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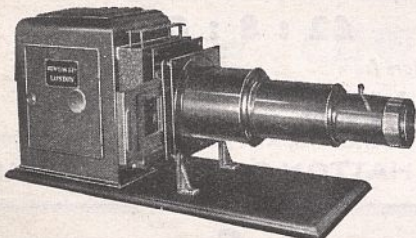
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Vol. 145, No. 3668

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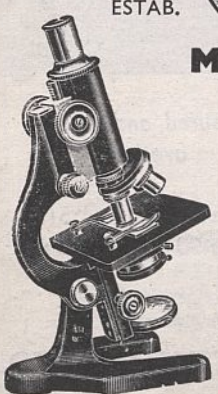
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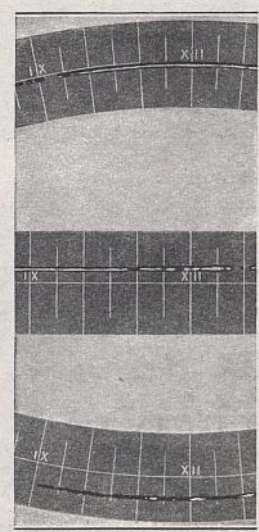
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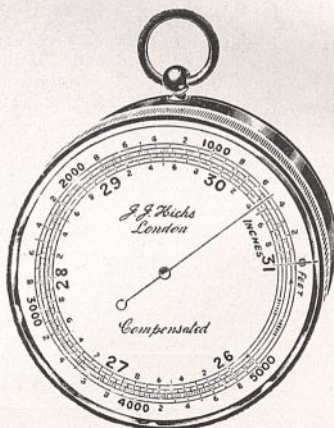
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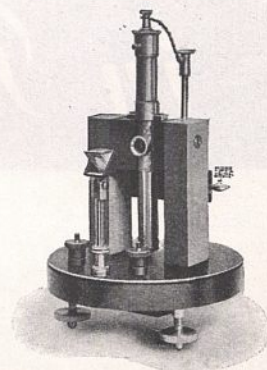
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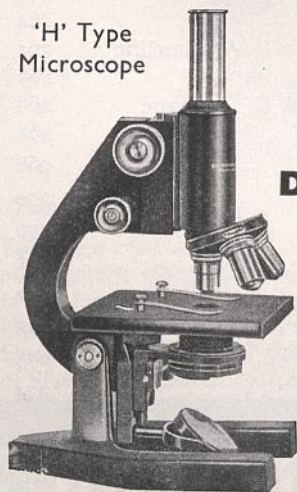
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SATURDAY, FEBRUARY 17, 1940

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CIVILIZATION AND THE RIGHTS OF MAN

MUCH has been said and written recently on the causes of the present conflict between Germany and the Allies and the conditions of peace, but most of it has been from the point of view of national expediency and little from that of the history of civilization or the future of mankind. In his two latest books—"The Fate of *Homo sapiens*" and "The New World Order"—Mr. H. G. Wells takes an eagle-eyed view of the world of man, as he did in his "Outline of History", and brings his critical mind to bear upon what he sees. With a few other students of history he realizes that the scientific method of inquiry can be profitably applied to political and social problems, as it is to other aspects of biological development. In the struggle for existence of all forms of life, many factors are involved; and the aim of scientific investigation is to discover their nature and influence. The history of civilization shows that the chief causes of war have been migratory movements—represented in modern times by access to natural resources and the claim for *Lebensraum*—aggressive nationalism, racial lust and religious hatred.

In the natural instincts which have led to struggles between groups of peoples, mankind is the same as it was at the beginning of civilization six thousand years ago. There has been great increase of knowledge but not a corresponding increase of wisdom in the use of it. If an individual or a nation has the will to assert a claim by force, he can acquire in an open market whatever power he is prepared to pay for and use. In a civilized community, citizens protect themselves from such dangerous disturbers of the peace by means of a police force; but there is no similar force to prevent breaches of the world's order by truculent

nations, and no international court whose judgments upon disputes are accepted as final.

If the civilized world is to survive, the hour has come when measures will have to be devised to control the "gangster" element in human nature, whenever or wherever it manifests itself. Authority to exercise such power will come only when nations believe that it is in their own interest to combine for the common good of the whole community of mankind. How this end can be attained, and the changes which will have to be made in social and political structures in order to achieve it, signify reconstruction of existing systems in a manner which may rightly be described as revolutionary. The aim of such a revolution is not, however, to readjust class relationships, but to create a world commonwealth of free peoples conscious of their responsibilities one to another, and accepting the principle of "Live and let live" rather than that of "Lie and let lie", which is often an excuse for political diplomacy.

This is the type of revolution which Mr. Wells foresees, if civilization is to be saved from self-destruction. He urges that "It is the system of nationalistic individualism and unco-ordinated enterprise that is the world's disease"; and that the old foundations of the system have proved unable to support the ponderous structure which has been built upon them. To strengthen one part by political balance of power or alliances makes other parts of the structure relatively weaker, with the result that the stability of the whole suffers. Mr. Wells has, therefore, no sympathy with the movement for the federation of a number of European States, unless it is deliberately made the basis of a system designed ultimately to comprehend all the peoples of the world.

There is nothing new in the spirit of this intention. The philosophy of the Stoics included the principle of the brotherhood of man and the merging of all nationalities in a cosmopolitan citizenship. Christianity adopted the same ethical doctrine, and still pursues it; yet neither in economic nor in political spheres are national policies or actions determined by it. After nearly two thousand years of teaching peace on earth, good will towards men, this principle of all systems of ethics does not enter into the field of practical politics of Christian nations any more than it does in other communities. It may be that a world commonwealth of nations is just as far off as a world fellowship of religious faiths, but that does not make the ideal less worthy of effort to attain it. The mines and torpedoes which lie in the track of civilization at the present time make it more necessary now than ever it was for navigators to be guided by a single light, instead of each ship of State, or convoy, following a course which must cross the tracks of others and lead to collisions.

Though, in the past, war has played a part in the formation of certain groups, it represents only one phase in the development of civilization. It is true that civilization has developed through individual peoples, as, historically speaking, mankind has been organized on that basis, but we, as heirs of the ages—to use a trite but expressive phrase in this connexion—are not interested in the survival of these peoples, except in so far as they have contributed to the general advancement of the human race. The trend of cultural achievement in the advancement of mankind has been to operate through larger and larger unities—tribe, people, nation, confederacy—eliminating war and the struggle for existence as physical facts, and relying more and more on the struggle for existence between ideas.

It is towards such a world commonwealth, in which each nation can be free to follow its own course of cultural development, that Mr. Wells would direct civilized thought. It may be held that this conception represents merely a reversion to primitive social structures; but the difference is in the extent of outlook. Whereas, in the primitive form, the sense of responsibility embraces the members of the same blood-kin only, or those of the local group within which the members are more or less intimately acquainted, in a modern society it may reach out to embrace all members of a great nation, and possibly, when

conflicting creeds and ideals agree to sink their differences, it may extend to all men of good will, to whom the dignity of man as an individual entity transcends racial and political boundaries.

When, if ever, this comes to pass, it will be possible to gauge how far mankind has advanced along the road of ethical as well as material progress. To many, the way seems long to go. The urge of nationalism and its ideals, combined with belief in might as the sole arbiter of right, has diverted the thoughts of peoples away from the main stream of human progress into narrower channels in which rocks and rapids threaten at every turn to shipwreck all that is best in civilization.

In what is conceived to be the highest type of civilization to-day, certain ethical and humane sentiments, such as those of truth and righteousness, justice and mercy, and sympathy with the weak and suffering, are possessed and practised by a greater number of the community than ever before. These high attributes of human nature have survived the ages of violence, cruelty and rapine which have disgraced European history, and by which the recrudescence in our own times will be remembered. In spite of these degrading influences, there has been an increase in the true, the humane and the just, and the standards of conduct towards others have become ethically higher, until now no people or nation which reverts to such methods can claim to be in the van of modern civilization. In so far as the present conflict is one of ideals, it may fairly be said that those of the Allies represent a far higher ethical standard than exists at present in Germany.

Freedom of thought and speech, belief and investigation, subject only to the recognition of the same liberty on the part of others, is threatened by the new tyrannies which, through their aggressive militarism and economic nationalism run mad, seek to reduce the citizen to a soulless unit and a condition of moral and intellectual servitude. The existence of economic antagonism and military rivalries among nations is as grave a danger to scientific thought and investigation, upon which so many material achievements are based, as it is to the general progress of civilized life. Science must, therefore, stand for high human values, as against slavery of the spirit of man, if civilization is to be preserved from the dangers which now threaten it.

There are certain fundamental human rights the recognition of which would do much to promote a sense of common interest among the

peoples of the world. Mr. Wells gives the first draft of such a Declaration of the Rights of Man in his "New World Order"; and the *Daily Herald* is submitting it to free and wide discussion with the view of constructing a new charter to represent man's just claims in a modern society. The intention is eventually to produce a Declaration which will represent world-wide opinion, and will crystallize the thoughts of men and women of all ranks and of all races who believe in the essential greatness of mankind. It is hoped that such a Declaration at the present epoch may have valuable consequences in shaping the structure of human society to the benefit of mankind.

Representatives of science are invited, with those interested in other fields of progressive life, to assist in making the final form of the Declaration a worthy and enduring statement of human needs. The time has come for the assertion of the rights of scientific and other intellectual workers in modern life, in view of the conditions of cruelty and suppression to which their work is now subject in some countries. Such a Declaration would insist that creative ideas are the essence of progressive thought and achievement in science, as in art and literature; and that to make them subservive to the principles of any social doctrine or political system is to restrain the expansion of the

human mind and its means of expression. Research can be organized and team-work be profitably applied to solve particular problems, but the true heart of science is in original independent thought; and this can neither be created nor regimented by political authority.

It has been suggested that a charter should be framed embodying these and other principles of liberty of thought, and freedom from the frustration by authority, which have long been assumed to be characteristic of scientific activity. Little encouragement has been given to this idea in scientific circles, otherwise the Society for the Protection of Science and Learning, or the British Association's Division for Social and International Relations of Science, would no doubt have produced such a charter. The world of science is international in its constitution and aims, and citizenship can be claimed in it by men and women of any race or nationality who will respect the principles implied in the pursuit of scientific truth and endeavour to contribute to the advancement of natural knowledge by following them. The Declaration of the Rights of Man which should emerge from the discussion organized by the *Daily Herald* will no doubt include these principles, among others which may be justly claimed by all the citizens of the modern world.

PROPERTIES OF MATTER IN BULK

Statistical Thermodynamics

A Version of Statistical Mechanics for Students of Physics and Chemistry. By Prof. R. H. Fowler and Dr. E. A. Guggenheim. Pp. x + 693. (Cambridge: At the University Press, 1939). 40s. net.

PROF. R. H. FOWLER, with the able assistance of Dr. E. A. Guggenheim, has produced a book which will serve in many respects as a third edition of his "Statistical Mechanics", but which does not supersede the former work entirely. The present book is written with rather a different aim in view. The first edition of "Statistical Mechanics" gives the impression that the author's interest was centred primarily on a new and elegant mathematical technique, the "method of steepest descents", which could be applied with profit to a very large number of physical problems. The second edition represents a transition stage, with more emphasis on the physical problems and less on the principles of statistical mechanics. In the present work the shift of emphasis is complete.

It is a book, admittedly written from a mathematical point of view, about the properties of matter in bulk. Theorems of statistical mechanics and of thermodynamics are both used, as may be convenient, to discuss the problems under consideration; once the laws of thermodynamics and their connexion with statistical quantities have been derived, full use is made of them whenever it seems advantageous. It was this fact which suggested the title "Statistical Thermodynamics" given to the book.

In accordance with the utilitarian nature of the book, no discussion is given of the truth of the fundamental axioms of statistical mechanics; these are merely stated, and the reader is referred to recent books on the foundations, such as that by Tolman. Since, moreover, it is intended primarily for students of physical chemistry (or, may we say, chemical physics), the chapters which appeared in the old book about astrophysical and atmospheric problems are omitted.

After the general methods of statistical mechanics have been discussed, the book opens with a discussion of the specific heats of perfect gases, which has been brought thoroughly up to date. Chapters on crystals and on chemical equilibria follow, and then chapters on imperfect gases, liquids, and the theory of condensation. Solutions of electrolytes, adsorbed surface layers, elementary electron theory of metals, lattice imperfections and order-disorder in crystals, and dielectric and magnetic properties of matter in bulk are other subjects treated. There is also a chapter on chemical kinetics, which, although not a subject which can be included under the heading of the properties of matter in equilibrium, is nevertheless a field in which the methods of statistical mechanics have been applied extensively to calculate the number of molecules in the activated state.

A study of the book and in particular a comparison with Prof. Fowler's earlier treatise is interesting especially in reminding the reader of the subjects in this field which have received the most attention from theoretical physicists during the last four years. There are in particular the complexities of the problem of the liquid state, which resist as obstinately as ever all attempts to write down a partition function even for the simplest liquid. The authors give an account of the various more or less crude models which have been proposed to describe liquids, and they also develop the theory of Mayer, Born and others about condensation.

The recent discovery of the existence of alloys in which an ordered superlattice gradually disappears as the temperature is raised has provided an invigorating incentive to mathematical research on what are known as co-operative phenomena. By this term is meant the variation with temperature of the equilibrium state of a body in which the forces holding each molecule in some normal or ordered position depend on the number of its neighbours which are themselves in ordered positions. In a sense the fusion of a solid may be regarded as a co-operative phenomenon, but the order-disorder transition in alloys presents a problem which is much more amenable to mathematical treatment, because in an alloy each atom has the choice only of an ordered or a disordered position, instead of the infinite number of positions which are possible for a molecule in a liquid.

The earliest mathematical treatment of any phenomenon of this type is Weiss's theory of ferromagnetism and its disappearance above the Curie point; but the further development of the subject as a problem in statistical mechanics has been hindered by the difficulty of giving a satisfactory account, from the point of view of quantum mechanics, of the interaction between the ele-

mentary magnets. The difficulty arises partly from the fact that the elementary magnets, namely, the electrons, do not stay in the neighbourhood of definite lattice points but wander through the crystal. In alloys, on the other hand, in spite of the primitive state of our knowledge of metallic cohesion, it is a reasonable hypothesis that the simple assumption of a law of force between neighbours is a sufficient basis for a theoretical attack on the qualitative aspects of the problem. This, at any rate, is the point of view taken in the book under review, and a very full account is given of the various theoretical attempts to set up a partition function for the system, and to find out whether there should be a phase change at the transition point, or whether only the specific heat or even its first derivative is discontinuous.

The present reviewer welcomes the appearance for the first time of an account of the Wagner-Schottky theory of lattice defects in crystals in thermodynamical equilibrium. Apart from its interest in explaining ionic conduction in crystals, and the importance of the concept for the theory of chemical reactions in solids, the theory has a considerable didactic value. In teaching statistical mechanics to students, it is often advisable to put off the study of gases for as long as possible, because of the difficulty in evaluating the chemical constant, and hence the entropy of a gas, without a much deeper incursion into quantum mechanics than the average student can follow. Interstitial atoms or vacant lattice points in a crystal have many of the properties of a gas, but since one can count directly the number of ways in which they can be arranged, expressions for their entropy and free energy can be written down without any appeal to quantum mechanics at all. The present reviewer has found that the subject forms an excellent introduction to the study of chemical equilibria, in the further development of which there is a good deal that the average student has to take for granted.

Readers of Prof. Fowler's earlier books will not need to be assured of the thoroughness with which the work of revision has been done, or of the masterly and complete mathematical treatment of the physical problems which are discussed. Students approaching the subject without much mathematical knowledge will, we think, find it easier than in the previous books to discover the formulæ that they want and to understand the steps by which the formulæ are obtained. The book is written with the needs of practical workers in physics and chemistry in mind, and it is a remarkable achievement to produce a treatise so eminently useful without sacrificing mathematical rigour or completeness in any way.

N. F. MOTT.

PRINCIPLES AND PRACTICE OF EDUCATION

Knowledge and Character

By Dr. Maxwell Garnett. Pp. xii + 358. (Cambridge: At the University Press, 1939.) 18s. net.

DR. MAXWELL GARNETT in this book approaches the problems of moral education from the point of view of physiology and experimental psychology. Time was when recourse to scientific method would have meant that the author was committed to a materialistic and determinist interpretation of the mental and moral life. But that is no longer the case. Science has shed almost every trace of *a priori* dogmatism, and we find Dr. Garnett frankly advocating the hypothesis of interaction between mind and body as the most reasonable explanation of the facts. True, he raises a good many problems of a speculative order which the limits of his space do not permit him to discuss fully. He ranges in the course of his argument over the theory of knowledge and of being, touching also in highly suggestive ways on questions of religion and the ultimate aim of life. We find him speaking of what are strictly psycho-physical generalizations, such as the five formulated in the earlier chapters, and summarized collectively on p. 273, as though they were laws of *thought*; and a good deal of his physiological theory of neurograms, each of which corresponds with varying complexity to a concomitant mental process, is of the nature of highly inferential construction from data that are strictly psychological. Indeed the concept of correspondence which occurs very frequently in these pages seems to us to stand in need of a good deal of detailed explanation. It may well be questioned whether the method of explaining psychological facts by speculative physiological deductions from the very facts to be explained has sufficient logical validity.

An adequate criticism of the book would require a combination of expert knowledge in physiology, psychology and philosophy. The present reviewer can claim competence only in the last-mentioned of the three. In regard to the physiological sections he can but note how carefully documented is the evidence from the highest authorities such as Head and Sherrington. In psychology, Dr. Garnett naturally draws upon his own work in collaboration with Spearman. His mastery of the technicalities of factor analysis, and especially of the *g*-factor, in the mental outfit of the individual, is strikingly displayed in Chapter vii, and should prove most fruitful in the shaping of educational theory.

On the broader speculative issues handled in the last half of the volume, Dr. Garnett's views will doubtless cause some searchings of heart among philosophers. One of the points most open to question is his theory that the soul acts only through the will, and by way of selection and choice between alternative neurograms. It is a little difficult to understand the status of the soul, which seems to be of the nature of a pure ego, in itself unaffected by the development of character, and yet capable of functioning without any physiological correlate. Indeed, in one very interesting note, Dr. Garnett suggests the possibility of direct communion between souls, and again between the human soul and God. Such a relationship is presumably purely spiritual. "It is not inconceivable," he says (p. 162, note 1), "that another Soul—God perhaps—or other souls should communicate directly with our souls. In such a case it is possible to imagine that the other soul which communicates with mine does so directly, soul to soul, or indirectly by first causing excitement in my brain. Since, however, my own soul cannot create, but only re-inforce, excitement in my brain, it is not to be supposed that any other human soul has power to *create* excitement in my brain; but we may choose to suppose that God has it, and sometimes exercises it. It is, however, simpler, and therefore preferable, to suppose that all purely psychical communications proceed direct from soul to soul."

In another respect, the adoption of a strictly scientific approach leads Dr. Garnett to lay stress on the importance of psycho-physical generalizations in the training of moral character. As he rightly says, "it is the faith of every science that an unlimited number of phenomena can be comprehended in terms of a limited number of such propositions, principles, or 'laws'. The phenomena are explained as particular examples of the working of general 'laws'." (p. 8).

Now this method is certainly very fruitful when we are dealing with character and conduct on their lower and less complex levels. Then these general rules and laws of habitual behaviour come predominantly into play. But on the higher levels of thought and action, purposes and interests are increasingly unique and individual, defying reduction to any combination of generalities. It is to Dr. Garnett's credit that he frankly recognizes this limitation of scientific method in its application to education. He puts great stress on the development of personality in the individual, who is

moved, in William James's phrase, by "partial purposes and private ends". This is all the more suggestive because of Dr. Garnett's frank adoption of the Christian hypothesis (Chapter xv) as making more sense of human experience than any other. Christian saints and teachers have always insisted that the element of self-love is ineradicable from human nature, even in the state of perfect consummation in communion with God. Spiritual growth consists in the passage from self-love, detached from love of God, to self-love in and through love of God. It is interesting to find repeated confirmation of this cardinal religious

tenet in the physiological and psychological positions advocated by Dr. Garnett.

Enough has been said to show the wide range of interest in this volume. Dr. Garnett brings to his task long experience in educational administration, a wide knowledge of human affairs and a humanistic culture that is rare in a trained man of science. The result is a book that throws light both on educational principles and on their practical applications, as, for example, in the Spens Report, to which frequent reference is made throughout the volume. There is an excellent index.

W. G. DE BURGH.

SIR JAMES FRAZER'S NOTEBOOKS

The Native Races of America

A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (*Anthologia Anthropologica*.) Pp. x+352. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35s.

THE issue of the fourth and concluding volume of extracts from the notebooks of Sir James Frazer, edited by Mr. R. A. Downie, must inevitably provoke certain general reflections on the work as a whole. Among these, the first to emerge in the minds of all will be admiration for Sir James's genius, mingled with a profound amazement at the stupendous energy and industry which have extracted and digested the material apt to his purpose from so vast a literature as has been sampled in these four volumes. With a penetrating insight into the working of what might be termed the 'traditional' mind of primitive man, he has disentangled from an enormous body of recorded fact the significant threads in the evolutionary development of religious beliefs and emotional reactions in a vast variety of forms of the social environment. The task has demanded a logical grasp and a power of generalization which have been equalled by the lucidity and persuasive eloquence with which the argument has been presented to the world. The supplementary evidence contained in "*Anthologia Anthropologica*" is no less an integral part of the monument, which is Sir James Frazer's life work, than "*The Golden Bough*" or "*Totemism*". For its publication we are deeply indebted to Lady Frazer and the editor, to both of whom Sir James pays well-deserved and graceful tribute in a foreword.

