practice is a five-year training of young people after completing the primary and, in some cases, part of the secondary school course. They are then indentured to individual employers and are required to enrol for part-time courses at the technical colleges, a portion of their attendance there being timed to take place during ordinary working hours. For those resident in places far removed from centres where technical colleges exist, the Government has arranged for correspondence courses under the aegis of the Witwatersrand Technical College and, where students show satisfactory diligence, employers are responsible for the class or correspondence fees. It will thus be seen that South Africa is making every endeavour to provide for the needs of her technical students in the most practical way, and it may be premised that these preparations will react most favourably upon future industrial developments.

* Industrial Development in South Africa and Facilities for the Establishment of Factories. Published by the Department of Commerce and Industries. Edited by Dr. Vernon Bosman. (Pretoria: Government Printer, 1936.) 1s.

Science News a Century Ago

The Reef at Pernambuco

FROM Ascension, H.M.S. *Beagle* sailed for Bahia in order to complete the chronometrical measurement of the world. Arriving there on August 1, 1836, she sailed for the Cape Verde Islands on August 6, but being delayed by unfavourable winds on August 12 put in at Pernambuco, anchoring inside the reef. Of this reef, Darwin wrote: "I doubt whether in the whole world any other natural structure has so artificial an appearance. It runs for a length of several miles in an absolutely straight line, parallel to, and not far distant from, the shore. It varies in width from thirty to sixty yards, and its surface is level and smooth; it is composed of obscurely stratified hard sandstone. At high water the waves break over it; at low water its summit is left dry, and it might then be mistaken for a break-water erected by Cyclopean workmen. . . . Although night and day the waves of the open Atlantic, turbid with sediment, are driven against the steep outside edges of this wall of stone, yet the oldest pilots knew of no tradition of any change in its appearance. This durability is much the most curious fact in its history; it is due to a tough layer, a few inches thick, of calcareous matter, wholly formed by the successive growth and death of the small shells of *Serpulæ*, together with some few barnacles and nulliporæ. These nulliporæ, which are hard, very simply-organised sea-plants, play an analogous and important part in protecting the upper surfaces of coral-reefs, behind and within the breakers, where the true corals, during the outward growth of the mass, become killed by exposure to the sun and air. These insignificant organic beings, especially the *Serpulæ*, have done good service to the people of Pernambuco; for without their protective aid the bar of sandstone would inevitably have been long ago worn away, and without the bar, there would have been no harbour". Darwin in 1841 described the bar in detail in the *London and Edinburgh Philosophical Magazine*.

Monument to Champollion

ON August 13, 1836, the *Athenæum* said: "The monument erected at Figeac to the memory of Champollion, is an Egyptian obelisk of the purest and severest style, of very hard granite from a quarry near Figeac. It bears an inscription to the following effect: 'To the memory of F. J. T. Champollion, who first penetrated into the mysteries contained in the writing and monuments of ancient Egypt, and who was taken from Science by a premature death on the 4th of March 1832. He was born at Figeac the 23rd of September 1791'." Champollion died in Paris, and was buried in the Père-Lachaise cemetery. His grave is marked by an obelisk bearing a medalion.

Aerial Surveying from Balloons

In the *Mechanics' Magazine* of August 13, 1836, is a note from the *Scotsman* referring to the work of Charles Green (1785-1870), the aeronaut who up to that time had made 218 ascents. On the last occasion when Lord Clanricarde went up with him, he observed, it was said, that surveyors and architects

could with greater facility take plans of noblemen's estates by ascending in a balloon, as they could have a bird's-eye view of every locality, and if they only once adopted that method they would never relinquish it. Since the suggestion was made, an artist named Burton had called on Mr. Green to obtain the plan of a balloon constructed so as to be used for this purpose. The inventor proposed to fasten the car to the balloon by a swivel and to build a waggon to which the balloon could be attached. The waggon could be conveyed to any place a surveyor required, where, on a calm day, he could take plans, carrying with him the proper instruments.

Sir Charles Bell leaves London

SIR CHARLES BELL, the eminent surgeon, having accepted the chair of surgery at Edinburgh left London in August, 1836. One of the last letters he wrote from his residence, 30 Brook Street, was to his sister Miss Bell. In this he said: "The house is in a hustle. Books gone—pictures packing. People surveying the house! This does look like a change. All my sacred corners usurped—a naked house not a home. . . . I leave no enemy behind me, and Marion is universally beloved. . . ."

