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Vol. 146, No. 3689

SATURDAY, JULY 13, 1940

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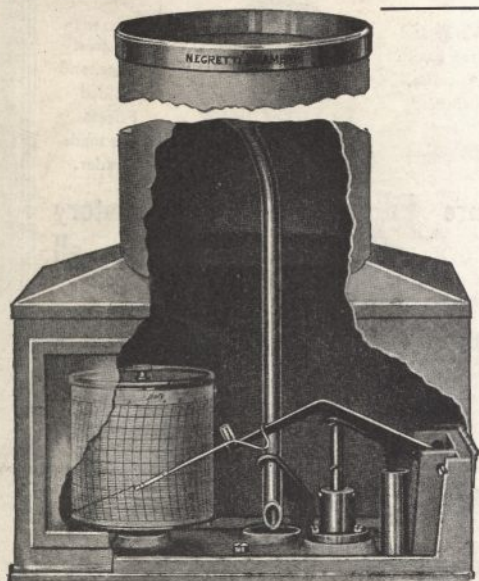


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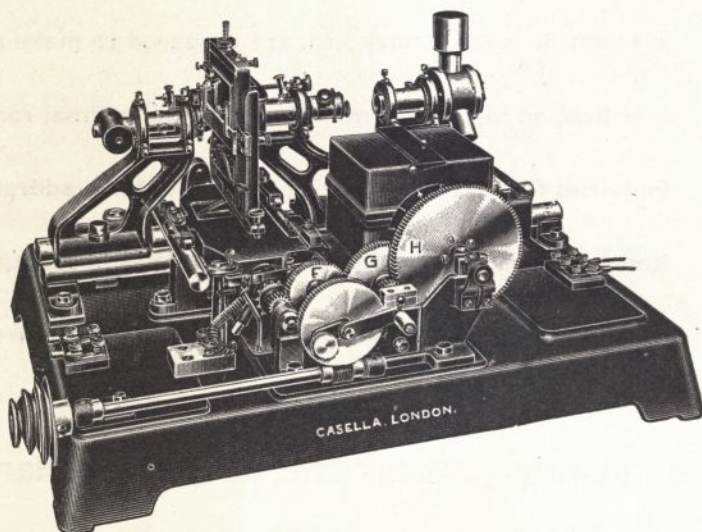
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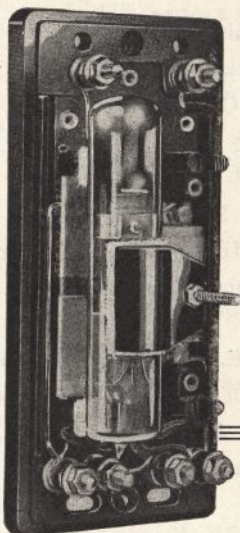
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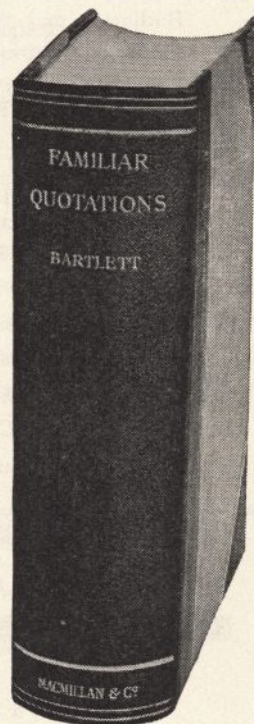
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## THE FUNCTION OF THE PRESS

**A**N important declaration of policy was made by the Lord Privy Seal, Mr. Attlee, on July 3, in answer to a Parliamentary question regarding the liberty of the Press. He said :

“The policy of the Government is to interfere as little as possible with the liberties of the Press to express freely their opinions and comments on the conduct of the war or on supposed peace overtures.” He pointed out, however, that information useful to the enemy can be included in statements that appear to be opinion only, and that the Government was not prepared to undertake not to interfere with such statements.

The question and answer came as a sequel to a number of comments in the daily Press which seemed to indicate that an extension of the present method or scope of censorship was imminent, and they will reassure public opinion to some extent. In these critical days, it cannot be denied that a measure of censorship is necessary. On the other hand, one of the fundamental issues of the conflict is the right to freedom of the Press, freedom of speech and thought for the individual. How can these contradictions be resolved? Under the present system, editors of journals are responsible for seeing that nothing likely to be of use to the enemy is published by them. When doubt arises, the matter can be submitted to official censorship. On the whole, the method has worked well. The Press in Great Britain has grown up in an atmosphere of free discussion, and it recognizes the need for the present restrictions in the interests of the welfare of the country and the cause to which we are committed. It is not prepared, however, to accept interference with its long-established function of criticism of policy and action.

So far as the lay Press is concerned, the question

of censorship is concerned mainly with the publication of news in letterpress and pictures of events, of weather conditions and similar information, much of which, if not carefully weighed, would be of considerable value to the enemy. The technical Press is somewhat differently affected. Among other matters, a strict watch has to be kept so that information as to the location of new industries is not disclosed, and industrial developments or progress must obviously be treated with caution.

In *NATURE*, the problem is different again. All scientific advances can be regarded as possibly of service to the enemy; but to follow this line of action literally would be tantamount to suppressing the diffusion of knowledge. In consequence, all communications submitted for publication in the correspondence columns of *NATURE* are examined carefully from this point of view and in the light of knowledge of current events; and the Editors have not hesitated to take further advice when an element of doubt has seemed to be present. Many contributors are themselves doing work of national importance, and they should know at once whether their results ought or ought not to be published. On the other hand, many others whose duty it is to carry on their normal work, will naturally wish to inform their fellows of results obtained. They should then ask themselves whether their work is likely to have practical applications which might be of service to the enemy.

Another function of *NATURE* is to keep scientific workers and others informed by means of descriptive articles of the progress made in selected subjects. Here again the needs of the times have to be borne in mind, and in addition to surveys of progress, *NATURE* is publishing articles dealing with topics of immediate impor-



tance, such as those now appearing on various aspects of the utilization of waste materials.

It is, however, in the matter of leading articles and critical notes that NATURE is perhaps most deeply concerned in the freedom of the Press. A rigidly controlled Press is a characteristic feature of totalitarian rule, echoing with fulsome monotony the official view. It is equally characteristic of the democratic system that officialdom is open to

criticism, out of which comes further progress. This is the particular 'freedom' for which a journal such as NATURE must stand; not the freedom to make malicious attacks on the policy of Government, but the freedom to make constructive criticism in order to promote the cause we all have at heart. It is a hardly won privilege, which we have used, and shall continue to use, with a keen sense of responsibility.

---

## SCIENTIFIC METHOD IN ADMINISTRATION

THE willingness and cheerfulness with which the whole nation has accepted the drastic restrictions now being placed on civilian supplies and the use by the Minister of Labour and National Service of the wide powers of control which he now possesses over labour and industry, are a measure of the determination of the British people to continue the struggle for freedom in the world. The magnificent response of labour to Mr. Bevin's appeal indeed shows that the people of Great Britain have shed any lingering illusions as to the magnitude of the effort demanded of them all, but it would be unfair to place all the responsibility for this apparent change on the dramatic swiftness with which the tide of war has rolled towards our own shores since the invasion of the Low Countries and France. Part at least of the response is due to a leadership for which many had been impatiently waiting for months.

The changes and effort involved in the transference from a peace-time to a war economy have been reviewed in a number of admirable broadsheets issued by PEP (Political and Economic Planning), notably under the titles "The Home Front" and "Industrial Man Power", and the second of these broadsheets reviewed the position up to the recent change in Government. Since then we have moved much nearer to a full war economy. It has become a matter of life and death that the habits and customs of a *laissez-faire* society should be abandoned, and the economic and social implications of modern warfare be fully recognized. Just as the new order gives the Minister of Labour full and drastic powers over every man and woman in the land to ensure the most effective use of the nation's resources of man or woman-power, so the new rationing order limiting supplies to home consumers, issued by the

Board of Trade, supplies the power to check any who are still reluctant to curb their own private requirements at a time of national need.

Fully as significant, however, as the evidence that these developments afford that the Government possesses a definite economic policy and the vision and vigour to elaborate it into the detail required, is the fact that they have been gladly accepted by a nation which was indeed largely impatient for them. For that, as we have said, credit must be given to wise and imaginative leadership, alive to the necessity of education in a constructive enterprise of this magnitude. By taking the people into its confidence, the Government kindled their imagination and paved the way for the magnificent response which in due course will enable us to wrest the initiative from the enemy, and bring final success to our efforts.

Neglect of such educational work has been an important factor in the failure of the earlier evacuation schemes for school children, and there are still many fields such as rationing, the restriction of private purchases, and civil defence, in which educational work is still required. This may well be one of the directions in which the Ministry of Information may make important contributions. With such education, there must go the utmost diligence to see that the full purpose of the new efforts is not impeded by vested or private interest of any kind. Nothing can be tolerated which is liable to endanger confidence in the impartiality or integrity of our leadership; this has special significance in considering the restriction of certain forms of sport or pleasure or of the production of some types of foodstuffs or beverages.

We are none the less entitled to the conclusion that in these difficult and anxious days, we have now a Government which is in advance—even if



only a little—of public opinion, and not far behind it in its ideas of the sacrifices and effort that must be made, and made at once. This fact and the opportunities thereby opened up constitute at least one reason for hope in a desperate situation. If our present intense effort is wisely and effectively organized, we can gain the time and opportunity, as the full power of our resources is brought into play, to deal with those many interlocked problems not merely of a war economy but also of reconstruction after the war. We have at least come within sight of leadership of a quality competent not merely to organize effectively our resources for war but also to use wisely the immense opportunities which the catastrophe of war gives us of overthrowing obstacles which have impeded the development of society in time of peace.

It is well that this question of reconstruction should remain in our minds even at this critical hour, for many of the problems with which we are now dealing urgently are vitally related to them, and it may well be that the solutions to some of our longer range war problems and those of reconstruction may be found on similar lines. The immediate problems involved in the most efficient use of our man-power have their bearing on the unemployment problem, the magnitude of which after the War may well be determined by the lines on which our labour problems are now handled. Measures affecting the mobility of labour, its training in new types of skill, the neglect or encouragement of technical education, and the care taken in regard to training in safety methods or the safeguarding of health, whether in respect of hours of work, or factory or workshop conditions such as lighting, ventilation or the like, may have as a significant influence on the morale and adaptability of the industrial population after the War as on the efficiency of our immediate war effort.

That the Ministry of Labour has taken over from the Home Office the whole administration of the factory, including the health and welfare provisions, and that the Factory Department of the Home Office is now incorporated for the duration of the War in a new department of the Ministry of Labour called the Factory and Welfare Department, are signs that concern with the short-range problems of immediate intensive production will not lead to those of a long-range policy being overlooked. Steps have also been taken, at long last, to facilitate the development of a food policy based on scientific knowledge and control; in no other field could a scientific policy have more far-

reaching and beneficial effects both after as well as during the War. The building industry and the shipping industry are two further examples where policy or machinery established during war-time must have far-reaching repercussions on recovery.

If there are thus signs not only of energy but also of the forward-looking mind in the leadership of the Government, there is one element in the situation which has given rise to some misgivings. In his volume "Security: Can we Retrieve It?" published shortly before the War, Sir Arthur Salter directs attention to the desirability of strengthening the Civil Service by reinforcing its personnel, at the top with leading men in industry and science, and throughout its ranks with young men of energy and constructive ability. Sir Arthur urged that only in some such way could the present machinery of civil government become competent to deal even with the task of preparation for war, for which in some ways the Civil Servant's experience is a definite handicap to him. The importance of bringing fresh blood and new methods of training into the administrative class of the Civil Service was also emphasized by Prof. Ernest Barker in an essay in the *Political Quarterly* so long ago as 1936 and afterwards reproduced in "The British Civil Servant" edited by Dr. W. A. Robson.

Failure to implement such criticisms or suggestions has in the meantime led to widespread concern as to whether the Civil Service, and with it the local government service, is capable of taking the measure of its war-time task. To exert our maximum effort, it is not sufficient to change Ministers and Under-Secretaries and to deal justly with causes of Parliamentary inefficiency. The increasing extent to which under modern conditions the permanent Civil Service has come to control the key-points in national administration makes it essential that we should consider carefully whether, by outlook, training and technique, this machinery is competent to discharge its duties at the tempo demanded by war-time conditions.

In such an examination there is, of course, no suggestion of departure from the high traditions of integrity, capacity and devotion to duty which have given the British Civil Service its world reputation. What has to be recognized is that the Civil Service attained its position of eminence in easier and more spacious days than our own, and that the fundamental principles of lengthy examination of all proposals and minute control of expenditure, on which its work is based, operated



formerly in a restricted field. There is now real danger that loyalty to these principles, good and sound in themselves, may be carried to a point which delays action where speed is essential to safeguard our very existence.

It is now generally recognized that the growing complexity of the task of national administration, in peace no less than in war, makes demands on the machinery for which training in precedent is not the primary qualification. Parliamentary government indeed depends for its efficiency upon the existence of a body of permanent officials, serving all Governments alike and preserving the continuity of stabilizing traditions. Nonetheless, it is essential that this permanent service should be characterized not merely by vigilance, integrity and loyalty to tradition, but also by receptivity to new ideas and flexibility of mind. Absence of such receptivity and flexibility, it is argued, are seriously affecting our war effort.

This position is attributed not merely to defects in training, among which the absence of a scientific outlook may well be noted. It is attributed also to the destruction of ability in the War of 1914-18, which robbed the Civil Service of many who would now have been its natural leaders. It is attributed also to the tendency of policy in the last eight years to sap the vigour and integrity of public life, checking initiative and independence in the Civil Service, thus fostering the worst features of bureaucracy.

If the immediate needs of the hour are to be served no less than those of reconstruction and re-integration after the War, some means must be

found immediately of redressing this situation, whether by bringing in fresh blood or giving real opportunity to the younger men of first-class ability who are undoubtedly to be found in the Civil Service. Besides the introduction of ability from outside and the extension of transfers or promotion, devolution of authority at the lower levels to hasten decision is no less imperative than changes in personnel. There is no room for inertia or for the leisurely methods of an earlier period. We must be prepared when necessary to take drastic action to secure competence and prompt and efficient administration; only thus can we hope to see the immense resources of good will and effort stirred up by the challenge of recent weeks directed into the channels which will best serve the national purpose. From top to bottom of the administrative machine, there must be an energy and drive no less intense than that which has led so many to sacrifice leisure hours, possessions and life itself at the nation's call. Coupled with it there must be a sense of values and a width of outlook which will ensure the weighing of all factors and the basing of decisions on facts no less scientifically or surely ascertained because they are determined at the same pressure and strain which the whole nation now endures. Scientific workers may well hope that changes in the Civil Service imposed to meet our immediate War needs may facilitate the speed of a scientific outlook which will lead to much more effective use being made of our scientific resources to all departments of the national life.

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## TOWARDS THE NEW SYSTEMATICS

### The New Systematics

Edited by Julian Huxley. Pp. viii+583. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 21s. net.

**D**R. HUXLEY and his co-authors have succeeded in producing a book which makes most stimulating reading. In all, twenty-two authors have contributed a chapter each and, as mentioned in the foreword, British authors predominate, since it was felt that this would facilitate the co-ordination of the articles. Where Great Britain could not supply a suitable authority on some subject, authors of other nationalities were invited to write a chapter. Some idea of the ground covered may be obtained from a few of

the chapter headings taken at random: A museum zoologist's view of taxonomy; Mutations and geographical variation; Ecological aspects of plant taxonomy; Problems of the origin of species; Polymorphism and taxonomy; The statistical consequences of Mendelian heredity in relation to speciation; Taxonomic species and genetic systems; The new systematics of cultivated plants; and so forth. Minor systematics have naturally received the greatest share of attention for the very good reason that it is the minor units which most urgently require attention, and also, as it happens, they are the most amenable to experimental analysis.

If the reader expects to find concrete suggestions for a radical revision of the present taxonomic



system he will be disappointed, for the book is mainly concerned with the discussion, in the light of recent experimental evidence, of the processes which are responsible for initiating and maintaining population differentiation. In fact it provides an admirable survey of the present-day problems which confront the systematist and his colleagues in other fields of biology.

A point of particular interest to all taxonomists which emerges from this general survey is that the available evidence amply justifies the majority of species being regarded as truly biological units separated from each other largely by genetical or chromosomal barriers to free interchange of genes. Nevertheless, in certain circumstances this isolation may be broken down and a complicated system created; such a case is illustrated in Chapter iv. At a lower taxonomic level the study of micro-evolutionary processes is of equal, if not of greater importance to the systematist, for unless the variational categories are given due consideration it can scarcely be hoped to put minor systematics on a satisfactory footing. The new mathematical interpretation of the consequences of selective processes operating under different conditions has obvious taxonomic implications, and in Chapter v it is shown that random differentiation is likely to be favoured when the breeding community is very small. Examples of differentiation probably due to this cause are given in Chapter ix.

Sometimes the formation of closed breeding communities may have rather unexpected results, results which may have little or no hereditary basis. For example, although structural differentiation is not involved, the chaffinches in the southern U.S.S.R. can be distinguished "solely on the basis of variation in song, into well-defined populations each confined to a given area" (Chapter xi). In Chapter iii, however, it is pointed out that territorial fragmentation of a population is not necessarily a sure guide to the degree of isolation actually afforded to its local colonies; this gives point to the value of careful field work in connexion with taxonomic investigations. Moreover, the methods of collecting suitable samples for taxonomic work deserve much more thought than hitherto: to give only one example, for a critical examination of polymorphic populations it may be necessary to collect a series of samples over a period of years for reasons mentioned in Chapter xix.

Some biologists will, no doubt, disagree with the view expressed in Chapter xv to the effect that for a classification to be natural it must necessarily be phylogenetic. It is fairly certain that any classification involving minor units is bound to include many populations of known biological significance, but

the precise 'natural' affinities of which are simply a matter for conjecture. In contrast, a natural classification is defined in Chapter xvii as one "which groups together individuals having a large number of attributes in common, whereas an artificial classification is composed of groups having only a small number of common attributes . . . both types are created by the classifier for the purpose of making inductive generalizations regarding living things". One obvious advantage of an interpretation of a natural classification in this logical sense is that it does not carry with it the implication that classifications which are not 'natural' are merely keys for convenience and thus devoid of true biological meaning.

Under the present taxonomic system it is usually possible to refer an individual specimen in terms of morphology to its proper species. This means that the species represents both a discrete morphological class and, as mentioned previously, a true biological unit. But unfortunately, as many examples throughout the book show, this coincidence of the biological unit with the morphological class by no means invariably holds. Apart altogether from the fact that some differentiated biological units possess no distinctive morphological features, there are many other instances where minor populations can only be distinguished by their different average expressions of one or more quantitative characters, or by different proportions of contrasting qualitative characters. That is, discreteness in terms of morphological discontinuity is frequently lacking. But since characters of this kind are undoubtedly valuable as guides to the biological status of populations, although not being of primary classificatory value themselves, taxonomic emphasis in such cases must be shifted from the morphological class to the population's variational category as determined by a combination of morphological, ecological, genetical and cytological investigation.

The question therefore arises: Should units, so difficult to define with morphological precision, be incorporated in the existing taxonomic system? Essential as the delimitation of minor populations is for both theoretical and economic reasons, it would be most unfortunate, as is clearly indicated in Chapter xviii, if by widening the scope of traditional taxonomy its practical functions were to be diminished in the process. The alternative is to adopt a subsidiary classification with its own distinctive terminology. Many new taxonomic categories have been proposed within recent years (a few of which may yet find a place in some such subsidiary scheme), and it is perhaps a pity that their relative merits or demerits have not been critically discussed in the present volume.

J. W. GREGOR.



## GROUP THEORY

### The Classical Groups

Their Invariants and Representations. By Prof. Hermann Weyl. (Princeton Mathematical Series, 1.) Pp. xii+302. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1939.) 4 dollars.