It will be remembered that the principle upon which the contents of these volumes have been selected is that recent sources have been set aside, with a few exceptions, and only the older, less accessible and less known material has been included. Hence from the nature of the material, the extracts present a view of primitive man unsophisticated and as he was to be found in the remoter parts of the world between the sixteenth and latter parts of the nineteenth centuries, but more especially in the eighteenth and nineteenth centuries. The conditions in which he was observed by those writers from whom these extracts have been drawn have long passed away; and their record correspondingly is of enhanced significance for the anthropologist.

This consideration is of special application in estimating the value and interest of the extracts which deal with America. They are records, of which some were familiar to a past generation of anthropologists, but with the development of new methods and a new outlook in America, now receive less consideration than they deserve. Such are for example H. Rink and Hall on the Eskimo, and the valuable reports over a series of years of the *Ethnographical Survey of Canada*, unfortunately interred in the *Annual Reports of the British Association*. Here also is much of the early work of F. Boas on the Kwakiute of the north-west, of J. Teit on the Thompson Indians of British Columbia, and the valuable Reports of the *Jesup North Pacific Expedition*. It is, however, in its earliest records that the literature of indigenous America is at its best, and although "*The Golden Bough*" has drawn liberally on these sources, it has been possible to add much from Sahagun, Valdes, Herrera, and Ariaga on the extirpation of idolatry in Peru, and other early

Spanish writers who were in a position to obtain or give first-hand information on pre-conquest or early post-conquest peoples in Central or South America—material of which anthropologists, with the exception of those known specifically as ‘Americanists’, make too little use.

The records of American peoples, whether early or late, from which these extracts are taken, are of even greater interest than those relating to other parts of the world. Outside America, except for isolated instances, such as the Tasmanians, the people still exist, though their conditions of existence have suffered modification. In North America, excepting in the remote north-west and among the Eskimo, as Harlan I. Smith pointed out some years ago, it is becoming increasingly necessary to employ the methods of the archaeologist in ethnographical investigation. The transfer of the Indians to reservations has sapped or destroyed

their culture, except where special reasons, mostly economic, artificially prolong an attenuated existence. Recent ethnographical studies have had to depend upon the memories of a few rapidly disappearing elders among the tribesmen. Hence the value of even the scantiest record of earlier conditions.

A map of “Some Indian Tribes of North America” is included. It is too incomplete to be of much value as a guide to the text and is unworthy of the care which has been lavished on the production of this and the three earlier volumes.

The fifty-five notebooks containing the material, written in Sir James Frazer’s own hand, and the product of more than fifty-two years of unremitting labour, from which the extracts appearing in the four volumes of “Anthologia Anthropologica” have been taken, have now been accepted for custody by the British Museum (Bloomsbury).

THE PLANT ALKALOIDS

The Plant Alkaloids

By Dr. Thomas Anderson Henry. Third edition. Pp viii + 689. (London: J. and A. Churchill, Ltd., 1939.) 42s.

IN spite of the fact that modern fashions in chemical research have inclined towards the hormones and vitamins, much work has been accomplished during the past twenty years in the field of the plant alkaloids. This fact is reflected in the third edition of Henry’s “Plant Alkaloids”, which to all intents and purposes is a completely new book. It bears little relationship to the second edition published in 1924, although the arrangement of the material on the basis of a chemical classification according to the nuclear structure has been retained. Slight deviations from this plan occur where important biological relationships would be obscured by a slavish adherence to such a plan. On the other hand, the reader is warned against placing too much reliance on such relationships in considering possible structures of new alkaloids with the reminder that sparteine, long known as the characteristic alkaloid of broom tops (*Leguminosæ*), has also been found to occur in *Anabasis aphylla* (*Cheniopodiaceæ*) and as an associate of chelidone in the greater celandine (*Papaveraceæ*).

The fascinating problem of the biogenesis of alkaloids is illustrated by reference to many of the experiments conducted by chemists under so-called physiological conditions—at temperatures about 25° C., in presence of feeble acidity and

using materials known to occur or to be capable of formation in the plant. Those of Robinson involving the conversion of lysine and arginine into hygrine, and of Schopf and others on the synthesis of tropinone, pelletierine and lobelanine are typical examples. Such work necessarily follows progress in the correct diagnosis of molecular structure.

Special reference should be made to the section on the alkaloids of cinchona. Numerous and complicated as they are, the efforts at chemical diagnosis have been successful and in many cases confirmed by synthesis. The complex problems of stereochemistry have been solved and it is natural that the literature covering this field is very voluminous. Dr. Henry, himself an outstanding figure in this work, has managed to condense the matter available into digestible proportions. There is no better summary of the cinchona alkaloids than that found within the pages of this volume.

Probably no other department of chemical endeavour has given rise to so much controversy as the structure of certain of the alkaloids. Mention of morphine, strychnine and berberine emphasizes this point. The author has given a critical account of all the important work on alkaloidal structures and has managed to escape being didactic, whilst giving reasoned assistance in the formation of opinion as to the merits and demerits of opposing contentions. In this respect the book should receive a welcome from all concerned, from the research worker to the honours student.

The pharmacology of the alkaloids has been adequately reviewed, much of the exact work being of recent date. This section has been read critically by Dr. White and will be useful alike to the chemist and the pharmacologist. The importance of such work reaches beyond the confines of the 'pure' pharmacologist on account of the comparatively modern endeavours to relate pharmacological action with chemical and physical properties and thus with molecular structure; that is, chemotherapy in its widest sense not limited by the hampering definition of being concerned only with those products which attack an invading organism. Dr. Henry has directed attention to this aspect of the problem by reference to the work on esterified amino-alcohols as cocaine substitutes in local anaesthesia and to the modified cinchona alkaloids. Such work attracts both the pharmacologist and the chemist, and hence it is a great convenience and help to have chemical and pharmacological summaries and references treated in a single book.

Even a work of this size is inadequate to deal

with all facts of alkaloidal work, and some selection was imperative. In this connexion Dr. Henry has rightly chosen to deal very briefly with the methods of extraction from the plants and has been content to refer to the more important papers concerned with the chemical and biological determination in plants and plant extracts. Sufficient references are included to help those interested in this aspect of the subject.

The value of such a work as this depends largely upon the bibliography: this is remarkably complete and includes references published little previous to the date of issue. Numerous tests for the presence or absence of references were made, but in no case was the book found wanting.

In conclusion, this work forms a perfect reference book in its subject, and even if criticism were possible, to criticize would be an act of sheer ingratitude. The enormous amount of work involved in the collection, correlation and interpretation of the huge mass of material available represents scholarship of a high order.

W. H. LINNELL.

STRUCTURE AND FUNCTION

Life and Living

By Frederic Wood Jones. Pp. x+268. (London: Kegan Paul and Co., Ltd., 1939.) 10s. 6d. net.

THOSE who have had the opportunity of admiring Prof. Wood Jones's facility and effectiveness as a lecturer will be grateful to him for the publication in a book of some of his recent public lectures. His style of lecturing is particularly well adapted for reproduction in the form of written essays, and these make exceptionally pleasant reading.

While dealing with a variety of subjects, the lectures concern themselves mainly with problems of medical education, and with biological problems raised by the consideration of the relation between structure and function. Biologists who have devised theories to explain the structural organization of living creatures have usually appreciated the difficulty of linking structure and function in a common theory of causation. These contrasting aspects of biological study have in the past, indeed, led to an artificial separation of the two scientific disciplines anatomy and physiology, and this again has inevitably encouraged a somewhat dualistic conception of living organisms. Prof. Wood Jones is intent upon the destruction of such an illusion, and would re-orientate the teaching of anatomy so as to stress the fact that structure is only the ultimate expression of function.

Prof. Wood Jones's own views are frankly Lamarckian. For him the precision and consistency with which structures, developed in embryonic life, are adapted for their ultimate function are not intelligible unless the inheritance of acquired characteristics is postulated. Yet even he finds remarkable instances of a disharmony between structure and function. The formation of a median vagina in marsupials, according to his interpretation, was a last-minute effort on the part of Nature to avert a catastrophe which was nearly brought about in metatherian evolution by the fact that the initial vaginal canals were too small to allow parturition to occur. He conceives, also, that by some sort of morphological accident the vertebrate eye during early phylogenetic development became caught up with the infolding medullary tube and inadvertently buried. By good fortune, however, it managed to "struggle" towards the surface again, but only at the expense of becoming inverted, and therefore less perfect as a piece of apparatus than it might have been.

Such instances are here quoted to illustrate the fertility of the author's mind, a fertility which expresses itself in many original ideas and novel interpretations. We cannot but feel that all biologists and many other scientific workers will derive very considerable pleasure and intellectual exercise from reading these lectures.

SCIENCE AND PRACTICE OF FODDER CONSERVATION

The Science and Practice of Conservation
Grass and Forage Crops. By Dr. S. J. Watson.
In 2 vols. Vol. 1. Pp. xi+415. Vol. 2. Pp.
vii+417-820. (London: *Fertiliser and Feeding
Stuffs Journal*, 1939.) 2 vols., 30s.

FARM animals are wintered on fodder and root crops, supplemented by concentrates, that is, grain, milling offals, oil-seed residues, etc.; the fodder, roots, and frequently the grain also are home grown. The preservation of the fodder crops, for use in the winter, presents more difficulties than that of the other home-grown foods, and the quality of the product is very variable, depending on the kind of crop, its stage of maturity when cut, etc. The quality of the product is important, because it governs the amount and kind of concentrates that have to be purchased.

Two recent developments, the improvements in the technique of making silage, and the application of artificial drying to grass and other fodder crops, have aroused much interest among farmers and research workers in fodder conservation, since they have resulted in widening the range of crops for preservation, and also in making it possible to preserve them at a younger stage; these developments have brought within reach of the farmer fodders of higher nutritive value, and with a greater proportion of proteins.

On the Continent of Europe, the new and improved methods of making silage have resulted in the preservation, for use in winter, of large areas of clover, or of grass and clover mixtures, while in Great Britain interest has been aroused in the conservation of young pasture grass by artificial drying, and by ensiling. Young grass contains up to 20 per cent, or more, of crude protein in the dry matter, and its conservation would dispense with the need for purchasing most of the concentrated foods now fed to cattle, sheep and horses.

It can be readily understood how important this possibility is in a country like Great Britain, which is so suited by climatic and other conditions for producing grass. Even in the United States, where there are such ample supplies of grain and of some oil-seed residues, much interest is shown in the possibility of reducing the requirements of concentrates by improvements in the quality of fodders.

Dr. S. J. Watson, in "The Science and Practice

of Conservation", has brought together, from all parts of the world, the results of research and practical experience in fodder conservation, and the two volumes present an excellent account of the state of knowledge on all aspects of the subject. The first volume deals with the various processes of conservation, natural drying, artificial drying, and ensilage; separate chapters are devoted to the losses of nutrients in each of these processes. The author directs attention to the heavy rate of losses in haymaking, pointing out that the losses are really heavier than are commonly supposed because of the failure to realize that the actual loss of feeding value exceeds that of the dry matter, since the material lost is the most digestible part.

Silage-making occupies a large share of the volume. Before discussing the old and the new methods, the author deals fully with the principles underlying the making of silage. Although the crops for ensiling and the climatic conditions vary from one country to another, the fundamental requirements of successful silage-making are the same, and this volume gives the research worker the type of information that will help him to solve the problems involved in directing the chemical and biological changes in the material in the desired direction.

The second volume deals with the nutritive values of the various conservation products, and contains accounts of the numerous feeding trials reported in the literature. One chapter is devoted to the effects of conservation products on dairy produce, a subject of great importance in peace time in those countries exporting cheese and butter. The last chapter is devoted to the place of conservation in agricultural practice at home and abroad, and deals also with its effect in cheapening the costs of foods for human consumption, and in improving their quality with regard to the health of the nation.

Dr. Watson, by reason of the large amount of research that he has carried out on this subject at Jealotts' Hill, and of his contacts with the practical aspects of the problems, is well qualified to undertake the writing of such a work. Both volumes are of great value to all those interested in fodder conservation, and can be particularly recommended to those engaged in research investigations touching any aspects of this subject.

E. J. ROBERTS.

THE BRITISH EMPIRE CANCER CAMPAIGN

BY DR. E. BOYLAND,
THE ROYAL CANCER HOSPITAL, LONDON

THE publication of the sixteenth annual report of the British Empire Cancer Campaign was very little delayed by the outbreak of hostilities, and the report has appeared in its usual form and is actually larger than it has ever been before. During the War as much cancer research as possible will continue, so long as the scientific workers concerned are not all required for emergency work. There is no doubt that the greatest progress in cancer research has been made in Great Britain and in the United States. Government support and large endowments in the United States are likely to increase American cancer research in the future, and it is to be hoped that the British effort will not fall off.

Among the clinical accounts in this report is a description by Mr. J. P. Lockhart-Mummery and Dr. C. E. Dukes of the familial adenomatosis of the colon and rectum and its relationship to cancer. Adenomatosis is an inherited disease, which is not generally manifested until childhood or puberty. The malignant disease which frequently develops from this adenomatosis occurs at a relatively early age and often has multiple foci of carcinoma. The adenomatosis appears to be transmitted by both sexes, probably as a Mendelian character.

Much of the clinical work describes the results of radiological treatment. Such material is given in the reports of the Westminster Hospital, St. Bartholomew's Hospital, the Marie Curie Hospital and the Mount Vernon Hospital. One interesting development of research on radiations is the discovery of the rhythmic or periodic variation in their action on colloids. If colloidal solutions of carbon, graphite, quartz, gold or albumin are irradiated with a certain dose of neutrons, X-rays, γ -rays or by ultra-violet light, they are coagulated, but if the dose is increased by a certain amount no coagulation occurs. With increasing amounts of radiation, the effect on coagulation alternately increases to a maximum and then falls to zero. This appears to be a periodic phenomenon analogous to the formation of Liesegang rings, and it would be extremely interesting to know if the same periodic variation occurs in the irradiation of living tissues.

At the recently formed Cancer Research Centre of the University of Oxford, Dr. I. Berenblum, Dr. E. Chain and Dr. N. G. Heatley have investigated the metabolic activities of very small amounts of surviving skin epithelium in a micro-respiro-

meter. This tissue shows aerobic glycolysis and has a respiratory quotient of 0.7, properties which at one time were considered to be peculiar to tumour tissues. In fact, the current report from the Royal Victoria Infirmary, Newcastle-on-Tyne, contains the following rather misleading statement. "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. First the ability of cancer cells to form lactic acid persists even when the tissue is respiring, secondly cancer tissue has a respiratory quotient indicating that the oxidation of carbohydrate is abnormal." Since Warburg discovered that slices of malignant tissues produced lactic acid from glucose in the presence of oxygen, retina, smooth muscle, striped muscle, liver, cartilage, bone marrow, lymph glands, kidney medulla and skin have also been shown to glycolyse aerobically. It is therefore impossible to consider this characteristic to be peculiar to tumours. Neither is the lowered respiratory quotient specifically characteristic of malignant tissues.

It was known that the magnitude of respiration and glycolysis did not vary greatly in tumours of different rates of growth, and now Dr. E. Boyland and Mrs. M. E. Boyland have shown that this holds even with enormous variations in growth-rate and that it is possible to inhibit the growth of sarcomata in mice without significantly reducing the respiration and glycolysis as measured *in vitro*. Thus the largest metabolic processes do not vary with rate of growth; this suggests that some tumours must be extremely inefficient in obtaining energy for growth from carbohydrate.

Experiments on carcinogenesis are described in several of the reports. At St. Bartholomew's Hospital, 1:2:5:6-dibenzanthracene in olive oil was introduced into the stomachs of mice in an attempt to produce cancer of the alimentary tract. No alimentary tumours were produced but 95 per cent of those mice which survived the period of injection died with pulmonary tumours. Only minute amounts of the carcinogenic compound could have reached the lungs, and the experiment indicates that the lungs are very sensitive to the tumour-inducing action of dibenzanthracene and that the tissues of the alimentary canal are very resistant.

Other experiments showing the amounts of carcinogenic agent necessary for tumour production were carried out by Dr. P. M. H. Browning at

Glasgow. In these the injection of 0.0025 gm. of 2(*p*-amino-styryl) 6(*p*-acetylamino benzoylamino) quinoline methoacetate ('Styryl 430') into mice was necessary to produce sarcomata, while even with 0.0005 gm. a small coloured depot may be found more than a year after injection. Many other trypanocidal compounds related to Styryl 430 have been tested, but as yet this is the only known compound of its type with carcinogenic activity.

Mr. J. C. Mottram, at the Mount Vernon Hospital, has used the sensitivity of Infusoria to demonstrate the photo-oxidation of carcinogenic compounds. On the whole, the carcinogenic compounds are easily oxidized in ultra-violet light to water-soluble toxic products, and there is rough but not exact parallelism between this action and carcinogenic power. Similar results were obtained some years ago by Dr. E. Boyland, who examined the effect of photo-oxidation products on the enzyme lactic dehydrogenase. The chemical changes which carcinogens undergo in ultra-violet light in the presence of oxygen are still obscure, but Prof. J. W. Cook and Mr. R. Martin of the Royal Cancer Hospital have isolated the photo-oxide of 9:10-dimethyl-1:2-benzanthracene. The parent hydrocarbon, 9:10-dimethyl-1:2-benzanthracene, has very high carcinogenic activity, producing epithelial tumours in mice in thirty-five days; 5:9:10-trimethyl-1:2-benzanthracene, however, is now the most active compound and has given skin tumours in thirty-one days in tests carried out at the Royal Cancer Hospital. Derivatives of 1:2-benzanthracene with substituents in the 9 and 10 (meso) positions not only give more stable photo-oxides but also more stable maleic anhydride derivatives; thus Dr. L. D. Parsons and Mr. F. L. Warren find that the α - β -endo-succinate of 9:10-dimethyl-1:2-benzanthracene is very stable and is not carcinogenic, while the corresponding derivative of methylcholanthrene dissociates and is actively carcinogenic. These results indicate that the action of these water-soluble carcinogenic compounds is due to their ability to dissociate and liberate the parent hydrocarbon after injection rather than to the action of the water-soluble compound *per se*. These water-soluble carcinogenic compounds cause lysis of red blood cells *in vitro*, but this action is also shown by similar derivatives of some compounds which have no carcinogenic action.

Dr. P. A. Gorer at the Lister Institute has investigated immunity within pure lines of inbred mice. While it is relatively easy to produce immunity to a tumour in mixed stock animals it is extremely difficult to demonstrate immunity within a pure line. With two types of leukaemia which have been maintained in the pure lines in

which they arose, it has not been possible to produce immunity within the homologous pure strain. The response of grafted embryonic tissue is similar to that of neoplastic tissues and different from that of placental tissue, which will not grow even in mice of the homologous pure line; but in general the defence reactions to implanted tissue are governed by genetically determined antigenic differences between the implanted tissue and the host. Experiments on resistance to the Jensen rat sarcoma carried out at the Middlesex Hospital by Prof. S. Russ and Dr. G. M. Scott have shown that the immunity induced by treatment of tumour-bearing rats with X-rays is inherited by the offspring. This appears to be an example of inheritance of an induced or acquired character.

By far the largest individual account in this year's report is that from Dr. P. Stocks, of the General Register Office, Somerset House, on the distribution of cancer of various organs in England and Wales. This account, which is the third and concluding instalment, deals with the cancer mortality of the female population and is more of the nature of a scientific paper than an interim report of work in progress. The standardized mortality ratios for separate towns and counties have now been computed and the results are given in a series of tables and maps. As would be expected from analogous investigations, the mortality from cancer of all sites varies much less than the mortality due to cancer of particular sites. Thus the cancer mortality of part of Wales (Anglesey, Carnarvon, Denbigh, Flint and Merioneth) and of Lincolnshire is higher than that of the rest of the country; but the excess mortality is only of the order of 15 per cent. The high cancer mortality of North Wales is entirely accounted for by an excess of stomach cancer, affecting both sexes. Dr. Stocks suggests that this excess, which is about one and a half times the expected mortality, is due to dietary factors. It is hinted that the bulk of the North Wales population does not consume sufficient vegetables and fruit, and uses the frying-pan too frequently. If this mortality from gastric cancer could be reduced, people escaping might contract cancer at some other site, which might be more amenable to treatment, and some of them would probably avoid cancer altogether.

In the results are several examples of low mortality from cancer of one particular site being compensated for by excessive incidence at some other site. Thus there is a high incidence of uterine cancer in the north-east of England, and in this area cancer of the breast is correspondingly low. Analogous differences are found in the social classes. The incidence of cancer of the uterus in married women decreases steadily with rise in

social class, while cancer of the breast is more frequent in the upper classes. This may be connected with birth-rate, as fertility varies inversely with income. Also it is known that countries with high birth-rates tend to have higher relative proportions of uterine and lower proportions of breast cancer; cancer of the mouth, pharynx, oesophagus, skin and vagina, like uterine cancer, are more common in the lower classes, while cancer of the ovary and thyroid, like breast cancer, are more common in the upper classes.

For almost all sites of cancer that are examined (except cancer of the ovaries) the urban incidence is higher than that in rural districts. The figures for cancer of the lung in different districts are difficult to explain; the incidence being very high in Manchester, Leeds, Sheffield and Birmingham,

but low in other towns in Lancashire, Durham and Stoke-on-Trent.

The results of Dr. Stocks's investigations have been dealt with at some length partly because it is conceivable that men of science who are not specially working at the cancer problem might see some explanation of the regional distribution of cancer mortality. Such explanations might give rise to fruitful research on the cause of the disease at a particular site.

Until the outbreak of war, British cancer research had been increasing in its extent and effectiveness, as is clearly shown by the annual reports of the British Empire Cancer Campaign. Let us hope that the work will continue and that the present position will be consolidated and extended in the immediate future.

MACROMOLECULES

SOME developments in the chemistry and physics of macromolecules were discussed at a recent meeting of the Plastics Group of the Society of Chemical Industry and the Faraday Society. Many fundamental problems were raised in the papers contributed by Dr. R. Bhattacharya, E. G. Couzens and H. W. Melville, and in the subsequent discussion; only a few can be referred to in the present article.