"While the season lasts, our society is all we could wish; but now our friends hurry to their better houses in the country, where they invite us, but where we cannot go. Many a long day we have been left solitary in a crowd, losing spirits and health."

"Without independent fortune, the relations which we have formed with society are not without their drawbacks. I must be independent and through exertion more than fortune. I must pursue that course through which I have attained station to feel comfortable. I could have made a fortune, and so my friends say, but I could not also attain to what I am, and to what they would have me. . . ."

Statistical Desiderata

In the Section of Statistics at the sixth meeting of the British Association held at Bristol in August 1836, Mr. W. R. Greg brought forward proofs of the total deficiency of statistical information in some subjects of international importance, and the unsatisfactory nature of that which had been collected by public authority in others. From examination of population tables, tables of births and deaths, criminal statistics, the statistics of education, of illegitimate birth and of stolen property, the author was led to conclude, that "with the exception of the revenue and commercial tables, no general documents yet exist in England from which any philosophical influences can be safely drawn, and that till the materials are wholly re-collected, all attempts to elicit such inferences can only end in disappointment and error". In order to obtain more satisfactory results in future, he deems it highly necessary to depart from the plan so commonly resorted to, of issuing circular queries, and to commit the task of obtaining authentic and complete information to individuals who shall make the execution of it their professional duty and whose labours shall be remunerated accordingly.

County Natural History Societies

In a paper entitled "A Proposal to Establish County Natural History Societies for Ascertaining the Circumstances in all Localities which are

Productive of Diseases or Conducive to Health", Dr. J. Conolly, late professor of the practice of medicine in the University of London, after pointing out the advantages which the country practitioner possessed over those living in towns, especially as regards the intimate acquaintance he gradually acquired concerning every circumstance in the locality, suggested the formation in every county in England of a society consisting of scientific men of every class and description and comprising the following sections: (a) statistics, (b) geology and mineralogy, (c) geography, (d) meteorology, (e) agriculture, (f) botany, (g) archaeology, (h) chemistry and (i) medical topography and statistics. The business of this last section would be "to apply all the exact knowledge furnished by the other sections to the subject of health and disease; to note, with extreme care, the relation of phenomena developed in the human body to the natural or statistical or historical and political and moral circumstances in which the subjects of such phenomena were placed". (*Trans. Prov. Med. and Surg. Assoc.*, 1, 180; 1836.)

Societies and Academies

Paris

Academy of Sciences, June 29 (*C.R.*, 202, 2109-2220).

JEAN TILHO: The present condition of the zone of capture of the Logone by the Bénoué. Further measurements and observations confirming the possible danger of the capture of the Logone (Tchad basin) by the Bénoué (Niger basin).

VITO VOLTERRA: The integration of the equations of biological fluctuations.

CLAUDE CHABAUTY: Certain ternary diophantic equations.

FARID BOULAD BEY: The general forms of equations of nomographic order 6 and 5 representable by conical nomograms.

S. BUCHEGUENNE: The deformation of Bianchi surfaces.

GEORGES GIRAUD: A general class of equations with principal integrals.

ALEXANDRE GHICA: The interpolation of analytical functions.

EMILE MERLIN: The nature of the trajectories of certain perfect heterogeneous fluids.

HENRI MINEUR: The galactic rotation of globular clusters.

JEAN JACQUES TRILLAT and Mlle. RENÉE VAILLÉ: A method of measuring the adsorption of oils by metallic surfaces.

PIERRE CIBIÉ: A method of laboratory control of the light projectors of motor-cars.

A. HAUTOT: The K-radiation of crystallized boron. It is concluded that the remarkable variation of the electrical conductivity of boron with temperature is due to a variation of the energy distribution of the conductivity electrons.

JACQUES ERRERA POL MOLLET and MARY L. SHERRILL: The infra-red absorptions of liquid hydrocarbons. The influence of the double linkage.

HENRI BIZETTE and BELLING TSAI: The thermal variation of the magnetic double refraction of nitric oxide (NO) and of compressed oxygen.