### Topological Groups

By Prof. L. Pontrjagin. Translated from the Russian by Emma Lehmer. (Princeton Mathematical Series, 2.) Pp. ix+299. (Princeton, N.J.; Princeton University Press; London: Oxford University Press, 1939.) 4 dollars.

IT is convenient to review these two books together since they are complementary to each other, with a negligible overlap, and there is an interesting contrast between their characteristic features. Between them they present some of the most interesting work which has been done on groups during the last twenty years, largely by the two authors themselves, and the Princeton University Press is to be congratulated on the first two books in its new series.

The groups which are indicated by the title of Weyl's book are the full group of linear transformations,  $GL(n)$ , the orthogonal group,  $O(n)$ , and the symplectic group,  $Sp(n)$ , in Cartesian  $n$ -space. The co-ordinates for the latter are taken from a given field, which is subject to certain conditions, but need not be the field of real or of complex numbers. The symplectic group is what has often been called the complex group, namely the subgroup of  $GL(n)$  ( $n$  even), under which a non-degenerate, skew symmetric bilinear form is left invariant.

Using the idiom of some thirty years ago—for nowadays the theory of groups, and especially the algebraic part of the Lie theory, is often included in the term algebra—these groups are studied from the algebraic point of view, rather than that of group theory. That is to say, nearly everything in the book is subordinated to a description of their algebraic invariants and representations in tensor space, as apart from their pre-eminence among the simple Lie groups. Whereas the classical theory of algebraic invariants, of which Cayley and Hilbert were the alpha and omega, was almost entirely confined to invariants under  $GL(n)$ , Weyl emphasizes the fact that each group has its own invariant theory. This fact, as he points out, is particularly significant in the light of Klein's description of a geometry as the theory of a transformation group. The account of invariants centres around the problem of constructing,

first a basis for the rational, integral invariants of one or more vectors, under a given group, and secondly a complete set of relations between these basic elements.

As a preliminary to the discussion of representations in tensor space there is an account of linear associative algebras, with special reference to simple algebras and the commutator algebra of a given algebra. This is divided into two parts. The first contains an account of representations, and Wedderburn's theorem that any simple algebra is equivalent to a complete matrix algebra, with elements in some division algebra. The second part explains the reciprocity between the invariant sub-spaces in the regular representations of the group ring,  $\rho$ , of a finite group, and the sub-spaces which are invariant under the commutator algebra of a given linear representation of  $\rho$ . This is applied to the representations of  $GL(n)$  in tensor space by taking  $\rho$  to be the symmetric group in  $f$  things, and deriving the primitive idempotents from the Young symmetrizers.

Two chapters on the representations of  $O(n)$  and  $Sp(n)$  are followed by what is, perhaps, the kernel of the book, namely, the chapter on characters. The characters of a given representation of  $GL(n)$ ,  $Sp(n)$  or  $O(n)$  are calculated with the help of the unitary group. Two methods are given. The first is transcendental in that it involves some simple topological and analytical considerations. The second is purely algebraic and depends on the relation between the representations of  $GL(n)$  and of the symmetric groups. The Poincaré polynomials for the various groups considered are given at the end of the chapter. The book concludes with second chapters on invariants and on matrix algebras.

Pontrjagin's book opens with three fairly elementary chapters, one on the generalities of group theory, one on topological spaces, and one on topological groups. These are followed by a chapter on the representations of an arbitrary compact group satisfying the second axiom of countability, which is based on the construction of an abstract invariant integral over the group. It is shown that the elements of the matrices which constitute the representations, selecting one from each class of mutually equivalent representations, form a complete set of functions on the group, meaning that a suitable linear combination of these, with constant coefficients of which all but a finite number are zero, provides an arbitrarily close approximation to a given continuous function of elements in the group. The characters of the



representations constitute a complete set of class functions. The next chapter presents the theory of orthogonal, commutative groups, which was developed by Pontrjagin himself in connexion with Alexander's duality theorem. It also gives a brief account of topological fields, including the theorem that the real and complex fields, and the quaternions, are the only locally compact, connected topological fields which satisfy the second axiom of countability. This is followed by three short chapters on Lie groups, compact groups whose dimensionality is finite, and on locally isomorphic groups respectively. The second of these contains von Neumann's solution, for compact groups, of the famous problem, which was proposed by Hilbert, to prove that any 'locally Euclidean' topological group is a Lie group.

The book concludes with a fairly complete account of the foundations of the Lie theory. This does not include the deep algebraic analysis of an infinitesimal group, or Lie algebra as it is now called, which was originated by Killing and carried out by Cartan. But it goes beyond the elements of the subject in giving, among other things, the third fundamental theorem of Lie in its complete form. The proof given depends on E. E. Levi's theorem that any infinitesimal group consists of its maximum invariant solvable sub-group, together with a semi-simple sub-group.

It will be seen from this brief description how the two books complement each other. Weyl presents a very thorough and complete account of certain groups in an algebraic setting. Pontrjagin is interested in general classes of groups and his background is primarily topological. The characteristic theorems in Pontrjagin's book are of the kind whose discovery demands imaginative brilliance, and when discovered can be presented in such a way that they are easy to follow. Of course, this implies a high tribute to the exposition. Indeed, the lucidity with which this book is written amounts in itself to genius, and the translator also deserves high praise. To return to the theorems, they are easy to follow just because of their generality. By contrast, the main theorems in Weyl's book are more special and, at the same time, more explicit. They do not merely assert existence, but actually calculate whatever is in question (a class of invariants, characters, or what not), and are intrinsically more difficult than the type of theorem in which simplicity accompanies great generality. As Weyl says in his preface: ". . . I am convinced that the special problems, in all their complexity, constitute the stock and core of mathematics; and to master their difficulties requires on the whole the harder labor."

J. H. C. WHITEHEAD.

## SCIENTIFIC ADVANCEMENT

### Science Front, 1939

By Dr. F. Sherwood Taylor. Pp. 301 + 8 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1939.) 7s. 6d. net.

THE flood of literature which has recently been pouring into the scientific ocean with each passing day renders it more and more difficult for scientific workers to keep abreast of developments in science other than those in which they are particularly engaged. Usually, too, lack of time and facilities for visiting libraries make it especially inconvenient for non-specialist science advocates like members of the teaching profession to consult, even occasionally, current periodicals. Frequently, their only contact with progress in science is obtained through 'popular' works or standard text-books, and inevitably their teaching becomes antedated, and now that scientific research has acquired a momentum which is little short of bewildering, any means whereby current developments may be more quickly transmitted to other scientific workers, teachers, etc. (and hence to the community at large), should be care-

fully investigated. For this reason Dr. Sherwood Taylor's book is worthy of consideration. The author has selected a dozen topics which, to him, represent the most significant advances made in science in the years up to and including 1939. He has, of course, been unable to include references to the bulk of the original work of 1939, since much of it remains obscure, tentative and unconfirmed. The choice of subjects will not accord with all points of view as to what constitutes the more important developments in science—workers in the applied sciences would undoubtedly feel that they have been rather shabbily treated—but at least the author has revealed a sense of perspicacity.

In the chapter on plant growth there is a historical sketch of the discovery of the auxins and heterauxins and their use in commercial plant-growing processes. Brief reference is also made to recent developments in hydroponics. "Progress in Chemotherapy" is concerned with a description of the methods by which the sulphamide drugs, particularly Dagenan (*M. and B.* 693), were elaborated. The far-reaching



importance of these drugs in treating bacterial infections, such as septicæmia, pneumonia, meningitis and gonorrhœa is graphically presented. In this chapter the author occasionally departs from factual statements and introduces opinions which are highly controversial. It is extremely doubtful, for example, whether Dr. Taylor is justified in speaking for all members of enlightened communities when he writes ". . . there is no community which does not despise the (sexually) impotent with a contempt which the victim himself shares". It is to be hoped that there has been some change of outlook in the 270 years that have elapsed since Mr. Wycherley made a butt of a sexually impotent man in his play, "The Country Wife". A further matter for regret is that some grave moral and social issues are dismissed in a flippant manner.

In other chapters are discussed the steroid compounds and their physiological effects upon human beings, as well as recent investigations in protein chemistry and physics, including an account of the action of intracellular proteinases.

"The War Against Cancer" consists mainly of a description of Kögl's method for investigating stereoisomeric proteins inside the cell. The insulin shock treatment for schizophrenia is adequately described, while in a further chapter is an account of the Bergius, Fischer-Tropsch and other processes for making oil from coal. The chapter on television is involved and confusing, and would offer considerable difficulty to non-specialists in this field. Among other topics discussed are the quartz clock, helium II, present-day atomic hypotheses, the aurora, and finally, an account is given of modern ideas in astronomical science, this being partly devoted to R. A. Lyttelton's binary star hypothesis of planet origin and partly to interpretations about the composition and distribution of bodies in space.

By his industry in collecting material, and his assiduousness in collating it, Dr. Sherwood Taylor has made a substantial contribution to extending the range of science. On its merits his book deserves a wide circle of readers.

T. H. HAWKINS.

## MENTAL TESTS

### The Measurement of Abilities

By Dr. Philip E. Vernon. Pp. xii + 308. (London: University of London Press, Ltd., 1940.) 10s. 6d. net.

IN the past five years or so, the work of the International Institute Examinations Enquiry in Great Britain and elsewhere has, to some extent, awakened the public to the need for some radical revision of the examination system. Those who are alive to this social need will welcome Dr. Vernon's book, for it provides for teachers, school medical officers and students of education generally an up-to-date survey of simple methods which can readily be applied to this end.

Under present evacuation conditions, the necessity for just and accurate methods of assessing the abilities and attainments of school-children is particularly urgent. Large numbers of children will have missed many months of their normal education or will have had their normal course of development hindered or diverted. The discrepancies between ability and achievement will probably become more irregularly distributed in the school population. The book under review gives the teacher, headmaster and school examining bodies a means of overcoming these difficulties.

About half of Dr. Vernon's book is devoted to elementary statistical techniques applicable in

educational work. The author's aim is wholly practical, so considerations appropriate to statistical theory are omitted. A wealth of illustration is provided of almost every type of problem in evaluating ability or achievement that might arise in school or clinic. The remainder of the book is mainly a critical account of mental tests and examinations, especially of the new type. The sections on construction and improvements of new-type examinations are particularly useful.

The author admits that contemporary psychological and educational research, unfortunately, makes far too much use of correlational techniques, while neglecting such valuable methods as the analysis of variance. In spite of this, we find about fifty pages devoted to the former and a brief single page, conveying little, to the latter.

The statement (p. 161) that most ways of factorizing tests "will lead to quite illogical results" must be questioned. If different results are obtained from different methods of factorial analysis, this is because these methods have different objectives and consequently vary in procedure as, for example, in estimating the diagonal cells in a correlation table. The final results of different methods may not be comparable, but they can scarcely be called "illogical".

J. I. COHEN.



## KITCHEN WASTE FOR FEEDING FARM STOCK

By JOHN BEHARRELL,

BRITISH FEEDING-MEALS AND MILK PRODUCTS Co., LTD.

**N**EEDS and risks of war have enforced a drastic reduction in Britain's imports of food for livestock, and because of this the Minister of Agriculture recently warned those farmers who have been mainly dependent on supplies of grain and meal that they must prepare to cut down the numbers of their pigs and poultry to one third by the autumn.

There were on farm holdings in Great Britain in June 1939, 3,750,000 pigs and 63,000,000 poultry—including turkeys, ducks and geese; and a more recent census, taken last spring, showed, according to an official statement, that these numbers had undergone scarcely any diminution. Their management and care represent a considerable industry, and a capital expenditure of far more than £10,000,000 for housing and equipment. Large-scale reductions of pig and poultry stocks would therefore cause considerable hardship and, at the same time, appreciably lessen the available supplies of eggs and bacon.

Search for possible substitutes for imported feeding stuffs has directed attention to edible kitchen scraps, which hitherto have been wasted by the local authorities. Estimates of the quantity of edible kitchen waste produced in Great Britain vary. Mr. Price, an official of the borough of East Ham, said recently that food wastage averages 1 lb. per family daily. On this basis, and representing a family as 4.5 persons, the yearly waste of edible material in Great Britain would exceed 1,500,000 tons. Another authority has placed the national food waste at the much smaller average of 1 ton per 4,000 persons weekly, or rather more than 600,000 tons a year for the whole population. If this conservative basis be accepted, London alone is producing annually more than 100,000 tons of edible waste.

Obviously the best way of utilizing domestic food scraps is to keep poultry or pigs, and the new Order in Council setting aside tenancy and other restrictions on 'back garden farming' will no doubt help in this direction. An active campaign is in progress to stimulate the formation of cottagers' and allotment holders' pig clubs, which will make it their business to collect the food waste. As an inducement to them, the Ministry of Food has promised to earmark a proportion of available feeding meals to supplement the scrap collection.

A few farmers utilize swill from neighbouring towns, but are under compulsion to boil it. Neglect

to boil thoroughly or even at all is declared to have been responsible for numerous recent outbreaks of foot-and-mouth disease and swine fever.

There are urban councils and boroughs enterprising enough to sort out and sterilize edible waste and either sell it to farmers or use it in their own piggeries. Watford, between January 14 and June 8 last, saved 210 tons, and besides selling to nearby farmers, has been feeding as many as 260 pigs at a time. Employees of Tottenham Cleansing Department have been encouraged to keep their own pigs, and now a hundred animals are being fed mainly on house scraps.

But after these and similar praiseworthy efforts have been taken into account, and after full allowance is made for a big prospective increase of poultry and pigs in back gardens, there will still remain an enormous residue of waste.

A new Order by the Ministry of Supply compels the larger local authorities to rescue metal and paper from domestic refuse, and also requires householders to do their part in the salvage. Provisions of the Order may soon be extended to food waste. But while non-perishable substances can be saved and transported at convenient times to conversion factories, food must be handled promptly if decay is to be arrested.

Fortunately, a number of well-equipped factories exist in various parts of Great Britain for the utilization of waste from the fish markets; and, until a few months before the War, were producing more than 70,000 tons a year of white-fish meal. On the declaration of War, more than one half of the country's fishing fleet was occupied on patrol work and other defence duties. The ports of Hull and Grimsby were almost closed and the various white-fish meal factories from Aberdeen in the north to London in the south were laid idle because of the lack of raw material. All these factories can convert any perishable food material into a dry, sterile meal, and indeed they have the equipment to handle a very large proportion of all the country's food waste.

The London factory with which I am associated has been converting market and domestic waste into a feeding meal for the past ten months, and is capable of dealing with 50,000 tons annually. The factory has been placed at the disposal of the Ministry for the duration of the War without profit. Already a number of London municipalities are collecting the food scraps, which consist of



vegetable leaves, potato peelings and other residues, portions of bread and cake, particles of meat and fat, and are delivering them to the factory daily. The City of Westminster has instructed its street sweepers to make a systematic collection of kitchen waste. Tottenham, one of the pioneer boroughs in the salvage of domestic waste, is collecting about 25 tons of food scraps weekly. East Ham started experimentally in April; during the week ending June 22, thirty-three of the Council's sweepers brought in 13 tons of edible waste from 15,000 houses, and it is hoped to increase this quantity very considerably.

In these and other London areas the scheme has started with distribution by the Women's Voluntary Services of literature which explains the urgent need of war-time economy, and asks housewives to place their food scraps in a separate container, such as a cardboard box or carrier bag, which can be emptied by the sweeper as often as he calls. They are also asked to exclude tea leaves, orange and similar skins and rhubarb leaves.

At the present moment the London factory has guaranteed a minimum payment of 25s. per ton delivered to the works, based upon the market price to the farmer; but all public authorities have been assured that if after three months an audit by the Ministry of Supply or other authority shows a higher price to have been justified, the difference will be placed to their credit, and the local authority, and indirectly the ratepayers who have provided the material, will receive the benefit.

In heavily rated boroughs the new source of revenue from reclaimed waste is welcomed. East Ham, last May, received more than £1,000 from salvage, and Tottenham's gross income from this source is at the rate of approximately £15,000 a year.

As soon as the food waste reaches the factory, it is taken by conveyors to drying cylinders in which it is sterilized at 250° F., and dried until it is reduced to one fourth of its original bulk; after drying, the material is ground to a fine meal. Analysis of a sample of this meal by Dr. Bernard Dyer and Partners Ltd., shows the following:

Moisture .. .. .	7.25
Oil or fat .. .. .	8.00
Crude albuminoids (protein) .. .. .	20.95
Digestible carbohydrates .. .. .	41.17
Indigestible fibre .. .. .	7.20
Mineral matter .. .. .	15.43
	<hr/>
	100.00

The production starch equivalent is calculated at 63, the protein equivalent at 15.8, and the linseed cake equivalent at 85, entitling dried town-waste to rank among concentrated foods. The mineral content is noteworthy because it includes 3.4 per cent of lime and 1.65 per cent of phos-

phoric acid. These are in the satisfactory ratio of 3.4 of calcium to 1 of phosphorus, and would make unnecessary the addition of a mineral supplement to any ration of which the meal forms a part. One feature revealed by the analysis is the presence of 30 parts of carotene per million—about the same proportion as is found in meadow hay. As the precursor of the fat-soluble vitamin A, carotene can play an important part in the nutrition of animals or birds which do not receive cod liver oil or a liberal allowance of green food.

Actual farm tests have shown that any mixture containing the town-waste meal is eagerly eaten by pigs and poultry, and that the response in growth or egg production is all the more satisfactory because in recent months they have not received as large a proportion of protein in their ration as they need. Digestible protein and its equivalent are utilized by the living body to repair waste, build up flesh and perform other vital functions. They cannot be stored, and as any excess of requirement is eliminated a fresh supply must be constantly maintained. A ration is wasteful and unprofitable if it is deficient in protein or in those minerals which are closely linked with them in the processes of nutrition.

Imports of oil cakes and similar concentrated foodstuffs rich in protein have been among those greatly curtailed, and supplies that are available must be reserved mainly for the feeding of dairy cattle. Substances consisting principally of protein, such as white-fish meal, dried milk and dried blood, are also restricted, and it is accepted as sound policy by the Government that it will be fairest to the farming community as a whole if they are incorporated in compound meals and so shared out impartially. When combined with town waste, they make a meal so highly concentrated that it can be used in the proportion of 1 part to 8 of cereals, and will go far towards meeting the normal requirements of farm stock.

Accepting the estimate quoted above of an annual domestic wastage of at least 500,000 tons of food in Great Britain, there must be material available for the production of a minimum of 100,000 tons of a dry, sterile and wholesome foodstuff which agriculture urgently needs. At about £12 5s. per ton to the farmer, it would be bought as quickly as the factories could maintain production, and would then be converted by the kindly processes of Nature into most useful food for the nation.

Housewives have shown themselves eager to help as soon as the need has been explained to them, and wherever collection facilities have been organized. Only systematic effort on the part of public authorities is now needed to make a very great success of the campaign.



## GEOLOGY AND EARLY MAN: II\*

By T. T. PATERSON,

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### A CLASSIFICATION OF LOWER PALÆOLITHIC CULTURES

The Lower Palæolithic nomenclature is rapidly approaching a state of complete chaos. Industries are found in greater frequency and their discoverers with enthusiasm set up not only new industrial names but also cultural. Correlation and comparison is becoming more and more difficult. Convergent technical similarities are wildly seized upon as indication of cultural spreads. A flake with plain, high-angled striking platform denotes the presence of the Clactonian culture even though found thousands of miles away from the home of that culture (*sensu stricto*). It seems the time has come to attempt to put order into this muddle of names, and it has been found that the application of a binomial system is of great assistance. The following is concerned only with cultures appearing in the Pleistocene up to and including phase  $u_2$  and not with the 'Middle Palaeolithic' of  $u_3$  or the 'Upper Palaeolithic' of the end of the Pleistocene.