In the synthesis of macromolecules from vinyl derivatives of the general type $\text{CH}_2 = \text{CXY}$, much controversy has arisen about the nature of the active polymer molecules which react with the monomer. Two extreme types may be recognized. The monomer may be converted by absorption of energy to a diradical. To each end of this molecule monomeric molecules may add on, giving rise to a bigger diradical. This may be called the free radical mechanism. On the other hand, the monomer may merely be excited to an extent such that the addition of monomer is facilitated. In this mechanism there is always a terminal double bond in the macromolecule which is the centre of reactivity. It would now appear that it is possible to polymerize one and the same molecule by either mechanism, depending on conditions.

The difficulty really arises in discovering in any one instance which particular mechanism comes into operation. In gas phase polymerization it is often possible to settle the matter in the following way. Hydrogen atoms or methyl radicals add on readily to vinyl derivatives, such as vinyl acetate, producing a single free radical with which monomer easily reacts to form a linear polymer until two such radicals combine. By altering various

parameters, it is then easy to characterize this free radical growth and compare it with the polymerization under observation. If the kinetics are identical, it must be supposed that the latter reaction is of the free radical type. In the photo-polymerization of gaseous vinyl acetate, the kinetics are so different from those of the free radical reaction that it would seem the ordinary polymerization occurs by some double-bond mechanism. The difficulty yet to be solved is how the terminal double bond of the active molecule retains its activity. It is well known that a large number of these molecules, including vinyl acetate, also polymerize in the liquid phase, but so far no similar attempt has been made to discover by what mechanism the molecules grow, though it is of interest to mention that a free radical polymerization has been induced in styrene by the addition of tetraphenylsuccinodinitrile, which dissociates to free radicals in solution.

From the photochemical point of view, vinyl ketones are of especial interest. Both methyl vinyl ketone ($\text{CH}_2 = \text{CH} \cdot \text{CO} \cdot \text{CH}_3$) and methyl isopropenyl ketone ($\text{CH}_2 = \text{C}(\text{CH}_3) \cdot \text{CO} \cdot \text{CH}_3$) polymerize on illumination with light at 3000 Å., though the former molecule does so much more readily than the latter. Once more this is in accord with the general observation that α -methyl substituted vinyl derivatives are more difficult to polymerize than the parent molecule. Methyl vinyl ketone exhibits rather peculiar behaviour. Like most gaseous ketones, it is decomposed by light, and therefore in considering the mechanism of polymerization, it is not impossible that, besides the two mechanisms mentioned above, another must

be taken into account. The primary products of decomposition may well be free radicals, in which circumstance they may start off a free radical polymerization. Here a comparison of the kinetics of the methyl radical sensitized reaction with the direct reaction shows that the latter reaction does in fact take place by the free radical mechanism, initially started by the photo-decomposition of the methyl vinyl ketone molecule. The product of the reaction is, however, insoluble in all solvents, which points to the fact that the molecule is extensively cross-linked. This is reflected too in the abnormal kinetics of the reaction, in that at high enough pressures the order may be as much as five and the negative energy of activation is a function of temperature, whereas in any ordinary photo-reaction the order is rarely greater than two and the rate may only vary exponentially with temperature. Such kinetics can only be explained by postulating branching of the growing molecules—by what precise mechanism is not known. This is the first simple molecule to be studied in which so-called kinetic as well as structural branching have been observed simultaneously.

This introduces the problem of correlating the properties of macromolecular substances with their structure and mode of synthesis. Even correlation of structure and properties is difficult with natural and synthetic polymers. Probably the two most important groups of molecules to be considered in this respect are (a) cellulose and its derivatives, and (b) vinyl polymers. In neither case is it possible to account quantitatively for the relatively poor mechanical properties, such as tensile strength and modulus of elasticity, as compared with the values calculated theoretically on the assumption that these properties are wholly dependent on the nature of the primary valencies existing in those macromolecules. This is to be expected to some extent, because in any test it is impossible to determine the properties of an adlined bundle of molecules in view of the small size of even the largest of such linear molecules. The forces which determine these physical properties must therefore consist largely of an intermolecular variety the magnitude of which is exceedingly difficult to compute.

Matters are much more complicated when an attempt is made to define accurately terms such as toughness, and to correlate this with molecular architecture. Practical experience soon singles out those polymers which are generally recognized as tough, with the result that the consensus of opinion appears to be that toughness is a complicated function of impact resistance, tensile strength, extensibility, Young's modulus and bending strength. Some of these properties are in themselves difficult to determine by unequivocal

methods. None the less, it is practicable to gain a qualitative idea of the type of molecule most suitable for any given purpose. Such studies will no doubt eventually provide the material for putting the subject on a more scientific basis. But a useful working criterion appears to be given by the total area under the so-called Schopper curve. This is a curve obtained by plotting the load on a material as a function of the percentage elongation. With those plastics normally regarded as tough, for example, cellulose nitrate and acetate, ethyl cellulose suitably plasticized, the curve rises rapidly and then flattens out over a considerable elongation. The triacetate and nitrocellulose are particularly good in this respect. For the exhibition of high extensibility, however, all these molecules must be plasticized, but experiments with other cellulose have shown that a plasticizer is not really necessary if, say, ethyl groups replace the hydrogen atoms of the hydroxyl groups. Unfortunately, the tensile strength of ethyl cellulose is inferior to that of nitrocellulose. Vinyl compounds, on the other hand, do not show this high extensibility, although vinyl chloride is regarded as being very tough. The great extensibility of the cellulose derivatives can be simulated if appropriate side chains are added to the molecule as in polyvinyl butal, but at the expense of a decrease in tensile strength. The addition of plasticizers does not improve matters, as with cellulose, for then the material loses its resistance to deformation and becomes rubber-like in character.

Progress in this field is greatly hampered by the fact that the molecular weights and molecular size distribution are not known for the majority of these polymers. The viscosity method of Staudinger is the only one which is used extensively for large linear molecules, but the discrepancies brought to light when the results obtained with this method are compared with those from end-group determination and by osmotic methods show that all is not well. In view of these difficulties, attempts have been made to modify the simple Staudinger relationship that the specific viscosity of the solution is proportional to the molecular weight of the dispersed phase, but with only limited success. A striking example of the enormous influence of the solvent is shown by the fact that a twenty per cent solution of cellulose in acetone is easily pourable, whereas a similar solution in dimethyl phthalate forms a stiff gel. Part of the trouble would seem to lie in the sensitiveness of specific viscosity to the distribution of molecular sizes in the polymer. Moreover, it is just this factor which is so important in influencing the physical properties mentioned above. It seems to be a general rule, however, that properties such as tensile strength and Young's modulus increase

to a rough maximum with increase in molecular weight. The absolute value of these quantities depends on the nature of the side groups. Those groups exhibiting relatively small interactions, such as phenyl, lead to weakness, while hydroxyl, formal, acetal groups and chlorine atoms yield stronger polymers even although the length of the carbon chain is identical in both cases.

All this work has had its effect on improving natural resins by systematic methods. Shellac may be cited as a typical example. It consists of a saturated pentahydroxy monobasic acid of partially known constitution and molecular weight of about 1,000. As such the substance is of no use as a plastic, but it may be modified to give a great variety of useful products. On heating, it may be polymerized to linear molecules of much higher molecular weight. That this is due to interaction between hydroxyl groups and carboxyl groups of different molecules is shown by the fact that, if

either of these groups is chemically bound to other small molecules, such as by the formation of ethers or esters, this polymerization will not take place. By further heat treatment the shellac may be made insoluble, owing presumably to the cross linking which can occur by means of the multiplicity of hydroxyl groups in the 'monomer'. If, however, these hydroxyl groups are modified by reaction with ethylene glycol, this reactivity is cut down to such a point that cross linking is impeded. The result is that much longer linear molecules may be formed with molecular weights up to 25,000. The polymerized lac is then a tough flexible rubber-like substance. Interpolymerization of shellac with naturally occurring unsaturated resins gives rise to a product similar to drying oils used in paints. Further, such composite molecules may be induced to react with formaldehyde to give complex cross-linked molecules of desirable film-forming properties.

CARBON DIOXIDE IN ARCTIC AND ANTARCTIC SEAS

BY DR. G. E. R. DEACON,
"DISCOVERY" INVESTIGATIONS

FOR many years past, Prof. K. Buch of the Åbo Akademi, Finland, has been leading the research on the distribution of carbon dioxide in the sea and its interchange between sea and atmosphere, and lately by a survey of the surface waters of the North Atlantic Ocean¹ he gives a very clear demonstration of the value of his methods.

Less than one per cent of the carbon dioxide in the sea is in ordinary physical solution, the greater part being there as carbonate and bicarbonate ions. First there is an equilibrium between dissolved gas and H^+ and HCO_3^- ions, and then between HCO_3^- , H^+ and $CO_3^{=}$ ions, both reactions being influenced by temperature and pressure, and by the concentration of the other ions present, particularly Ca^{++} , Na^+ , Mg^{++} and $SO_4^{=}$. The behaviour of sea water towards carbon dioxide is therefore very different from that of fresh water: it acts as a buffer solution, and a comparatively large volume of carbon dioxide can be absorbed or given up at the surface without much change in the concentration or partial pressure of the part of the gas that is in physical solution.

Buch and his collaborators had already reached the important conclusion that the equilibrium between dissolved and combined carbon dioxide is fully determined by hydrogen ion concentration, temperature, pressure and alkalinity (as measured

by titration)²: if these are known, the partial pressure of dissolved carbon dioxide and the concentrations of HCO_3^- and $CO_3^{=}$ ions can be calculated; and since Wattenberg has shown that alkalinity is in general proportional to chlorine content³, it is sufficient to know temperature, pressure, hydrogen ion concentration and chlorine content.

Buch's recent observations cover practically the whole of the North Atlantic, from Denmark and New York as far as the Arctic pack-ice; but they were all made during the summer months. His calculations based on *pH* measurements, amply confirmed by direct analyses, revealed the remarkable fact that the carbon dioxide content of the surface water (free plus combined carbon dioxide), in any part of the extensive region examined, bore a constant relation to alkalinity, and therefore to chlorine content and salinity: expressing the total carbon dioxide of any sample in millimols per litre, he found the expression $\Sigma CO_2 = 0.108 Cl^{\circ}/_{\infty} \pm 1.5\%$.

This means that the total concentration of carbon dioxide in the surface water was controlled within very narrow limits until it had a certain relation to the power of the water for combining chemically with carbon dioxide.

Biological activity and vertical mixing with the deeper water will have an effect on this relation:

a diatom outburst will lower the carbon dioxide content, while the upwelling of deeper water or a rich zooplankton will cause an increase. The fact that Prof. Buch's observations were all made during the summer months must therefore be emphasized; and attention given to his reasoning that in winter, when the phytoplankton activity is very small and vertical mixing greatly increased, the carbon dioxide may bear a higher ratio to chlorine.

ratio $\Sigma\text{CO}_2 = 0.108\text{Cl}/100$ demands) partial pressures of carbon dioxide in the surface water as low as 1.6×10^{-4} atmosphere—about half the pressure which is needed to satisfy the same relation for total carbon dioxide in the warmer and more saline waters of the temperate region. The partial pressure of carbon dioxide in the air above the ice-edge was 3×10^{-4} atmosphere; but the wind was blowing southwards off the ice and had not

Type of Surface Water	SUMMER Nov. 23–March 18, 1938–39					WINTER July 2–Sept. 26, 1938				
	Number of observations	ΣCO_2 m.mol/l.	ΣCO_2 Cl‰	$p\text{CO}_2$ 10^{-4}atm.	O_2 % sat'n.	Number of observations	ΣCO_2 m.mol/l.	ΣCO_2 Cl‰	$p\text{CO}_2$ 10^{-4}atm.	O_2 % sat'n.
Subtropical (south of 35° S.)	13 11.8° C. to 21.5° C.	2.04 1.99–2.09	0.104 ±3%	2.8 2.4–3.8	96 93–100	11 11.4° C. to 18.6° C.	2.08 2.05–2.11	0.107 ±2%	3.2 3.1–3.5	92 89–95
Sub-Antarctic	22 3.7° C. to 17.6° C.	2.06 2.02–2.09	0.108 ±3%	3.0 2.6–3.5	98 94–99	17 3.9° C. to 12.4° C.	2.09 2.07–2.12	0.110 ±2%	3.3 2.9–3.5	94 92–95
Antarctic (north of 57° S.)	17 –1.8° C. to 2.9° C.	2.10 2.08–2.13	0.112 ±1%	2.9 2.3–3.6	95 90–99	18 –1.8° C. to 2.0° C.	2.14 2.11–2.17	0.114 ±1%	3.3 3.1–3.6	91 85–94
Antarctic (south of 57° S.)	23 –1.4° C. to 1.3° C.	2.10 2.06–2.13	0.112 ±1%	2.6 2.3–3.6	95 90–102					

This is proved in the Southern Ocean by repeated observations made by the R.R.S. *Discovery II* in the sector between 0° and 20° E., summarized in the accompanying table. In some contrast to the conditions in the North Atlantic, it was found that the $\Sigma\text{CO}_2/\text{Cl}$ ratio increased from low to high latitudes, and subtropical, sub-antarctic and antarctic waters were found to have their own typical ratios. Extreme values in each zone were found to overlap with those of the next; but there was sufficient grouping about the mean values to give them significance, and the existence of such typical values for each zone is not unlikely because biological activity and vertical mixing depend on sunshine, concentration of nutrient salts, stability of the upper part of the water column, and strength and variability of wind, all of which are to some extent determined by latitude and by the hydrographical conditions typical of the zones. In the part of the subtropical zone that was examined, and in the sub-antarctic zone, the variations of the extreme values about the means were greater than Buch's figure of 1.5 per cent for the North Atlantic, but the upper part of the water column is less stable.

Prof. Buch's papers contain much more information. Although the salinity of the water in a particular region will fix the total carbon dioxide content, the proportion of dissolved to total carbon dioxide will vary with temperature, and the partial pressure of the dissolved gas (the pressure of carbon dioxide in an atmosphere in equilibrium with the water) must show a still greater variation because it depends on the solvent power of the water, which is greater at low temperatures.

Near the Arctic pack-ice Buch found (as the

reached an equilibrium with the water; by the time it had passed over some 100–200 miles of the open sea, its partial pressure of carbon dioxide was reduced to 1.6×10^{-4} atm.—as low as that of the water. The air in the polar region—derived from upper-air currents which have their origin in temperate regions—has apparently a normal carbon dioxide content, but in summer at least it is greatly modified during its passage across the fertile Arctic fringe, and even as far south as Iceland and Petsamo, 'Arctic air' can be distinguished from winds of temperate and continental origin by its low carbon dioxide content.

In the Antarctic sector between 0° and 20° E. the partial pressure of carbon dioxide was not found to fall as low as Buch's Arctic values; but although the figures in the accompanying table appear to be typical of the greater part of the Antarctic Ocean, the conditions in the more sheltered localities are very like those of the Arctic. In such places the $\Sigma\text{CO}_2/\text{Cl}$ ratio becomes reduced below any value shown in the table, and, for example, in the Bay of Whales in the Ross Barrier, off the west coast of Graham Land, at the edge of the pack-ice after exceptionally long spells of fine weather, and near South Georgia at a time of exceptional phytoplankton activity, the partial pressure of carbon dioxide in the surface water has been found to be as low as 1.6×10^{-4} atm.—the same as at the Arctic pack-ice.

The only determinations of atmospheric carbon dioxide in the Antarctic appear to be those quoted by Buch⁵, from the results of one of Charcot's expeditions to the west coast of Graham Land: ten samples ranged from 1.45×10^{-4} atm. to 2.55×10^{-4} atm., with an average of 2.26×10^{-4} atm.

The *Discovery II* observations show that the low carbon dioxide pressures are likely to be found only in the summer months: in winter the $\Sigma\text{CO}_2/\text{Cl}$ ratios were so high that even the freezing water had carbon dioxide partial pressures of at least 3.1×10^{-4} atm.

It has not been possible in this short article to do justice to the earlier workers on the carbon dioxide problem, notably Prof. A. Krogh and J. F. McClelland, or to describe recent work in the Barents Sea and the Baltic, and more particularly Prof. Wattenberg's treatment of the *Meteor* observations, but enough has been said to show what great opportunities the accurate measurement of hydrogen ion concentration in the sea offers.

It may, for example, be worth while to review what has been done on the relations between animal behaviour and alkalinity in the sea, because carbon dioxide concentration may be as effective in governing shoaling and distribution as hydrogen ion concentration; there are also many outstanding problems relating to the decomposition of plankton that can be re-examined by calculating carbon dioxide concentration from hydrogen ion concentration measurements; the *Discovery* Committee's data will help to solve some of them.

Carbon dioxide determinations have also geographical and climatological interest. Since the

ocean has such a tremendous capacity for carbon dioxide, it must, practically speaking, control the carbon dioxide content of the atmosphere, and where equilibrium with the surface water is established the atmospheric carbon dioxide pressure will depend to some extent on biological activity and distribution of nutrient salts; the low carbon dioxide pressures around the polar fringes in summer give these regions an added attraction. Continental air has generally a high carbon dioxide content; but Prof. Buch shows that modern development can have very little influence on the total carbon dioxide content of the atmosphere, and his figures are refreshing, as his papers are.

¹ Buch, K., "Beobachtungen über chemische Faktoren in der Nordsee, zwischen Nordsee und Island sowie auf dem Schelfgebiete nördlich von Island", Conseil perm. intern. pour l'exploration de la mer. *Rapp. et proc. verbaux*, 89, III, 13-31 (1934); "Beobachtungen über das Kohlensäuregleichgewicht zwischen Atmosphäre und Meer im Nordatlantischen Ozean", *Acta Acad. Aboensis, Math. et Phys.*, 11, 9, Åbo, Finland (1939); "Kohlensäure in Atmosphäre und Meer an der Grenze zum Arktikum", *Acta Acad. Aboensis, Math. et Phys.*, 11, 12, Åbo, Finland (1939).

² Buch, K., Harvey, W. H., Wattenberg, H., and Gripenberg, S., "Über das Kohlensäuresystem im Meerwasser", Conseil perm. intern. pour l'exploration de la mer. *Rapp. et proc. verbaux*, 79 (1932); "On Boric Acid in the Sea and its Influence on the Carbonic Acid Equilibrium", Conseil perm., etc. *Rapp. et proc. verbaux*, 85 (1933).

³ Wattenberg, H., "Kalziumkarbonat und Kohlensäuregehalt des Meerwassers", *Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition, 1925-27*, 8 (1933).

⁴ NATURE, 143, 1033 (1939).

⁵ Buch gives the reference: Lundegårdh, Henrik, "Der Kreislauf der Kohlensäure in der Natur", Jena, pp. 37-38 (1924).

OBITUARIES

Sir Gilbert T. Morgan, O.B.E., F.R.S.

SIR GILBERT MORGAN died after a very short illness on February 2 in his seventieth year. For fifty years he had been engaged in chemical research and probably no other chemist had such wide knowledge of scientific and applied chemistry. A fitting mark of the Jubilee was the presentation to him in July last of the medal of the Society of Chemical Industry, its highest honour; on this occasion he gave an account of his career and an outline of his researches.

A professor to-day has the advantages of laboratories and equipment such as were never dreamed of by his forebears; he is more dependent than they were on his research students and collaborators. Morgan was happy in this respect; he gave full credit, developed the personal side and received the most loyal support. This in part accounts for the great volume of work accomplished.

Handsome, with alert and friendly eye, yet quiet in manner, Morgan had an amiable personality. He was wedded to chemistry, and when not at the laboratory bench or directing research he was to be found working for one or other of the chemical societies. In their more sociable gatherings he had the gracious assistance of Lady Morgan, *née* Kathleen Desborough.

Morgan was a student of Meldola at Finsbury and came under the practical teaching of Streatfield, who has influenced so many chemists. Meldola was then working on dye stuffs and consulting for Read Holliday at Huddersfield, who found a post for Morgan at the end of his college career.

Here a wide field was open for research, and among other tasks, Morgan prepared the ten dihydroxynaphthalenes, which took him four years. He relates that he condensed formaldehyde with phenol to a product which solidified to a clear amber resin. As the material had no value for making colours it was set aside. This was in 1893, and it was not until 1906 that Bakeland patented the process as a synthetic resin and made a large fortune out of it.

In 1894 Morgan became restless in industry and went back to college, graduating at the Royal College of Science under Sir William Tilden and being appointed to the staff there. In 1904 he began the fruitful co-operation with Miss Micklethwait leading to work on organic derivatives of phosphorus, arsenic and antimony.

Morgan passed on to the Royal College of Science, Dublin, where he was at the outbreak of the War of 1914-18. In 1915 he went back to his old firm, now British Dyes, for a short period to help reconstruct

the industry. But in 1916 he returned to academic life and to Finsbury to succeed Meldola, transferring to Birmingham as Mason professor in 1919. In 1925 came what he described as "a State experiment in Chemical Research", namely the decision to form a Government Research Laboratory at Teddington under the Department of Scientific and Industrial Research, with Morgan as its first director.

It was generally felt that no one was better fitted for the task, but opinions were sharply divided as to the nature of the work which could best be carried out there. It is widely accepted now that Morgan made a success of the task, and that when he retired after thirteen years he left the Chemical Research Laboratory as an asset of real value to the nation. The work done by the Laboratory during the first few months of the War has fully justified all the hopes which Morgan had for its future, and it was a keen pleasure to him to hand over the directorship to one of his students, Dr. G. S. Whitby.

Morgan organized a variety of work at Teddington, including an installation for high-pressure reactions, a branch of chemistry then in its infancy. His interest in chemical engineering had always been strong, and he did much to develop the autoclave.

Morgan's scientific researches cover so wide a field that any reference to them in detail here is impossible for lack of space. Their very diversity prevented perhaps the highest achievement in any one field, though all were fruitful to a greater or less extent. Morgan's claim to fame rests on broader foundations. He did as much as anyone to place the science of chemistry on a sure basis in Britain. By teaching and research, by co-operation with industry, he inspired men to succeed in solving chemical problems and advanced the national status and prestige in chemistry, pure and applied.