Mlle. MADELEINE GEX: Variations in the ultra-violet spectrum of phenol as a function of the pH. Over a range of pH from 1 to 12, the changes in the ultra-violet spectrum suggest four changes in the structure of the phenol molecule.

F. HAMMEL: The analogy of the monohydrated sulphates of the magnesium series. Results of X-ray studies of the monohydrated sulphates of magnesium, manganese, iron, cobalt, nickel, copper and zinc.

FRANÇOIS BOURION and Mlle. ODILE HUN: The cryoscopic determination of the total hydration of the ions of hydrochloric acid.

Mlle. CÉCILE STORA: The mechanism of the Becquerel effect of organic molecules.

Tr. NÉGRESO and W. J. CROOK: The equilibrium relations of the oxides of iron in the slag of refinery furnaces.

Mlle. JEANNE BOULANGER: The systems zirconyl oxalate, alkaline oxalates and water.

PIERRE CARRÉ and LOUIS PEIGNÉ: The relative mobilities of the normal alkyl radicals in their chlorothioformates.

HENRI WAHL: The chlorination of *p*-chlor-toluene. The chlorination of *p*-chlor-toluene gives a mixture containing 58 per cent of the 2,4-dichlor-toluene and 42 per cent of the 3,4-compound. This proportion is not affected by the nature of the catalyst, or by variations of temperature between 20° and 40° C.

PIERRE LEGOUX: The origin of the gold of the Guinea-Sudan borders.

LOUIS DONCIEUX, LOUIS DUBERTRET and HENRI VAUTRIN: The Oligocene and Burdigalian of the Syrian desert.

MAURICE PARAT: The Oxfordian and Kimmeridgian of Milne Land (Eastern Greenland).

ANDRÉ AURIC: The suitability of a cycle of 334 years for meteorological predictions.

HENRI COLIN and MARCEL SIMON: The proportion of ash and its alkalinity in the beetroot.

ETIENNE FOEX and MAURICE LANSADE: A bacteriosis of the banana tree.

M. and MME. FERNAND MOREAU: The toxicity of some cations for the Saprolegniae.

LÉO ESPI and GABRIEL MANDILLON: The action of bromacetates on various alkaloids. Sodium bromacetate reacts with strychnine sulphate, giving a non-toxic product. The toxicity of this alkaloid would appear to be connected with the existence of a free amino group.

MME. VÉRA DANTCHAKOFF: Sex hormones and the role of the placenta in the ontogenesis of mammals.

ISRAEL and MICHEL MAGAT: The ultra-violet spectrum of normal and leucæmic blood.

FRED VLÈS: The conditions of stimulation of fluorescence of proteins.

ERNEST KAHANE and Mlle. JEANNE LÉVY: The origin of the choline of sperm. The existence in sperm of free choline is a secondary phenomenon due to the action of a diastase on a precursor of choline.

ALI MUSTAPHA: The action of the cholera vibron on milk and cholerigen power.

GEORGES BLANC and MARCEL BALTAZARD: The influence of privation on the development of the virus of murin typhus in the flea (*Xenopsylla Cheopis*).

ALEXANDRE BESREDKA and MICHEL BARDACH: The intra-cutaneous immunization of rabbits against epithelioma inoculated in the eye. Intra-cutaneous epithelioma, a benign tumour, acts as a true vaccine against epithelioma of the eye, a malignant tumour.

Amsterdam

Royal Academy (*Proc.*, 39, No. 6, June 1936).

W. H. KEESOM and G. SCHMIDT: Researches on heat conduction by rarified gases. (1) The thermal accommodation coefficient of helium, hydrogen, neon and nitrogen on glass at 0° C.

J. BOESEKEN: The oxidation products of thio-urea. The dioxide as derivative of sulphylic acid (H_2SO_2).

E. D. WIERSMA: Physical resemblance in connexion with mental similarity (1). Researches on the inheritance of temperament and resemblance of offspring and parents.

K. MAHLER: An analogue to a theorem of Schneider (2).

H. FREUDENTHAL: (1) A class of rings in Hilbertian space. (2) The abstraction of the concept of an integral.

W. BLEEKER: Meteorological data from the three Dutch expeditions to the Karakorum (1). Observations of pressure, temperature, humidity, etc., at various stations in the Karakorum range.

