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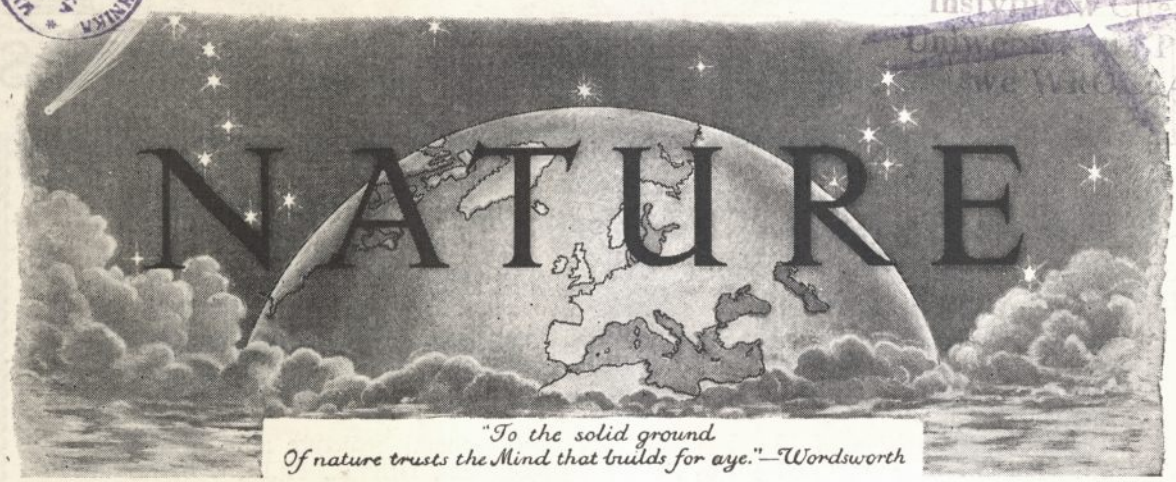

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NATURE

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CONTENTS

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SOCIAL AND ECONOMIC RECONSTRUCTION

NOTHING could be more marked than the contrast between the aim of the Allies in the present struggle and that at the close of hostilities in 1918. Then everything was directed to the interests of the group, racial or national. Now we fight for the rights of the individual—justice and individual freedom. In both Wars the Allies were constrained to take up arms in resistance to the spirit of aggression, and as it was phrased on that earlier day, "to make the world safe for democracy". In the event, the victory of 1918 became the instrument of group survival. The formula of peace settlement was the application of the principle of self-determination on a national or racial basis and the safeguarding of minorities—not, be it noted, of the interests of the individuals of which those minorities were composed. In the political and economic stresses of post-War years, self-determination, unfortunately, was too readily transmuted into a claim to the right to realize national aspirations, from which in its more extreme form it was but a step to the theory and practice of the totalitarian State and aggressive nationalism. Against such a consequence of the peace settlement to come we must be on our guard. We must not allow our aim to be obscured by the dust of conflict, or refuse to profit by the lessons of the last twenty years.

When the day of settlement comes, it will be no time for the formulation of Utopian schemes of world regeneration. The arduous task of social reconstruction on a world-wide scale will demand the closest scientific study of actual conditions, in which there must be a place for a clear perception of the allowance to be made for the spiritual and emotional factors which have operated and will continue to operate in the social, political and economic spheres of human evolutionary development. In this relation the failure of the last post-War settlement was two-fold. It attempted to restore a pre-War world order which had vanished for ever ; and in so doing it ignored, or failed to appreciate, the significance of the fact that thousands of millions of pounds, the savings of more than a hundred years of prosperity, had been blown into the air. Hence it also failed to foresee the consequences—the immobilization of gold, the paralysis of international exchange of commodities, and as a vain remedial measure, the intensification of economic nationalism—the whole forming a vicious circle, from which in the years preceding the present War it was becoming increasingly apparent that there was no escape short of complete social and economic reconstruction.

While vision failed to discern objectively and on a scientific basis the new set of social and economic conditions imposed by belligerent expenditure in the War of 1914–18, the one great constructive proposal put forward as a palliative for the situation to which the War had given rise, as well as of the conditions in which it arose, the League of Nations, embodied too high an ideal for the stage of social development and consciousness of international responsibility of even the most advanced of the peoples of the world. It attempted to ignore, or to override, differences of culture and cultural history, of temperament and of constitution, social and moral ; but above all it neglected to take into account the group mentality which, as already mentioned, had been fostered and strengthened by the peace settlement—in short, the whole complex of acts and sentiments constituting

the rock upon which the League eventually foundered, which may be summed up in the single term 'sovereignty'. Yet, as is so frequently pointed out, it is highly instructive to contrast the political failure of the League with its achievement in the one sphere in which it was supremely successful, namely, that of scientific inquiry in a variety of matters affecting the well-being of mankind on a world-wide scale, in which universal co-operation was possible without the intervention of particularist interests or nationalistic bias.

The contrast in the practical results which emerged in what have been differentiated thus as two spheres of the League's activities points to a difference in concept and outlook which it may seem difficult to resolve. On one side, a rationalistic world in which effort is directed to the objective scientific study of facts and principles with an ultimate view to their utility to mankind without regard to racial, national or other distinction, except in so far as these may in certain eventualities be relevant to the issue; on the other, an arena in which a contest occurs between the interests and aims of discrete groups—interests not necessarily always conflicting, but in so far as they are prepared to co-operate in a common purpose, moved by self-regarding and emotional springs of action rather than a rational and comprehensive conception of a universal aim. Yet it may be that the contrast must not be too deeply stressed. Even in the search for truth of the most detached rationalist, something of passion and emotion must enter to inspire his disinterested devotion to an ideal; while in the give and take of the conflict of groups, emotion alone, even of the most fervent patriotism, has not sufficed to bring about those settlements and compromises in the less spectacular political fields in which the League of Nations has achieved some success, even if it failed on a larger and more conspicuous stage.