At a moment when most men would have sought ease, he was ready to start again in a new branch of his subject as chairman of the Research Fund Committee, Institute of Brewing. He received numerous honours, a knighthood in 1936, honorary degrees at Dublin, Birmingham, St. Andrews, the fellowship of the City and Guilds Institute, to mention only a few. He was formerly president of the Chemical Society and of the Society of Chemical Industry, and an indefatigable worker on committees.

We have lost his kindly presence and the help of his clear incisive mind all too soon. A life crowded with change and incident may have caused him to live faster than some of us; we could have wished for his ripe counsel in old age.

E. F. ARMSTRONG.

Mr. E. S. Harkness

MR. EDWARD STEPHEN HARKNESS, the American philanthropist, who died on January 30 just a week after his sixty-sixth birthday, devoted his last score of years to administering and sustaining the benefactions instituted by his mother, who founded the Commonwealth Fund in America in 1918. The Harkness fortune was made in Standard oil. It dates

from about seventy years ago, at which time Stephen V. Harkness, the father, who was in a small way of business in Cleveland, Ohio, is said to have lent the daring young Rockefeller £1,200. In the present century the example set by Rockefeller in efficient philanthropy inspired the Harkness family. After the death of the father, mother and son made philanthropy their first interest. The elder Mrs. Harkness died in 1926, leaving for the Fund an endowment of about £7,500,000, which sum Edward Harkness later increased to more than £10,000,000. But he also bestowed large personal gifts.

Efforts of the Commonwealth Fund have taken chiefly the lines of education and of public health. In England the first major gift was the fellowships for post-graduate Britons in American universities, the counterpart to the Rhodes scholarships, except that Commonwealth fellows may proceed to any of about twelve universities in America, either between the Atlantic coast and the Mississippi, or on the Pacific coast. The stipend is £600 a year for two or three years; to date appropriations for these fellowships have reached a total of £650,000. Most of the holders have studied science in America—physics, chemistry, biology, engineering. In 1930 Harkness gave to England the Pilgrim Trust, £2,000,000, the first grant from which was given to the building fund of the Royal Institution. The five original trustees of the Pilgrim Trust still serve. A third Harkness philanthropy in Great Britain was the Child Guidance Council, a centre of information upon 'mental health' for children. Recently in Woburn House, the Council is now evacuated to Bath, and is itself at present engaged in an inquiry into "emotional and behaviour problems" of evacuees.

Grants from the Commonwealth Fund in America have taken a general medical turn, following in that subject the pattern of the Rockefeller Foundation, and contributing in the past twenty years about £4,000,000. Part of this sum has subsidized research in trachoma, leukæmia, functions of the kidneys, and bodily resistance to disease. An annual grant has been given to Dr. May Wilson's clinic in New York for rheumatic fever. Large sums have gone on one hand to the advance of medical teaching, and on the other to fellowships for young post-graduates in medicine. Harkness built ten hospitals. In these, mostly in the rural south, as in Virginia and Tennessee, he took a steady personal interest. In one area, Rutherford County, Tennessee, the Fund has for fifteen years served the cause of public health, and has strikingly reduced the death-rate there from typhoid fever, diarrhoea, tuberculosis and puerperal fever together with infant mortality. Only a fortnight before Harkness died he announced the enlargement of two of his hospitals in this region. But apart from this medical philanthropy, Harkness will be chiefly remembered in America for his great gifts to Harvard and Yale Universities—about £6,000,000 altogether—for a scheme under which those unwieldy institutions were enabled to build separate colleges—seven at Harvard and nine at Yale—after the plan of Oxford and Cambridge, and at last give staff and students an opportunity to become individuals.

A reticent and diffident man, Harkness used to say he devoted almost as much time to shunning publicity as to studying philanthropy. A widow survives him, but no children. WILLARD CONNELLY.

[It has been announced that Mr. Harkness has left the bulk of his estate, which is believed to exceed 100,000,000 dollars, in trust to his wife. After her death it is to be divided among twelve institutions including: the Commonwealth Fund, the College of Physicians and Surgeons of Columbia University, Harvard University, Yale University, and Atlanta University.]

WE regret to announce the following deaths:

Prof. Alexandre Desgrez, a member of the Section of Free Academicians of the Paris Academy of Sciences, and professor of medical physics in the Faculty of Medicine, University of Paris, on January 20.

Prof. S. J. Hickson, F.R.S., emeritus professor of zoology in the University of Manchester, on February 6, aged eighty years.

Mr. H. I. Smith, formerly chief Dominion archaeologist and assistant director of the Canadian National Museum, aged sixty-seven years.

NEWS AND VIEWS

Horace Bénédict de Saussure (1740-1799)

ON February 17 occurs the bicentenary of the birth of the celebrated Swiss naturalist and geologist Horace Bénédict de Saussure. He was born at Conches, near Geneva, in which city he passed most of his life and in which he died on January 22, 1799. As a boy he was a diligent collector of plants and minerals, being stimulated in his studies by his uncle, the naturalist Charles Bonnet (1720-93). At the age of twenty he made his first tour to the glacier of Chamonix, an excursion regarded generally as dangerous. This was the beginning of his many journeys in the Western Alps and his travels in England, Germany, Sicily and Italy. At the age of twenty-two he was given the chair of physics and philosophy at the Academy of Geneva, and this post he held until 1786 when he resigned and was succeeded by his pupil Marc-Auguste Pictet (1752-1825). Among his earliest writings was a volume on electricity published in 1766. Year by year he extended his knowledge of the Alps, and in 1787 on August 2 with Michel Cachet he ascended Mont Blanc. The first Englishman to make the ascent, Mark Beaufoy (1764-1827), reached the summit a week later. In 1788 Saussure spent about a fortnight on Col du Géant and between 1789 and 1792 climbed Monte Rosa, the Breithorn, and other mountains. The upheaval in Switzerland due to the revolutionary movement in France drew him for a time into political life, but in 1794 most of his activities were brought to an end by a stroke of paralysis. From this he never really recovered.

Saussure's great work "Travels in the Alps 1779-1786" was described by von Zittel as a model of clear language, exact observation and cautious reasoning. His "glowing descriptions of the Alpine world removed the prejudice against the 'Montagnes Maudits', and awakened a feeling of enthusiasm for the infinite wonderland of beauty and delight in the higher altitudes of the Alps. Apart from his achievements in science de Saussure may be regarded as the pioneer of a practically new cult in human enjoyment, the love of mountain climbing". As a geologist de Saussure's aim was to observe, and to observe accurately. He

examined the mineral composition of the rocks and studied their topographical, meteorological and physical relations on the mountains. He improved the hygrometer and the anemometer and devised a cyanometer and a diaphanometer for comparing the degrees of transparency of the atmosphere at different altitudes. Half a century after de Saussure's stay on the Col du Géant, J. D. Forbes visited the same spot and in 1843 he wrote in his "Travels through the Alps of Savoy" that "No system of connected physical observations at a great height in the atmosphere has ever been undertaken which can compare with that of de Saussure. At any time such self-denial and perseverance would be admirable; but if we look to the small acquaintance which philosophers of sixty years ago had with the dangers of the higher Alps, and the consequently exaggerated colouring which was given to them, it must be pronounced heroic".

A biography of de Saussure was published by Dr. Douglas Freshfield in 1920 and was reviewed by Prof. T. G. Bonney in NATURE of February 10, 1921.

Evacuation and the Schools

LORD DE LA WARR'S recent speech as President of the Board of Education in the House of Lords in reply to a motion by the Archbishop of Canterbury has been sent out as an announcement of the Board. It is a timely recognition that educational affairs in Great Britain are not as they should be, and that improvements are needed at once. Granting that the wholesale evacuation of children was a necessary and difficult process, more pains should have been taken to cope with the problems to be faced, one of which, now urgent, is an increase of illness at this time of the year. Every schoolmaster knows the dangers of the Easter term. Things have been done in a hurry and in alarm which should certainly be undone. An important school in a non-danger area was closed until further notice and reopened when better sense prevailed; much of the commandeering or use of school buildings for Government officials or civil defence was unwarranted, and its extent has been reduced.

The Faraday Society

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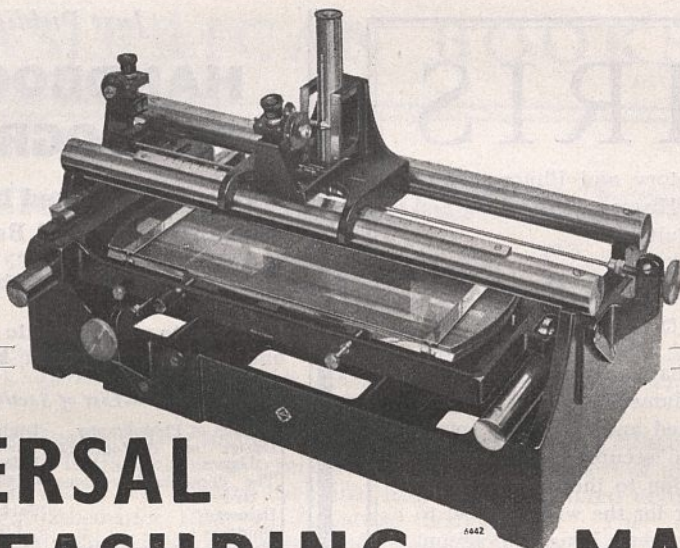
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The President of the Board says nothing of buildings long condemned as unsatisfactory and remaining unrepaired. Children lounging about the streets are a nuisance to themselves and everybody else, and rapidly deteriorate. This misguided leisure is being rectified by the allocating of camps and hiring of extra halls. Authorities have been told that children may be admitted to school before protection is completed. The 400,000 at present "receiving no schooling or care at all" present an urgent problem. In some cases "provision has been made and the children are not attending", and it is stated there are those who "bolster up evacuation by keeping schools closed". The announcement of compulsory school attendance for older children is a step in the right direction. Examinations should go on and full-time schooling be made compulsory as soon as possible. Lord De La Warr realizes that "education is not less important in wartime but more so". At a national conference of secretaries of the National Union of Teachers, a resolution was passed warmly welcoming "the decision of His Majesty's Government to enforce compulsory school attendance in evacuable areas no less than in neutral and reception areas".

Evacuation and Science Work in Schools

THE transference of schools from 'vulnerable' to 'safe' areas in Britain, where they now work in conjunction with other schools of the same type, was a necessary part of the scheme adopted at the outset of the War to minimize loss of life in the event of air attacks upon the civil population. Since last September, normal educational work has therefore not been possible for a very large number of secondary school pupils, and whatever gain there may have been for those from towns coming into closer contact with Nature, it is perhaps offset by reduced teaching and laboratory facilities. Even the better equipped of secondary schools cannot be expected to accommodate double the usual number of science classes, and though in many instances the amount of time devoted to science subjects has not been seriously curtailed, the work is often done in unfavourable circumstances, especially as regards the senior work. It is difficult to accommodate all the senior students in the small advanced laboratories found in most secondary schools even when a system of 'double shifts' is arranged, so that practical work has suffered more than theoretical teaching. The standard of proficiency of pupils who will leave school this year to continue at the universities will be examined with much interest. That the experiment of evacuating schools was a wise one, despite the dislocation involved, there can be no doubt, and the authorities are doubtless watching its consequences so far as secondary and higher education is concerned.

Health of the School Child

SIR ARTHUR MACNALT'S report for 1938 on "The Health of the School Child" has been issued by the Board of Education (H.M. Stationery Office. 1s. 3d.). The introduction considers the circumstances rendering necessary the evacuation of school children from

large urban centres of population and its effect upon the school medical service. During the year the nutrition of 1,674,023 children was assessed at routine medical inspections, and 14.5 per cent were found to be excellent, 74.2 per cent normal, 10.8 per cent sub-normal and 0.5 per cent bad. During twenty years, improvement in the nutrition of the school child is striking. Thus in Sheffield, compared with 1920, five-year-old boys average nearly 2 inches taller and 3 lb. heavier, and five-year-old girls 1.4 inches taller and 1 lb. heavier; twelve-year-old boys are more than 2 inches taller and 9½ lb. heavier, and twelve-year-old girls 3 inches taller and no less than 12.4 lb. heavier. The numbers of children in receipt of free meals or milk continue to increase—from 535,300 in 1936-37 to 687,855 now—and the milk-in-schools scheme is in operation in 87 per cent of public elementary schools. Much information is given respecting medical inspection and treatment, hearing of children, the school dental service, and the care of the young child.

Rhodes-Livingstone Institute, Northern Rhodesia

A BRIEF note on the work of the Rhodes-Livingstone Institute since its inception in 1937 prefaces a contribution on "Anthropology as a Public Service" by Mr. Godfrey Wilson in the current issue of *Africa* (13, 1; January 1940). This Institute, it may be remembered, was founded largely through the efforts and interest of Sir Hubert Young, then governor of Northern Rhodesia, and was the first institute for systematic sociological research to be established in colonial Africa. In the words of the founders, it was intended "as a contribution to the scientific efforts now being made in various quarters to examine the effect upon native African society of the impact of European civilization." In the first instance, funds were asked for three years only, with a view to a special appeal in 1940, a year specially linked with the two men whom the Institute commemorates. It is the centenary year of Livingstone's departure for Africa and the jubilee year of the foundation of the two Rhodesias by Cecil Rhodes.

The Institute is not a Government department but an independent body governed by trustees. Although for the moment the bulk of the income is derived from Northern Rhodesia, contributions are made by all the Governments from Southern Rhodesia to Uganda. Not only has the museum founded in memory of Livingstone in 1934 been incorporated in the Institute, its curator acting as the secretary, but also two research officers have been appointed, of whom Mr. Wilson is one, and the results of their investigations will be published in a series, the *Rhodes-Livingstone Papers*, to which non-members are also invited to contribute.

Pioneers in Amerindian Portraiture

THE February issue of *Man* is a Catlin centenary number, and Mr. L. J. P. Gaskin recalls that on February 1, 1840, George Catlin, artist, traveller and ethnographer, opened his North American Indian Museum and Gallery in the Egyptian Hall, Piccadilly,

London (see also NATURE, January 27, p. 158). Catlin was a self-taught artist and ethnographer. By contrast, Paul Kane (1810-71) was an artist by training and profession, and in his home in Toronto he had been familiar with the appearance and dress of Indians of various tribes who visited that seat of government. After travelling in the United States and studying in Europe, he set out on the first of his two expeditions among the Indians in 1845, when he spent five and a half months in recording portraits of "the principal chiefs, and their original costumes to illustrate their manners and customs, and to represent the scenery of an almost unknown country". In 1846 Kane started on his second and more important journey, which occupied two years and six months and extended across the continent to Fort Victoria. He did not keep a journal during his travels, and his book "Wanderings of an Artist among the Indians of North America" (1859) appears to have been written from memory.

Kane's sketches, exhibited on his return, attracted much interest, and a number of pictures were commissioned from him, some by the Government. Some of his pictures are now in the National Gallery, Ottawa, the House of Commons, Ottawa, and the Royal Ontario Museum of Archaeology, Toronto. Of his field sketches, some are likewise preserved in Toronto, while a number are in the possession of David I. Bushnell, jun. Reproductions of these have now been published with an account of the artist's life and work by the present owner (*Smithsonian Miscell. Collect.*, 99, 1; 1940). They show a number of variations, important in an ethnographical sense, from the studio portraits and studies painted later.

Tibetan Ceremonial and the Dalai Lama

SINCE the revelation of the reincarnation of the late Dalai Lama in the body of a small boy and his entry into Lhasa, further observances of the ritual ceremonial have affirmed the youthful succession in his position—in this instance all the more necessary in view of the slight discrepancy between his age and the period of time that has elapsed since the death of his predecessor. Among these is the assumption of the new name or names by which the Dalai Lama will be known officially in future. These are, it is stated (*The Times*, February 9), Jampel Ngawang Lobsang Yishey Tenzing Gyatso, of which the meaning is "Tender Glory, Mighty in Speech, Excellent Intellect, Absolute Wisdom, Holding to the Doctrines, and Ocean-Wide". These names derive from titles of former Dalai Lamas, including the first, which was bestowed by the Mongol prince Yushi Khan.

Large numbers of Buddhist priests and nuns are now present in Lhasa for the installation ceremonies, and have attended the ceremonial performances which have taken place in the courtyard of the Potala, the vast monastic establishment in which the Dalai Lama resides. The important part of the New Year observance, as with many primitive peoples, and also among the more primitive of the

European peasantry even to-day, is the ceremonial of driving out all the evil influences of the Old Year. In Tibet this is of especial significance in view of the element of 'devil-worship' which has been introduced into the practices of Tibetan Buddhism, and the ecstatic 'devil-dances' in which its followers indulge more especially in eastern Tibet.

On this occasion, it is reported in a dispatch from Lhasa (*The Times*, February 12), the dancers, wearing masks representing the heads of stags or bulls and grinning skulls with fangs, enacted the reception for the skeleton dance which was performed by four skeleton dancers, with two attendant death's heads, scattering ashes. A magician wearing an apron of bones and a tall black hat topped with a fan-shaped ornament conjured spells from a skull while spinning in a rhythmic dance, which was the preliminary to ceremonies performed over an artificial corpse, which no doubt represented the Old Year, although this is not stated. Fire, as always a purificatory agent, appeared in the ceremonial when pictures of Tibetan devils were burned.

Forgotten Methods of Painting

IN his discourse on "Forgotten Methods of Painting" at the Royal Institution on February 2, Mr. Hesketh Hubbard spoke of the almost forgotten *sfumato* and *botizar* systems of oil painting, and dealt with the method of dusting dry powdered pigment over a sticky mordant which was used by some of the sixteenth and seventeenth century painters for laying certain pigments—a method known as 'strowing'. He outlined the technique of the fourteenth century English painters who worked in water-colour on woven linen; the linen was first saturated with gum-water, and then stretched over coarse woollen and frieze cloths which absorbed most of the colour, leaving the linen transparent after painting. The method of elydoric painting, or painting miniatures in oil whilst the painting ground was submerged in water, and the techniques of encaustic painting were among the topics mentioned.

In his ceaseless search for new pigments, before the chemist rendered him much assistance, the painter had not despised even the food upon his table. The great Paul Sandby himself had converted into pigment burnt crusts and peas that had been cooked to a cinder. Mr. Hubbard said that there is no reason to suppose that the painter has discovered all the manifold uses of his materials; the more media he has at his disposal the less restricted will be the mental outlook of the painter. Every medium of painting shares a frontier with one or more other media. At one point tempera touches fresco; at another it borders on oil painting. Glass painting and enamelling share much in common. It is along these frontiers, in the region of mixed methods, that the painter, in these latter days of painting will, in Mr. Hubbard's opinion, find the most profitable fields for experiment and research. For the same reason, the painter and student might profitably turn their attention, at least in their leisure hours, to some of the forgotten methods of painting.

Lunar Tide in the Atmosphere

THE *Meteorological Magazine* of December 1939 contains a summary by Prof. S. Chapman of his presidential address to the Association for Meteorology at the Washington Assembly of the International Union for Geodesy and Geophysics last September, the subject being the lunar tide in the atmosphere. The author describes the difficulty that was met when the detection of this lunar tide, achieved first by Lefroy in 1842 for St. Helena, was attempted for higher latitudes, which resulted in a succession of failures that was not broken until his own determination in 1918 of the very small Greenwich air tide, from sixty-four years of hourly data. From that year, when the tide was known for three tropical stations and one non-tropical, progress was rapid, and the rate of determination by Prof. Chapman and his assistants was increased threefold in 1930 through a loan of Hollerith machines by the British Tabulating Machine Co. Now the tide has been determined for more than fifty places.

With this number of determinations available for study of the world distribution of phase and amplitude, several interesting peculiarities have come to light; for example, an early maximum is shown at Salt Lake City, San Diego and San Francisco, this being two hours before the upper and lower lunar transits at the last two places, but at the neighbouring high-level stations of Mount Wilson Observatory and Mount Hamilton (Lick) the tide, although similarly small for the latitude, has roughly the normal phase with high tide after the moon's transits, an effect doubtless due to the presence of the great mountain chain of North and South America. Similar effects are, however, not shown by Kodai-kanal and Periyakulam, in India, although the heights of those places differ more than do those of the American stations, the differences being as much as 2,249 metres. Equally remarkable is the practically world-wide retardation of the time of high tide in December and January as compared with April or May, in spite of the fact that summer in one hemisphere corresponds with winter in the other. Work has been begun on the determination of the air currents of period equal to half a lunar day that must be associated with the pressure tide; this problem is being attacked with the aid of the long record available at Batavia.

Ultra-Violet and Infra-Red Radiations on the Farm

L. C. PORTER, of the General Electric Company's incandescent lamp department in Cleveland, said, at a meeting of the American Society of Agricultural Engineers held on December 7, that if only electric current becomes cheap enough and suitable equipment is developed, then ultra-violet and infra-red radiations can have many uses on the electrified farm of the future (Science Service, Washington, D.C.). Adaptations of the familiar dull-red glowing electric heaters can readily be made for use in poultry-houses, in barns to keep new-born animals warm, and for the quick drying of hay. The greater com-

compactness and decreased fire risk will give them considerable advantage over present types of equipment. Ultra-violet rays are known to have certain well-marked physiological effects, as in activating sterols to produce vitamin D and in keeping in check the growth in length of plants. For producing well-proportioned plants in greenhouses, the use of a new kind of incandescent lamp is suggested which has a globe permeable to ultra-violet as well as to visible rays.

With these and other lamps in proper proportions, a close approximation to natural sunlight can be obtained with control of duration and intensity not possible under natural conditions. The well-known germicidal effects of ultra-violet rays still await a number of possible practical applications on the farm. They may be used, for example, in dairies and stable buildings, as they now are in hospitals to keep down the germ population of the air. They may be called on to control the spread of epidemics among farm animals, and to check the growth of moulds and other fungi on hay, grain and other products. Their fluorescent effects may aid in diagnosing animal diseases and in examining vegetables and fruits. With Dr. Buttolph, physicist of the General Electric Company, Mr. Porter is publishing some of his suggestions in *Agricultural Engineering*.