T. WEEVERS: A consideration of some phytochemical problems. The phytochemical characteristic of a species, genus or family of plants is not a single compound, but a particular combination of several compounds.

T. E. DE JONGE-COEN: *Radix pramolarica unilateralis*.

N. SUZUKI: The diencephalic and some other systems in *Xantharpyia amplexicaudata* (1).

B. VAN DER EYKEN: Dentition and teeth development in the irisforelle (*Salmo irideus*) (6). Teeth development.

A. CHARLOTTE RUYTS: The isolation of typhoid bacilli from water. Wilson and Blair's medium readily permits of the isolation of the typhoid bacilli from infected water.

D. VAN DANTZIG: Ricci calculus and functional analysis.

Geneva

Society of Physics and Natural History, May 7.

KURT H. MEYER and W. LOTMAR: Note on the elementary lattice of crystallized caoutchouc. From a study of the interferences, the dimensions of the elementary lattice of crystallized caoutchouc can be calculated. It is monoclinic ($a = 8.54 \text{ \AA}$; $b = 8.20 \text{ \AA}$; $c = 12.65 \text{ \AA}$; $\beta = 83^\circ$). The arrangement of the atoms in this lattice, which includes eight isoprene radicals, can be established. Thus, caoutchouc should be classed in the C_{2h}^2 spatial group.

A. WEINSTEIN: The equations of vibration of a plate. Calculation of close upper and lower limits for the frequency of the overtone of a square clamped plate.

ERNEST C. G. STUECKELBERG: Continuous γ -radioactivity and unitary field theory. The Fermi explanation of continuous β^+ radioactivity allows for a recombination between the created positive electron and an orbital electron. The annihilation radiation can escape from the atomic system even if there is not enough energy available to produce a positive electron. Thus there is a pure and continuous γ -ray emission. Considering electron, neutrino, proton and neutron as different quantum states of one elementary particle, only four different transitions are possible if conservation of charge and Dirac's equation are postulated. They explain the Fermi

formula of β -decay and the nuclear exchange forces of Heisenberg and Majorana. If a neutrino theory of light is developed, the electric field and the material field (particles) can be described by the 16 components of a unitary spinor field (see also NATURE, June 20, p. 1032, and June 27, p. 1070).

B. SUSZ and S. FRIED: The Raman spectrum of gallic acid, of some of its derivatives and of tannin. The authors give the Raman spectrum of gallic acid, of methyl gallate, methyl trimethylgallate, triacetyl gallic acid and Chinese gallotannin with some interpretations of the frequencies found.

Moscow

Academy of Sciences (*C.R.*, 1, No. 7, 1936).

S. SOBOLEV: Evaluations concerning the families of functions having derivatives with integrable squares.

L. KANTOROVICH: The general theory of operations in semi-ordinated spaces.

A. I. ALICHANIAN, A. I. ALICHANOV and L. A. ARZIMOVICH: The law of the retention of impulses at the annihilation of positrons.

V. ARKADIEV and A. MOROSOVA: Photographic representation of a Hertzian dipole.

N. SELJAKOV: To what class of symmetry does ordinary ice belong? There are two modifications of ice; α -ice is hexagonal and β -ice is rhombohedral.

M. ELLASHEVICH: The rotation-vibration wave equation for a polyatomic molecule.

D. RAUZER-CHERNOUSOVA: The Fusulinidae and the stratigraphic subdivision of the oil-bearing limestones in the Sterlitamak district.

J. M. URANOVSKIY: The role of the nervous system in the regeneration of the extremities in axolotl.

Sydney

Royal Society of New South Wales, June 3.

A. H. VOISEY: The Upper Palaeozoic rocks around Yessabah near Kempsey, N.S.W. The various rock types in an area of about thirty square miles are described, classified and mapped, these rocks being mainly of sedimentary origin. This work reveals a very interesting story of bygone ages. More than three hundred million years ago there existed a shallow sea abounding in life; but many organisms were killed by showers of ash from violently explosive volcanoes. Later came uplift, and then another subsidence again ushered in marine conditions. The climate then was cold, and icebergs floated about on this sea fringed with active volcanoes. Further uplift and depression followed, with a gradual dying out of volcanic activity. After a final uplift, came extraordinary changes—pressure folded the rocks into great arches and troughs, and huge rock masses were displaced along cracks. Then for perhaps two hundred million years the land surface was gradually but effectively worn down, until it was but little above sea-level: uplift followed, and out of the highlands so formed the present Macleay River cut its valley.