Two great families are recognized: the *Acheul* and the *Clacton*. The *Acheul* elements of culture comprise the *biface*, manufactured from a given mass of material by striking off flakes from upper and lower surfaces in such a manner that the edges separating these surfaces are defined working edges, a form being obtained which can be included under the group name *biface*; flakes produced during the manufacture of the *biface*; and controlled secondary working (which does not appear in the very early *Acheulian* industries). The *Clacton* elements of culture comprise a series of ten types of cores, with the corresponding flakes removed from them: the irregular mass, the asymmetrical, the simple pebble proto-biconical, the multiple pebble proto-biconical, the biconical, the asymmetrical biconical, the proto-tortoise, the convergent tortoise, the longitudinal tortoise and the steep core. There is also a series of artefacts made from pebbles, flat based—end, side, and boat-shaped; rounded—with pointed or convex edges; nucleates (commonly called 'choppers').

The *Acheul* family shows no subdivision into what might be called genera, but it is otherwise with the *Clacton* family.

Family	'Genus' (Culture)	'Species'
Clacton	Breckland	Kafuan-Oldowan pre Stellenbosch I Anyathian, etc.
	Levallois	
	Moustier	
	Soan	
	Choukoutien	

Combinations of the *Clacton* elements constitute the various forms of culture or genera. In Europe the *Breckland* (hitherto known as the *Clactonian sensu stricto*) is the precursor of *Levallois* and carries the same generalized core elements as the *Soan*, which varies only in the dominant presence of pebble tools. The *Levallois* is a culture which early (end of phase  $m_1$ ) separates off from the *Breckland*. The *Moustier* does the same at a somewhat previous time. The *Soan* includes the *Kafuan-Oldowan* complex and the various pebble 'cultures' found in East Africa, the pre- and early *Stellenbosch*, and the *Anyathian* from Burma, besides the industries discovered by Collins in Malaya, and by Koenigswald in Java. The *Choukoutien* is very closely allied to the *Soan*, especially in the light of the bigger pebble elements it carries. The material, as in the *Anyathian*, plays a most important part.

Where cultures come into contact, which was a very common occurrence especially after periods of climatic severity—cold in the north and aridity in the south—hybridization took place. The resultant mixed culture is therefore named according to the group cultural elements involved. The dominant group is given the 'generic', substantival name, and the secondary the 'specific', adjectival. A prefix is added to indicate time relationships, and a suffix where necessary to show local variation. An actual case is the Upper *Brecklandian Acheul* (*Hoxne*), which is that variety of industry occurring during phase  $u_2$  at *Hoxne* in which the dominant element is *Acheul* and the secondary *Breckland*. Or in East Africa, the industry of the *M-Horizon* would be called *Middle Acheulian Soan* (*Oldowan*), so signifying the dominant *Soan* (*Oldowan*) element and the age as phase  $m_2$ .

The accompanying three-dimensional diagram (Fig. 1) represents in the simplest fashion the culture development throughout the Pleistocene, all but the last phase  $u_3$ . In the Lower Pleistocene

\*Continued from page 15.



there occurred the first great subdivision of cultures, probably from a very generalized ancestral pebble tool form. The evolution to the Acheul form is partly illustrated in *analogous* fashion in

cultural significance, but represents only an early stage in the development of the Acheul culture. Lower Acheul, which occupies phase  $m_1$ , is here understood to include late Abbevillian. Early

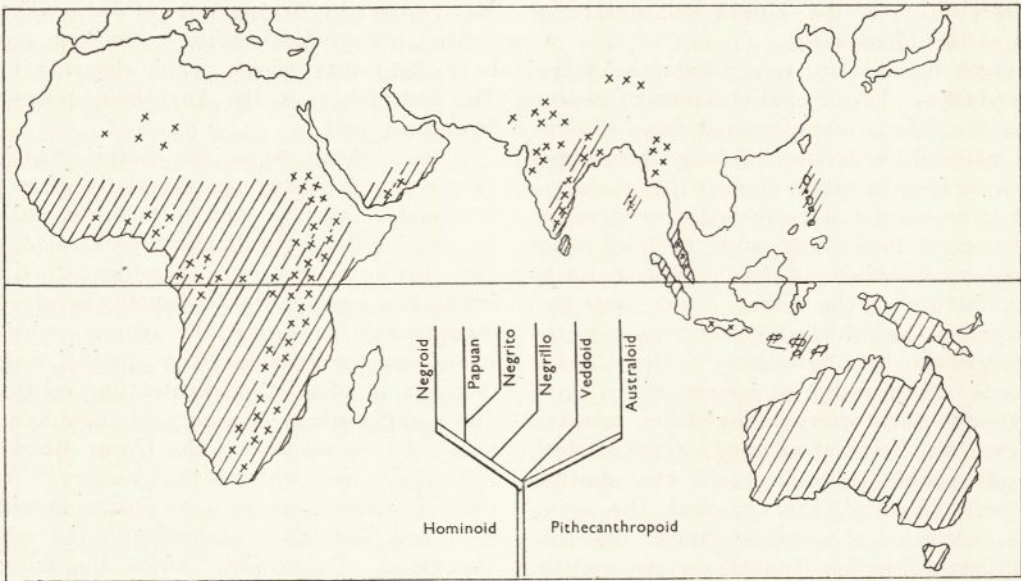
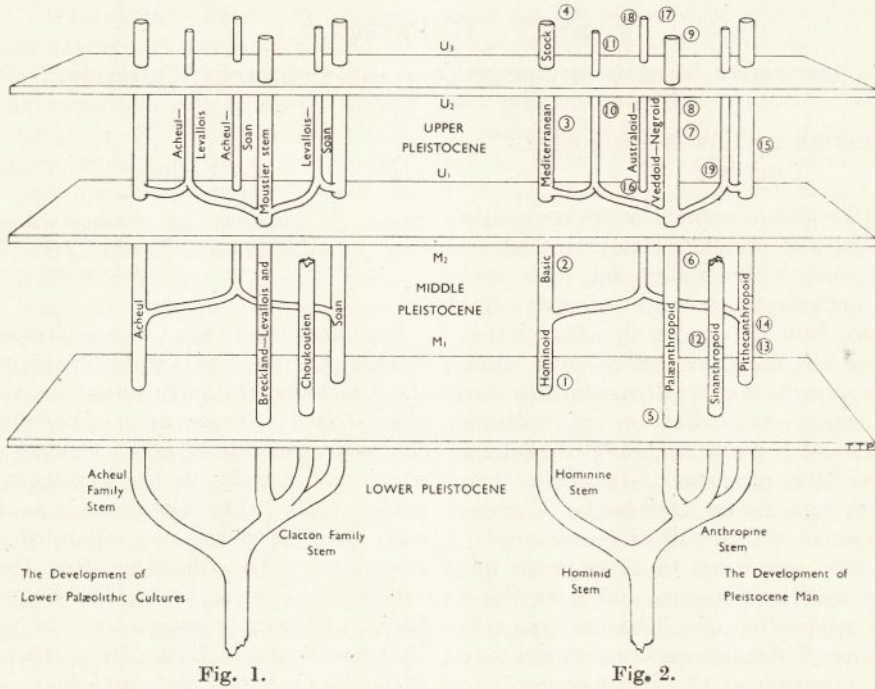


Fig. 3. SHADING REPRESENTS THE DISTRIBUTION OF AUSTRALOID-VEDDOID-NEGROID STOCK ; CROSSES, THE SOAN CULTURE.

Stellenbosch I (which is, of course, much later and Soan). It should be stated here that according to the definition of Acheul culture elements given above, the Abbevillian can have no separate

Abbevillian would then become the pre-Acheul of phase  $l_2$  of the Lower Pleistocene. Corresponding pre-Clacton and pre-Soan occur in  $l_1$ . Lower Breckland and Lower Soan come in phase  $m_1$  like



the Lower Acheul. The Middle Acheul, Breckland and Soan occupy  $m_2$ , Upper of all three in  $u_1$  and  $u_2$  and Final in  $u_3^*$ . Lower, Middle, Upper and Final Levallois, and Moustier, occur in phases  $m_2$ ,  $u_1$ ,  $u_2$  and  $u_3$  respectively.

In the Middle Pleistocene in tropical latitudes the Soan and Acheul came together and we find in South Africa Stellenbosch II, in East Africa the Sangoan and the Middle Acheulian Soan (Oldowan), and in Peninsular India, Middle Soan Acheul and Middle Acheulian Soan. This hybrid culture form may develop on its own lines; for example, as the Tumbian in East Africa, and a Tumbian-like culture all over India in the late Upper Pleistocene. The climatic extremes of the dry phase of  $m_2$  in the tropics and the third glacial in the north brought all three main cultural groups together and much contact took place. In East Anglia, for example, there are Upper Brecklandian Acheul (Hoxne) and (Elveden), Upper Acheulian Levallois (Southacre)†, Upper Soan Levallois and Upper Levalloisian Soan in North India. Such hybrid forms developed on into phase  $u_3$ , when the great climatic extreme during the fourth glacial period not only wiped out Pleistocene faunas but caused again tremendous upheaval amongst mankind—the 'Middle Palaeolithic', essentially a stage of flux, came into being. Sometimes Levallois, sometimes Moustier, Acheul or Soan dominated, mixing and passing, coming and going—the pulsating birth of the 'Upper Palaeolithic' which emerged towards the end of the Pleistocene. In Fig. 1 no attempt is made to indicate the Middle Palaeolithic flux, which would obscure the main form of the thesis the figure is intended to represent. Finally, it may be stated that within the Pleistocene, up to and including phase  $u_2$ , all industries can be adequately named by the use of one, or combinations of two or more, of six terms, Acheul, Breckland, Levallois, Moustier, Soan, Choukoutien, and with the aid of suffixes and prefixes, any special local characteristics (varietal forms) and the ages respectively can be represented.

#### THE DEVELOPMENT OF PLEISTOCENE MAN

It is already well established that Palæanthropoid man is associated with 'Levallois' culture and 'Homo sapiens', as distinct from 'Palaeanthropus', with the Acheul. At the symposium on the Middle Palaeolithic during the British Association meeting at Cambridge in 1938, I further demonstrated the association of the Breckland with Ehringsdorf type, Levallois with Palestine type, and Moustier with the La Chapelle type. These associations are

\* A summary of the Acheul and Breckland subdivisions has already been given in NATURE, 143, 822 (1939).

† Discovered by Mr. J. S. Sainty.

not given in the accompanying diagram (Fig. 2), since they would complicate the point at issue.

The first proposition submitted is that just as the cultural development shows mixture of cultural forms, so there have been produced hybrid physical forms owing to the mixture of stock following upon culture contact. Cultures do not remain consistently pure, nor do the racial stocks associated with them. Therefore in any attempt at classification of human Pleistocene fossils, regard must be paid to the factor of mixture, and even though a skull should show dominant characteristics of one racial form, nevertheless the presence of other racial characteristics must be indicated. It will be shown that racial hybridism was widely developed in the Upper Pleistocene, probably because of the same climatic catastrophe which altered the fauna, therefore the classification cannot follow the normal zoological method but the pedigree system applied to cross-bred domesticated animals. After all, man, especially in primitive societies, is essentially a domesticated animal subject to similar selective processes.

In the three-dimensional diagram (Fig. 2) two main lines represent the Palæanthropoid stem—associated with Breckland, Levallois-Moustierian—and a Hominoid basic Mediterranean stock—associated with Acheul. In the latter stem is placed Piltown man (1) in very early Middle Pleistocene times. This interpretation of the age of the gravels of the Piltown region, following Clement Reid, is based on their similarity to a very wide spread of gravels of  $m_1$  age all along the southern coast of England. Swanscombe man (2) appears in phase  $m_2$ , in gravels heralding the third glacial stage. Here too, I suggest, would come the Kanjera skull. The artefacts associated with it are Middle Acheul on the system here adopted (Section C). From Upper Pleistocene loams of phase  $u_2$  comes the Bury St. Edmunds fragment (3) and probably Galley Hill. At the end of the Pleistocene the man of Combe Capelle (4) represents this stock. In the Palæanthropoid stem there is *heidelbergensis* (5), probably intraglacial in age at the beginning of  $m_1$ . The age of the Steinheim skull (6) is doubtful, but it is probably similar to that of Swanscombe. Tabun and *ehringdorsifensis* (7) and *neanderthalensis* (8) come from the Upper Pleistocene with *krapinensis* (9) at the end of the Pleistocene.

The contact between Acheul and Breckland—Levallois-Moustierian cultures first took place in phase  $u_1$ . In the Upper Pleistocene in a hybrid culture is found Skhul man (10), showing not only Palæanthropoid characteristics but also others approaching those of the basic Mediterranean stock. At the end of the Pleistocene (11) come the



La Chapelle group of types where the Neanderthaloid characteristics are still prominent.

It has been seen that there is a third great cultural stem, the Soan. So far the associated skeletal remains are Pithecanthropoid. Nevertheless the agreement of the distribution of the Soan culture with that of the Australoid-Veddoid-Negroid stock (Fig. 3) is suggestive. This brings forward the second proposition, that these peoples are survivors of those who produced the Soan industries. Towards the periphery of the distribution there is the series "*Homo*" *modjokertensis* (13) and *Pithecanthropus erectus* (14) in the Middle Pleistocene, *Homo soloensis* (15) in the Upper Pleistocene. Closely related is Pekin man (12) also of the Middle Pleistocene. In the latter period it has been noted that the Soan and Acheul cultures were in contact. In South Africa where this contact is extremely prominent has been found *rhodesiensis* (16), which is tentatively placed in phase  $u_1$ . The resemblances of this type to *soloensis* are quite well marked. *Africanthropus* (19) is associated with a contact Soan Levallois in the Upper Pleistocene. By this period the Negroid characteristics are already beginning to separate out; whereas, in the peripheral areas, a contact form has probably been evolving along its own lines, Wadjak (17), towards the modern Australoid. The Negroid characteristics of Grimaldi man (18) are well known. It is difficult to make any real constructive suggestion in relation to this 'outlier' except to point out that the Soan culture has reached well north in the Sahara, and the Languedocian of southern France may be its most northerly occurrence. The point must remain in question, but should the Soan have reached to Europe, then Grimaldi man must be the survivor of a contact between Hominoid and Pithecanthropoid types with probably late Palæanthropoid.

The third proposition is that the Australoid-Veddoid-Negroid stock differentiated in the following manner (see also diagram inset in Fig. 3). In Middle Pleistocene times somewhere to the west of Java, the Soan culture having already been widely distributed, a cross between a Hominoid and a Pithecanthropoid gave rise to the basal stock. On one side where the Hominoid element was stronger the Negroid developed, receiving very probably in the Upper Pleistocene some Palæanthropoid characteristics (vide *Africanthropus*). In the Australoid branch there was less Hominoid element. Early from the Negroid branch sprang the Veddoid, and later the Papuan racial type. The Australoid characteristics among some

Negroid groups are due not to direct connexion with the Australoid race but are derived from a common ancestor, almost certainly Pithecanthropoid—as witness *wadjakensis*.

Thus it can be seen that, on general lines, morphological development corresponds with geological sequence. It must be remembered that should certain skeletal forms not agree with the theoretical morphological sequence, the lack of material is significant and survivals of early forms may occur out of their natural time grouping. In the Middle Pleistocene there was already a subdivision into three main stocks which it is suggested should be called Hominoid, Palæanthropoid and Pithecanthropoid (Sinanthropoid being regarded as close to the last). Since the assumption is made that hybridization occurred, then an absolute zoological taxonomic system ought not to be applied, but it is proposed that the skeletal remains belonging to these three generalized Middle Pleistocene stocks be given the status of genera. By the Upper Pleistocene, when much crossing had taken place, the various racial forms of present mankind were beginning to be moulded out. Remains from this period could then be given specific status. All later forms would be varieties of *Homo sapiens*. The suggested classification is set out below\*.

LATEST AND POST-PLEISTOCENE. *Homo sapiens*, VARIETIES.

Homo species	Homo	Homo	Homo
Upper Pleistocene	<i>edmundi</i> . (Bury St. Edmunds) <i>londiniensis</i> . (Galley Hill), etc.	<i>krapinensis</i> . <i>palestinensis</i> . <i>ehringdorfiensis</i> . <i>neanderthalensis</i> , etc. (To be set up on a pedigree system.)	<i>wadjakensis</i> . <i>soloensis</i> . <i>rhodesiensis</i> . <i>njaransensis</i> .
Hominid genera	Homo	Palæanthropus	Pithecanthropus
Middle Pleistocene	<i>H. marstoni</i> . (Swanscombe) <i>H. dawsoni</i> . (Pitdown) <i>H. leakeyi</i> . (Kanjera)	<i>P. steinheim</i> (?)  <i>P. heidelbergensis</i> .	<i>P. modjokertensis</i> .  <i>P. erectus</i> .  <i>P. pekinensis</i> .
Hominid sub-families Lower Pleistocene	Homininæ	Anthropinæ.	

It seems that of the three genera the Hominoid was predominant, the other two recessive, since it is the Hominoid which has alone survived in essence. The spread of the Hominoid stock which established its world-wide supremacy took place in the Upper Pleistocene and is associated with the distribution of the 'neanthropic culture'. Nevertheless, there seems to be no doubt that already before that the modern distribution was shaping itself. Weidenreich believes, for example, that he can see in *P. pekinensis* relationships to some present-day Mongoloids.

I would be grateful for criticism of these propositions.

\* Mr. J. C. Trevor has been most helpful in discussing this matter.



## THE SURVIVING CROSSOPTERYGIAN FISH, LATIMERIA

BY SIR ARTHUR SMITH WOODWARD, F.R.S.

IN NATURE of May 6, 1939, p. 455, Prof. J. L. B. Smith, of Rhodes University College, Grahamstown, announced the discovery in South African seas of a living Crossopterygian or paddle-finned fish. He recognized that it belonged to the group of Coelacanths, which was known only by fossils and was supposed to have been extinct since the end of the Cretaceous period. In the *Transactions of the Royal Society of South Africa*, he now describes in detail the remains of this fish\*. Unfortunately, there are no more than dried remains; for when the specimen was sent to the East London Museum its scientific value was not appreciated, and it was entrusted to a taxidermist, who preserved little beyond the external parts and damaged some of these by piercing them with pins and nails. Prof. Smith laments his "relatively crude equipment" for dealing with the fish, but he is to be congratulated on his laborious effort and on the technical account of so much as he has been able to observe. His memoir is illustrated by an exhaustive series of photographs and a few diagrammatic text-figures. There is also an explanatory list of the numerals and letters used in all the illustrations, and this is arranged on a page which unfolds outwards so that it may be kept always in view.

The Coelacanths have changed very little since their first known appearance in Upper Devonian formations, and it is difficult to separate the new living fish from some of the old genera which are represented by fossils. For convenient reference, however, Prof. Smith has done well to give this fish a new generic name, *Latimeria*, which commemorates Miss Courtenay Latimer, the curator of the East London Museum. Very curiously, it retains the complete supplementary tail fin which characterizes the Jurassic and earlier genera, and thus differs from the latest or Cretaceous genera, *Macropoma* and *Mawsonia*, which have the tail extension reduced and lacking fin rays. Only the anterior dorsal fin, with its eight strong rays armed with upwardly pointing denticles, and the scales with their sharp denticles, are specially like those of *Macropoma*. The caudal fin seems to have a few more rays than any of the known extinct genera.

As in all Coelacanths, there are no scales on the head, and the sensory canals are conspicuous. The circumorbital plates, so commonly observed

in Coelacanths, are absent. The two nostrils are well seen on each side of the snout, but Prof. Smith has been able to dissect this region and he thinks that they do not communicate direct with the olfactory capsules. These capsules are described as situated on either side of a large median chamber, which he names "ethmoidal nasal cavity"; and the cavity is said to be connected by tubes both with the two pairs of external nostrils and with a pair of openings on the front end of the snout. The remarkable arrangement needs further study in a better preserved specimen. The cranium, indeed, is so much damaged that Prof. Smith has been able to observe very little of it.