Helium Production in the United States

THE developments of the last twenty years in helium production in the United States are described in *Engineering* of January 26. Reference is made to a lecture delivered recently in the College of Engineering of the University of Maryland by Dr. C. W. Siebel, supervising engineer of the Government-owned helium plant near Amarillo, Texas, and to a memorandum issued by the United States Bureau of Mines. The present helium-producing plant at Amarillo has a capacity of 24 million cubic feet of helium of 98.2 per cent purity a year, but it is stated in the Bureau of Mines memorandum that, by installing another production unit in existing buildings, the output could be raised to 36 million cubic feet a year. As the present military and commercial requirements, aggregating approximately 6 million cubic ft. a year, are met by operating the plant at about one quarter of the installed capacity, there is a large reserve for emergencies.

In addition to the Amarillo installation, the U.S. Government owns two smaller helium plants, at Dexter, Kansas, and at Thatcher, Colorado; these are not being worked. They were built by private interests and purchased by the Government in 1937. To supply the Amarillo plant with helium-bearing natural gas, the Bureau of Mines has purchased all gas rights in 50,000 acres of land comprising the Cliffside gas field. It is stated that, on the basis of a conservative estimate, the Cliffside area contains at least 100,000 million cubic feet of natural gas having a helium content of 1.8 per cent. This is equivalent to a reserve of 1,800 million cubic feet of helium, or approximately two hundred times the

average annual production during the last ten years. In addition to the resources at Cliffside, the U.S. Government possesses two helium reserves in Utah, which are being retained for future needs.

Mineral Resources of the British Empire

DURING the War of 1914-18 a Royal Commission formed the conclusion that an Empire Development Board was desirable, and there the project has been allowed to rest. An editorial article in *Sands, Clays and Minerals* (autumn issue, 1939) urges that no time should be lost in an intensive survey of the mineral resources of the Empire. The War, so far from causing a postponement of such a survey, should hasten it, and the survey must be carried out from a national point of view regardless of the possible financial profit that may accrue from the mining of any mineral. We cannot afford to wait while commercial interests debate the potential profit in a new venture: access to new supplies of a mineral ore may be vital to victory. The writer makes it clear that he is not thinking in terms of politicians and their methods of control. In that direction he foresees no hope of initiative. If anything is to be done, technologists will have to get together and do it for themselves.

It is proposed that the scientific men of Great Britain should draw up a scheme of Empire development, communicate it to corresponding groups in the Dominions and Colonies, and then give the plan such publicity that even the dead hand of the politician could not destroy it, and possibly some public-spirited men might launch the venture free from the shackles of official control. Emphasis is laid on the conception of a just minerals policy for the Empire in the peace that is to come, the necessity for preventing the exploitation of resources falling to the wrong kind of private enterprise in which profits are the one consideration, and finally the desirability of making the Empire's mineral resources available to all.

An Artificial Mastoid for Audiphone Measurements

THE *Bell Laboratories Record* of November 1939 contains a paper on the development of bone-conduction audiphone receivers by M. S. Hawley, of the Transmission Instruments Engineering Department of the Laboratories. To provide a method of measuring the response of bone conduction receivers under the correct mastoid load, an artificial mastoid was developed. The impedance offered by the mastoid to a bone conduction receiver was measured on a number of people and then a rubber block was designed that presented to a receiver placed upon it approximately the same impedance as the average human mastoid. Since the artificial mastoid is based on average values of mastoid impedance, there may be slight variations in the results obtained with it and with some particular subject. The possible deviations are indicated by a diagram, which shows responses obtained with the artificial mastoid and with one particular subject. At very low frequencies here is an evident slight departure, but over the

major part of the frequency range the results are in close agreement. Measurements on the same instruments made over a period of a year have shown very good correlation. Eventually the rubber pad ages and its impedance changes. The replacement of the old pad by a new one is a simple matter, so that the ageing of the rubber pad is not of much consequence. The artificial mastoid may be used in making other tests on receivers in which it is desired that the receiver be coupled to an impedance load equal to that of the head. Such tests include electrical impedance measurements, rattle tests, and non-linear distortion measurements.

Earth Tremor in New Jersey

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has now determined the epicentre of the earthquake of November 14, 1939, to have been near lat. $39^{\circ} 45' N.$, long. $75^{\circ} 18' W.$, which is only 10' due south of the point suggested as being very near to the epicentre by the Franklin Institute at Philadelphia. The depth of focus is estimated as having been about 25 km.

We are indebted to Prof. William A. Lynch, of Fordham University, New York, for the information that in the summer of 1938 a series of local shocks occurred to the north-east of the above epicentre in the region of lat. $40^{\circ} 8' N.$, long. $74^{\circ} 32' W.$, the two most severe of which were on August 23 at 3h. 36m. and 7h. 3m. G.M.T. On the basis of a canvass of volunteer correspondents and observers, the Coast and Geodetic Survey then announced that the intensity of these "apparently did not exceed V according to the Modified Mercalli Scale of 1931" (felt by nearly everyone; many awakened; some dishes, windows, etc., broken; a few instances of cracked plaster, etc.). The earth tremor was not strong enough to be registered on the seismographs at Kew Observatory. "Earthquake History of the United States", part 1 (1938), published by the Survey, lists only four moderately strong earthquakes for New Jersey up to the year 1936. In our previous note on the earthquake (*NATURE*, Nov. 25, 1939, p. 904) New Jersey was wrongly stated to be one of the New England States.

Central European Observer

WHEN the Czech nation lost its independence in 1620 its cultural life ceased. Yet Comenius and other teachers continued their educational work in exile. To-day, the nation is again under foreign domination, its universities and scientific institutions are closed and its cultural publications no longer appear in the country itself. One has, however, resumed publication in London. From 1923 until the end of 1938, there appeared in Prague the *Central European Observer*, a review in English dealing with science, art, literature and industry and with European affairs generally. In common with other Czech cultural reviews, it suspended publication after the virtual loss of independence in 1938. It is now appearing again as a fortnightly journal "to study, as it had done

in Prague, the problems of the Danubian basin with special attention to the peaceful collaboration of peoples inhabiting it, in the new Europe which must arise from the present cataclysm".

The *Central European Observer* was always well informed on scientific as well as other matters, and gave readable accounts of archaeological, biological, chemical, physical and other scientific discoveries and advances made in Central Europe, and its industrial sections frequently referred to new technical applications of scientific knowledge. The first issue of the new series, which retains most of the features of the former *Central European Observer*, contains an article by the late Karel Čapek entitled "The Death of Archimedes".

American University Education

A DECEMBER number of *School and Society* opens with "Statistics of Registration in American Universities and Colleges, 1939", a remarkable survey by the president of the University of Cincinnati. No fewer than 648 institutions are noticed with various comments in detail, and one realizes the vast attendance in a population, perhaps, four times as big as that of Great Britain. The figures, 873,697 full-time students, and with part-time and summer schools, 1,323,874, show an advance on 1938. The United States spends more of its holidays in learning than Great Britain does, though some of the instruction provided and degrees awarded do not reach the British level of attainment. The south-central divisions of East and West and teachers' colleges and technological institutions show the largest increase. In the Freshman Table the trend of the time appears in the 34 per cent additions to engineering, and we are glad to see a distinct though lesser gain in liberal arts. The establishment of a Graduate School of Education at Los Angeles may in time modify the crudities of American films and scenario writers.

Whales

UNDER the title of "Whales, Giants of the Sea", Mr. R. Kellogg contributes to the *National Geographic Magazine* of January a long article on whales and whaling which is specially noteworthy for the detailed notes on the size, appearance, distribution and habits of more than thirty species of cetaceans and coloured illustrations of nearly every species. Each illustration depicts the whale at sea, often feeding, sometimes in contact with its enemy and frequently in schools. These pictures probably constitute a unique gallery and are of considerable value.

Society for the Bibliography of Natural History

AT the annual general meeting of the Society for the Bibliography of Natural History held on February 3, the following officers for 1940 were elected: *President*, Dr. C. Davies Sherborn; *Treasurer*, Mr. Francis Hemming; *Secretary*, Mr. Francis J. Griffin. The Treasurer's report indicated that the Society's financial position is strong; but the need for new members was stressed if the Society is to continue its activities on the present scale. It was reported that a fund has been set up for the publication of

facsimiles of rare works, and the president, Dr. C. Davies Sherborn, has started the fund with a handsome donation.

Aftershocks of the Earthquake in Turkey

THESE still continue in considerable numbers and some reach a high intensity. In the Erzincan area the two villages of Besin and Pular were destroyed by a shock which killed forty-five people and injured many more on February 3. On February 4, tremors were felt at Ankara, Sivas and Zara, and a village was destroyed, killing ten people and seriously injuring three others.

The Colonial Service: Recent Appointments

THE following appointments and promotions have recently been made in the Colonial Service: M. Halcrow, agricultural officer, Kenya, agricultural officer, St. Helena; T. D. Marsh, agriculturist, senior agriculturist, Malaya; F. R. Mason, deputy director of agriculture and fisheries, director of agriculture and fisheries, Palestine; R. Smeathers, assistant conservator, Tanganyika Territory, assistant conservator, Trinidad; T. G. Wood, senior assistant conservator, conservator, Nigeria; R. Coulthard, veterinary officer, senior veterinary officer, Nigeria; R. M. Gambles, veterinary research officer, Palestine, veterinary officer, Cyprus; D. R. R. Burt, lecturer and head of Department of Zoology, professor of zoology, University College, Ceylon.

Announcements

THE Harben Gold Medal for 1940 of the Royal Institute of Public Health and Hygiene has been awarded to Sir Leonard Hill, formerly professor of physiology in the University of London. The Smith Award for 1940 has been conferred on Sir William Savage, formerly medical officer of health, Somerset.

AT a meeting of the Royal Astronomical Society held on February 9, the following officers were elected for 1940-41: *President*, Prof. H. C. Plummer; *Vice-Presidents*, Prof. David Brunt, Prof. Alfred Fowler, Dr. H. Spencer Jones, Sir James Jeans; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Dr. R. d'E. Atkinson, Mr. D. H. Sadler; *Foreign Secretary*, Sir Arthur Eddington.

THE annual prize awarded by the Royal Asiatic Society for its universities prize essay has been awarded this year to Mr. Asa Briggs, of Sidney Sussex College, Cambridge. Of the subjects offered, Mr. Briggs wrote on "The Influence of Sea Power on the History of the East India Company".

THE Sixth International Congress for Experimental Cytology, which had been arranged to take place in Stockholm during July 25-August 1, 1940, has, on account of the international situation, been postponed indefinitely.

PROF. BIDHAN CHUNDER ROY, of Calcutta, has been elected president of the Medical Council of India in succession to Major-General E. W. C. Bradfield. Prof. Roy is the first non-official president and the first Indian to hold the office.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They 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.

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 267. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Anthropological Nomenclature

ANYONE who has followed the revelation of new knowledge on Pithecanthropus and Peking man by Weidenreich and von Koenigswald in the columns of NATURE and elsewhere during recent months cannot but agree with the opinions expressed by Prof. Le Gros Clark¹. If the usual rules of nomenclature are to be followed, the generic name *Sinanthropus* must now be regarded as a synonym of *Pithecanthropus*.

Prof. Le Gros Clark's letter raises once more the whole question of nomenclature in physical anthropology. To put the matter briefly, the naming of the forms of recent and fossil man is in a chaotic state, and the misuse of the term 'race' in anthropological literature has long been a matter for adverse comment. Several ineffectual attempts have been made to rectify matters, most of them over-enthusiastic; for example, those of Sergi² (1908) and of Pycraft³ (1925).

To be consistent, the same general principles should be adopted as in dealing with other zoological groups. Differences within the family Hominidae may be of three or more orders, and in assessing the value of physical (including morphological, physiological, serological) differences the following general principles should be followed.

(1) *Generic* differences involve differences in external or internal anatomical structure. Examples: the differences between a lion (*Panthera*) and a cat (*Felis*), or those separating *Pithecanthropus* from *Homo*.

(2) *Specific* differences involve no differences in structure. They include differences in bodily proportions (total size or relative differences in appendages); differences in bodily form; constant major differences in coat pattern, or the distribution of pigment in skin and hair. Specific characters are not necessarily associated with geographical range. Examples: the differences between lions and tigers, or between Negroes and Mongoloids.

(3) *Subspecific* (syn. racial or geographic variational) differences are those occurring between the members of a widely distributed species, and are correlated with climatic and other geographic factors, although experimental removal to other localities proves the characters to be usually fixed. Subspecific differences include differences in colour and texture of pelage; variations in length of coat, or of its special peculiarities (manes, crests, etc.) and minor differences in pigmentary pattern. Examples: the differences between the lions of Asia and those of Africa, or between, say, American Indians and typical Mongoloids.

It is essential that the term 'race' in anthropology be synonymized with 'subspecies', and used for no

other purpose. By so doing considerable confusion at present existing will disappear. Groups of Hominids of lesser rank than subspecies should be designated 'peoples' (*populi*), and this term should likewise be restricted to this usage. Linguistic differences should on no account be utilized alone in physical anthropological diagnosis, though they may carry weight as confirmatory evidence.

Mutants are not synonymous with subspecies, though they may be subspecies in the making. Commonly but single individuals or small family groups (for example, of albinos) are concerned, but sometimes, as in certain lower Primates, whole colonies of mutants occupy certain localities to the exclusion of the normal form. Where a particular mutation is common, it may affect all the subspecies of a given species (for example, partial albinism in the monkey *Kasi senex* in Ceylon).

Interspecific hybridism is unusual, though not unknown in Nature. It is commoner under domestication, hence frequent in *Homo*, the most completely domesticated of all animals. Fertility of the hybrids will depend on chromosomal compatibility or the reverse.

Intersubspecific hybridism is the rule where two subspecies meet in Nature, as on the geographic frontiers, where intermediate types are usually found. Chromosomal incompatibility is lacking; if it were not, the differences would be of specific rank. Geographic separation is normally the only barrier to complete commingling of subspecies, with the consequent swamping of the differences; but in man, artificial barriers, such as caste, constitute additional factors tending to isolate breeding groups.

It remains to apply the above generalizations to the members of the family Hominidae, both recent and fossil. There seems to be no dissenting voice to the generic separation of *Pithecanthropus* and Peking man from other Hominids, but most anthropologists lump all or nearly all the remaining forms under *Homo*, and even under a single species thereof. It is manifest that, if the above principles are observed, the Neanderthaloids at least require generic separation, and this has already been suggested by some, the name *Palaeanthropus Bonarelli* being available.

Most isolated new discoveries of fossil man are automatically placed under *Homo* and labelled with a specific name based on the locality of the discovery. This procedure has been very loosely carried out in the past, without waiting for complete examination of the specimen or comparison of its status with known forms. It is generally merely to serve as a label for description of the specimen. For example, we have *Homo modjokertensis*, which, with advancing knowledge, proved to be a juvenile *Pithecanthropus*, and *H. kanamensis*, based on a mandibular fragment.

On the other hand, many anthropologists, disregarding the rules of nomenclature, relegate all forms of *Homo* that do not differ structurally from what they loosely term 'modern man' to the sole species *Homo sapiens*, irrespective of geological age, geographical distribution or differences of a specific order.

The problem of the conspecificity of all living humanity has always been a thorny one. Allowing, however, for modern concepts of the status and limits of 'species', there is no reason to assume, as was once done, that acceptance of several species of living *Homo* necessarily implies a polygenic origin. If we are to be consistent and adhere to the general principles enunciated above, it is impossible to escape the view that there are several 'species' of living man, and several more fossil kinds. Moreover, some, if not all, these species have evolved geographical variants requiring trinomial nomenclature.

Many changes will be required if the above argument is to be acted upon, and new definitions will have to be prepared in certain cases. There will, no doubt, be plenty of scope for differences of opinion, but in any event the adoption of this or some similar scheme will assist in smoothing out considerable confusion. Space forbids the discussion of any details here, but one point that particularly comes to mind is the necessity of restricting the term *Homo sapiens* either to 'white man'—in which case Mediterranean, Alpine, etc., will become subspecies of it—or to some particular group of Europeans.

W. C. OSMAN HILL.

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¹ Le Gros Clark, W. E., *NATURE*, 145, 70 (1940).

² Sergi, G., *L'Uomo* (1908).

³ Pycraft, W. P., *Man* (1925).

Scope and Limitations of Physical Anthropology

RECENT statements regarding physical anthropology are full of interest, but they omit the practical issue, which is the definition of a standard. During 1917-18, I was a medical officer employed in Egypt to assess the physical and mental capacity of soldiers, and decide who should be put into front line service and who should be employed in supporting services and in what capacity.

The story of national efficiency soon revealed itself. It is set out in a work of mine called "A Vision of the Possible". Some soldiers saw sufficiently well with glasses, some had some defective hearing on one side, and some had a varicose vein. I did not regard the vast majority of these as physically deficient, and, with the exception of those who had some ear disease, I could not see how anything could have been done to prevent these conditions. A vast number had bad teeth and were relegated at once to a large number of dentists stationed close to the front line, and were duly attended to.

In this respect I think something could be done in the way of national prevention. I believe I am correct in stating that the predynastic Egyptians, the original Hawaiian and Maories and the uncivilized (if it is justifiable to use such a term) Australian aborigines all had good teeth. The recent publication of the elaborate uncultivated diet of the Australian aborigine explains why he lived and thrived

where civilized man died of starvation. But the Pharaohs suffered from dental disease, and so do the other races named, since contact with Europeans and different foods.

In the course of my work I realized that if the defects mentioned were regarded as barriers, there would be a sadly depleted army, and I am grateful that the commander-in-chief, Lord Allenby, endorsed this view and our action.

In the course of an investigation made long since, Lang and I found that in most wild animals refractive errors were not common, though certainly met with in some of the marsupials which have almost rudimentary eyes. But gross errors of myopia, hypermetropia and astigmatism were met with in many domesticated animals.

It is more than evident that Le Gros Clark, Mellanby and others have a powerful case for inquiry on the broadest basis possible, for the problem is not simple. But I conclude by stating that if you reject one man for refractive error, another for defect in one ear and so on, you get an utterly false standard of physical efficiency, and for that reason the usual figures given for rejection from the army never make any serious impression on me, as I think they do not express the common sense of the problem.

JAMES W. BARRETT.

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Jan. 3.

Blood Groups of the Angami Nagas

REFERENCE has been made in *NATURE*¹ to the report of the British Association Research Committee on Blood Groups among Primitive Peoples. The blood group percentages of the Angami Nagas, based on 96 tests, are given as follows:

O	A	B	AB
35.4	34.4	25.0	5.2

These differ greatly from those on the same people published by Capt. Mitra², which are as follow:

O	A	B	AB
46.06	38.78	11.52	3.64

The percentage of *B* given in the British Association data is thus more than double that published by Capt. Mitra and there is also an appreciable difference in blood group *O*. It is also stated in the British Association report that the blood group results accord with the view of Mr. J. P. Mills that the Konyaks are more primitive than the Angami-Rengmas, but if Capt. Mitra's Angami Naga results are compared with those of the British Association on the Konyaks, they appear to be closely similar. They are as follows:

	No.	O	A	B	AB
Angami (Mitra)	165	46.06	38.78	11.52	3.64
Konyak (B.A.)	127	45.7	40.2	10.2	3.9

The British Association results, however, confirm the predominance of *A* over *B* in this region excepting among the Thado-Kukis, which I also had pointed out in my recent paper on "Blood Grouping Investigations in India, with special reference to Santal Perganas, Bihar"³.

S. S. SARKAR.

Bose Research Institute,
Calcutta.
Dec. 14.

¹ *NATURE*, 144, 714 (1939).

² Mitra, P. N., "Blood Groups of the Angami Naga and Lushei Tribes", *Indian J. Med. Res.*, 23 (1935-36).

³ *Trans. Bose Research Institute, Calcutta*, 12 (1936-37).

Coprophygy in the Wild Rabbit

REPORTS of recent experiments by Madsen¹ and Eden² have shown refection to be a normal physiological process in the laboratory rabbit. A few observations collected by me, while studying the ecology and population dynamics of the wild rabbit, suggest that this process also occurs in natural conditions. From Eden's experiments, 54-82 per cent of faeces passed are shown to be normally relected, the advantage of the process to the rabbit being equivalent to "chewing the cud". It is possible that there is a further ecological advantage, which operates under wild conditions.

The population studied by me was that of a warren near Oxford, and a little more than 50 per cent of them were trapped during 1939 and marked in the ear with numbered celluloid disks, so that observations could be made from a neighbouring 'hide' and the individuals and sexes identified by means of a telescope.

Most of these observations (March 1939 to date) were made in the late afternoon, the time when wild rabbits become active and come out to feed. Generally the period of feeding activity is preceded by about half an hour, in which some, at any rate, of the inhabitants are sitting about basking or cleaning themselves. About a hundred observations (15-60 minutes) have been made to date at this hour. Another period of feeding activity is during the late night and early morning, and this is often followed by quite a long period of basking and cleaning, especially in sunny weather, though only about 5 per cent of the population remain to do this, as contrasted with 33 per cent, which is the average proportion observed feeding. About thirty morning observations have been made. In addition, about twelve observations have been made in the early afternoon during the winter. Rabbits may exceptionally feed and bask at this time, according to weather conditions.

In all these observations refection has been observed on four occasions, three times in the early morning and once in the early afternoon. It may seem curious after noting the high proportion of total faeces relected in Eden's experiments, that this was not observed more frequently; but in the first place it evidently occurs largely at night, and secondly most of it probably occurs in the burrows. It may in fact only happen rarely above ground, so that a long series of observations, such as these, is needed to record it at all. It is clear from the observations that little, if any, coprophagy takes place in the evening, even when basking and lying out occur, and that the morning is the more usual time. This is to be expected from the rhythm demonstrated by Madsen. The one afternoon observation may have been due to exceptional weather conditions (see below).