GERMAINE A. JOPLIN: The Ben Bullen Plutonic Complex, N.S.W. The Ben Bullen complex consists of two intrusions of partial magma. The earlier mass is of noritic composition, and has differentiated *in situ*. The later intrusion is a quartz-mica-diorite, and this has reacted with the solid norites and given rise

to a series of cognate hybrids. Five chemical analyses show that the complex is closely related to the Hartley series, and possibly represents a northerly extension of the Hartley-Bathurst bathylith.

H. G. RAGGATT: Geology of the north-west basin of Western Australia, with particular reference to the stratigraphy of the Permo-Carboniferous. The stratigraphy and lithology of the Permo-Carboniferous system in the north-west basin of Western Australia are described in detail, and a subdivision into series and stages suggested. Correlation of these rocks with the Permo-Carboniferous of the Irwin River is discussed. An outline of the stratigraphy of the Cretaceous and the geological history and structure of the region are given.

WINIFRED MANKIN: An attempt at quantitative analysis of silver-gold alloys. Arc spectra were obtained from alloys of silver and gold in various proportions in the attempt to find a definite relation between the ratio of the intensities of corresponding lines in the spectra of the two metals and their proportions in the alloy. The alloy formed a bead in the crater of a carbon arc. Three pairs of corresponding lines were examined. No regular relations were obtained, and this is due mainly to the relative rates of volatilization varying considerably with slight changes in the arc conditions. Chemical analysis showed that the relative proportions of the metals were changed considerably, and in an erratic manner, by the passage of the arc. Suggestions are made for modifications of method.

H. FINNEMORE and JOYCE M. COOPER: Cyanogenic glucosides in Australian plants (4). *Zieria levigata*. The leaves of this rutaceous plant yield by the action of its own enzyme 0.2 per cent of hydrocyanic acid, and approximately twice this amount with additional enzyme. It is shown that this is due to the decomposition of zierin, the glucoside of meta-hydroxybenzaldehyde cyanhydrin.

Other Countries

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1935. Pp. 19. (Entebbe: Government Printer.) 2s. [67]

Memoirs of the Kyancutta Museum. No. 2: Further Notes on Archaeocyathi (Cyathospongia) and other Organisms from the Lower Cambrian of Beltane, South Australia. By R. and W. R. Bedford. Pp. 9-20+plates 7-20. (Kyancutta: Kyancutta Museum.) [67]

Survey of India. General Report 1935, from 1st October 1934 to 30th September 1935. Pp. xi+74+14 plates. 1.8 rupees; 2s. 6d. Index to Annual Reports of the Survey of India, 1904-5 to 1926-7. Compiled by Lieut.-Colonel A. H. Gwyn. Pp. 21. (Calcutta: Survey of India.) [67]

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelse. Serie Fiskeri, Bind 10, Nr. 3: Young Herring and Sprat in Faroese Waters. By A. Vedel Tåning. Pp. 28. 1.20 kr. Serie Fiskeri, Bind 10, Nr. 4: On the Eggs and Young Stages of the Halibut. Pp. 23. 1.00 kr. (Copenhagen: C. A. Reitzels Forlag.) [67]

Madras Fisheries Department. Administration Report for the Year 1934-35. By Dr. B. Sundara Raj. Pp. iii+74. (Madras: Government Press.) 10 annas. [67]

Imperial College of Tropical Agriculture. Fifth Annual Report on Cacao Research, 1935. Pp. 55+4 plates. (Trinidad: Government Printing Office.) 5s. [67]

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 31: Quality of Lint in relation to Ginning Factors. Part 1: The Effect of (i) Moving Knife Setting; and (ii) Saw Speed. By Dr. Nazir Ahmad and R. P. Richardson. Pp. ii+30. 1 rupee. Technological Bulletin, Series A, No. 32: The Effect of employing Different Roller Settings and Twists on the Spinning Performance of Three Indian Cottons. By R. P. Richardson and Dr. Nazir Ahmad. Pp. 16. 8 annas. (Bombay: Indian Central Cotton Committee.) [77]