There is nothing unusual in the external bones of the head, but, as already suspected, it is now clear that the preoperculum is extended on the cheek as in the early Chondrosteans. There are also degenerate remnants of the suboperculum and interoperculum. The mouth is very interesting because, although there is no bony maxilla, this element is represented by "a thickened fold of skin" which bears the usual little tooth-plates or clusters of conical teeth. Especially important and new is the identification of the hyomandibular bone, which is described as "very firmly bound to the inner face of the anterior margin of the opercular". It is ossified only in its middle portion, the long ends remaining cartilaginous. From the hyomandibular there extends downwards and forwards a relatively large symplectic bone, which articulates with a hollow facet on the articular bone of the lower jaw, well behind the quadrate articulation. As Prof. Smith remarks, the arrangement is suggestive of that in the existing Chondrosteans. He points out that the facet on the articular bone has already been shown in published drawings of the lower jaw of the Devonian coelacanth *Diplocercides*; and he might have added that a pit in the same position has been described in the lower jaw of the Cretaceous *Macropoma* and *Mawsonia*.

The spiracle is supposed to have been functional, but this portion of the head is badly preserved. The gill arches were destroyed, but the copula seems to show that there were only four pairs. Five pairs have been seen in some of the extinct Coelacanths.

The internal parts of the dried body have been so completely removed that little remains even of the skeleton. One hæmal spine in the tail, however,

\* J. L. B. Smith, "A Living Coelacanthid Fish from South Africa", *Trans. Roy. Soc. S. Africa*, 28, Pt. 1, 1-106, pls. i-xliv, 1939 (received April 1940).



is seen to consist chiefly of cartilage surrounded by a thin cylinder of bone, thus exhibiting the structure to which the name *Coelacanth* (hollow spine) refers, for the cartilage disappears and leaves a hollow space in the fossils.

The only new character described in the fins is the extension backwards of the membrane of the anterior dorsal fin beyond its eight rays. The extension is low and rapidly tapers behind, without any skeletal stiffening. The scales appear normal, and Prof. Smith observes ring-markings which he thinks prove the age of the fish to be between twenty and twenty-five years.

The exceptionally oily nature of *Latimeria*, already mentioned in the preliminary notice, is interesting geologically, because it indicates one possible source of the oil in many stratified rocks. Like most of the extinct *Coelacanth*s, there is no doubt that it is a sea fish, not a straggler from a river. As Prof. Smith remarks, however, the annulation of the scales shows that it cannot be a denizen of the ocean depths. It must be well within reach of the ordinary fishermen, and the interest now aroused should induce the trawlers off the east coast of South Africa to save any more specimens which they may find.

## OBITUARIES

Sir James Baillie, O.B.E.

**SIR JAMES BLACK BAILLIE**, who died on June 9 at the age of sixty-seven, was vice-chancellor of the University of Leeds from 1924 until 1938. A Scotsman, he was educated at the Universities of Edinburgh, Cambridge, Halle, Strasbourg, and Paris. At Edinburgh he had a particularly distinguished record, gaining the Ferguson scholarship and Shaw fellowship in philosophy, both open to graduates of the four Scottish universities. After graduation he was an assistant at the University of St. Andrews. Later he was lecturer in philosophy at University College, Dundee. He was professor of moral philosophy at the University of Aberdeen during 1902-24. He was knighted in 1931.

The most significant period of Baillie's life was when he was vice-chancellor at Leeds. He was keenly interested in problems of administration, and at Leeds this interest was fully satisfied. The University of Leeds saw great developments under his leadership. In 1925 an appeal was made by the University for the sum of half a million pounds for the purpose of erecting more adequate buildings. This appeal had realized about £700,000 at the time of his retirement, and many fine buildings had been erected, notably the Brotherton Library. Five new chairs and many lectureships and scholarships were instituted during Baillie's period of office, and valuable benefactions received. But human life is not merely thought or intellect in a narrow sense, as he himself showed in his "Studies in Human Nature"; there are other highly important activities. So Baillie did not forget, for example, the athletic and social sides of university life. Playing fields were developed at a cost of more than £50,000 and a beginning was also made with a new Students' Union, which has recently been completed.

In his administrative work Baillie showed great tenacity of purpose. He had the mind of an arbitrator, and indeed, both during the War of 1914-18 and since, he served in the capacity of arbitrator on several important Government com-

missions. His attitude of mind and methods were perhaps sometimes rather cold and impersonal. He had weighed the pros and cons, he had come to a conclusion, he must give effect to the conclusion for the conclusion's sake. But there was a warm and sympathetic side to Baillie's nature. He was an excellent host to a wide circle of friends and he was a good conversationalist and a good listener.

Baillie's main philosophical interest was Hegelianism. In 1901 he published a commentary, "The Origin and Significance of Hegel's Logic". His "Outline of the Idealistic Construction of Experience", 1906, is avowedly based on Hegel's "Phänomenologie des Geistes". Perhaps Baillie's most important contribution to philosophy was his translation, with an introduction and notes, of the "Phänomenologie". It appeared in 1910 and in a second edition, with a much improved text, in 1931. Its first appearance was particularly notable, for here was a major work of Hegel's made available in English for the first time. In 1924 Baillie was a contributor to the first series of "Contemporary British Philosophy", a collection of personal statements by leading philosophers, edited by J. H. Muirhead. He was also a contributor to Hastings' "Encyclopædia of Religion and Ethics", the *Hibbert Journal*, *Mind*, and other periodicals. As a philosopher Baillie was an ingenious and acute dialectician. He was, too, a most stimulating lecturer, illuminating his theme from all sides of human nature. In many respects his outlook was not unlike that of his illustrious predecessor, Thomas Reid, expounder of common sense. W. M. DICKIE.

Prof. Giuseppe Sanarelli

PROF. GIUSEPPE SANARELLI, the eminent Italian hygienist, whose death occurred recently, was born on September 24, 1865, at Monte San Savino, Arezzo. He studied medicine at Siena, Pavia, under Golgi, Munich under Pettenkofer, and Paris under Pasteur, and qualified in 1889 at Siena, where he began his



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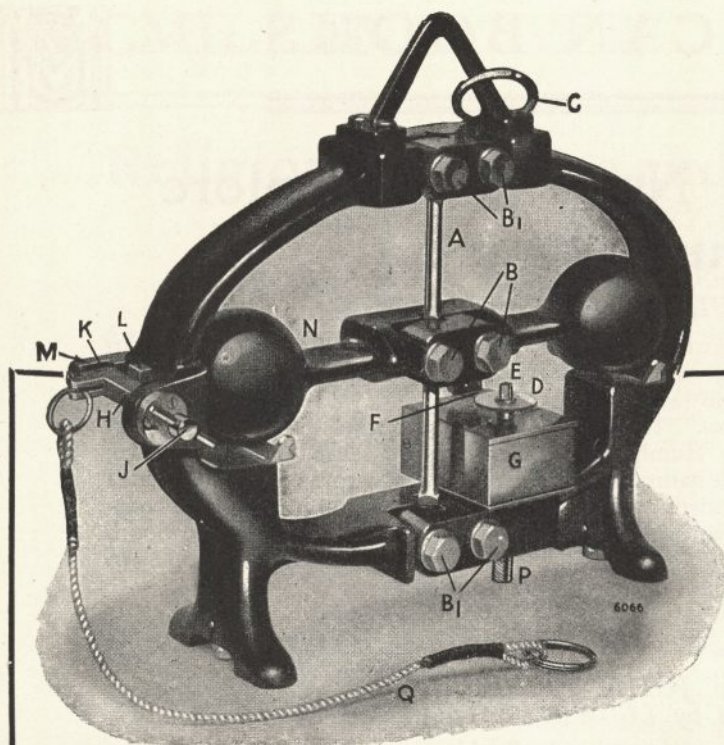

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career by being assistant to the professor of general pathology. In 1894 he was appointed professor of hygiene and director of the Institute of Hygiene at Siena, and during the next few years held corresponding posts at Montevideo (1895-98), Bologna (1898-1915) and finally at Rome.

Sanarelli's most important work was connected with the pathogenesis of cholera, typhoid fever, and spirochaetosis, immunity and ultra-viruses. His name has been attached to the organism which is the cause of myxoma in the rabbit (*Sanarellia cuniculi*), but the organism which he called *Bacillus icteroides* and claimed to be the cause of yellow fever was shown by Reed and Carroll to be merely a variety of the swine cholera bacillus. In addition to numerous articles in periodical literature, such as the *Centralblatt für Bakteriologie*, *Comptes rendus de l'Académie des Sciences*, *Annales de l'Institut Pasteur*, etc., he was the author of several books. He was also the editor of the *Rivista di Malariologia*, which was founded in 1922 under the name of *Bolletino Malariologico*. He was the recipient of many honours. He was made a senator of Italy in 1920, and was rector of the University of Rome in 1922-23. He was also an honorary member of many learned societies in Italy and other countries. J. D. ROLLESTON.

#### Mr. F. M. Davis

EDUCATED at Harrow and at Caius College, Cambridge, Mr. F. M. Davis joined the staff of the Fisheries Department of the Ministry of Agriculture and Fisheries as an assistant naturalist in 1911; at the time of his death at the age of fifty-one he was principal naturalist in charge of the Fisheries Laboratory, Lowestoft.

Davis served in the War of 1914-18 as a captain in the London Regiment, was wounded, and held prisoner for nearly two years. On his return he spent many months carrying out investigations on trawlers, and he also made a very thorough survey of the fishing gear and methods employed in the maritime fisheries of England and Wales, the results of which are embodied in his well-known paper on the subject, now in its third edition (*Fishery Investigations*, Series II, 15, No. 2; 1936). He took part in an exploratory voyage to Lousy and George Bligh Banks in 1920. His subsequent work included several years investigation of the bottom fauna of the North Sea by means of the Petersen grab, resulting in two papers of great ecological interest, demonstrating *inter alia* the existence of vast beds of shellfish (*Spisula* and *Mactra*) on the Dogger Bank, which were subject to great fluctuations from year to year.

Thereafter Davis devoted several years to the practical study of the relation between the mesh of the trawl and the size of fish caught, and his results were basic for the international convention on mesh and size-limits signed in 1937. In the last year or two he became greatly interested in the great cod fisheries in the far north, and made several trips on trawlers to the Bear Island and Spitsbergen grounds. His bent was essentially practical; he was happiest

at sea, and the vast experience there gained made him an acknowledged expert on all practical fishery problems, especially those relating to fishing gear.

Davis was a first-class rifle shot and had many successes at the Bisley meeting, which he attended regularly. His modesty was excessive; only those who knew him well could appreciate the shrewdness of his judgment and the depth of his knowledge, which he was apt to hide under a casual manner. He was greatly loved by his colleagues and a wide circle of friends. E. S. RUSSELL.

#### Mr. Jonathan Hodgkinson

OXFORD mathematics have suffered three grievous losses in the past few weeks by the deaths of Prof. A. E. H. Love, Mr. Jonathan Hodgkinson and Dr. E. G. C. Poole.

Jonathan Hodgkinson went up to Jesus College from Carlisle Grammar School as mathematical scholar in 1904. He won the University Mathematical Exhibition in 1906, was the Senior Mathematical Scholar in 1910 and obtained two first classes in the school of mathematics. From 1913 until 1921 he was a prize fellow of Merton College, one of the few colleges which retains this traditional reward of learning. During the War of 1914-18 he served in the infantry and with the Tank Corps as a major.

After the War, Hodgkinson became fellow and tutor in mathematics at Jesus College, and was for a time University lecturer in mathematics. He was a great teacher. He got good material with which to work and he made the very best of it. He worked his men hard but they responded, and the record of University honours in mathematics by the Jesus College men of the past twenty years is an impressive one. Although Hodgkinson was primarily a teacher he found time to do original work on the pure mathematics of applied mathematics. He was an authority on hypergeometric functions and published many papers on this and other subjects. For some years he was one of the three editors of the *Quarterly Journal of Mathematics*, and worked well and ungrudgingly at that difficult task.

In his college Hodgkinson was particularly helpful in matters of finance, where his analytical mind and shrewd commonsense were of value to his colleagues. Like so many of the mathematical and scientific dons in Oxford, he was an efficient administrator, and for some years wisely guided his college in disciplinary matters. During the last eighteen months his health had failed him, and though there were periods when it seemed that he might recover, at least in part, his health, he died on June 21. He was fifty-four years of age.

WE regret to announce the following deaths:

Mr. G. S. Blake, formerly geological adviser to the Palestine Government.

Dr. Alvin S. Wheeler, emeritus professor of organic chemistry in the University of North Carolina, on May 12, aged seventy-three.



## NEWS AND VIEWS

**Medicinal Plant Cultivation**

EVENTS associated with recent developments of the War come as a disagreeable reminder of our dependence upon countries abroad for practically all kinds of vegetable *materia medica*. When Germany and areas in mid-Europe under German influence, followed by Poland, ceased to be sources of supply, the deficiency of most of the vegetable drugs could still be made good by imports from other countries. Belgium, Holland, France and Italy were alternative reservoirs which could be drawn upon abundantly, while the produce of areas in the Mediterranean zone, rich in many varieties of the raw materials of medicines, reached British ports almost unfailingly. Some of these outlets are now shut completely, and the rest of them have ceased to be easy of access. It is true that lands farther afield—India, various British Dominions and Colonies, the Americas, Japan, China and the Netherlands Indies, for example—can send us their produce, but most of these countries are almost as dependent as ourselves upon importation from the same sources as those from which we have obtained our supplies. This is all the more curious, because it would be difficult to name a single vegetable drug which could not be produced economically in some part of Britain overseas or in the Americas.

The need of the moment is to establish as speedily as possible a system by which Great Britain may provide itself with all the medicinal plants which can possibly be cultivated on British soil. Good stocks of the more essential of the vegetable drugs are already in the country, and if plans for extensive cultivation are brought into operation without delay, there need be no shortage of many of the commonly prescribed vegetable drugs. The Pharmaceutical Society is anxious to do what it can to support a campaign to make Great Britain as self-sufficient as possible in this respect; further, Mr. T. E. Wallis, Hanbury medallist for 1940 of the Society, has volunteered to give advice to amateur gardeners who are prepared to undertake the work of cultivation. Admittedly there is a limit to the variety of plants which can be grown in British soil, but home production can be supplemented by the support of Britain overseas. In past times when medicinal herb cultivation by smallholders has been attempted, an obstacle to complete success has been the absence of drying and collecting centres, but the need for production is now so urgent that it is impossible to believe that means will not be found for the proper organization of a necessary industry, even if the State has to lend a hand.

**Work of the Patent Office**

THE fifty-seventh report of the Comptroller-General of Patents, Designs and Trade Marks, for the year 1939, indicates that the steady increase in the number of applications for patents and complete specifications characterizing the previous three years continued until the outbreak of war, afterwards

decreasing by about one third in comparison with the same period of the previous year (Pp. 26. London: H.M. Stationery Office, 1940. 6d. net). In regard to patents, the total number of applications was 33,109, of provisional specifications 20,095, of complete specifications 20,610, and of patents sealed 17,605, as compared with 37,973, 22,696, 23,098, and 19,314 in 1938, respectively.

The trend of invention showed considerable activity in the production of motor fuels of high anti-knock value by alkylating isoparaffins with olefines in presence of a catalyst. The preparation of organo-metallic compounds for addition to motor fuels to increase their anti-knock value has also received attention, as well as the synthesis of the hormones of the adrenal cortex. Marked progress has been made in the synthesis of some of the more important vitamins the chemical structure of which has recently been elucidated. Attention is being directed to methods of extracting cellulose from plant materials hitherto not utilized, such as highly resinous woods and certain grasses, and also to the preparation of polyamide resins for use in the manufacture of artificial fibres. The contemplated extension of full automatic working to the setting up of long-distance telephone connexions has led to considerable activity, and numerous aspects of passive defence such as respirators, air-raid shelters, electric torches, masks and shades, blinds and shutters, etc., also figure prominently.

Applications for licences under separate patents under the Emergency Act have numbered 754, and for the variation of pre-War licences in respect of individual patents 109. Orders have been made granting 207 licences in respect of separate patents and amending 12 pre-War patent licences. In dealing with applications for licences under this Act, it has been taken that the main object of the licensing provisions is to enable and encourage the working in Great Britain of useful inventions which are covered by enemy-owned patents, and for that reason could not or would not be utilized here during the War. Steps have also been taken to prevent the risk of publication abroad of details of any invention of which disclosure might be contrary to the interests of the realm or of service to the enemy.

**Re-grassing**

ADVICE supplied by the Welsh Plant Breeding Station at Aberystwyth on grassland management is sure to be studied with interest as it is based on so much practical experience. In its War Food Production Advisory Bulletin No. 1, entitled "Re-grassing" (1s.), Sir George Stapledon stresses the importance of developing a far-seeing policy, which both aims at increasing current food production and at the same time has due regard to creating enhanced fertility of the land for the future. Grassland now being ploughed up for cereal growing should be brought under some fertility sustaining rotation, while grassland at present too poor to be worth



ploughing up for cereals should be improved as such, so that it can be ready for the plough in two or three years time. Further, every effort must be made to improve the quantity and quality of existing grass to compensate for the acreage lost to the plough.

The means of achieving these aims, Sir George maintains, is the ley, those of three years and upward making for a sound system of alternate husbandry, and the bulletin is largely devoted to describing methods which will most rapidly convert poor permanent grassland into good leys. Three main methods of procedure are given, namely, the sowing of seeds mixtures, with or without a cereal covering crop, directly on the prepared surface of the upturned sod, and the sowing of rape and Italian rye grass as a preparation for a subsequent ley mixture. The all-prevailing notion that a ley can only be economically established under a cereal nurse crop at the end of a rotation is shown to be contrary to facts, for experience has proved that newly broken grass is an excellent starting point and that a cover crop is not essential. The value of sowing pioneer crops such as Italian rye and rape on land which is at present unproductive is also strongly stressed, as it provides back end and early spring keep and will help to make the land sward- or cereal-worthy at a later date. The bulletin supplies numerous details regarding manuring and seeds mixtures and gives examples of the experience of farmers from different parts of the country in support of the policy advocated.

#### Family Allowances

In a pamphlet entitled "An Aylesbury Broadside" (price 3d.), the *Lancet* surveys the case for family allowances. The subject is dealt with mainly as a public health problem, for in 1938 there were at least 189,000 school-children in England and Wales suffering from malnutrition. Unfortunately, in most cases wages do not expand with the advent of children, and what sufficed for the family of one or two children becomes inadequate when there are three or more. Further, malnutrition in men is serious enough, but it is trivial in its effects on the race compared with ill-health in child-bearing women. Food requirements and the cost of adequate diets are discussed, and from the medical point of view the *Lancet* considers that there is an excellent case for paying a flat rate of 5s. for every child in the country. The principle of family allowances is actually admitted in the case of certain income-tax payers and in separation allowances for the families of soldiers, and a growing number of industrial firms have established family allowance schemes of their own. Various suggested schemes are outlined, namely, to place the whole onus on the employer, to let the State pay out of taxation, or a contributory scheme in which employers, workers and the State all take a share. A State scheme would probably cost £118,000,000. Certainly a case seems to be made out for the payment of family allowances of the order of 5s. for at least the third and subsequent children.

#### Economics of the State

A PAMPHLET, "The New Social Order: its Mechanism", by a group of scientific workers, which is edited by A. H. Mackmurdo, emphasizes the importance of the economic position and advocates the elaboration of an economic unit to organize distribution of resources upon an equitable scale (London: The C. W. Daniel Co. 6d.). In each State, the national economy would be based on a fixed price for the staple foodstuff, this fixing the price of all home-grown foods and, in turn, the price of all national goods and services, and each living wage would be measured upon this price-scale. The social mechanism to remove the paradox of potential plenty and actual poverty is regarded as involving three changes: a radical change in the mechanism of a commonwealth distribution; an instrument for measuring the distribution of the portions of this common wealth to be distributed to the members of the community as co-partners of it; and a regulative organ to control and guide the highly specialized organs of production, regulate the machinery of distribution and control all national imports and exports. The first change involves a new wage system and the disappearance of public or private ownership in the fruit of the common effort. The second involves the establishment of a new form of national money, and in the third, growth of the social service conception is essential, leading to the development of occupational organizations, which will regulate the economic affairs of the industry or occupation in the interest of the whole community.