The method of taking the faecal pellets was not the same in every case, and the rhythm also varied. One doe was watched at 7 a.m. in August; she extended one hind leg, lifted up the foreleg and bent the head straight down. Another doe, watched at the same time, in September, leaned over on one flank and bent the head round and down outside both forelegs. A third, a buck, watched at 2.30 p.m. in December, did the same as the latter without leaning over on the flank. The two does took pellets at the rate of one every 5 seconds for about 45 seconds, while the buck watched in the afternoon

took them at the rate of one every 30 seconds for 3 minutes. 'One pellet' may, of course, mean a group of pellets evacuated simultaneously. The fourth instance watched was at another warren too far away for details to be made out well.

The afternoon observation was made during very cold weather, when the ground was frozen and food difficult to obtain. In this way the rabbit's coprophagy may well be of ecological importance, enabling it to do without a supply of fresh food for certain periods. I examined three rabbits, which had lain up in a bury for at least three days (the length of time traps had been set at the entrances) and in each case the stomach contained a small amount of brownish material very different in appearance from a fresh grass meal. This almost certainly consisted of faecal pellets broken up. They must have been taken some hours before, since they showed none of the usual 'stomach pellet' shape or discreteness well known to me from examination of normal live rabbit stomachs.

Thus during difficult periods or when scared into 'lying up' during trapping operations, the rabbit may increase the degree of refection. It would be interesting in this connexion to have counts of normal diurnal pellets produced under different environmental conditions. The ability of the rabbit to lie up for as much as a week at a time in unfavourable conditions is remarkable and is an important factor in forming policies of extermination. The degree to which refection is bound up with this ability is also important and deserves further attention.

H. N. SOUTHERN.

Bureau of Animal Population,
University Museum,
Oxford.
Jan. 13.

¹ Madsen, H., "Does the Rabbit Chew the Cud?" *NATURE*, **143**, 981 (1939).

² Eden, A., "Coprophygy in the Rabbit", *NATURE*, **145**, 36 (1940).

Growth Behaviour of Plants following Seed Treatment by Organic Mercury Compounds

ALBINISM in citrus seedlings is not uncommon. Frost¹ suggests that its frequent production by some parents may be due primarily to heterozygosis for various genes for albinism, and perhaps to the presence of unstable genes such as occur in cases of variegation in other plants.

Successful control of seedling albinism in citrus has been achieved in Palestine² by treating the seeds in a 1 : 1,000 solution of 'Uspulun' or 'Ceresan' in water.

In this connexion, Perlberger and Reichert³ state that albinism can also be controlled by dipping the seeds in salt solutions of other metals, including lead, copper, cobalt and nickel. From this they argue that albinism in citrus is a constitutional property inherent in the plant, which manifests itself only at germination and is probably due to a disturbance of the enzymatic systems of the plant at this stage. This is borne out by the fact that salts of heavy metals which are known to have an effect on enzymatic systems cause citrus seeds to produce normal seedlings.

An alternative explanation, however, may possibly be found in a recent communication by Kostoff⁴ reporting the induction of atypical growth and chromosome doubling in Gramineae after treatment with the fungicide 'Granosan' (ethyl mercury chloride). It is conceivable that control of albinism is associated with the induction of abnormal mitosis as the result of seed treatment by organic mercury salts.

The beneficial effects in respect of germination and freedom from seed-borne diseases following the treatment of seed by organic mercury dusts are well known.

Some curiosity has been expressed at the high yields thus obtained with cotton⁵, and the opinion has also been advanced that a factor other than the control of seed-borne disease must have entered into the effect.

It would undoubtedly be of interest and importance to investigate this matter more closely in order to determine the correct explanation of these phenomena.

G. R. BATES.

Citrus Experimental Station,
P.O. Mazoe,
Southern Rhodesia.
Jan. 8.

¹ Frost, H. B., *Hilgardia*, **1**, 365 (1926).

² Reichert, I., and Perlberger, J., *Bull. Agric. Res. Stat., Rehovot, Palestine*, **22** (1936).

³ Perlberger, J., and Reichert, I., *Bull. Agric. Res. Stat., Rehovot, Palestine*, **24** (1938); (abstract in *Hort. Abs.*, **9**, No. 3 (1939); only this seen).

⁴ Kostoff, D., *NATURE*, **144**, 334 (1939).

⁵ Miles, L. E., *Phytopath.*, **29**, 986 (1939).

Identity of the Bacterium Causing Potato Blackleg

As a result of the comparative study of Leach¹, the blackleg disease of potatoes is now generally ascribed to *Bacterium carotovorum*, which is also responsible for the soft rots of many of our vegetables and other plants. Previous investigators^{2,3,4,5} had described and named slightly different organisms which Leach endeavoured to show were either identical with or at most variants of *B. carotovorum*. This conclusion was based mainly upon four sets of observations recorded by himself or by others: (1) the similarity of the reactions in dextrose, sucrose and lactose; (2) the proved pathogenesis of authentic strains of *B. carotovorum* when inoculated into potato stems; (3) the isolation of this organism from a soft rotted tuber; (4) the blackening of "potato tissue killed by almost any organism" (Leach).

Lacey⁶, however, had shown that the organism isolated from blackleg potato plants produced acid and gas in maltose, a sugar not used by Leach, whereas authentic strains of *B. carotovorum* did not, and furthermore, the latter when inoculated into potato stems produced a white pith rot, but never the characteristic blackening of the cortex caused by the former. Lacey considered these were sufficient reasons for retaining the original name of the organism, namely, *Bacillus phytophthorus* Appel. Bonde⁷ has recently investigated the soft rots of the potato tuber in the United States and, following Leach, ascribes most of these to *B. carotovorum* (*Erwinia*

carotovora of U.S. nomenclature). Like Leach, Bonde did not include maltose among the sugar reactions investigated but worked only with the same three used by Leach. In his tabulated results Bonde indicates that, while the organisms isolated from blackleg produced the characteristic blackening when inoculated into potato stems, some of those isolated from naturally rotted tubers did not.

During the past summer, I commenced a re-investigation of the disease, mainly with the object of trying to ascertain how it is propagated. From blackleg plants collected in various parts of Great Britain and sent to Cambridge for examination by the courtesy of the Ministry of Agriculture and Fisheries, an organism has been isolated which behaves in the manner described by Lacey, that is, produces acid and gas in maltose and the characteristic blackening of the tissues when inoculated into stems of living potato plants. At the same time a soft-rotting organism isolated from carrots was used for comparative studies, the results of which confirm those of Lacey, as it produced only wilting upon inoculation and formed no acid in maltose. It seems certain, therefore, that the organism isolated from blackleg is not identical with what is generally accepted as *B. carotovorum*, in that the former differs in pathogenesis and in an important biochemical character.

The blackleg organism must, therefore, be given a special label, for while it is correct to state that it will reproduce the disease upon artificial inoculation and forms acid and gas in maltose, this is not true of all strains of *B. carotovorum*. It is considered that the differences are good specific characters and that the original specific name should be employed, modified to conform with the generic name Bacterium. Appel's original name was *Bacillus phytophthorus*, but the genus Bacillus can no longer be used for non-sporing rods (Resolution I(e) approved by the Second International Congress for Microbiology, London, 1936⁸), and I⁹ have stated my reasons for using the generic name Bacterium for the soft-rotting bacteria which are closely allied to the colon-typhoid group and for which this generic name is employed by Topley and Wilson¹⁰. The name of the blackleg organism should therefore be *Bacterium phytophthorum* (Appel) n. comb.

To sum up, blackleg is caused by a specific organism, *B. phytophthorum*, which also produces a soft rot in potato tubers and other plant tissues. Another and distinct organism, *B. carotovorum*, produces a similar rot in tubers, etc., but not blackleg of potato stems. The former produces acid in maltose, the latter does not. Potato tubers found in a rotted condition may harbour one or both organisms.

W. J. DOWSON.

Botany School,
Cambridge.
Jan. 24.

¹ Leach, *Phytopath.*, **20**, 743 (1930).

² van Hall, Inaug. Diss. Univ. Amsterdam (1902).

³ Appel, *Arb. biol. Abt. Land. u. Forstwirtschaft.*, K. Gsndhtsam., **3**, 134 (1903).

⁴ Harrison, *Centralbl. Bakt.* (II), **17**, 34 (1907).

⁵ Pethybridge and Murphy, *Proc. Roy. Irish Acad.*, Sect. 29B, **1** (1911).

⁶ Lacey, *Ann. Appl. Biol.*, **13**, 1 (1926).

⁷ Bonde, *Phytopath.*, **29**, 831 (1939).

⁸ St. John-Brooks and Breed, *J. Bact.*, **33**, 445 (1937).

⁹ Dowson, *Centralbl. Bakt.* (II), **100**, 177 (1939).

¹⁰ Topley and Wilson, "Principles of Bacteriology and Immunity", 2nd ed., 515 (1936).

Listeria: Change of Name for a Genus of Bacteria

I HAVE been informed that at the Third International Congress for Microbiologists, held in New York City, September 2-9, 1939, it was reported to the Committee on Nomenclature that the name *Listerella*, which I proposed for a genus of bacteria in 1927, had already been given to a Mycetozoan by Jahn in 1906.

My proposed name therefore becomes a homonym, but as the genus has acquired some importance in both human and veterinary pathology and references to "Listerellosis" are becoming fairly common in literature, I think that a name as near to my original proposal as possible is desirable. I therefore propose *Listeria* as the name for the genus of bacteria as defined by me in Publication No. 20 of the South African Institute for Medical Research, "The Plague Problem in South Africa", by J. A. Mitchell, J. H. Harvey Pirie and A. Ingram (Whole vol. 3, p. 169).

J. H. HARVEY PIRIE.
(Acting Director.)

South African Institute for Medical Research,
Johannesburg.
Jan. 16.

Neurosecretory Cells in the Ganglia of Lepidoptera

FOR many years the investigators of metamorphosis in the Lepidoptera have maintained that the source of the moulting hormone is the brain rather than the corpora allata, which Wigglesworth¹ formerly considered to be the organs producing the secretion in the bug, *Rhodnius*. Recently, however, Wigglesworth² has produced evidence which suggests that an area in the pars intercerebralis of the supra-oesophageal ganglion of *Rhodnius* is responsible for

the production of the moulting hormone. As he points out, Hanström³ had already described modified nerve cells in this same region which are considered, on morphological grounds, to be probably secretory in function. Neurosecretory cells have been described in several other insects, but it has been reported that, in spite of careful search, no such cells could be found in the brain of the moth larvæ (*Ephestia kuehniella*) studied by Schrader⁴.

It seems of interest, therefore, to be able to report the discovery of cells very similar to those described by Hanström which I have found in the ganglia of certain Lepidoptera. They have been demonstrated in the pars intercerebralis of the supra-oesophageal ganglion of adult moths, in larvæ of all instars, and in pupæ. They have been found occasionally in the sub-oesophageal ganglia of larvæ, and in certain of the abdominal ganglia, but not in all. These cells have essentially the same staining properties as those of *Rhodnius*, being apparently modified ganglion cells, from which they differ in containing a granular cytoplasm or a number of droplets which are intensely fuchsinophil. They are well differentiated by Mallory's Triple strain.

They have been most studied in the larvæ of the moth *Ceratonia catalpæ* Bdv. (Sphingidæ), in which they are generally scattered singly, but may be grouped as those of *Rhodnius*. Although they may vary in number and in their exact position from larva to larva, no indication has been found of a cyclical production of secretion.

Similar cells have been found in the brains of several species of Heterocera belonging to the families Citheroniidæ, Phycitidæ, and Saturniidæ.

In view of the above-mentioned experimental evidence, it seems possible that these cells are the source of the moulting hormone in the moths, but the fact that similar cells can be demonstrated in some abdominal ganglia indicates that further experimental work must be done before a function can definitely be assigned to them. However, the similarity in staining properties of the cells from the brain and the abdominal ganglia does not, of course, necessarily indicate identity of function.

M. F. DAY.

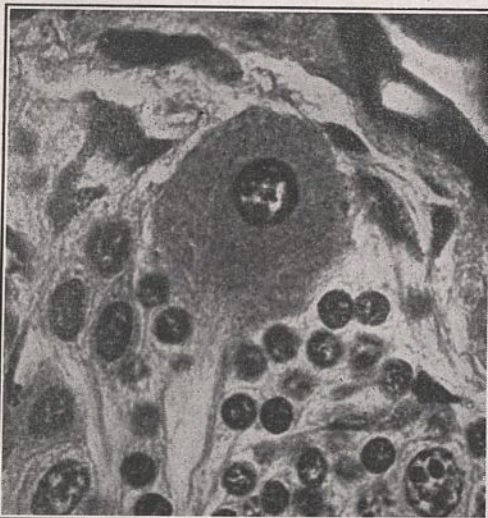
Biological Laboratories,
Harvard University,
Cambridge, Mass.
Dec. 21.

¹ Wigglesworth, V. B., *Quart. J. Micr. Sci.*, 77, 191 (1934).

² Wigglesworth, V. B., *NATURE*, 144, 753 (1939).

³ Hanström, B., *Lunds Univ. Årsskrift*, N.F., 34, No. 16 (1938).

⁴ Schrader, K., *Biol. Zbl.*, 58, 52 (1938).



SECTION OF THE SUPRA-ESOPHAGEAL GANGLION OF THE MOTH *Eacles imperialis* DRU., SHOWING LARGE FUCHSINOPHIL CELL WHICH IS CONSIDERED TO BE SECRETORY IN FUNCTION. BOVIN FIXATION, GOLD IMPREGNATION FOLLOWED BY MALLORY'S TRIPLE. PHOTOMICROGRAPH $\times c. 700$.

Zoological Nomenclature

PROPOSAL of a 'stereotyped' zoological nomenclature almost invariably comes from a non-systematist or from a systematist working sporadically on a restricted group in a field where there is but a small literature and few workers. Any active worker in a large and progressive systematic field would realize at once that any 'stereotyping' plan is impossible. In my own subject, ichthyology, there is no general world monograph suitable for 'stereotyping' subsequent to Günther's "Catalogue" (1859-1870), and Günther's classification and nomenclature are now so out of date that no ichthyologist would

accept it. There are a number of large faunal works of more recent date, but if they were 'stereotyped' for particular regions, their nomenclatural differences would force the wide utilization of different generic or specific names in different regions for identical genera or species. The vast number of forms thus affected would preclude any sensible arbitration of the conflicts. Not long ago one eminent anatomist proposed that the vagaries of elasmobranch nomenclature be settled by a return to the 1838 nomenclature of Müller and Henle's "Plagiostomen". But he did not suggest what was to be done with the numerous genera and species described since that time and with the various subsequent segregates of Müller and Henle's genera. As a matter of fact, return to this nomenclature of 1838 would necessitate the change of more valid names than were contained in the whole of Müller and Henle's work!

Those systematists who sincerely study zoological nomenclature in an effort to find a way of avoiding vexatious changes usually reach the conclusion that Linnean binomial nomenclature will never be entirely stable, since it is firmly wedded to classification and no one can prevent ideas of classification from changing so long as systematic research is carried on. If absolute stability is imperative, we must cast the entire Linnean system overboard. In my opinion, this will never be done.

As a matter of fact, the particular situation which has troubled Prof. Garstang¹ and Dr. Crossland² is not due to the Rules, but to what I consider misuse of the Rules by a small group of Australian nomenclaturists. The nomenclatural *tour de force* to which this group has treated conchology, ornithology, ichthyology, and other fields is deplored by most of the systematists of Europe, America and especially Australia. I am familiar only with the ichthyological side, but in regard to this I can say that comparatively few of these Australian innovations hold water systematically, and many are directly contrary to the Rules. Very likely Prof. Garstang's strictures, if applied to British nudibranchs *in conjunction with full knowledge and correct interpretation of the International Rules*, would restore at least some of the old nomenclature.

I say, at least some. A blind condemnation based purely on personal nomenclatural prejudice is unworthy of consideration in view of the long labours of the many persons who have built up the present International Rules in an attempt to evolve some universal basis for the greatest possible nomenclatural stability in all animal groups. Some general system of rules is imperative, and we have such a system. A great many of the cataclysmic nomenclatural revolutions that occur now and then in restricted groups are due to the utterly irresponsible and capricious nomenclatural practices of past workers. When at last a new and more able generation of workers, cognizant of the importance of adopting a universally acceptable nomenclature, appears, old names by the dozens are likely to fall and older workers to protest bitterly. The latter sometimes fail to realize that they are possibly at fault, or that their particular nook might perhaps need some change in order to make way for a more universal practice.

The present International Rules are not perfect. They have been arrived at only through an enormous amount of work and compromise. How great that work has been, and how difficult it is to obtain agreement on sensible amendments and to prevent the

enactment of senseless ones, at the International Zoological Congresses, is largely unknown except to those who have studied the history of the Rules or who have actually been present at the nomenclatural sessions. Some idea of the complexity of points of view that had to be compromised may be gained by reading Dr. Stejneger's paper, "A Chapter in the History of Zoological Nomenclature"³, and I recommend it to anyone wishing to amend the Rules. But certain improvements might be made without any change in the Rules. Nearly every systematist with whom I have discussed the matter has agreed that the creation of a number of sub-commissions for various animal groups, whose decisions should be subject to reversal only by the main International Commission, would speed up nomenclatural decisions enormously and remove any present causes for dissatisfaction. With several of my colleagues, I hope to present a plan of this sort formally in the near future.

GEORGE S. MYERS.

Stanford University,
California.
Jan. 10.

¹ NATURE, 144, 481 (1939).

² NATURE, 144, 942 (1939).

³ Smithsonian Misc. Coll., 77, No. 1.

Barkhausen-Kurz Oscillations with Positive Ions

Kownacki and Ratcliffe¹ have previously described an experimental method of investigating electron inertia effects in thermionic vacuum tubes. By replacing the electrons in a triode by positive ions of caesium, of mass 25×10^4 times greater, they were able to slow down the effective transit times involved by a factor of about 500. In this way they demonstrated the occurrence of rectification effects, dependent upon a resonant transit time, at a wave-length of about 500 metres.

We have now found that it is possible to maintain oscillations of the Barkhausen-Kurz type by using positive ions emanating from a filament. A cylindrical electrode valve of the Type AT 40 had some caesium inserted, and was kept at a temperature of about 30-70° C. with an accelerating potential of the order of 200 volts on the grid and with the anode at zero potential, or at a slightly retarding potential. Under certain conditions of positive ion current, determined by bulb temperature, the valve was found to maintain oscillations with a wave-length of the order of 500 m., corresponding to the time of transit of ions between the electrodes. We satisfied ourselves that the triode alone, with no external circuit tuned to a wave-length greater than about 50 cm. (the natural wave-length of the wire leads), would maintain an oscillation with a wave-length of about 500 m., and the wave-length depended on the electrode potentials employed. The addition of an external tuned circuit greatly increased the amplitude of the oscillation, but had only a second order effect on the frequency. There seems no doubt that the frequency of the oscillations was determined inside the valve itself. Oscillations of this type have often been called true Barkhausen-Kurz oscillations, in contrast to Gill-Morrell oscillations, the frequency of which is mainly determined by an external circuit.

This is not the place to describe our results in detail, but they may be summarized by saying that, at zero D.C. plate potential and with the minimum space current required for oscillation maintenance, the oscillation gave a pure heterodyne note corresponding to a single oscillation with a period approximately equal to one half the time T of ion transit from filament to plate and back, as given by the Scheibe expression²:

$$T = 4r_g \left\{ f \left(\sqrt{\log_e \frac{r_g}{r_f}} \right) + g \left(\sqrt{\log_e \frac{r_p}{r_g}} \right) \right\} / \sqrt{\frac{2eV_g}{M}}$$

Here T is the transit time in seconds, r_f , r_g and r_p are the radii of the filament, grid and plate respectively, V_g is the grid potential in E.M.U., e/M is the specific ionic charge in E.M.U./gm., and f , g are functions given in Scheibe's paper². "Resonance rectification" effects were observed at periods of about T , $T/2$ and $T/3$.

As the space current was increased, the period of the oscillation became increasingly smaller than $T/2$. At a critical space current the type of oscillation suddenly changed, and the single oscillation was replaced by a set of oscillations of slightly different frequencies, which gave an impure heterodyne note. With further increased current the frequencies of the multiple oscillations diverged, and when the condition of space-charge-limited emission was approached, there was an abrupt change to a single oscillation period of rather less than T .

It appears that much information concerning the mechanism of electronic oscillations might be obtained by applying this method of investigation to valves with different electrode structures, and preferably to valves with structures which can be altered without opening up the tube.

W. S. ELLIOTT.
J. A. RATCLIFFE.

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Jan. 22.

¹ NATURE, 141, 1009 (1938).

² Scheibe, *Ann. Phys.*, 73, 70 (1924).

Optical Anisotropy of Cellulose Sheet

THE birefringence¹ of 'Cellophane' (regenerated cellulose sheet) has been measured for more than two hundred samples, kindly supplied by the makers. Three main points have emerged:

(1) The birefringence (B) varies with the wavelength of the light used, the law being approximately

$$B = B_0 (1 - 0.000016 \lambda),$$

where λ is in angstroms.

(2) Results for the birefringence of the thinnest material (about one thousandth of an inch) vary from 0.0056 to 0.0132, with a concentration around 0.0089. The thicker materials (1.2 and 1.6 thousandths of an inch) give, on the average, lower values of birefringence.

(3) The birefringence is least in the middle of the web, and is about 30 per cent greater near the selvages.

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Glasgow.
Jan. 26.

¹ Drummond, D. G., NATURE, 145, 67 (1940).

Kornerupine from Ceylon: a New Occurrence

SOME years ago we discovered specimens of kornerupine in mixed parcels of typical cut Ceylon gem-stones, and this prompted us to search for the mineral in gem gravel concentrates kindly sent to us direct from Ceylon by Mr. Hans Van Starrex. From the first lot of rough so examined, which consisted mostly of green zircons, two small pieces of kornerupine were recovered, so that yet another species must be added to the already long list of gem minerals found in the Ceylon gravels.