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 56: Marbles and Limestones of Connecticut. By Fred Holmsley Moore. Pp. 56+14 plates. (Hartford, Conn.: State Geological and Natural History Survey.) 60 cents. [87]

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 23, No. 2: A List of the Birds of the Atlin Region, British Columbia. By Harry S. Swarth. Pp. 35-58. Vol. 23, No. 3: Origins of the Fauna of the Sitkan District, Alaska. By Harry S. Swarth. Pp. 59-78. (San Francisco: California Academy of Sciences.) [87]

A Compendium of Minerals and Stones used in Chinese Medicine from the Pen Ts'ao Kang Mu. Compiled by B. E. Read and C. Pak. (Published by the Peking Natural History Bulletin.) Second edition. Pp. viii+98. (Peiping: The Franch Bookstore.) 1.75 dollars. [107]

Ministry of Commerce and Industry, Egypt: Fisheries Research Directorate. Notes and Memoirs, No. 13: Les fonds de pêche près d'Alexandrie. 6: Hydroidea. Par Armand Billard. Pp. 12. Notes and Memoirs, No. 15: The Fishery Grounds near Alexandria. 7: Decapoda. By Heinrich Balss; with an Appendix: Schizopoda, by C. Zimmer. Pp. 68. Notes and Memoirs, No. 16: The Fishery Grounds near Alexandria. 8: Pantopoda. By Dr. H. Helfer. Pp. 6. Notes and Memoirs, No. 17: The Fishery Grounds near Alexandria. 9: Sponges. By Maurice Burton. Pp. 28. (Cairo: Government Press.) [107]

Ministry of Finance: Coastguards and Fisheries Administration: Fisheries Research Directorate. Rapport sur les pêcheries d'Egypte en 1933. Par Hussein Faouzi. Pp. vi+135. (Cairo: Government Press.) [107]

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 11: Pressures under a Model of Panjnad Weir and under the Prototype. By Harbans Lal Uppal. Pp. 6. 4 annas; 5d. Research Publication, Vol. 2, No. 12: Design of Khanki Weir Bay 8. By J. P. Gunn and Harbans Lal Uppal. Pp. 2+4 plates. 4 annas; 5d. Research Publication, Vol. 5, No. 4: On the Electrical Method of Investigating the Uplift Pressures under Dams and Weirs. By Dr. V. I. Vaidhianathan and Gurdas Ram. Pp. 5+8 plates. 5 annas; 7d. Research Publication, Vol. 5, No. 5: Floation Gradient for the Flow of Water through Porous Strata and its Bearing on the Stability of Foundations. By Dr. V. I. Vaidhianathan and Hans Raj Luthra. Pp. 13+8 plates. 6 annas; 8d. (Lahore: Punjab Irrigation Research Institute.) [137]

Brooklyn Botanic Garden Record. Vol. 25, No. 3: The Early Vegetation of Long Island (A Long Island Tercentenary Publication). By Henry K. Svenson. Pp. 207-228. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [137]

Tanganyika Territory: Department of Lands and Mines: Geological Division. Short Paper No. 13: Geology of the South and South-Eastern Regions of the Musoma District; being a Preliminary Geological Survey of the Ikoma and Kilimafoza Regions and the Serengeti (Complete) Game Reserve. By G. M. Stockley. Pp. 48. (Dar es Salaam: Government Printer.) 4s. [137]

Ceylon. Part 4: Education, Science and Art (G). Administration Report of the Marine Biologist for the Year 1935. By A. H. Malpas. Pp. G9. (Colombo: Government Record Office.) 10 cents. [137]

Osiris. Vol. 2, Part 5: Historical Introduction to the Study of Teleostean Development. By Jane M. Oppenheimer. Pp. 124-148. (Bruges: Saint Catherine Press, Ltd.) [157]

Official Publications Received

Great Britain and Ireland

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 2: Pneumatic Equipment for Horse Drawn Vehicles. By Alexander Hay. Pp. 20. (London: Rubber Growers' Association.) [137]

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