#### The School of Salerno

In a paper read before the Section of the History of Medicine of the Royal Society of Medicine on June 25, Dr. H. P. Bayon referred to his previous communication on this subject (*NATURE*, March 30, 1940, p. 507), and said that it was generally agreed that a broad stream of Hippocratic medicine could be traced from classical times to the present day. Hippocrates was mainly concerned with the observation of symptoms for prognostic purposes, while Galen seven centuries later made diagnosis subservient to treatment. During the following nine centuries the Hippocratic stream became a mere trickle, just recognizable in the writings of philosophers like Hrabanus. In the ninth century the practitioner of medicine, when not a monk, was a *medicus* who employed spells and charms and could scarcely read or write. In the East, on the other hand, physicians and surgeons were trained by learned teachers. At the time of the first Crusade the Masters of Salerno first arose, adopted the title of *Magister* like that of expounders of the law and taught by means of the excerpts and compilations of Moslem and Hebrew writers like Constantinus Africanus, who died about 1087.

The Salernitans established by example and precept that the practitioner of medicine should be a learned person, not only a skilled craftsman. They concentrated on the treatment of symptoms, made a timid attempt to learn anatomy, and, what is par-



ticularly remarkable for their time and locality, avoided magical formulæ or miraculous faith-cures. It may be surmised that they modelled themselves on the practice of Moslem and Hebrew physicians. Their literary activity stopped with the sack of Salerno in 1196; but the famous edict of Frederick II regulating the practice of medicine was issued in 1240 when a "College" had been formed. The *Regimen Salernitatum* in its original form was not particularly important medically; when it became popular, it was altered by others; the significant Salernitan writings were *Copho*, *Antidotarium*, *Trotula* and *Rolandina*. The essential achievement of the Salernitans was the advancement of medical practice on those professional lines which it had preserved to the present day.

### Stone Age Cilicia

A REMARKABLE prospect of the future which will lie open to intensive archaeological investigation in Cilicia was given by Mr. Miles C. Burkitt in a report recently presented (May 7) to the Royal Anthropological Institute on his examination of the stone industries of the lower levels found at Tell Halaf, near Mersin. This Tell, which is being explored by the Neilson Expedition under Prof. J. G. Garstang (see NATURE, 143, 464; 1939), has proved to be one of the most important sites in the Near East. Mr. Burkitt's examination of the lower levels by a terrace excavation beginning at the lower limit of the Tell Halaf culture, and extending downward nearly to river-level, has revealed a proto-chalcolithic culture with deposits of 3 metres depth, and below this an upper and lower neolithic of 9 metres together.

Each of these deposits has yielded a characteristic pottery, of which the chalcolithic is a painted ware, some reminiscent of Nineveh, while other sherds resemble painted pottery of Thessaly. In this level mud-brick was in use and there was a poor industry of obsidian and chert. In the Upper Neolithic level the pottery was fine but undecorated. Mud-brick was not in use, while obsidian implements were more numerous than in the higher level. The pottery of the Lower Neolithic consists of hole-mouthed vessels of softer, coarser ware, which are well burnished and frequently show an incised decoration. Similar wares at present have been found only at Ras Shamra in the lowest levels. The obsidian industry is striking and includes beautiful lance-heads and daggers, flaked by pressure. These industries antedate anything hitherto discovered in this part of the Near East. In Mr. Burkitt's opinion these discoveries auger well for the prospects of the discovery of late Paleolithic industries in the many rock shelters to be explored in the foothills of Taurus bordering Cilicia.

### Wolf-Children

In his presidential address on this subject delivered before the Folk-Lore Society on February 21 (*Folk-Lore*, 51, 9; 1940), Dr. J. H. Hutton deals with the cases recorded from classical antiquity down to the present time of children having been reared by

animals, especially wolves. The earliest record of a wolf-child which he has discovered in northern Europe is that reported by William Dilich in 1341 as occurring in Hesse. Two Lithuanian cases of wolf-children were described by Connor in his "History of Poland", published in 1698, since when no cases have been described in Europe. Many recent cases, however, have been reported from India, mostly from the United Provinces, and also from Central India, as well as from Africa.

Wolves are not the only animals which have been said to have carried off and suckled children. In classical antiquity, Atalanta is stated to have been suckled by a bear and Cyrus by a bitch, while in recent times bear-children, jaguar- and leopard-children have been recorded in India, and lion-children and a baboon-child in Africa. It is a remarkable fact that no stories of the kind have been reported from the New World, where examples of wolf- and bear-children might have been expected from North America and jaguar- and puma-children from South America. Although it has been suggested that wolf-children are idiots who have wandered into the jungle and taken up their abode in the dens of wolves, this hypothesis is by no means universally applicable, notably in the case of the jaguar-child in the North Cachar Hills, India. Dr. Hutton comes to the conclusion that the evidence from India of wolf- and leopard-children and from Africa of a baboon-child seems to support the hypothesis that the belief is founded on observed facts.

### Research at Port Erin

THE report for 1939 (No. 52) of the Marine Biological Station at Port Erin, Isle of Man, drawn up by the director, Prof. J. H. Orton, shows that the oyster investigations and other researches have been continued and that the director submitted to the Manx Government a memorandum on the prospect of the development of an oyster fishery in the neighbourhood of the Isle of Man. It is stated that during the past year pressure of work caused Dr. R. J. Daniel to resign his directorship. Arrangements are being made for the transfer of the direction of the Station from the Department of Oceanography to the Department of Zoology in the University of Liverpool.

The new plans for the development of the Station unfortunately have all been temporarily cancelled owing to the War. These include increase of staff, new tanks, more efficient pumps, electricity for light and power, a store hut on the quay for gear, and funds acquired to keep the motor-boat continuously in commission and available for all research workers. It is to be hoped that these additions are merely postponed and that a successful future will be assured for this laboratory which has produced so much good work.

### Swiss Short-Wave Emissions

AN article by Paul Borsinger, chief of the Swiss short-wave service, is published in *Swiss Industry and Trade* of May. The Swiss short-wave service was



inaugurated some years ago. It was organized before the existence of an exclusively Swiss transmission station. The League of Nation's transmitter, located at Prangin near Geneva, was rented for that purpose at certain free hours. In the first stage, the service was limited to one weekly broadcast for Swiss citizens in each continent separately. The programmes intended for the Swiss were of a homely popular character, but for foreigners an endeavour was made to convey a rounded-out conception of Switzerland's artistic achievements, of her general activities and of her age-old ideals. The talks were enhanced by samples of Swiss musical art, popular music with the more stately and the classical with the modern. Unfortunately, when the first station was practically finished it was burnt down.

The new Swiss station is now well on the way to completion. It is situated at Schwarzenburg, about twenty kilometres from Bern. The construction of a short-wave station is a heavy and costly undertaking for a small country of no more than four million inhabitants. The reconstruction of the station without loss of time and in spite of the enormous difficulties of a world crisis is a proof of the tenacity and capacity of Swiss engineers. Until quite recently, the short-wave transmissions have been in the experimental stage. But now rapid progress is being made. It is expected that a regular daily programme will be organized for all continents. The first step will include a one station service only, with two directed aerials for North America, one for South America, two for Africa and one for the Far East. The second step will bring two additional areas for Central America, Southern Asia and Australia, and a circular emitter which will ensure the listeners in bordering European lands of good reception, and in addition a second station will be connected with all these different types of emitters, allowing thus simultaneous transmissions of two programmes on different wavelengths and for different destinations. The station will for financial reasons have to find ways and means of recuperating a part of its investment. To this end, the second transmitter will be placed principally at the disposal of a radio-telephone service with overseas countries.

#### "Metallurgical Abstracts"

THE Minister of Labour in a recent speech said: "I want to shorten the war. I believe it can be shortened, but nothing but metal will do it". No more emphatic statement of the importance of the metallurgist in the present struggle could be desired. In connexion with all metallurgical work the accessibility of complete and authoritative abstracts of the research work published throughout the world is essential. For many years the "Metallurgical Abstracts" of the Institute of Metals have been widely recognized as fulfilling these requirements, and the latest volume fully upholds the reputation of its predecessors ("Metallurgical Abstracts" (General and Non-Ferrous). Edited by S. C. Guilan. Vol. 6 (New Series), 1939. Pp. xii+683. 1940. London: The Institute of Metals, 4 Grosvenor Gardens, London,

S.W.I. Subscription price, including two bound volumes of the *Journal of the Institute of Metals*, £4, post paid). In every metallurgical and most engineering establishments of the country where non-ferrous metals are produced, fabricated or used, this volume is essential.

#### The Journal of Pathology and Bacteriology

WITH the May issue, this journal completes its fiftieth volume. Founded in 1892 by the late Prof. Sims Woodhead, it has consistently maintained its position as an authoritative journal of British pathology, and much of the best work in pathological and bacteriological research of British investigators has appeared in its pages. Commendation must be expressed with regard to paper and type, and the excellent illustrations have always been a feature. The present number which, in spite of war-time restrictions, maintains the high standard of its predecessors, contains thirteen papers covering a wide range of subjects in human and animal pathology, bacteriology, chemotherapy and other topics, together with some shorter articles and book reviews.

#### University of Iceland

IT is stated by the Reykjavik correspondent of *The Times* that the University of Iceland recently celebrated the twenty-ninth anniversary of its foundation by inaugurating a new university building, erected with the proceeds of a lottery authorized by the State. The British Minister, Mr. Charles Howard Smith, was present, and messages of congratulation were received from the Universities of Cambridge, Dublin, Leeds, London, Oxford, and Abo (Finland), and Yale University. The new building is large enough to house all the faculties of the University, which has until now had to make use of temporary quarters in the Parliament Building.

#### Announcements

DR. RICHARD KRONER, the well-known German Jewish philosopher and formerly professor at Dresden, Kiel and Berlin, who left Germany two years ago, has been appointed professor of logic and metaphysics at McGill University, Montreal.

THE National Academy of Medicine of Mexico has recently celebrated the centenary of the birth of the Mexican hygienist Edoardo Liceaga (1839-1926), author of works on inoculation against rabies, protection of the ports and frontier cities of Mexico against cholera, and the geography and prevention of yellow fever and typhus.

ERRATUM.—In the leading article on salvage and utilization of waste in *NATURE* of June 29, p. 988, reference was made to the utilization of woollen rags in the manufacture of high-grade paper. For "woollen" should be read "cotton".



## 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.

## Site of Action of Œstrogens

We have attempted to determine whether Œstrogens act directly on the vagina or whether they have to be absorbed into the general circulation before they can produce their action by the following method. Female mice were operated under ether anaesthesia and the vagina was separated from the bladder and urethra. It was then cut into approximately equal upper and lower parts. The upper end of the lower part of the vagina was sewn up, thus making a small vaginal sac with a normal opening. The lower end of the upper part of the vagina was then drawn up to the region just above the symphysis pubis, and implanted into the anterior abdominal wall. This upper vaginal sac, with an opening into the suprapubic region, was thus entirely separate from the lower vaginal sac. Healing occurred rapidly and a few days after the operation a bilateral ovariectomy was performed. Some ten days later the animals were ready for experiments.

In control experiments, Œstradiol in saline was injected subcutaneously and the response of the upper and lower vaginae were measured quantitatively by the method previously described<sup>1</sup>. The extent of the Œstrogenic response was greater in the lower than in the upper part of the vagina, a result in agreement with that obtained by Robson and Wiesner<sup>2</sup> from histological examination of the vagina of ovariectomized mice following the administration of Œstrin.

Œstrogens were now injected into the lumen of the upper vagina in doses which are insufficient to produce any appreciable effect when administered by the subcutaneous route. The substances, in solution or suspension in saline, were administered by means of a micro-syringe, with which 0.001 c.c. was given at each injection.

It was surmised that if the Œstrogen had to be absorbed from the vagina into the general circulation before any effect could be produced, the response, if any, would be more marked in the lower than in the upper vagina. On the other hand, if the Œstrogen could act locally without absorption into the general circulation, it might well produce a marked effect in the upper vagina without affecting the lower vaginal sac.

Œstrogen	Total dose given ( $\mu$ gm.)	Site of injection	Average scores of vaginal responses		No. of animals
			Upper vagina	Lower vagina	
Œstradiol	0.1	Subcutaneously	5.0	7.5	4
Œstradiol	0.25	" "	6.0	8.4	5
Œstradiol	0.005	Upper vagina	2.7	0	4
Œstradiol	0.01	" "	6.6	0.9	15
StilbŒstrol	0.01	" "	5.9	1.3	7
StilbŒstrol	0.2	" "	11.4	0.4	9
Œstriol glucuronide	5.0	" "	7.3	1.2	15

The results are shown in the accompanying table. It will be seen that all three Œstrogens used, namely, Œstradiol, stilbŒstrol and Œstriol glucuronide produced some degree of cornification when injected into the upper vaginal sac and that there was practically no effect in the lower vagina. The results obtained with stilbŒstrol were especially striking, since the administration of 0.2  $\mu$ gm. of this substance into the upper vagina produced very marked effects, four out of the nine animals showing complete cornification, while the lower vaginae were practically completely unaffected. These results thus show that natural and synthetic Œstrogens can act locally without absorption into the general circulation.

Emmens and Ludford<sup>3</sup> have recently shown that Œstrogens produce no effect on the vaginal epithelium in tissue culture and have suggested, like Hechter, Lev and Soskin<sup>4</sup>, that the effects of Œstrogens may be dependent upon the production of hyperaemia. The present experiments are in no way in disagreement with such a hypothesis, since the local response to Œstrogens occurred in the presence of an intact vaginal blood supply.

The local response to Œstriol glucuronide is also of interest since it shows that either the vagina can respond to conjugated Œstrogens or that the compound can be split locally in the vagina.

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June 5.

<sup>1</sup> Robson, J. M., *Quart. J. Exp. Physiol.*, **28**, 195 (1938).

<sup>2</sup> Robson, J. M., and Wiesner, B. P., *Quart. J. Exp. Physiol.*, **21**, 217 (1931).

<sup>3</sup> Emmens, C. W., and Ludford, R. J., *NATURE*, **145**, 746 (1940).

<sup>4</sup> Hechter, O., Lev, M., and Soskin, S., *Endocrinology*, **26**, 73 (1940).

## Gluten Protein

THE validity of Osborne's conclusions<sup>1</sup> that gluten is made up of the two proteins, glutenin and gliadin, has been rendered doubtful by more recent work, but no general agreement as to the true nature of the material has been reached. The work of Krejci and Svedberg<sup>2,3</sup> using the ultracentrifuge, and of Lamm and Polson<sup>4</sup> using diffusion suggested that more detailed studies using these methods would contribute greatly to solving this problem. Such studies have been in progress in Uppsala during the past winter. It has been considered essential to include as much as possible of the whole gluten protein in these studies, and as sodium salicylate has previously been shown to be the most generally satisfactory dispersing agent for gluten<sup>5,6</sup>, this solvent has been used almost exclusively.

Two series of results are of primary importance. First, the dispersing power of sodium salicylate is



directly proportional to its concentration up to 8 per cent. This had already been determined<sup>7</sup>, but concentration calculations from the ultracentrifuge diagrams show that only part of the protein dispersed is in true molecular solution. The crude dispersions, even after the complete removal of starch, are opaque. This opaque material is rapidly sedimented out at a relatively low speed in the ultracentrifuge, as is some of the protein in the clarified dispersion. About 35 per cent of the gluten protein was dispersed in 2 per cent salicylate, but less than half of this (14 per cent) was in molecular solution. Dispersions of a soft wheat gluten in 2, 4, 6, 8, 10, 12 and 16 per cent sodium salicylate were ultracentrifuged at 65,000 r.p.m. (centrifugal force about 300,000 times gravity). The percentages of the gluten protein found to be in true solution were 14, 34, 48, 68, 72, 84, and 77 respectively. This relation is approximately linear up to 8 per cent, the point at which dispersion is virtually complete<sup>7</sup>. The sedimentation constant ( $s_{20}$ ) of the molecularly dispersed protein was nearly constant at about 2.5. (Sedimentation constants are given in units of  $10^{-13}$ , and diffusion constants in units of  $10^{-7}$ .) Some of the protein that sedimented out of solution at low concentration of salicylate was molecularly dispersed in higher concentrations, and yielded the same  $s_{20}$  values as the more soluble fractions. This fact was verified by fractionating the protein into four fractions and subjecting each to ultracentrifuge studies. The  $s_{20}$  values obtained were the same for all fractions, but the percentage of the protein molecularly dispersed decreased with decreasing solubility of the fractions.

The second series of results was obtained by diffusion<sup>4</sup>. Gluten protein was clarified in a low-speed ultracentrifuge at 12,000 r.p.m. (centrifugal force about 10,000 times gravity) and fractionated to yield four fractions on the basis of solubility. The diffusion constant ( $D_{20}$ ) of each fraction was determined and found to be 2.14, 3.13, 4.12 and 4.83 for the four fractions, starting with the most insoluble. The fractions were recombined and the diffusion constant of this material was 3.36, in good agreement with the weighted mean of the results for individual fractions, which was 3.32. The diffusion curves showed that each fraction was itself highly inhomogeneous, and the values of diffusion constants given are mean values. These results are substantiated by the use of the equilibrium centrifuge. The mean molecular weight of the most soluble fraction (23 per cent of the total gluten) was 44,000, this value being obtained by both the sedimentation-diffusion method, and the equilibrium method<sup>8</sup>. The weights of the other fractions were much higher and increased progressively with decreasing solubility.

Considering the two series of results together it is at once obvious that the shape of the molecules in the different fractions must be very different. The molecules are undoubtedly long and thin, and it seems certain that the dissymmetry increases as solubility decreases. It also seems certain that there are many lengths of molecules, and that the theory of two, and only two, distinct and different proteins, 'glutenin' and 'gliadin', in the gluten, must be rejected. The suggestions of Sandstedt and Blish<sup>9</sup> and of Blish<sup>10</sup> that there are three or only a few rather distinct components do not seem to fit the present results any better. (Studies on acetic acid dispersions also showed gluten to be inhomogeneous.) The hypothesis advanced in earlier papers<sup>7,11</sup> that

the gluten protein is a protein system made up of components varying regularly and systematically in chemical and physical properties is strongly supported by the present work.

Full details of this research will be published in the *Canadian Journal of Research*. We wish to thank Prof. The Svedberg, Uppsala, for providing facilities for carrying out the studies. The expenses incurred at the Institute of Physical Chemistry, Uppsala, were defrayed by grants from the Rockefeller and Wallenberg Foundations. The salary of the senior author was paid by the National Research Council of Canada, and other expenses were supplied by the Searle Grain Co., Ltd., Winnipeg.

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<sup>6</sup> Cook, W. H., and Rose, R. C., *Can. J. Research*, **12**, 248 (1935).

<sup>7</sup> McCalla, A. G., and Rose, R. C., *Can. J. Research*, **12**, 346 (1935).

<sup>8</sup> Svedberg, The, and Pedersen, K. O., "The Ultracentrifuge", Oxford (1940).

<sup>9</sup> Sandstedt, R. M., and Blish, M. J., *Cereal Chem.*, **10**, 359 (1933).

<sup>10</sup> Blish, M. J., *Cereal Chem.* (Supp.), **13**, 16 (1936).

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## Production of Oxygen by Illuminated Chloroplasts

THE activity of isolated chloroplasts in light, measured by the oxygen evolved from ferric oxalate, has been shown to be relatively high. The ferric oxalate is reduced to ferrous oxalate and oxygen, which is equivalent to the iron reduced, and was measured by means of hæmoglobin. The maximum pressure of oxygen obtainable, however, was only 4 mm. mercury<sup>1,2</sup>. It has now been proved, by direct measurement of the oxidation of ferrous oxalate, that this low limit of oxygen pressure obtainable simply results from the re-oxidation of the ferrous oxalate produced by the illuminated chloroplasts. If the oxygen uptake due to the oxidation of the ferrous salt can be prevented, oxygen should accumulate to a higher pressure and be capable of direct measurement. It was found that ferricyanide rapidly oxidizes ferrous oxalate in the presence of excess of potassium oxalate.