These two specimens, greenish-brown in colour and weighing 0.430 gm. and 0.436 gm. respectively, have the following properties: density, 3.33; refractive indexes, α 1.671, β 1.683, γ 1.684; $2V$, 25°, $r < v$; α light brown, β yellow, γ dark green. It may be noted that Madagascan kornerupine differs in having r greater than v .

Credit for the identification of our specimens is due to Dr. L. J. Spencer, and confirmation was provided by Dr. G. F. Claringbull, who kindly carried out X-ray measurements.

It is hoped that later a fuller account, together with a complete analysis, will be published in the *Mineralogical Magazine*.

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C. J. PAYNE.

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Jan. 26.

Blue Rocksalt

SPECIMENS of natural rocksalt are frequently coloured, the more usual colours being blue, violet and pink. Blue halite from Stassfurt in particular has received much attention, and many suggestions have been offered to account for the tint. Siedentopf's¹ theory that the colour is due to colloidal sodium was regarded generally as satisfactory until Spezia² pointed out that its solution should then be more alkaline than that of the colourless form—which it is not. Doelter³ regards the colour as caused by foreign inclusions, colloidal or otherwise, and favours a mixture of iron and manganese, though sulphur and organic substances are not ruled out.

More recently, however, Kennard, Howell and Yaeckel⁴ have decided against any pigmental theory, as the result of a spectroscopic examination of a specimen of colourless Stassfurt rocksalt containing a distinct zone of blue. No difference in composition between the coloured and colourless parts could be detected; traces of several foreign elements, including aluminium, lithium, silicon and titanium, were present in both. The authors regard their results as supporting the views of those earlier investigators⁵ who have attributed the colour to some structural cause.

Apparently, however, gold has not been specially looked for; it may easily escape detection spectroscopically because it is not one of the very sensitive elements, some 10 p.p.m. being the lower limit of detection by ordinary methods. The *Glimmschicht* procedure, developed by Goldschmidt and his

co-workers, is claimed to be some fifty times more sensitive⁶, but does not appear to have come as yet into general use amongst mineralogists.

We have already shown⁷ that sufficient gold is present in the blue and reddish-brown translucent celestines from Yate, Glos., to impart the observed colour if the metal is present in the colloid state. It occurred to us, therefore, that possibly blue Stassfurt halite might likewise contain colloidal gold. This appeared possible for two reasons. First, it is known that sea water frequently contains gold and if, during evaporation, this became concentrated locally, it might easily, if reduced to the colloid state, give rise to coloured streaks in the resulting rock salt. Experiment shows that, under favourable conditions, 1 to 4 p.p.m. of colloidal gold suffice to give a decided tint to a crystal although gold chloride would not, in general, be perceptible.

Secondly, Prziham⁸ has noted the analogy between the blue tints of halite and anhydrite. Through the kindness of Mr. Arthur Russell, president of the Mineralogical Society, we have been able to examine a blue-tinted specimen of anhydrite from Cropwell Bishop, Notts., and find it to contain 4 p.p.m. of gold, amply sufficient to yield the observed tint.

Messrs. Gregory and Bottley generously gave us

some deep blue Stassfurt halite and in it we found an average of 23 p.p.m. of gold, using an *o*-di-anisidine method⁹. This was again amply sufficient to impart the observed colour. We have found gold to be present also in specimens of both blue and pink halite from other localities, including Hallstadt and Wieliczka (Cracow).

Though we hesitate to draw definite conclusions from a mere half dozen analyses, we do venture to suggest, as worthy of consideration, the view that the colour of halite may, in certain cases at any rate, be connected with its gold content.

J. NEWTON FRIEND.
JOHN P. ALLCHIN.

Technical College,
Birmingham.
Jan. 27.

¹ Siedentopf, *Phys. Z.*, **6**, 855 (1905).

² Spezia, *Zentr. Min.*, 398 (1909).

³ Doelter, *Monatsh.*, **52**, 241 (1929).

⁴ Kennard, and others, *Amer. Min.*, **22**, 65 (1937).

⁵ Notably Prziham, Guthrie, Phipps and Brode.

⁶ See "Spectrum Analysis" by Strook (Hilger, 1936).

⁷ Friend and Allchin, *NATURE*, **144**, 633 (1939).

⁸ Prziham, *Chem. Zentr.*, **2**, 753 (1936).

⁹ Based on Pollard, *Analyst*, **62**, 597 (1937), and Jamieson and Watson *ibid.*, **63**, 702 (1938).

Points from Foregoing Letters

W. C. O. Hill shows that differences within the family Hominidæ are of three orders—generic, specific and subspecific. Brief specifications of the status of these are given, but it is pointed out that the members of the family are particularly liable to interspecific and intersubspecific hybridism. Nevertheless, a plea for the observance of the same rules of nomenclature as employed by zoologists is made, and an effort thus made to remove some of the confusion at present existing in anthropological literature. The misuse of the term 'race' and the irregular usage of the title *Homo sapiens* are particularly to be regretted.

Although coprophagy has recently been shown to be a normal physiological process in the laboratory rabbit, there are apparently no previous records of it occurring in the wild. Observations by H. N. Southern of a wild population have shown several instances of refection, and the process is probably important in enabling wild rabbits to tide over unfavourable periods, when food supply is short, or when they are kept in their burrows by persecution.

The slightly differing bacteria causing potato blackleg, the first of which was called *Bacillus phytophthorus*, are now considered to be identical with *Bacterium carotovorum*. One organism isolated from blackleg, however, forms acid in maltose and reproduces the characteristic symptoms of the disease upon inoculation, whereas authentic strains of *B. carotovorum* do not. These differences are considered by W. J. Dowson to be sound specific characters, and necessitate a separate name for this blackleg pathogen. As *Bacillus* can no longer be used, the correct name should be *Bacterium phytophthorum*. Both organisms may occur in naturally rotted tubers.

M. F. Day describes modified nerve cells from the ganglia of several species of moths, and suggests

that these may be the source of the moulting hormone in these insects.

G. S. Myers discusses the difficulties of rigid application of the International Rules of Zoological Nomenclature. In order to hasten the procedure, he suggests the formation of sub-commissions for various animal groups, the decisions of which would be subject to reversal only by the International Commission itself.

'Barkhausen-Kurz' oscillations have been obtained by W. S. Elliott and J. A. Ratcliffe at a wave-length of 500 m. by the use of heavy positive ions in place of electrons in a cylindrical triode. The production of oscillations did not require the presence of any tuned external circuit, and the frequency was determined solely by the operating conditions of the triode. The Scheibe transit time formula was obeyed in the case of weak oscillations. Various types of oscillation have been found for different operating conditions.

The birefringence of regenerated cellulose sheet is found by R. C. Gray to decrease slightly with increasing wave-length, to vary within wide limits about a mean value of about 0.0089, and to be, at the selvages of the web, about 30 per cent greater than at the middle of the web.

Small pieces of the rare mineral kornerupine have been recovered from samples of Ceylon gem gravel, an occurrence not hitherto reported. Optical data for these specimens are given by B. W. Anderson and C. J. Payne.

Blue Stassfurt halite has been found by J. N. Friend and J. P. Allchin to contain gold which, if in colloidal condition, would be ample to cause the observed colour. It is suggested that the colours of various rocksalts may be connected with their gold contents.

RESEARCH ITEMS

Coloured Families in Liverpool

AN investigation undertaken under the auspices of the Liverpool Association for the Welfare of Coloured People into the economic status of 225 coloured families, supplements an investigation made some ten years ago, while reflecting changes in conditions which have taken place in that period ("The Economic Status of Coloured Families in the Port of Liverpool". The University Press of Liverpool, 1939. Pp. 23. 1s. net). The investigation was organized and directed by D. Caradog Jones, the material collected and analysed by Kathleen Johnstone of the Department of Social Science in the University of Liverpool. The coloured families investigated belonged to the class of those who had made "domicile of choice", and were known to have been insured under the Unemployment Insurance Acts. The bulk, but not all, of the men were West African in origin. Only one had been in the country for less than five years, while the largest proportion, 100, had been here for more than twenty and less than thirty years. The investigation in the main was confined to householders. Of the families visited, 201 had a married man as head, 2 with a widower, 3 with a single man, and 19 with a widow as head. Of the 206 male heads, 4 were old age pensioners or invalids; of the remainder 149 were unemployed. There are relatively few of pensionable age. There is a high proportion between 45 and 65, with a low proportion between 21 and 45 years. The mean number of children per family is 2.6 as compared with white 4.8. During the last ten years a change for the worse in economic conditions has taken place. Of coloured only 40 per cent were in receipt of earnings as contrasted with 75 of a survey sample of white seamen, while 73 per cent of the coloured were in receipt of unemployment benefit as against 34 per cent white. In relation to the poverty line, the figures are as follow: more than 50 per cent above, coloured 14.4, white 48.5; within 10 per cent above or below, coloured 22.3, white 10.0; and 10 per cent to 33 per cent below, coloured 20.4, white 15.4.

Marriage Customs among the Barolong, South Africa

THE Barolong belong to the western cluster of the Sotho group of the Bantu-speaking tribes of South Africa and are found mainly in British Bechuanaland. Their marriage customs have been studied by Z. K. Matthews on information collected in the course of two visits in 1935 and 1937 (*Africa*, 13, 1; 1940). Socially the Barolong are divided into four sections, named after sons of a former chief who died about 1760. A number of agencies of acculturation, especially missionary influence and administration, have been at work among them. Traditional forms of social grouping based on kinship, locality, age, occupation and rank persist among them, but are undergoing much change. The traditional marriage customs of the Tshidi Barolong attach a great deal of importance to the institution, which is regarded as a state which should not be lightly entered upon, not only in the interests of the individual, but also of their kinship groups, including both the living and the dead, as

well as the welfare of the tribe in which they live. It is a sacred duty to one's family to marry in order to continue the line of descent. Much litigation is concerned with family law, and constantly directs the attention of members of the tribe to the importance of the institution of marriage. Marriage is also regarded as a means of cementing friendship between two groups. It is therefore not surprising to find that parents claim and exercise the right to control the marriages of their children, especially when it is a matter of the chief wife, whose children receive first preference in the matter of succession to property. The term 'parents' includes other kinsmen who have the right to advise, especially father's father and brothers and important paternal kinsmen, while the views of the maternal relatives must be taken into account, especially those of the mother's brother, as no serious step can be taken in the affairs of her sister's children unless he be consulted. It must not be taken, however, that the wishes of the man or woman about to be married will be entirely ignored, or that an individual could be compelled to marry against his or her wishes.

Nitrogen Excretion and Metamorphosis

THE generalization that ammonia, urea and uric acid excretion are characteristic of aquatic, amphibian and terrestrial life respectively has received support by the work of A. F. Munroe (*Biochem. J.*, 33, 1957; 1939). He finds that a rapid change-over from ammonia to urea excretion occurs in the tadpole during the metamorphic stage of development, and this is also accompanied by a large increase in liver arginase. The initiation of the change is coincident with the period when the gills are shrivelling and the forelimbs are just piercing the gill coverings and thus giving rise to a functionally active terrestrial animal. He considers that liberation of thyroid substance, the stimulus for metamorphic change, exerts a direct effect on nitrogen metabolism in the liver, and he intends to continue the experiments on axolotls fed with thyroid.

Wing Dimorphism in a Dipterous Insect

JEAN GUIBÉ has published a detailed study of the growth and biology of the fly *Apterina pedestris* Meig., belonging to the family Sphaeroceridae or Borboridae (*Suppléments* (No. 26) au *Bulletin Biologique de France et de la Belgique*). The most important part of this memoir concerns his breeding experiments. The only known wild type of the insect is the micropterous form, which is widely distributed in the northern Palaearctic region. Three types have been bred out, and it is shown that their inheritance is along simple Mendelian lines. One type, the homozygous micropterous form, produces, *inter se*, its own and no other form. The heterozygous micropterous type produces its own and a macropterous type in approximately the proportion of 3:1; in one breeding experiment the progeny resulted in exactly that proportion, namely, 555 micropterous individuals and 185 of the macropterous

kind. By crossing heterozygous micropterous forms with macropterous forms, almost equal numbers of both resulted in the progeny. It is evident that micropterism is dominant and that macropterism is recessive. The author concludes that macropterism corresponds to a simple Mendelian mutation, but this idea seems contrary to Dollo's law, since it implies re-acquisition of the former fully winged state. Few biologists will dispute that the original ancestors were fully winged or macropterous at an earlier stage in evolution. It would, therefore, seem reasonable to dissent from the author and interpret the micropterous form as the mutant and the long-winged form as the persistent original type. A further point of great interest is displayed in the author's account of the morphological differences in the wings and venation of the homozygous and heterozygous short-winged forms.

The Genus *Streptocarpus*

W. J. C. LAWRENCE has reviewed the origins and horticultural development of the genus *Streptocarpus* in a recent paper (*J. Roy. Hort. Soc.*, 65, Pt. 1; January 1940). Plants of this group, though now florally valuable in many parts of the world, have been introduced to cultivation from South Africa, where they are concentrated on the Drakensberg Mountains. Stemless species which comprise the section *Eu-Streptocarpus* vary from the single-leaved forms, which are found mainly in the north, to the rosette kinds, which occur most commonly in the south. Intermediate forms appear in the middle of the Drakensberg range, and since all species of *Streptocarpus* have the same number of chromosomes, and many readily hybridize, it would seem that they are variants from some common stock. Mr. Lawrence then shows the effect of this variation upon the production of the beautiful garden hybrids now extant. A tetraploid form of a hybrid with *S. grandis* has occurred and has been named 'Merton Giant'. This geographical and genetical analysis of species in the making is a constructive replacement of the tendency to name each inconstant variable, so often favoured by the taxonomic 'splitter'.

Cirque Formation

THE *Bergschrund* hypothesis of cirque formation by a process of basal sapping of the rock has been more or less accepted in one form or another since it was suggested by W. D. Johnson. In recent years, however, W. V. Lewis has stressed the importance of meltwater in cirque formation, and he returns to this subject in an article in the *Geographical Review* of January. The evidence is obtained from cirques in Iceland, Spitsbergen and Switzerland. That meltwater occurs below the level of the *Bergschrund* and melts its way under the glacier seems to be established, but unless this water can refreeze it can have no plucking action on the rock wall. Various observations have shown that low winter temperatures do not penetrate very deep in glaciers, but in the want of contrary evidence Mr. Lewis suggests that freeze-thaw processes do take place at depths below the deepest *Bergschrund*. He points out that no temperatures have yet been taken at the head wall under a glacier, and that only a small amount of the meltwater need freeze in order to affect the rock wall, and finally that at great depths the temperatures must be fractionally below freezing point or the ice would melt under the pressure to which

it is subjected. The weight of 36 feet of ice is equivalent to one atmosphere, so that the temperature within a glacier must fall at least at the rate of 0.1° C. for every 500 feet in order that the glacier may exist. If local melting due to descending water releases the pressure at a point beneath a glacier, then the meltwater will rapidly fall in temperature, being chilled by the ice, and rapidly freeze. On re-application of the pressure any ice at 0° C. will melt again. Thus an alternation of freeze and thaw is possible.

Structure of the Pacific Basin

ACCORDING to B. Gutenberg (*Science*, 90, 456-458; Nov. 17, 1939) the movements along the San Andreas fault in California occur in such a way that the eastern (continental) side moves south-eastward relative to the western (Pacific) side. Ch. Tsuboi has also stated that in Japan, along all faults, without exception the continental (western) side is moving southward relative to the Pacific side. In addition, Bailey Willis contends that movements along the major fault in the Philippines occur in the same way, the continental side moving southward relative to the Pacific side. Gutenberg further states that the definite compression-dilatational patterns observed in all earthquakes without regard to their focal depth indicate that in all shocks the processes producing the waves are of the same type of faulting or shearing and cannot be due to a pure explosion or collapse in the interior of the earth. Great earthquakes are common around the Pacific, and all deep focus earthquakes so far accurately determined have originated in the circum-Pacific area. The boundary of the true Pacific basin is outlined by the earthquake epicentres. On the west side it follows the 'Andesite' line, which separates regions of different petrological and chemical composition. The foci of all earthquakes originating deeper than 200 miles have been found close to, and on the continental side of, this boundary. Different types of seismological evidence concur that continental surface layers appear to be missing over the greater part of the Pacific basin, but they are present in small thicknesses near Japan, New Zealand and California. There is also an area with 'continental' structure in the south-eastern part of the Pacific basin, though partially the Arctic basin appears to be of Pacific type.

Nuclear Isomerism in Zinc

IN the radioactive zinc obtained by bombarding zinc with deuterons, two β -emitters of half-lives about 57 min. and 14 hr. have been assigned to the isotope ^{69}Zn , which is therefore a case of nuclear isomerism. J. W. Kennedy, G. T. Seaborg and E. Segré (*Phys. Rev.*, 56, 1095) have now shown that the absorption properties of the β -rays from these two activities are the same. The β -spectra are presumably identical, and it is suggested that in each case the β -rays come from the 57-min. product, while the 14-hr. ^{69}Zn is a metastable excited state of the nucleus which decays to 57-min. ^{69}Zn with emission of a γ -ray. The γ -rays of energy 0.47 Mev. should therefore have no correspondence in time with the β -rays. This was verified by a coincidence counter arrangement which in a check experiment successfully detected the coincidences between the β - and γ -rays of thorium B. An attempt to separate the isomers chemically by taking advantage of the γ -ray recoil of the 57-min. product gave no positive result.

PROBLEMS OF EVACUATION

ASPECTS of evacuation problems are discussed in recent articles in the *Political Quarterly* and the *Quarterly Review*, which make a number of useful suggestions for their solution. Reviewing the working and present position of the evacuation scheme in the *Political Quarterly*, Mr. A. D. K. Owen suggests that in Scotland uncertainty concerning the financial aspects of evacuation played a considerable part in deterring many people from going away or permitting their children to leave vulnerable areas. He considers that more effective publicity, directed to the poorer sections of the population, relating to the financial implications of evacuation might have resulted in a more satisfactory response.

While in the reception areas the situation is in many ways not unsatisfactory, it is difficult to see how the evacuation scheme can be successfully rebuilt in the absence of compulsory powers. Mr. Owen suggests that certain districts within the existing evacuation areas should be scheduled as specially dangerous—all places, for example, within a certain distance of military or naval targets, shipbuilding yards, docks or important railway junctions—and children of school age prohibited from living in them save in very exceptional circumstances. He also suggests that the law of school attendance should be amended so as to prevent parents from bringing their children home from reception areas without good reasons.

The first measure would involve transferring all schools serving the prohibited districts to reception areas, and the second would make it possible to plan ahead with some assurance that the population for which plans are being made would not melt away before they matured. Schools in those parts of the evacuation areas which lie outside the prohibited districts should be opened as soon as they have been given reasonable protection, but a fresh approach made to parents in these areas to persuade them to allow their children to be evacuated or re-evacuated.

Capt. Frederic Evans, in the *Quarterly Review*, directs attention rather to measures which might be taken in the reception areas to organize new life for evacuees within the strange environment to which they have been taken. He emphasizes the importance of balancing out school accommodation and staffs, the development of specialized accommodation for

difficult children, clinics, recreation and other purposes. Holiday camps, youth hostels, and village halls could all offer important contributions, and if well organized might contribute to a closer wedding of the town to the country, with far-reaching and beneficial consequences to the whole nation.

Psychological and financial problems have to be faced and the careful planning of the medical services in the country is of special importance. Their staffing and provision pre-suppose a national service. Capt. Evans urges that the considerable expenditure involved in the various social services required to solve these problems must be incurred or we may find the War has been fought in vain.

Dr. W. A. Robson's article, "Evacuation, Town Planning and the War", is concerned with the wide issues which are opened up by the evacuation not merely of school children, but also of civil servants, business houses, etc., and the imperative need for some central control and planning if chaos is not to result from the indiscriminate location not merely of industry in the reception areas but also from the tremendous demand for premises and land by the civil and military authorities. The demands of the War Office and the Air Ministry for camps and aerodromes must be met without question or delay; but it would be the gravest mistake to permit all these new and necessary constructions arising from these as well as from civil needs, and also the consequences of evacuation, to take place in utter confusion or on the basis of *laissez-faire*, and with a complete disregard of the peace-time situation which will follow the War.

For this reason, and because our war-time exigencies are strangely consistent with socially desirable peace-time purposes, Dr. Robson views with such alarm the abandonment by the Government of the reports of the Royal Commission on the geographical distribution of the industrial population. Town and country planning should now acquire a new and more important status and be placed in the hands of a strong central department competent not only to deal with the special needs of the Service departments and the Government offices, but also to take over the long overdue task of directing the location of industry and formulating a national plan for the whole country.

AIR CONDITIONING

AN abstract of a paper on "Air Conditioning" read by W. Chambers to the North Midland Section of the Students of the Institution of Electrical Engineers and published in the Institution's *Journal* of December gives a clear account of the objects to be attained by air-conditioning and of the methods by which it can be done.

The object is to maintain in a building an atmosphere that is most beneficial to the health of the occupants or which is most suitable to the process

of manufacture carried on therein. To maintain these conditions, it is necessary to control the heat content or temperature, the purity, the moisture content (humidity) and the distribution of the air. A ventilating scheme in which the air is filtered, comfortable in temperature and adequate in volume, is sometimes considered entirely satisfactory, and little if any attention is paid to its moisture content, although the latter has a great effect upon the comfort of the human body.

In the case of public buildings where the number of occupants may be large and the lighting load large in comparison with the human content, the heat and emanations produced by the occupants have to be counteracted. The atmosphere should have a normal natural temperature and moisture content, with sufficient movement of the air to overcome stagnation.