Potassium ferricyanide does not itself produce oxygen with the chloroplasts in light. But when a mixture of potassium ferricyanide and ferric potassium oxalate is illuminated in the presence of chloroplasts, molecular oxygen is evolved at a pressure above the atmospheric. The gas evolved was proved to be oxygen by Krogh's method. Experiments were then carried out in Barcroft manometers at 20° C. and the rate of oxygen evolution determined. The results are shown in the table below, and were obtained as follows. The experimental fluid contained the chloroplast suspen-



sion in sucrose  $M/5$ , potassium oxalate  $M/2$ , potassium ferricyanide  $M/10$ , ferric oxalate  $M/500$ , and phosphate buffer  $pH\ 7.0\ M/15$ . 5 c.c. were introduced into each cup of the manometer with 10 per cent caustic potash in the centre pot. The left cup was darkened while the other was illuminated from below with approx. 10,000 lux. The concentration of chloroplasts is expressed in terms of the dry weight of the whole leaf from which they were obtained.

<i>Stellaria media.</i>		Dry weight 43 mgm.
$QO_2$	7-15 min.	7.8
"	at 40 "	1.8
Total $O_2$	at 40 "	143 c.mm.
<i>Chenopodium Bonus-Henricus.</i>		Dry weight 49 mgm.
$QO_2$	7-15 min.	8.9
"	at 30 "	5.8
Total $O_2$	at 30 "	199 c.mm.
<i>Chenopodium Bonus-Henricus.</i>		Dry weight 4.9 mgm.
$QO_2$	7-15 min.	17.8
"	at 30 "	4.3
Total $O_2$	at 30 "	33 c.mm.

The maximum  $QO_2$  obtained is 18, compared with a  $QO_2$  of 20 as originally measured by hæmoglobin. These new findings confirm the former experiments carried out with hæmoglobin as a means of measuring oxygen, and in addition show that the isolated chloroplast in light can evolve oxygen at a high pressure. The chloroplast then, with ferric oxalate as a hydrogen acceptor, behaves in a similar way to the whole cell as regards the production of oxygen during photosynthesis.

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<sup>1</sup> Hill, R., *Proc. Roy. Soc.*, B, 127, 192 (1939).

<sup>2</sup> Hill, R., and Scarisbrick, R., *Proc. Roy. Soc.*, B (in the press, 1940).

## Radiation and 'Stuffiness'

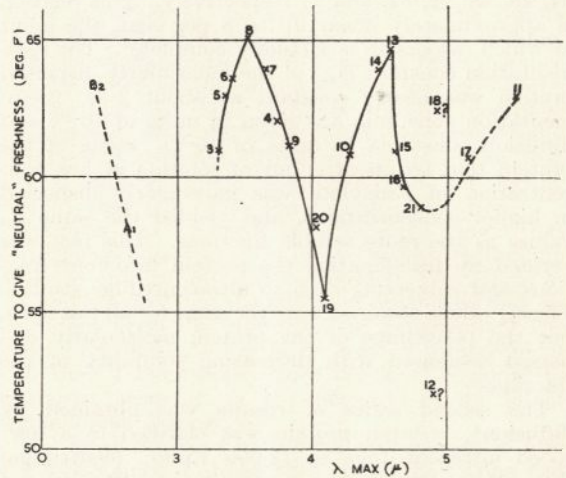
WHILE difficult to define, the sensation of 'stuffiness' is easily recognized subjectively by everyone. Since the sensation can be caused by overheating, it is essential in work on stuffiness to make sure that the human subjects of the experiment are comfortable as regards warmth.

Following the procedure of earlier investigations in the field of human comfort, a numerical scale, the substantial linearity of which has been demonstrated statistically, was allotted to the various comments on sensations of stuffiness and freshness expressed by the subjects. The reactions of 'sessions' of about ten people each, tested separately, could then be averaged. By such methods it has been shown that sensation of stuffiness increases, *ceteris paribus*, with air temperature, according to a definite smooth curve.

An experimental gas fire has been built consisting of a blackened iron plate 14 in.  $\times$  16 in. with nine chromel alumel thermocouples embedded in it at strategic points. Its temperature can be varied over a wide range by control of the gas rate, and can be measured by means of the thermocouples. Spectrometric investigations have shown that the fire

approximates to a 'black' or 'grey' body, and confirmed the wave-lengths of maximum energy calculated from temperature measurements.

Although in an incomplete state because of the War, the results so far obtained may be of interest. They suggest that 'stuffiness' is associated with values of  $\lambda$  max. of about  $3\ \mu$ ,  $4.1\ \mu$  and  $4.8\ \mu$ , with regions of freshness in between, as shown in the accompanying graph; where a low temperature for 'neutral' freshness, that is, neither fresh nor stuffy, means a wave-length associated with stuffiness and vice versa. With the longer wave-lengths, the quantity of radiation is smaller, the subject nearer to the fire, and therefore less evenly warmed by it, and the results more erratic. The numbers of the points indicate the order in which they were obtained.



RELATION BETWEEN SENSATIONS OF FRESHNESS AND STUFFINESS AND PEAK WAVE-LENGTH OF RADIATION. TOTAL, MORE THAN 200 VOTES. POINTS A AND B WERE OBTAINED WITH A DIFFERENT TYPE OF FIRE. ---, PORTION OF CURVE NEEDING FURTHER DATA.

Sir Leonard Hill<sup>1</sup> has given reasons for believing that nose closing, which may be a cause of stuffiness, is associated with radiation which does not penetrate the stratum corneum, though his views are not yet generally accepted<sup>2</sup>. Taylor<sup>3</sup> has given data on the infra-red absorption spectrum of the stratum corneum, showing the hydroxyl group absorption bands at about  $3\ \mu$ ,  $4.7\ \mu$  and  $6\ \mu$ . It is tempting, therefore, to associate the stuffiness bands at  $3\ \mu$  and  $4.8\ \mu$  with the absorption bands at  $3\ \mu$  and  $4.7\ \mu$ . Examination of Taylor's curves suggests that the use of a narrower spectroscopic slit (he used 0.01 in.) might show an absorption band between  $4.1$  and  $4.2\ \mu$ . Preliminary experiments have increased the probability of an absorption band at  $4.15\ \mu$ .

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<sup>1</sup> Hill, L., *Brit. Med. J.*, i, 977 (1939).

<sup>2</sup> Dufton and Bedford, *J. Hygiene*, 33 (4), 476 (1933). Winslow, *Amer. J. Hygiene*, 20, 195 (1934). Lehmann, *Arbeitsphysiol.*, 10 (4), 418 (1939).

<sup>3</sup> Taylor, *Proc. Roy. Soc.*, A, 142, 598 (1933).



## Types of Californian Miocene Foraminifera

FOLLOWING upon the review by "A.M.D." of Dr. R. M. Kleinpell's monograph on "Miocene Stratigraphy of California" in *NATURE* of December 23, 1939, p. 1030, it may be of interest to note that the topotype material with the actual described types referred to by the author of the above work have now been deposited by me in the micropalaeontological collection of the Stanford University.

On p. 21 Dr. R. M. Kleinpell refers to my contribution, "Foraminifera from the Tertiary of California", 1900, *Proc. Calif. Acad. Sci.*, Geol., 1, 241-258, pls. 29, 30 (1900) as the first description of Californian Foraminifera, as follows:

"Topotype material from Chapman's locality has not been obtained. As it is impossible to examine his original material, all synonymy is based on comparisons with his figures".

At the time of publication (1900) I was in communication with Dr. J. C. Merriam—who had forwarded me the foraminiferal marl through my late friend, Prof. Rupert Jones—with regard to depositing these original types in a permanent museum in America. On my removal from London to Melbourne, to take up the position of State palaeontologist, I was apparently lost to sight or memory by the American palaeontologists concerned, although actively publishing in the meantime. It was only lately, however, since the publication of Dr. Kleinpell's work, that I have been able, through him and Prof. Hubert G. Schenck, finally to deposit the types of this original sample, which have now a historic interest, labelled "From a well in Santa Clara Co., California" in the Stanford University.

*Inter alia*, may I point out that by an oversight the reviewer remarks that in the above work of Dr. Kleinpell's "there do not appear to be any new species", whereas that author has described sixty-six new species and varieties.

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I ACKNOWLEDGE the correction in Mr. Chapman's last paragraph of an unfortunate error, partly due to (though not excused by) the want of any typographical distinction in Kleinpell's book between new specific names and others.

A. M. D.

## Phosphate Separation in Qualitative Analysis

IN ordinary elementary qualitative analysis, it is usual to remove phosphoric acid from solution as ferric phosphate by dropwise addition of ferric chloride under certain conditions after removal of Group I as chlorides and Group II as sulphides. Zirconium phosphate is well known to be insoluble in acid solution and it appeared that, as an alternative method, phosphoric acid might be removed by addition of a soluble zirconium salt. The following scheme has been found to work well with elementary students in our laboratories.

As usual, the filtrate from Group II is boiled until free from hydrogen sulphide and a few drops of concentrated nitric acid are added. An acid solution of zirconium nitrate is added dropwise until further precipitation ceases; the whole is warmed and the insoluble zirconium phosphate filtered off. To the filtrate a further drop of zirconium nitrate is added and, if no precipitate forms, all the phosphate has been removed. Ammonium chloride and hydroxide are now added as usual, *the solution well* boiled and filtered.

The filtrate will contain any members of Group IV (Zn, Mn, Ni, Co), Group V (Ca, Sr, Ba) and Group VI (Mg, etc.) originally present and may be proceeded with in the ordinary way.

The precipitate contains the excess zirconium with any iron, chromium or aluminium originally present. It is boiled with sodium hydroxide, which extracts any aluminium; on filtration the filtrate is neutralized with acid and aluminium precipitated as usual with ammonia. The residue, if coloured brown, contains iron. In any event, water and sodium peroxide are added to oxidize the chromium, which passes into solution as chromate. After filtration the insoluble portion is extracted with dilute acid and the presence of iron confirmed.

The presence of chromate in the filtrate should likewise be confirmed lest any titanium in the zirconium salt should yield coloured pertitanate, which might either be mistaken for or serve to mask any chromate.

The foregoing method appears to be somewhat more straightforward than the usual procedure and is more easy to explain chemically to the elementary student than the usual method.

A disadvantage lies in the cost of the pure zirconium nitrate solution. But as zirconia is relatively inexpensive, and the presence of hafnium is immaterial, since it behaves exactly like zirconium in these reactions, it should not be difficult to place suitable solutions of the nitrate on the market at a reasonable cost, provided a sufficient demand arose.

It is, of course, important that the zirconium salt shall be pure. By spectroscopic analysis we have invariably found aluminium to be present both in zirconia and in various zirconium salts purchased from reputable firms. In our experiments, therefore, a solution of the nitrate was boiled with excess sodium hydroxide, the precipitate washed repeatedly by decantation and allowed to settle over night. The suspension was then dissolved by warming with half its volume of diluted nitric acid (1:1) and the resulting solution was ready for use.

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## Swelling of Wood Charcoal: Experiments with a New Silica Extensometer

AN all-silica extensometer was made to the senior author's design by E. L. Mays, with the object of overcoming certain difficulties encountered in the measurement of the linear expansion of wood charcoal by means of the metallic extensometer pre-



viously described by Bangham and Fakhoury<sup>1</sup>. The most important drawbacks to the metallic form are the risks accompanying outgassing at high temperatures, the difficulty of measuring the expansion on the adsorption of gases and vapours at temperatures as low as that of liquid air, and the need for investigating the expansive properties of the fatty acids, which would attack the extensometer itself.

The new form functions without knife edges by means of a plane silica spiral sealed in a vertical position from its outer end to the body of the extensometer, while its centre is directly sealed to the base of a long pointer through a U-shaped rod. The pointer moves freely in a vertical plane when subjected to a downward pressure on its base. The charcoal rod is mounted between two claws; the upper one rests against a fixed point on the body of the extensometer, while the lower one presses on the horizontal base of the pointer. The movement of the free end of the pointer is read on a calibrated scale by means of a cathetometer reading up to 0.01 mm. A special calibrating device in the form of a micrometer screw gauge was made reading up to 0.005 mm. to determine the magnification of the extensometer at different scale divisions. The magnification was about thirty times, and it proved to be uniform over a wide range.

Comparative experiments on the expansion of a certain piece of charcoal on immersion in methyl alcohol were made by both the metallic and silica extensometers, which proved the correct behaviour of the latter.

Preliminary experiments were made to test the expansive properties of gases and vapours at the temperature of liquid air. Methyl alcohol caused an expansion which amounted to at least half its value at 18° C. (0.58 per cent), though it was still far from saturation. Hydrogen, on the same piece, gave a fairly measurable expansion which increased gradually with the increase of pressure, amounting to 0.115 per cent at atmospheric pressure. Carbon dioxide, however, seemed to give no expansion at liquid air temperature; but it gave an expansion amounting to 0.42 per cent at -78° C.

Expansion experiments were also made on formic acid. A certain piece of charcoal ( $\gamma$ ), which gave a linear expansion of 0.704 per cent by saturated methyl alcohol vapour at 0° C., gave an expansion of 0.923 per cent on saturation with formic acid vapour at the same temperature. Unfortunately the sorption values could not be calculated with the present data at hand owing to the variation in the degree of association of formic acid molecules at different vapour pressures. As soon as these are obtained, the molecular expansion values will be available.

Measurements of the linear expansion of some wood charcoal specimens, supplied by Messrs. Becker and Co., on the adsorption of methyl alcohol revealed some interesting results. Tables 1 and 2 show some of the results obtained for three pieces of the above

TABLE 1.

Charcoal used	Outgassing temperature	Differential temp. coeff. between silica and charcoal	Saturation values		
			'S' gm. alcohol gm. charcoal	% Expansion $\frac{X}{273/T}$	Molecular expansion $\frac{MX/S}{273/T}$
$\alpha$	1000° C.	—	0.147	0.139	28.7
$\beta$	560° C.	$2.82 \times 10^{-6}$	0.121	0.377	92.9
$\gamma$	400° C.	$7.02 \times 10^{-6}$	0.144	0.704	180.0

TABLE 2.

Charcoal	$s/S$	$\log p/P$	$x \times 273/T$	$x/x_0$	$d(Mx/s)/dx$	$S$	$d(Mx/s)/dx \times S$
$\alpha$	0.90	$\bar{1}.50$	0.113	1.0	150	0.147	22.1
$\beta$	0.90	$\bar{1}.39$	0.227	2.0	225	0.121	27.2
$\gamma$	0.90	$\bar{1}.39$	0.394	3.48	230	0.114	26.2
$\alpha$	0.80	$\bar{1}.085$	0.064	1.0	205	0.147	30.1
$\beta$	0.80	$\bar{2}.930$	0.128	2.0	260	0.121	31.4
$\gamma$	0.80	$\bar{2}.930$	0.210	3.28	282	0.114	32.1

variety. Those of charcoals " $\beta$ " and " $\gamma$ " were obtained by the silica extensometer, while those of charcoal " $\alpha$ " were obtained by a metal extensometer, the magnification of which was 130.

It can be seen from Table 1 that:

(1) With the rise of outgassing temperature, the molecular expansion of charcoal seems to decrease. Such an observation needs further verification on one and the same piece of charcoal, differently treated, a problem which is under investigation.

(2) The charcoal which has a higher temperature coefficient seems to give bigger expansion on adsorption.

It was previously shown by Bangham and Fakhoury<sup>2</sup> that the slope of the molecular expansion curves at high relative pressures,  $d(Mx/s)/dx$ , is a measure of  $B/\Sigma$ , where  $B$  is the incompressible cross-sectional area per gm. mol. of the adsorbate, and  $\Sigma$  is the available adsorbing surface. Now for the same adsorbate, we expect  $B$  to be the same at the same relative concentration, ( $s/S$ ), for the different specimens of charcoal, and  $\Sigma$  to be proportional to the saturation adsorption values  $S$ . Therefore, the slopes of the different molecular expansion curves at the same relative concentrations would be expected to be inversely proportional to the saturation adsorption values, that is,  $d(Mx/s)/dx \times S$  should be constant, an expectation which is fairly justified by the figures in the last column in Table 2.

The data in Table 2 are taken from the molecular expansion curves, semi-log. isotherms and  $\log p - x$  curves for the three above-mentioned specimens of charcoal.

It is also satisfactory to see, from column 5, that within the range shown the ratio of the percentage expansion of the three charcoals remains constant at the same  $s/S$ .

In conclusion, we may add that the molecular expansion of charcoal by a series of esters is also under investigation.

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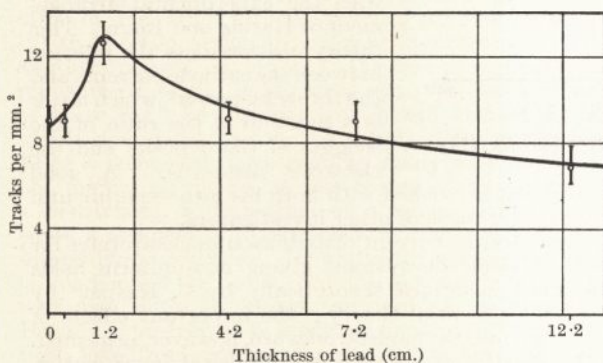
<sup>1</sup> Bangham and Fakhoury, *Proc. Roy. Soc., A*, **130**, 81 (1930).

<sup>2</sup> Bangham and Fakhoury, *J. Chem. Soc.*, 1324 (1931).



## Absorption of Heavy Cosmic Ray Particles

IN a previous note<sup>1</sup> we have described experiments with the object of obtaining information about the radiation producing the heavy particles in the cosmic rays. A set of Ilford half-tone plates (70  $\mu$  thick), sensitive to  $\alpha$ -particles and protons and covered with thicknesses of lead up to 12.2 cm., have been exposed to cosmic rays on the Jungfrauoch and at Bristol for a period of 230 days. It was found that the primary radiation producing the tracks is strongly absorbed in air, but very little absorbed in lead, and it was concluded that the majority of tracks observed in the emulsion are produced by the neutron component of the cosmic rays.



VARIATION OF NUMBER OF HEAVY TRACKS WITH THICKNESS OF ABSORBER.

We have now measured the absorption curve in lead, on the Jungfrauoch material, in more detail and with greater accuracy. The result is shown in Fig. 1, where we have plotted the number of tracks per mm.<sup>2</sup> against the thickness of lead. Only tracks with a visible range greater than 10 cm. air equivalent have been included since a large fraction of the shorter tracks are due to radioactive contamination. The curve shows a maximum at about 1.2 cm. lead.

It follows from this result that there are at least two components of cosmic radiation producing heavy tracks. The first component is very little absorbed in lead and consists very probably of neutrons. The second component has a transition curve in lead very similar to that of the soft radiation. It has a maximum coinciding precisely with the Rossi maximum and falls rapidly to a small value within 5 cm. of lead. We therefore conclude that the soft radiation (electrons and light quanta) is responsible for part of the heavy tracks and particularly for the maximum of our curve. It is plausible to assume that the process by which these tracks are produced is the direct nuclear photo-electric effect.

The cross-section for this photo-electric effect can only be estimated very roughly from these results for several reasons. First, the number of light quanta per cm.<sup>2</sup> min. at the Jungfrauoch is not known accurately. Secondly, since most of our tracks are passing through the whole emulsion, we do not know the actual distribution of range of our particles and, consequently, we do not know whether the bulk of our tracks originate from the lead or from the glass.

The number of soft ionizing particles at the Jungfrauoch is about 2 per cm.<sup>2</sup> min. After cascade multiplication in 1.2 cm. lead, we can assume that the number of light quanta with energies greater than 10 Mev. is about 6 per cm.<sup>2</sup> min. Assuming, further, an average range of the disintegration

protons of 1 m. air equivalent, we find an average cross-section for photo-disintegration with proton emission of  $10^{-25}$  cm.<sup>2</sup> per lead atom or SiO<sub>2</sub> molecule. This figure is very rough and may well be wrong by a factor 5. We may compare it with the cross-section for the photo-electric effect with neutron emission obtained by Bothe and Gentner<sup>2</sup> for copper and the lithium  $\gamma$ -rays, namely,  $5 \times 10^{-26}$  cm.<sup>2</sup>. Our figure may seem to be rather large, especially in view of the fact that neutron emission is much more probable than proton emission, but taking into account the many uncertainties involved, it is probably a reasonable order of magnitude.

If it is true that some of the protons are produced by photo-electric effect, it must be expected that an even larger number of neutrons is produced in the same way. Since we do not know the cross-sections for the photo-electric effect for oxygen and nitrogen atoms, it is difficult to decide whether the whole neutron component of cosmic radiation can be accounted for by a photo-electric effect taking place in the high atmosphere, or whether other processes are involved in the production of the neutron component too (compare also ref. 3).

Further details will be published elsewhere.

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<sup>1</sup> Heitler, Powell and Fertel, *NATURE*, **144**, 283 (1939).

<sup>2</sup> Bothe and Gentner, *Z. Phys.*, **106**, 236 (1937).

<sup>3</sup> Bethe, Korff and Placzek, *Phys. Rev.*, **57**, 573 (1940).

## Specific Ionization of Cosmic Ray Particles

MEASUREMENTS of the specific ionization of cosmic ray electrons with energies between  $0.1 \times 10^6$  ev. and  $30 \times 10^6$  ev. have been made by Corson and Brode<sup>1</sup> by counting droplets on photographs taken with a counter-controlled cloud chamber using a delayed expansion. They established the existence of a minimum ionization at about  $1.5 \times 10^6$  ev. and a logarithmic increase in ionization with energy beyond this minimum. Using essentially the same method, I have measured the specific ionization of cosmic ray particles over the energy range  $2 \times 10^6 - 6 \times 10^9$  ev.

The track photographs were classified in the following way:

(1) In general, all particles in showers were assumed to be electrons. The exceptions were a few particles of energy greater than  $10^8$  ev. which showed an ionization markedly less than that of electrons of the same energy, and were therefore considered to be mesons responsible for the production of 'knock on' showers. Three particles, each from a separate shower, were taken as mesons out of forty measured showers for this reason.

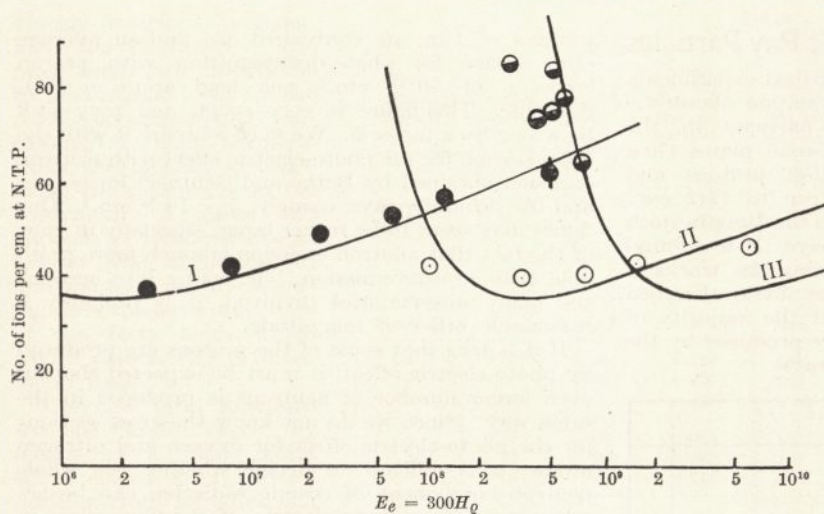
(2) Single particles with energy less than  $40 \times 10^6$  ev. not exhibiting heavy ionization were taken as electrons. Mesons of this energy would be recognizable because of their heavy ionization.

(3) Single particles in the energy region  $2 \times 10^8$  ev. to  $7 \times 10^8$  ev. showing markedly heavy ionization were taken as protons.

(4) All other single particles were assumed to be mesons, although certainly a small fraction were protons.

The theoretical curves for electrons, mesons ( $M = 170 m$ ) and protons are shown in the accompanying graph. The experimental results for electrons show good agreement with the theory over the





ENERGY IONIZATION CURVES FOR ELECTRONS (I), MESONS (II), PROTONS (III).

- = ELECTRON
- = MESON ( $M = 170 m$ )
- ◐ = PROTON

observed range, that is, between  $2 \times 10^6$  ev. and  $5 \times 10^8$  ev., both as regards absolute value and variation with energy.

For mesons, the agreement with theory is not as good. However, the results do show a small rise of ionization with energy, though not as much as is expected. Possibly the errors of the curvature measurements may be the cause of this discrepancy. Since the protons above  $2 \times 10^8$  ev. ionize less than mesons of the corresponding energy, the relatively low observed value in the highest energy group may possibly be explained as due to some protons being included in the group. Unfortunately, no meson track was observed with a momentum low enough to allow a reliable mass determination.

Among 3,000 tracks, eight recognizable proton tracks (all positive) have been observed. The observed values of the mean specific ionization on each individual proton track are shown as half-shaded circles, and show a satisfactory agreement with the theoretical curve. No alpha particles or other multi-charged particles were observed, nor any deuterons.

A detailed account of the investigation will be published elsewhere.

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<sup>1</sup> Corson and Brode, *Phys. Rev.*, **53**, 773 (1938).

## Current Distribution and Throwing Power in Electrolytes

THERE are two interesting aspects of the distribution of a direct current flowing between soluble metal electrodes in an aqueous electrolyte confined in an insulating vessel. Theoretically the problem appears to be soluble, ideally at least, by classical potential theory using the electrochemical theory of the anode and cathode fall. The distribution is of great practical importance in attaining uniform deposits on curved surfaces and in holes, and in avoiding heavy deposits on sharp edges and projections.

Although the current distribution between a

common anode placed between two equal cathodes at the same potential but at variable spacing has been extensively investigated experimentally, G. E. Gardam<sup>1</sup> appears to be the first to attempt a theoretical treatment. He showed that the ratio of the currents flowing to each cathode can be calculated in terms of the dependence of the cathode fall on the current density, the conductivity of the electrolyte, and the electrode spacings, for the case of a uniform field corresponding with the experimental arrangement of Haring and Blum<sup>2</sup>. This theory also predicts the relation between the cathode currents and the throwing power<sup>3</sup>, which latter is a function of the ratio of the weights of the deposits and the electrode distances. A good

agreement is reached with both his own experimental results and those of other investigators.

Recently the current distribution in electrolytes for various electrode systems giving non-uniform fields has been examined theoretically by C. Kasper<sup>4</sup> by applying potential theory; the important effects of potential falls at the electrodes are, however, neglected.

A new theoretical and experimental investigation of the current distribution between plane electrodes at variable spacings in a non-uniform field has been carried out in an attempt to remedy this defect. The experimental arrangement consists of an anode, a main cathode with a hole in the centre from which, on the side opposite to the anode, a rubber tube extends, ending in a small subsidiary cathode (at the same potential as the main cathode). The current to the subsidiary electrode is calculated approximately from the sum of two potential terms. The first is the potential at the centre of the hole determined by the potential field between the three electrodes; this field problem is similar to that in a cathode-ray oscillograph<sup>5</sup>. The second is equal to the difference between the two cathode falls. Allowance is made for the resistance of the electrolyte between the two cathodes. Assuming the usual logarithmic relation between the cathode fall and the current density, it is found that the ratio of the subsidiary to the main cathode current decreases with increasing distance between the cathodes and with increasing current to the main cathode, the rate of change being very rapid at small spacings. Furthermore, this ratio is independent of the distance between the anode and the main cathode over a wide range.

Using copper electrodes in neutral and acid solutions of copper sulphate, these theoretical predictions are found to be satisfactorily confirmed by the present experiments, in which measurements of the electrode potential fall by means of probe electrodes are introduced. A detailed report of these investigations will be published later.

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<sup>1</sup> Gardam, G. E., *Trans. Far. Soc.*, **34**, 695 (1938).

<sup>2</sup> Haring, H. E., and Blum, W., *Trans. Amer. Electrochem. Soc.*, **44**, 313 (1923).

<sup>3</sup> Field, S., and Weill, A. D., "Electro-Plating" (London, 1938).

<sup>4</sup> Kasper, C., *Amer. Electrochem. Soc.*, **77**, preprint 28 (April 1940).

<sup>5</sup> Ollendorff, F., "Potentialfelder der Elektrotechnik" (Berlin: Springer, 1932).



## RESEARCH ITEMS

## Native Medicine in Portuguese Africa

In a study of native conceptions of disease and healing in Portuguese Africa (Guinea, Angola and Mozambique) by Luiz de Pina (*Scientia*, 67; 1940) it is pointed out how close is the resemblance in basic ideas not only with those of primitive peoples generally, but also of the backward European peasantry. In Portuguese Africa illness may be attributed to any of three causes: (1) the introduction of a strange body or a spirit or soul of another person, often of a sorcerer, into the body of the sick person; (2) the hostile action of a *fetiço* (enchantment) by another person or object; (3) the vengeance or punishment of the gods, idols, etc. While any one of these may be operative, it is the idea of *fetiço* which dominates the native mind. The nature of *fetiço* is incorrectly presented by many writers. It is not merely an object, it also covers a charm, spell, a bewitching, a divination or a curse, and it may cause a tempest, a disastrous war, toothache, illness or any like misfortune. Its author, if a living person, is condemned to death, but the responsibility may rest also with an object, an idol, or a divinity. Usually, however, it is a wizard or witch. These are both loved and execrated according as their powers are exercised in the detection of, or the causing of, *fetiço*. Among certain African peoples the belief in a supreme and inferior deities, represented by idols, more or less crude, may be found, but there, it is to be noted, the powers of the supreme deity are less than those of the spirits controlled by the sorcerers, since the supreme deity exercises no influence over the affairs of this world. Some of the lesser deities are concerned only with certain specific diseases, and some of them are venerated in sacred places and have a priesthood attached to their cult. The practitioners concerned in the medical art are doctors, sorcerers and midwives. The doctor, who is both surgeon and physician, combines with his functions those of the sorcerer, as the sorcerer does those of the doctor. The basis of the healing art is magic, which in the detection and punishment of the individual responsible may be made the instrument of private vengeance. After the sorcerer comes the physician, who among his medicaments draws upon the wide variety of simples and drugs provided by the indigenous flora.

## Continuity of Culture in Scandinavia

Two contributions appearing in *Antiquity* of June 1940 deal with Scandinavian cultural survivals from prehistoric or earliest times. A. W. Brøgger sketches the development of Norwegian cultural history "from the Stone Age to the Motor Age". Up to a century ago on a farm was a stone bearing the runic inscription "Eiliv Elg carried fish in Rausjøen", indicating that in the days of Olaf the Holy, as in modern times, fry was transferred to the mountain tarns. Only fragments of the saga from the Stone to the Motor Age have been found; but the lines may be traced in the foundations of folk-culture. Two animals dominated the annual culture, the stag and the seal, supplemented by the elk and the reindeer. The first change was the introduction of domesticated animals and corn four to five thousand years ago. Henceforth

peasant culture is a combination of hunting and farming. With the Iron Age, peasant culture incorporated iron production from bog ores and native rock-species, while the introduction of the iron axe provided an efficient weapon against the forest. The foliage knife, which afforded fodder for the cattle, and the scythe are the fundamental elements in the emergence of the Norwegian farm, based upon cattle breeding, which was the social, economic and technical unit, with the family as its active centre. The Iron Age also brought a new type of boat which made possible the development of the maritime culture of the Vikings. A rural industry of Jutland, of which an account is given by Axel Steensberg, produces a hand-made pottery, small black vessels of great beauty which, notwithstanding the introduction of the potter's wheel into Denmark at the close of the Iron Age, has survived down to to-day.

## Biology of the Silverfish Insect

An important study of a silverfish, *Ctenolepisma longicaudata*, first described in 1905 from S. Africa, and since found to be widely distributed, has been made by Eder Lindsay (*Proc. Roy. Soc. Victoria*, 52 (N.S.), 35; 1940). The species, which is becoming a pest of increasing importance in Australia, since it feeds upon stored food materials as well as upon paper, cotton and artificial silk, has a life-history spread over about seven years, during four of which it is mature. Its temperature tolerance ranges from 11° C. where development stops and the insect becomes torpid, to an optimum at 25° C., temperatures higher than which cannot long be endured. In dry air silverfish die rapidly, and since they take no liquid, their moisture content is derived from food and oxidation of food-stuffs, as well as from moist air. The rate of egg-laying is low, but the long life of the adults leads to rapid increase in numbers: if each female laid 56 eggs a year and there were no fatalities, the progeny of one pair would lay 470,000 in the seventh year. Control is exercised by toxic sprays which must come in contact with the insect, and is most effective when carried out at night; but the nature of the life-history, feeding habits, and temperature and moisture tolerance, associated with the absence of enemies, suggests that control measures to be reasonably effective must be applied continuously.

## Madreporarian Corals of the "Discovery" Expedition

J. STANLEY GARDINER describes a small collection from a number of localities of Madreporarian corals with an account of variation in Caryophyllia (*Discovery Rep.*, 18, 323-339; 1939). *Flabellum curvatum*, obtained in seventeen dredgings, was remarkably widely distributed. Although the only common feature in these localities is the low temperature, there was no character found in this species which might be supposed to be related with this factor, and the specimens presented no difference in texture compared with species from the Indian Ocean. Very few positive conclusions emerge from the review of the variation in Caryophyllium, which is a cosmopolitan genus and usually inhabits waters deeper



than 50 fathoms. The study of ecological conditions with regard to variation does not help much owing to scanty knowledge of the natural habitats. Fossil forms are common in tertiary deposits and have also been described from the cretaceous. The author regards it as clear that many, perhaps most, fossil forms of *Caryophyllia* still continue to exist to-day.

#### Diffusing Factors

DIFFUSING factors which increase the permeability of the skin to injected fluids and particles can be obtained from such diverse sources as spermatozoa, testis, bacterial cultures, malignant tissues, leeches and snake and spider venoms. For example, a mixture of Indian ink and testicular extract is injected intracutaneously into the shaved back of a rabbit and a control injection of Indian ink in saline is also made. The area over which the particles of Indian ink spread is increased by high dilutions of the testicular extract. The passage of substances such as dyes, haemoglobin and diphtheria antitoxin is influenced by the diffusing factor. Madinaveitia and co-workers, in a series of papers (*Biochem. J.*, 34, 613, 621 and 625; 1940), discuss a possible theoretical mode of action for the diffusing factor. They also show that it can be separated from the proteases of a *Cl. Welchii* filtrate, and find that in a preliminary concentration from testicle powder, mucinase activity seems to run parallel with diffusing factor activity.

#### Inclusions in the Cells of Virus-infected Plants

F. M. L. SHEFFIELD, of Rothamsted Experimental Station, has published an informative summary of the effects of plant virus diseases on the cells of their hosts (*J. Roy. Micro. Soc.*, 59, 149-161; 1939). Descriptions of normal and diseased cells indicate the general effects, such as the increase in protoplasm content, which often accompany virus attack. Amorphous inclusions are shown to be composed of protoplasm, and to contain oil globules and chondriosomes. They are of two morphological types, namely, granular and amoeboid. Crystalline inclusions often accompany the amorphous products. The presence of inclusions indicates a relatively high concentration of virus within the cell. Amorphous inclusions may give rise to the crystalline type, and the review indicates a high probability that virus protein and both kinds of inclusion are really different manifestations of the same thing. The knowledge here collected is useful equipment for the research worker, but teachers of plant pathology will also find it invaluable.

#### Strawberry Yellow-edge Virus

A SHORT paper by W. F. Cheal in the *Gardeners' Chronicle* of March 2 describes field trials on the planting of strawberries free from yellow-edge virus. Plots in four centres of the Isle of Ely were established at varying distances from existing plantations which contained diseased plants. The virus disease was very rapidly transmitted to those healthy plants which were within a quarter of a mile of the diseased fields, but no transfer took place when they were separated by a greater distance. It therefore appears that the use of disease-free stocks in strawberry-growing areas is useless, unless they are planted an adequate distance, say a mile, from the existing fields.

#### Cell-Division

E. W. Sinnott and R. Black (*Proc. Nat. Acad. Sci.*, 26, 223-227; 1940) have shown that the orientation of the new cell wall between daughter cells is determined early in the life of the mother-cell by the cell body. They studied vacuolated plant cells and found that from very early prophase the cytoplasm tends to aggregate into a plate of more or less fused strands where the future cell wall will be laid down. They consider that the factors affecting the orientation of the division act on the cell as a whole and not only on the nucleus.

#### Translocation in Wild Grasshoppers

M. J. D. WHITE (*J. Hered.*, 31, 137-140; 1940) reports the finding of several individuals of *Metrioptera brachyptera* (Tettigonidae) in the New Forest which possess a reciprocal translocation between two pairs of chromosomes, III and IV. The first individual was found in 1937 and others were found in 1939, therefore the variety has been able to become well established. Usually chromosomes III and IV form separate bivalents, but occasionally a chain of four chromosomes is found. The small proportion of multiple configurations is possibly due to localization of chiasmata normally present in this species.

#### Polyploidy in Paramecium

TZE-TUAN CHEN (*J. Hered.*, 31, 175-196; *Proc. Nat. Acad. Sci.*, 26, 231-246) shows that different races of *Paramecium bursaria* differ in the size of the micronuclei. These differences are correlated with the chromosome number. Race *Fd* has about 80 chromosomes while others have several hundreds of chromosomes. Polyploidy probably originates from the fusion of the two pro-nuclei during conjugation. No interference with conjugation is caused by differences in chromosome number. After conjugation the two conjugants possess the same number of chromosomes. Animals without micronuclei can conjugate with animals possessing micronuclei. The behaviour during conjugation of *Paramecium bursaria* is analysed. Three animals have been observed to conjugate together at one time, but exchange of pro-nuclei only takes place between two of the conjugants.

#### Nature of Ore-forming Fluids

In a Supplement to *Economic Geology* (34, 197-358; 1940), L. C. Graton gives a valuable summary of present knowledge and theory as to the origin, state, composition, migrations and effects of the mobile medium which transports mineral-forming materials and deposits them to form the hypogene epigenetic ores. The survey starts from the arguments and conclusions of Fenner, Bowen, Ross and Schaller in the well-known "Lindgren Volume", and it is shown that widely differing and irreconcilable hypotheses are currently held and are causing confusion at a stage of the science when some clarification might reasonably be expected. Reasons for this situation are suggested, but it is nowhere indicated that one possible reason may be that some ores at least may not originate within the magma which most authors assume to be the unquestioned source. The dominant agent of hypogene ore genesis is thought to be a late-magmatic hot alkaline liquid extract. Derivation by



boiling from the normal magma is regarded as quantitatively insignificant. The contrast is emphasized between the confined conditions in depth where magmatic differentiation is supposed to be accomplished and the special superficial conditions where alone observation is possible of magma in action. It is thought that gas is far inferior to liquid for transporting mineral solutes, and pneumatolysis is therefore regarded as of slight importance except close to the surface. The weak point in all hypotheses of ore genesis from magma is the difficulty of suggesting a satisfactory mechanism of separation to account for the observed sequences of ore deposition, and one of the chief merits of Graton's review is that he frankly exposes this and other difficulties wherever they occur.

#### Crystalline Lactic Dehydrogenase

STRAUB (*Biochem. J.*, **34**, 483; 1940) has added lactic dehydrogenase to the list of proteins having enzyme activity which can be obtained in crystalline form. The reaction: lactic acid + cozymase  $\rightleftharpoons$  pyruvic acid + reduced cozymase is catalysed by lactic dehydrogenase, and the purification of the enzyme has been followed by measurement of the oxygen uptake occurring when lactic dehydrogenase is added to a mixture of lactic acid, cozymase, methylene blue, cyanide and flavoprotein, which forms a complete system for oxidizing lactic acid. The enzyme can be extracted from bullocks' hearts with water and adsorbed on to calcium phosphate gel. After elution with pH 7.2 buffer, purification by fractional precipitation with acetone and then ammonium sulphate is carried out. Finally crystallization is accomplished by gradually increasing the concentration of ammonium sulphate from 0.4 to 0.5 saturation. Lactic dehydrogenase is shown not to be identical with malic dehydrogenase.