To raise the temperature of the air in winter, it is only necessary to pass it over a hot surface, and most air heaters therefore consist of finned tubes which are steam-heated, and over which the air is forced to pass by means of centrifugal type fans. It must be remembered that heating lowers the relative humidity, owing to the fact that heated air is contained in a larger volume, but it still carries the same initial quantity of moisture as before heating took place. A pre-heated spray washer to maintain the humidity under control is often used.

In summer, in cooling the air the reverse applies, the relative humidity being increased, so that drying is necessary. This is done by exposing the air to cold surfaces or cold spray, whereby excess moisture is condensed and the air left saturated at a lower temperature. This can be done by mixing the air with air which has not been cooled.

In industrial neighbourhoods, it is necessary to extract from the air dust and grime particles. For

this purpose filters are used, and the entire volume of air to be circulated is passed through them. Washers, viscous-type filters and throw-away type filters are used. The last type consists of a cheap fabric which may be cleaned by a vacuum cleaner nozzle, but it is more usual to dispense with them entirely and replace by new fabric. The efficiency of these filters is claimed to be greater than 99 per cent with removal of particles down to 1/30,000 in.

The comfort chart which the American Society of Heating and Ventilating Engineers has evolved shows that summer and winter conditions vary and that the average conditions are a temperature of 72° F. with a relative humidity of 50–60 per cent for summer and a temperature of 66° for winter with a similar humidity.

In an actual installation, the air is first passed through a filter and then tempered in a preheater; this has the effect of preventing the incoming air from being too cold and freezing the water in the washer. The science of air-conditioning is making great progress. The engineer of the future who aims at a thorough mastery of his subject must know physics, especially thermodynamics, and have also some knowledge of those branches of chemistry, medicine, biology, psychology and physiology connected with it.

ORIGIN OF THE CORPUS CALLOSUM

IN "Man's Place in Nature", T. H. Huxley expressed some astonishment at the abrupt appearance of a corpus callosum in placental mammals, suggesting that this phenomenon represents "the greatest leap anywhere made by Nature in her brainwork". Later on, between 1887 and 1895, this problem was studied by a number of anatomists, including Osborn, Zuckerkandl, Symington, Herrick and Elliot Smith, and several divergent opinions were expressed as to the phylogenetic origin of the commissure.

The evidence was clarified to a very considerable extent by the detailed work of Elliot Smith, who made full use of his opportunities in Australia for studying the comparative anatomy of monotreme and marsupial brains. Elliot Smith believed the corpus callosum to be a neomorph which is characteristic of eutherian mammals, and he suggested that its development was facilitated by the bilaminar formation of the fornix commissure which is developed in the marsupial brain. This observation also led him to infer the probability of a metatherian ancestry for placental mammals. Elliot Smith further directed attention to the distorting effect of the corpus callosum on the hippocampal formation, whereby the latter becomes stretched out into a thin atrophic layer of grey matter—the indusium. The latter, again, becomes continuous anteriorly with the hippocampal rudiment found in the pre-commissural area of the cerebral hemisphere. All these observations, and the conclusions which are to be drawn from them, have been accepted for many years by most comparative neurologists.

Quite recently, however, the whole question has been raised afresh by the contention of an Australian anatomist—Dr. A. A. Abbie¹—that in its develop-

ment the corpus callosum does not, after all, make use of a previous pathway already established by the fibres of the dorsal lamina of the fornix commissure, but is an entirely new commissural connexion formed along a zone of fusion between the two cerebral hemispheres which occurs *dorsal* to the hippocampus. According to Abbie's interpretation, the indusium is thus not the rudiment of the hippocampus at all, but a representative of an adjacent cortical area, the subiculum.

In a communication to NATURE² Abbie discussed the bearing of his conception of the origin of the corpus callosum on the ancestry of the Eutheria. It is interesting to note, however, that his conclusions do not differ essentially from those inferred by Elliot Smith on other grounds, for Abbie contends that the expansion of the neocortex and the consequent formation of a hippocampal fissure are the minimal requirements for the development of a corpus callosum, and this condition is first realized in the brain of monotremes and marsupials.

But it is important to note that Abbie's interpretation of the development of the corpus callosum has not passed unchallenged. In the current issue of the *Journal of Anatomy* another anatomist in Australia, Prof. F. Golby, has subjected the new thesis to a very critical examination³. His observations suggest that Abbie has been misled in his interpretation of microscopic sections by the distortion of the hippocampal formation at the sub-splenial flexure, a distortion which has resulted in a reversal and displacement to a dorsal position of some of the fibres of the fornix commissure (forming the fornix superior), as well as in an illusory appearance in the position of the corpus callosum relative

to the hippocampus. Moreover, Goldby reproduces what appears to be a very convincing photomicrograph of a sagittal section of the brain of a rat which illustrates the precommissural hippocampal rudiment extending *dorsally* to the genu of the corpus callosum to become directly continuous with the indusium. Other observations of Goldby on the brain of a bat, *Eptesicus*, in which the disturbing influence of a subsplenic flexure is absent, also indicate that (as Elliot Smith maintained in his classical studies) the corpus callosum of placental mammals really does

lie morphologically ventral to the hippocampus or its vestiges.

It remains to be seen whether Dr. Abbie's theory will find acceptance with other comparative neurologists. It may be suggested, in any event, that it will require to be supported by embryological evidence before it is found to be acceptable.

¹ "The Origin of the Corpus Callosum", *J. Comp. Neurol.*, 70, 9 (1939).

² "The Ancestors of the Eutheria", *NATURE*, 144, 523 (1939).

³ "On the Relative Position of the Hippocampus and the Corpus Callosum in Placental Mammals". *J. Anat.*, 74, 227 (1940).

A ROMAN TOWN IN EAST YORKSHIRE

THE completion of five seasons excavation in the Bozzes Field, at Brough, East Yorkshire, affords an opportunity for a summary of the results of the investigation. Although further excavation may necessitate modification of detail, it is considered that the examination of this Roman site has gone sufficiently far to secure the main outlines and conclusions as to its history which have been attempted by Mr. Philip Corder and Rev. Thomas Romans ("Excavations at the Roman Town at Brough, 1937", *Hull Museum Publications*, No. 206; 1939).

Although the site lies within the northern military area and is on a route that was of great strategic importance during the early wars against the Brigantes, its occupation throughout its history, except for a brief period in the first century, was of a civil character. The Parisii of the wolds, in whose territory it was situated, were village dwellers, and no hill-top fort or town is known in the part of Yorkshire which they inhabited. Petuaria, as it is now known the town was called, eventually became the tribal capital and a walled town with Romanized institutions, but in size it never exceeded twelve acres.

Little is known of the life of the Parisii before the Roman conquest, but a settlement has recently come to light at North Ferriby on the north bank of the Humber, placed conveniently on the pre-Roman route across the Humber and at the same time well situated for overseas trade with the Belgae of the Continent, for which evidence is afforded by Samian ware, *terra nigrea* and butt beakers found side by side with native vessels. Occupation, apparently, closes in the middle of the first century, at about the time of, or soon after, the establishment of the Ninth Legion at Lincoln in A.D. 47 and the construction of Ermine Street. North Ferriby was then abandoned and the inhabitants, moving about three miles up the river, founded Petuaria at the point where Ermine Street crosses the Humber.

The phases of occupation may be summarized in brief as follows: The original settlement, little more than a kraal of native huts, without defences or regular plan, was swept away and the sites of the huts levelled to make way for the first Roman town in the opening years of the second century. This town also was without defences. For a period after A.D. 71 a semi-permanent military base camp existed north of the settlement, which was abandoned after the construction of a great permanent fort farther north at Malton. In the reign of Trajan at the turn of the century grandiose plans were initiated for rebuilding the whole town in stone in Roman fashion.

Massive foundations were laid and good roads made for the first time. These plans were never carried to completion.

The reason for the interruption, which appears also at Malton, is unknown. Early in the reign of Hadrian, building was resumed, attention being directed first to the defences, for which the earlier plan had made no provision. These defences are contemporary with Hadrian's Wall. The earliest buildings in stone within the town now appear, but their construction is poor and suggests haste. Thirty or forty years later much building activity is evident. In the reign of Antoninus Pius the defences, in which ramparts of turf had been employed, were entirely reconstructed in stone, a massive wall revetment being constructed in front of a rampart of red clay incorporating the earlier turf bank. The Antonine period marks the hey-day of Petuaria, and small though it was, it must have been a centre of Roman culture.

Throughout the third century town life in Britain declined, while large estates and farms flourished. Petuaria shared the general fate. No complete building can be ascribed to this century, though coins and pottery attest a continued occupation. It shared also, however, in the attempt to revive town life in the fourth century under Constantius Chlorus. The town walls received massive rectangular towers, 25 feet wide and 10 feet deep. Within the town old buildings were reconducted and new ones constructed. The attempt to put new life into the town failed here as elsewhere and beyond a few minor alterations to existing structures no building within the town can be attributed to a later date than the beginning of the fourth century. The coin list dwindles and ends with single coins of Gratian and Magnus Maximus, while late fourth century pottery of the period of the coastal signal stations occurs only sparsely. It is impossible to resist the conclusion that the life of Petuaria had already shrunk to insignificance at the time when the farms of the wolds were still prosperous.

Evidence of the status of Petuaria is afforded by an inscribed stone set up in the reign of Antoninus Pius by M. Ulpianus Januarius, *aedile* of the *vicus*, to commemorate work done at his own expense in connexion with a theatre. Normally the *vicus* was unimportant and the business of its council parochial. The existence of an *aedile* at Petuaria implies the dignity of a self-governing *civitas* with full jurisdiction over all the *vici* in its territory. This in conjunction with other evidence would go to show that Petuaria had now become the seat of cantonal authority.

MECHANISM OF DRUG ACTIVITY

"HOW DO DRUGS ACT?" was the subject of an address delivered by Sir Walter Langdon-Brown to an evening meeting of the Pharmaceutical Society on February 13. He classified the principal ways in which drugs act thus: (1) they increase or diminish the effects of stimuli reaching the cell from without; (2) they modify the chemical changes occurring within the cell itself; (3) they may themselves be so altered in chemical constitution by the cell as to be capable of fresh activity, yet with diminished toxicity. He illustrated each of these methods by examples, some of the best illustrations of the first group from hormones, of the second from vitamins, and of the third from chemotherapy.

It was little realized at the beginning of this century that a new era had dawned when Langley showed that the effect of adrenaline on any part was the same as if the sympathetic nerve to it had been stimulated; it merely seemed an interesting example of a chemical substance imitating a nervous stimulus. But it was much more important than that; although adrenaline has no effect on a structure which has never received a sympathetic innervation, Elliott found that cutting off that innervation did not abolish the effect of adrenaline on a structure which had once possessed it. On the contrary, its effect was actually increased. For this reason both Langley and Elliott independently put forward the theory of a receptive substance beyond the nerve ending, on which the drug acted. Sympathetic stimulation has been found to produce adrenaline at the nerve endings; this is in addition to the adrenaline always stored up in the medulla of the adrenal gland which can be drawn upon as an emergency ration when there is a sudden demand for widespread action of the sympathetic for purposes of defence. Other

illustrations were given showing how the normal transmission of the nervous stimulus is effected and the ways in which it may be interfered with or assisted by certain drugs.

Sir Walter next gave some examples of the way in which drugs may act by modifying the chemical changes within the cell itself; he started by discussing some of the activities of thyroid extract, the quickening effect of which on metabolism has been described as the draught to a fire.

Other observations on drugs and oxidation processes were followed by extensive references to vitamin C (ascorbic acid), which is now so widely used as a drug. As a strong reducing agent, it acts by balancing oxidation and reduction changes in the cell. Much study, said Sir Walter, has been recently directed to vague ill-health, short of that necessary to induce scurvy, due to lack of vitamin C. He gave an example which showed clearly that a specific case of vague ill-health was due to dietetic deficiency, and the material ascorbic acid was ready to hand to re-establish healthy oxidation and reduction changes within the cell.

Chemotherapy illustrates the third group, the alteration of a drug by the cell so that it assumes fresh activity yet with diminished toxicity. Sir Walter said that the treatment of any malady with a chemical agent of known composition may be included, strictly speaking, in the term chemotherapy, although it is almost universally limited to the treatment of parasitic diseases by chemical disinfection or control of the causative agent without producing marked toxic effect on its patient. The specific effects of drugs such as emetine in amoebic dysentery and arsphenamine in syphilis depends upon their chemical interactions with some constituent of the living cell.

MILK AND NUTRITION

A FULL account of a large-scale trial of the effects of giving various milk supplements to children at school is given in the final report of the Milk Nutrition Committee ("Milk and Nutrition". Part 4. National Institute for Research in Dairying, Shinfield, Reading. 2s. post paid). The researches of the Committee have been undertaken to compare the nutritive values of raw and of pasteurized milk. In the present report, results are given of tests upon school children of the growth and health-promoting properties of supplements of $\frac{1}{3}$ or $\frac{2}{3}$ pint of milk—amounts the same as those which figure in the Milk-in-Schools Scheme of the Ministry of Health.

Some eight thousand children from five different areas were divided at random into four groups, to receive, over one year, a daily ration at school of (1) biscuits; (2) $\frac{1}{3}$ pint of pasteurized milk; (3) $\frac{2}{3}$ pint of pasteurized milk; and (4) $\frac{2}{3}$ pint of raw milk. The children were periodically examined, measurements being made of their physique together with assessments of their state of nutrition, intellectual ability, and other features such as posture and complexion.

The general trend of the figures obtained, set out in a number of tables, shows that the children given milk supplements increased in height, chest-circumference, and strength of pull to a greater extent than those receiving biscuits, and also improved more in their general state of nutrition and in their teachers' assessment of their ability. In addition, those on the larger milk supplement usually showed an improvement above those on the smaller, while there was no consistent difference between those on similar supplements of raw and of pasteurized milk. The advantages accruing to the milk-drinkers compared with the biscuit-eaters were small, though uniform and significant, amounting to less than $\frac{1}{10}$ in. in height and $\frac{1}{4}$ -1 lb. in weight over the whole year during which the experiment was in progress. There was, unfortunately, no means of control over the home diet, and it is therefore possible that some given biscuits may have received additional milk at home, while milk-drinkers may have had extra biscuits.

A summary of the previously reported results of laboratory experiments on animals and feeding trials on calves is also given in this report.

SEVENTY YEARS AGO

NATURE, vol. 1, February 17, 1870

Measurement of Geological Time

THE first of two articles by A. Russel Wallace on this subject appears. "Modern geological research has rendered it almost certain that the same causes which produced the various formations with their embedded fossils have continued to act down to the present day." This, Wallace points out, should make it possible to estimate the time represented by the whole series of formations, but the changes observed are too minute and too imperfect for such an estimate to be of value. The gaps in the record might be filled from observation of the changes of animal and plant life presented by each formation. "To measure geological time, therefore, all we require is a trustworthy unit for the change of species: but this is exactly what we have not yet been able to get; for the whole length of the historical period has not produced the slightest perceptible change in any living thing in a state of nature."

Wallace then gives a summary of astronomical evidence on the subject, referring in considerable detail to Croll's calculation of the eccentricity of the earth's orbit and the precession of the equinoxes in relation to the production of climatic changes. "Mr. Croll considers astronomical causes to be the most important and effective agents in modifying climate while Sir Charles Lyell maintains that the distribution of land and water, with their action on each other by influencing marine and aerial currents, are of preponderating importance."

The Newall Telescope

"The 25-inch Equatorial Telescope, commenced several years ago by T. Cooke and Sons, of York, for R. S. Newall, Esq., of Gateshead, is now so far completed that it has been removed from the works at York into its observatory in Mr. Newall's grounds at Fern Deal. The completion of a telescope with an object glass of 25 inches aperture marks an epoch in astronomy, and its completion in England again places us in the front rank in the matter of the optical art."

The tube of the instrument was 32 ft. long, and cigar-shaped; it was constructed of steel plates riveted together; focal length of lens, 29 ft. A full-page wood-cut of the instrument was printed.

PROFESSOR LIEBIG disputes Pasteur's view that the decomposition of sugar in fermentation depends on the development and multiplication of yeast-cells and that fermentation generally is only a phenomenon accompanying the vital process of yeast. He expresses the opinion that Pasteur's researches have not explained fermentation; but have only made known another phenomenon—the development of yeast—which equally requires explanation.

The *Lancet*, in speaking of the arrangements of hospitals, instances, as much needing reform, the system of grouping together indiscriminately in medical words, cases of various affections, in an atmosphere which may be destructive to some patients while it is suitable to others. Thus we may find lying side by side a case of bronchitis and one of fever; a patient with phthisis and another with gangrene of the lung.

APPOINTMENTS VACANT

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

HEADMASTER of the Technical School, Oldbury—The Director of Education, County Education Office, County Buildings, Worcester (February 21).

BOROUGH ENGINEER AND SURVEYOR, BUILDINGS SURVEYOR AND SURVEYOR TO THE LOCAL EDUCATION AUTHORITY—The Town Clerk, Town Hall, Eastbourne (February 29).

HEADMASTER at the Queen Mary's (Boys) School, Basingstoke—The County Education Officer, The Castle, Winchester (March 1).

PROFESSOR OF CHEMISTRY—The Registrar, University of Allahabad, Allahabad, India (March 31).

PROFESSOR OF PHYSICS—The Registrar, University of Allahabad, Allahabad, India (March 31).

ENTOMOLOGIST to the South African Sugar Association—The Director, Sugar Experiment Station, Mount Edgecombe, Natal, South Africa.

TEMPORARY METEOROLOGICAL ASSISTANTS (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

ENGINEER for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9113).

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9114).

SUPERINTENDENT ENGINEER to the South Wellan Internal Drainage Board—Calthrop and Leopold Harvey, Clerks to the Board, Solicitors, Spalding.

MINERALOGIST OR GEO-CHEMIST—The Director of Research, British Pottery Research Association, Queen's Road, Penkhull, Stoke-on-Trent.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1938. Pp. v+277. (London: H.M. Stationery Office.) 4s. 6d. net. [29]

Ministry of Health. Memorandum on Scabies. (Memo. 229 Med.) Pp. 8. 2d. net. Memorandum on the Louse and how to deal with it. (Memo. 230 Med.) Pp. 12. 2d. net. (London: H.M. Stationery Office.) [22]

Other Countries

Journal of the Indian Institute of Science. Vol. 22A, Part 21: Investigations on the Nature of Additions of Aliphatic Diazo-Compounds to Conjugated Double Bonded Systems; Action of Diazo-methane and Ethyl Diazo Acetate upon Cyclopenta- and Cyclohexa-Dienes and their Derivatives. By P. C. Guha and G. D. Hazra. Pp. 263-274. 1 rupee. Vol. 22A, Part 22: Synthetical Investigations in the Thujane Series, Part 9: A New Method of Synthesis of Umbellulonic Acid, by P. C. Guha and M. S. Muthanna; Part 10: Experiments on a Total Synthesis of Thujone; Synthesis of an Isomer of α -Thujadicarboxylic Acid (1-isopropyl-1-carboxy-cyclopropane-3-acetic acid), by P. C. Guha and M. S. Muthanna; Part 11: Synthesis of an Isomer of α -Thujadicarboxylic Acid (1-isobutyl-cyclopropane-1:2-dicarboxylic acid), by P. C. Guha and M. S. Nande. Pp. 275-286. 1 rupee. Vol. 22A, Part 23: Reactions of Chromates at High Temperatures, Part 11: Structures of Chromium Chromates. By D. S. Datar and S. K. K. Jatkari. Pp. 287-308. 1.8 rupees. Vol. 22A, Part 24: Reactions of Chromates at High Temperatures, Part 12: Magnetic Properties of Chromium Chromates. By D. S. Datar and S. K. K. Jatkari. Pp. 309-316. 12 annas. Vol. 22A, Part 25: Synthetical Experiments in the Pinane Group, Part 6: Further Attempts to Synthesise Pinonic Acid, Nopinone and Verbenone, by P. C. Guha and P. I. Narasimha Rao; Part 7: Total Synthesis of Verbenone; a New Total Synthesis of α and β -Pinenes, by P. C. Guha and P. I. Narasimha Rao. Pp. 317-330. 1.2 rupees. Vol. 22A, Part 26: Activation and Clarifying Properties of Fuller's Earth, Part 6: Adsorption of Colouring Matter by Fuller's Earth in Decolorisation of Oils. By B. S. Kulkarni and S. K. K. Jatkari. Pp. 331-340. 14 annas. (Bangalore: Indian Institute of Science.) [301]

Ministry of Public Health, Egypt: The Research Institute and the Endemic Diseases Hospital. Fifth Annual Report, 1935. Pp. x+68. (Cairo: Government Press.) [12]

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1939. (Publication 3552.) Pp. ix+139. (Washington, D.C.: Government Printing Office.) 20 cents. [12]

Catalogues

Catalogue of Optical Projection Apparatus. Part 3: The 'Newton' and 'Wigmore' British Episcopes. Pp. 28. (London: Newton and Co.)

Epidemic Influenza Virus Suspension I.V.S. (B.D.H.). Pp. 8. (London: The British Drug Houses, Ltd.)

Natural History: Insecta Varia. (List No. 4.) Pp. 40. (Den Haag: Antiquariaat Junk.)

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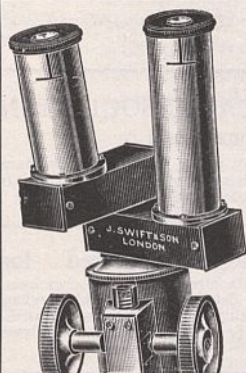
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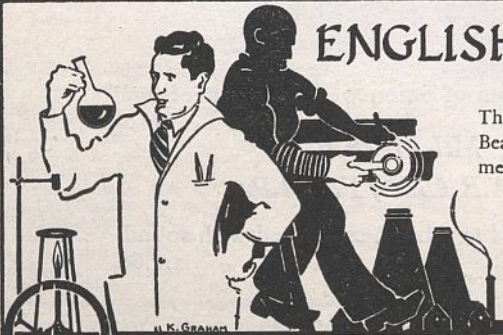
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