#### Directed Valency

THE two methods of studying problems of directed valency, namely, the Heitler-London method of localized electron pairs and the Hund-Mulliken method of molecular orbitals, both have the defect of not giving (a) all the possible stable electron groups which give rise to directed valency, and (b) the possibilities of multiple bond formation. A new method, based on group theory, is put forward in a paper by G. E. Kimbell of Columbia University (*J. Chem. Phys.*, **8**, 188; 1940). Any set of equivalent directed valency orbitals is representable by a characteristic symmetry group and, if the operations of this group are performed on the set, a (usually) reducible representation can be obtained, and, from the character table for the particular group, resolution into component irreducible representations can be carried out. Thus the possibility of covalent bond formation in any spatial arrangement of a given electronic configuration can be tested. Moreover, the possibilities of double- and triple-bond formation can also be worked out. Results of calculations of all configurations of from 2 to 8 *s*, *p* and *d* electrons are given. The molecules which are discussed in detail are: H<sub>2</sub>O, H<sub>2</sub>S, nitrosyl halides, NO<sub>2</sub>, Ag(NH<sub>3</sub>)<sub>2</sub><sup>+</sup> and I<sub>3</sub><sup>-</sup> ions, CO<sub>2</sub>, SO<sub>2</sub> (co-ordination number of central atom, 2); SO<sub>3</sub>, SO<sub>3</sub><sup>''</sup> (co-ordination, 3); XO<sub>4</sub> ions, SiCl<sub>4</sub>, Ni(CN)<sub>4</sub><sup>''</sup>, Ni(CO)<sub>4</sub>, ICl<sub>4</sub><sup>'</sup> (co-ordination, 4); PCl<sub>5</sub>, Fe(CO)<sub>5</sub>, IF<sub>5</sub> (co-ordination, 5); Fe(CN)<sub>6</sub><sup>'''</sup>, Fe(CN)<sub>6</sub><sup>''''</sup>, SF<sub>6</sub>, SeF<sub>6</sub>, TeF<sub>6</sub>, SbBr<sub>6</sub><sup>'''</sup>, (co-ordination,

6); ZrF<sub>7</sub><sup>'''</sup>, and TaF<sub>7</sub><sup>''</sup> (co-ordination, 7); Mo(CN)<sub>8</sub><sup>''''</sup>, OsF<sub>8</sub> (co-ordination, 8). For several symmetry types there are no known molecular or ionic examples, and invariably this is because these symmetry types are shown theoretically either to have great instability or to be much less stable than other possible configurations of the same co-ordination. The geometrical arrangements of the various possible electronic configurations are discussed. The structures deduced from this method are in agreement with those ascertained by the usual methods of investigation; but the method is also capable of predicting structures which so far have not been determined experimentally; for example, the OsF<sub>8</sub> molecule should be a face-centred prism, and the unknown ions Fe(NH<sub>3</sub>)<sub>4</sub><sup>++</sup> and Fe(CN)<sub>4</sub><sup>''</sup> should be irregular tetrahedra.

#### Diborane diphosphine

AN interesting compound, described by L. Gamble and P. Gilmore (*J. Amer. Chem. Soc.*, **62**, 717; 1940), is diborane diphosphine, B<sub>2</sub>H<sub>6</sub>.2PH<sub>3</sub>, which is formed from diborane B<sub>2</sub>H<sub>6</sub> and phosphine above -30° in the gas, and above -110° in the liquid phase. It is a white crystalline solid which dissociates above -30° into diborane and phosphine, thus behaving differently from the ammine compound B<sub>2</sub>H<sub>6</sub>.2NH<sub>3</sub>. It dissolves with difficulty in liquid ammonia, and above -60° the solution evolves phosphine; on evaporation a white solid, B<sub>2</sub>H<sub>6</sub>.NH<sub>3</sub>.PH<sub>3</sub>, probably NH<sub>4</sub>(BH<sub>3</sub>PH<sub>2</sub>BH<sub>3</sub>), remains, hence the formula of diborane diphosphine could be written PH<sub>4</sub>(BH<sub>3</sub>PH<sub>2</sub>BH<sub>3</sub>). The salt-like nature of the compound is, however, not well defined, as it will dissolve in liquid ammonia at -75° without the liberation of phosphine, unlike a true phosphonium salt, which liberates phosphine and forms an ammonium salt.

#### A Photographic Survey of Galactic Clusters

GEORGE ALTER has published a paper, the first of a series, describing the method of work with the Mond astrograph of the Norman Lockyer Observatory, Sidmouth, and also the application to N.G.C. 581 (M. 103) (*Mon. Not. Roy. Astro. Soc.*, **100**, 5; March 1940). The Mond astrograph has four telescopes for photographic purposes, and a full description of the instrument has already appeared in "Handbook of the Norman Lockyer Observatory". In the standard working scheme, Camera A serves for counting star clusters and determination of cluster diameters. Camera B is used for the determination of photovisual magnitudes, without colour screen, by using Ilford Hypersensitive Panchromatic plates, which give the photovisual scale almost perfectly. Camera C gives the photographic magnitudes by using Barnet Super Press plates. Camera D completes the magnitude series for the brighter stars by shorter exposure time. The magnitude determinations are made by exposures of 1h. on the cluster and 1h. on the north polar sequence on the same plate. Camera B has a second cluster plate to detect variables, and in this way a source of error is excluded as all photographs are exposed under the same conditions of atmosphere. A detailed account is given of the work, and the results of the investigation of N.G.C. 581 are as follows: Pleiades type, star number 44, angular diameter 6.8', distance 2040 (± 180) parsecs, linear diameter 4.5 parsecs.



## STEREOCHEMICAL TYPES AND VALENCY GROUPS\*

THEORY and experiment agree that the arrangements in space of the covalencies of a polyvalent atom, while they are subject, from a variety of causes, to small variations seldom exceeding  $5^{\circ}$ - $10^{\circ}$ , tend to conform to a quite limited number of types. Recent developments of mathematical physics have made it possible to calculate how these types are related to the electronic groups occupied by the valency electrons.

It is, however, not always possible to say which these sub-groups are, and it is in any event desirable for the chemist that he should be able to relate the spatial grouping to some more familiar property of the atom. The property here used is the size (in G. N. Lewis's sense) of the valency group of the central atom, and the number of shared electrons which it contains, together with that of the preceding (unshared) electronic group in the atom. The experimental results show the following relations.

When the valency group is less than 8 we have with a covalency of 2 a linear structure (as in Cl-Hg-Cl): with a covalency of 3 a plane structure with equal angles of  $120^{\circ}$  ( $\text{BF}_3$ ): with 6 electrons of which only 4 are shared, as in the vapour form of stannous chloride, probably a triangular molecule  $\text{Sn} \begin{matrix} \text{Cl} \\ \diagdown \\ \diagup \\ \text{Cl} \end{matrix}$ .

With a complete octet the arrangement can be either tetrahedral or planar. When the covalency is less than 4 (partially shared octet), it is always derived from the tetrahedron, as in the triangular  $\text{OH}_3$  and the pyramidal  $\text{NH}_3$ . The fully shared 4-covalent octet can be of either form. When the preceding electronic group,  $n$  in the grouping ( $n$ ) 8, is 2, 8, or 18, it is always tetrahedral. In the transitional elements where  $8 < n < 18$ , it is found that if  $n$  is not much more than 8 the structure is tetrahedral,

\*Substance of the Bakerian Lecture before the Royal Society delivered by Prof. N. V. Sidgwick, F.R.S., and H. M. Powell on June 27.

and if it is not much less than 18, planar; but the two series overlap, and for values of  $n$  of 13 to 15 and perhaps 16, both forms occur.

When the valency group is 10 with at least 2 of them (the 'inert pair') unshared, the structure of a divalent atom (as in  $\text{M}[\text{I}_3]$ ) is linear; that of the 3-covalent (as in  $\text{C}_6\text{H}_5\cdot\text{ICl}_2$ ) is unknown, while that of the 4-covalent decet is found in the thallos and plumbous compounds to be planar, but in tellurium tetrachloride may possibly be a distorted tetrahedron.

The peculiar 4-covalent duodecet in  $\text{M}[\text{ICl}_4]$  is planar. Covalency 5. So far as it has been examined (four different types), this has always been found to give a trigonal bipyramid.

Covalency 6. Three structures are theoretically possible: a trigonal prism, a trigonal antiprism, and a regular octahedron. Experimentally the structure is always found to be the octahedron, except in a few giant molecules such as those with the nickel arsenide lattice. The regular octahedron has been found with practically every possible size of the preceding group, as well as with the 'inert pair' of electrons.

A covalency of 7 has been examined in three or four compounds, which have two different structures, one derived from an octahedron and the other from the trigonal prism.

Covalency 8. The only compound examined,  $\text{K}_4[\text{Mo}(\text{CN})_8]$ , is found (rather unexpectedly) to have a dodecahedral arrangement of the 8 CN groups.

Nearly (but not quite) all the structures can be even more simply related to the size of the valency group by assuming that the mean positions of the electron pairs in this group are the same whether they are shared or not, the structure being linear for 4 electrons, plane symmetrical for 6, either tetrahedral or plane for 8, a trigonal bipyramid for 10, and an octahedron for 12.

## CONCENTRIC CONDUCTOR TYPE OF HIGH-VOLTAGE ALTERNATORS

A PAPER on "Operating Experience with High Voltage Alternators" by W. D. Horsley, of Messrs. C. A. Parsons and Co., Ltd., which was to have been read and discussed before the Institution of Electrical Engineers, has now been published in the *Journal* of the Institution of April. It was read and discussed before five local centres at various dates, and the discussions at these centres have been included.

The first high-voltage alternator of the concentric type was commissioned in August 1928, the pressure chosen being 33 kilovolts. The earlier history of this machine and its successful operation have been fully described by C. A. Parsons and J. Rosen and was published in 1929 in vol. 67 of the *Journal*. Since it was installed at the North Metropolitan Power Station, it has worked smoothly, the maintenance

costs being negligible although the conditions of operation were more difficult than the average in the early years of its life. There are now twenty-one machines of this type in service, and a review of some of the difficulties experienced is first given. The second machine built had an output of 25,000 kw. at a pressure of 33 kv., and was installed in the Brimsdown Power Station in 1932. But after being put into service, a breakdown occurred on the third day owing to the failure of a slot insulating tube and the core. This accident demonstrated the rapidity with which a bar can be replaced in the concentric type of winding. Soon afterwards, improved methods of inspection and testing, including the measurement of the dielectric losses of individual bars, were introduced, and the possibility of a faulty conductor being fitted in an alternator is now very remote.



In November 1933, a flashover took place from the end windings of the alternator to the station frame, and simultaneously a flashover to earth occurred from one terminal on the main oil circuit-breaker controlling the alternator. An examination showed that the path of the flashover in the stator windings passed through at least 4 in. of air, and it was computed that it could only have been caused by an over-potential exceeding 70 kv. The normal operating potential of the winding to earth at the point of the fault was 6.5 kv. When the flash occurred, the alternator was isolated from the transmitting system and had just been excited to normal voltage prior to being synchronized with the main busbars.

The characteristics of the voltage transformers and of the capacitance of the alternator windings and their connecting cables showed that the conditions which gave rise to the phenomenon known as neutral instability were present. It was calculated that the potential of the windings cable and switchgear could build up to 75–100 kv., which agreed closely with the value deduced from the examination of the failure from the available data.

While the satisfactory operating experience with the concentric-conductor winding proves the construction to be sound, investigations following the failure of a joint showed that a number of improve-

ments were possible. A new technique has been developed for the making and insulating of joints. Among other improvements is the use of glass silk as an insulating material. It is also being used in place of cotton or silk for other purposes. It is more durable and will withstand a higher temperature, and the individual fibres, being solid, cannot absorb moisture.

The earthing of systems through a tuned reactor or arc-suppression coil has received great attention in Great Britain in recent years and is being given a trial on a number of systems. As the coil has a comparatively high impedance, circulating currents due to harmonics should be negligible, and therefore it would be permissible to earth the neutral point of a generator by this means.

Experience has shown that the damage which is caused by an earth fault in an alternator is small, as the differential protection trips both the main and the neutral breakers very rapidly, thus interrupting the fault circuit. A fault between phases causes greater damage, as the fault circuit cannot be interrupted, and although the field circuit may be opened rapidly, an appreciable time is required for the main flux to collapse.

Mr. Horsley concludes by emphasizing the trustworthiness of concentric-conductor alternators, and thinks that they have a promising future.

## NATIONAL FRUIT AND CIDER INSTITUTE

THE annual meeting of members of the National Fruit and Cider Institute was held at the University of Bristol Research Station, Long Ashton, on June 27.

Chief among the items of interest were exhibits arranged by the Fruit Products Section dealing with methods of using fruit products to alleviate the difficulties occasioned by the sugar shortage. During the War of 1914–18, Prof. B. T. P. Barker organized a scheme for the conversion of apple juice into jelly. This work has been taken up again and extended by Mr. V. L. S. Charley, who has developed methods for concentrating fruit juices by vacuum evaporation. The acid content of the raw juice is first reduced by the use of potassium carbonate or pure chalk at a rate of 2–3 lb. per 100 gallons of juice. Acid cooking apples as well as dessert varieties can thus be converted into very sweet concentrates. The apple flavour is retained by recovering the volatile products during concentration and returning them to the concentrate. Treatment of the juice before concentration with a pectin-decomposing enzyme allows a high degree of concentration without danger of gelling, and the final product assumes the consistency of treacle, containing about 75 per cent soluble solids and 65 per cent invert sugar. One ton of cull apples produces 150 gallons of juice, which is concentrated to make 13 gallons of treacle.

Apple treacle has been successfully used as a sweetening agent for both domestic and industrial preparations such as jams, cakes, confectionery, cider and pickles. All kinds of excellent jam have been made by using half the normal amount of sugar with an equal quantity of apple treacle. The treacle itself is self-sterile and can be stored without special con-

tainers. Apple jelly is made by warming the concentrated juice with one tenth its volume of liquid apple pectin and adding a small amount of sugar. Plum concentrate has also been prepared, but its high acidity renders it less suitable for general use. A fuller account of this work appears in *Food Manufacture*, 15, 6 (June 1940) and in the Long Ashton Annual Report for 1939.

Another exhibit showed methods of maintaining the natural sugar in cider. The usual procedure is to allow the apple juice to ferment and to add sugar to the final product. By adding potassium metabisulphite as a source of sulphur dioxide and removing yeasts by centrifuging, fermentation can be suspended and much of the original sugar content retained.

A phase of the Station's work on plant nutrition was represented by an exhibition of vegetable and other crop plants suffering from manganese deficiency. This deficiency, recognizable by a chlorotic condition and yellowing of the foliage, has occurred with some frequency in oats sown on newly ploughed grassland, especially on highly calcareous soils. Garden beets, spinach beet, spinach, parsnips and lettuce have been found showing similar symptoms when grown in soil to which much lime and organic matter has been added. Successful control is being achieved in some cases by spraying the foliage with a dilute solution of manganese sulphate.

The Station plantations were open for inspection by the visitors. Considerable interest was shown in demonstration plots on which the cropping plans recommended in the Ministry of Agriculture Growers Bulletin No. 1 are being subjected to practical tests.



## THE ENGINEERING FOUNDATION

THE annual report for 1938-1939 of the Engineering Foundation of New York forms an interesting record of a year's activity in a wide range of research projects mainly of a technical nature, associated with engineering and designed to produce results of practical value to science, industry and public welfare. These researches are carried out in collaboration with engineering and other societies and the results are published by the institutions concerned and by the technical press. The part played by the Engineering Foundation is that of receiving applications for assistance, examining the merits of the projects submitted, recommending and making grants and maintaining contact with the work while in progress.

The present report records a number of researches undertaken and in progress in conjunction with seven other corporate bodies dealing with such important subjects as soil mechanics, critical pressure steam generation, cotton seed processing, and plastic flow of concrete. On the non-technical side, the Engineers' Council for Professional Development was supported in the establishment of central and local committees to deal with such matters as the selection and guidance of engineering students, engineering schools, professional training and professional recognition, the general trend and purpose of the labours of which is towards the raising of the status of the engineering profession.

The Engineering Foundation was established in 1914 "for the furtherance of research in science and engineering or for the advancement in any other manner of the profession of engineering and the good of mankind" and has now completed twenty-five years of useful service. The occasion is celebrated by the issue of a more comprehensive record of the work done during this period which gives particulars of no less than seventy-three major researches and projects which have received grants towards a total cost of more than three million dollars. This is a very remarkable result, more particularly when it is considered that the whole machinery had to be set in motion in the early years of the period. Of the grants made, a substantial portion has been devoted to matters associated with engineering instruction and the promotion of summer schools.

The report concludes with a statement of the increasing need for research. The policy of the Board has all along been one of giving aid to promising projects which otherwise would not have been undertaken because they did not fit into the programmes of other research agencies or because of lack of sufficient funds. Universities have the facilities for investigation but there may be no funds for a particular inquiry. On the other hand, scientific societies may have funds available but be without any research facilities. Again, an industrial concern may hesitate to undertake an investigation the results of which would be used by the whole industry. Such cases provide the kind of opportunity for which the Engineering Foundation exists, in order to deal with the problems and to promote their solution. Much as has been accomplished by the prudent use of the income derived from its endowments, much more remains to be done and the opportunities for productive research are constantly increasing. The Board of the Engineering Foundation looks forward to giving assistance in the work of the future and, by the help of further endowments, to be able to extend the range of its work and its grants.

## APPOINTMENTS VACANT

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

DIRECTOR OF EDUCATION—The Town Clerk, Town Hall, Stretford, Lancs. (endorsed 'Director of Education') (July 20).

DEMONSTRATOR IN PHYSICS—The Dean, Medical School Office, Guy's Hospital, Sherwood Park, Tunbridge Wells.

## REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

### Great Britain and Ireland

University College of Wales: Welsh Plant Breeding Station. War Food Production, Advisory Bulletin No. 1: Re-Grassing, an Essential Part of Food Production. By Sir R. George Stapledon. Pp. 40. (Aberystwyth: Welsh Plant Breeding Station.) 1s. [106]

Department of Scientific and Industrial Research. The Principles of Fumigation of Insect Pests in Stored Produce. Pp. iii+28. (London: H.M. Stationery Office.) 6d. net. [116]

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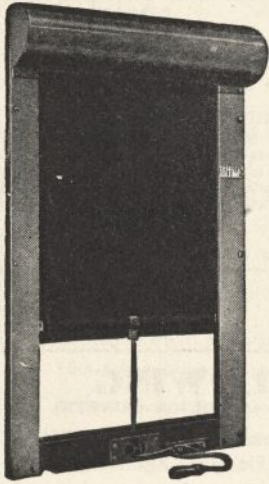
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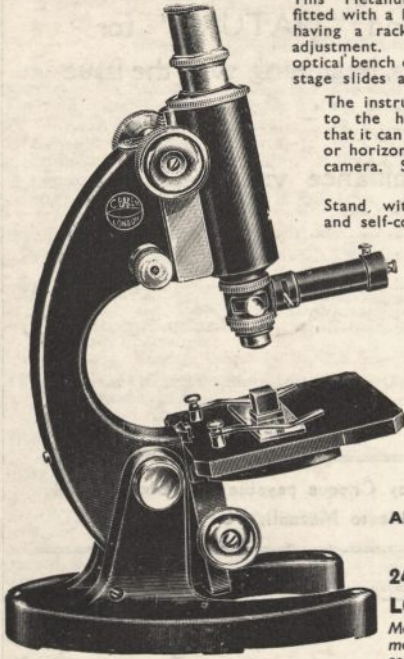
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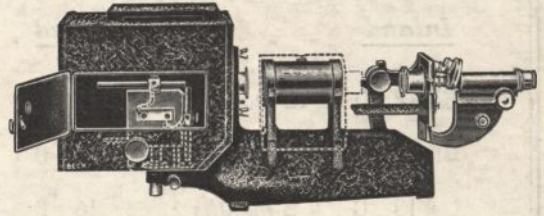
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