This phase of the League's activities is now past history; but its lessons cannot be too deeply pondered with a view to the future. After all, it was a great achievement that the chief powers of the world should have been brought together with the common object of discussion of affairs on a world basis with the view of attaining conditions favourable to the preservation of peace. It was in its mandate policy that the League of Nations perhaps approached most closely to what we should now stress most strongly as the true end of government. It insisted upon the rule of the mandatory Power being framed and directed in the interest of the native population. The well-being of the governed determines the nature and form of government. The State exists for the benefit of the individual and not the individual for the ends and purposes of the State, whether as a unit engaged in a group struggle or as embodied in the persons of a ruling class.

If we accept the fullest development of individuality as the true end of government, not merely individual freedom but also justice must follow as a corollary to ensure the mutual respect of individual rights. That at times the claims of the State must override all individual rights, as in recent legislation in Great Britain, may in the ultimate analysis be regarded as no more than a supreme affirmation of those rights in totality, to which all and every one individually will assent in the interest of all.

How best these interests may be safeguarded in the future, and in what conditions it will be possible for mankind to enter upon the approach to the great social and economic reconstruction which cessation of hostilities will imperatively demand, are problems which still have to be solved. The first essential, it would be generally agreed, must be to bring about such relations between peoples as will ensure the preservation of peace. In the long history of the development of human society, the advancement of the individual and the preservation of the conditions which promote peace both internally and externally in a given group have seen the continual formation of larger and larger groups, held together by emotional, social and economic bonds. Hence the belief that only on some distant day when mankind will assent to a state of world federation will peace be assured. The recent history of the League of Nations would suggest that that day is far distant; but we may perhaps draw inspiration from the remarks made by Mr. Winston Churchill in the House of Commons on August 20 referring to relations between Great Britain and the United States. As he put it, "these two great organizations of the English-speaking democracies . . . will have to be somewhat mixed up together in some of their affairs for mutual and general advantage"; an inevitable process which he compared in homely terms to the mighty waters of the Mississippi "rolling along". This collaboration in the field of defence may yet be the starting-point for a new form of world co-operation in which all men of goodwill, irrespective of creed, race or nationality, may play their parts in the advancement of civilization.

THE ANUAK

The Political System of the Anuak of the Anglo-Egyptian Sudan

By Dr. E. E. Evans-Pritchard. (Monographs on Social Anthropology, No. 4: Published for the London School of Economics and Political Science.) Pp. viii + 164 + 12 plates. (London: Percy Lund, Humphries and Co., Ltd., 1940.) 7*s*. 6*d*.

THIS volume is a noteworthy production from three points of view. In the first place it provides valuable information about a people concerning whom so little was previously recorded that they may be regarded as practically unknown. Secondly, it fills a gap in our knowledge of the great Shilluk-speaking group (though it must be confessed that it suggests a whole series of new questions), while thirdly, from the practical point of view, that is, that from which the work was organized, it has provided the Government with definite information concerning the sociology of a difficult and restless tribe whose administration has hitherto been unsatisfactory.

The Anuak are a Shilluk-speaking tribe of some 30,000–40,000 souls, inhabiting the country of the Baro and Pibor Rivers (themselves affluents of the Sobat) and their tributaries. Part of this territory lies in the Sudan, much of it extends into Abyssinia, and it is this political spread that constituted one of the Government's difficulties, for guns were readily procured in Abyssinia and rebels and trouble-makers could easily cross the border. This they sometimes did, carrying with them the royal insignia, of which we shall presently speak, and thus increased unrest and rendered more troublesome the administration of what is geographically a difficult country.

Linguistically the Anuak are more nearly akin to the Acholi of the south than to the Shilluk. It may be that there are also resemblances in their social organization. On the other hand, the Anuak claim common origin with the Shilluk, and the Anuak kingship certainly resembles that of the Shilluk rather closely, though perhaps not so closely as has hitherto been imagined. Since the author's chief aim was to discover what the Anuak political and royal systems really are, it is only natural that the greater part of this volume is devoted to these particular features. At the same time there is enough information to enable us to appreciate some of the general similarities that the Anuak show to other Nilotic tribes. Indeed there are hints that at one time the Anuak may have more closely resembled other Nilotes than they do at present, when they are predominantly agricultural. Actually considerable difference was found between the eastern and western portions of Anuak territory. In the west it seems that a more primitive condition persists; there is little inter-village organization and the authority of the headmen is for the most part limited to their own village or village group. In the eastern portion of the territory there is a closer relation between villages, and the system of headmanship has given place to a system of nobility and kingship, the latter, be it noted, very much more ritual than executive.

We may best approach the Anuak kingship and its insignia by considering their system of nobility. All nobles, *nyiya* (sing. *nyiye*) are members of a single group, and one member of this group who is in physical possession of certain beads, spears, stools and other objects—the insignia of kingship—is king. It is possible that at one time the insignia passed regularly from father to son, but this has not been the case for several generations. No *nyiye* being sufficiently powerful to retain the insignia for life—should he try he would be killed by a rival—it became more and more the practice for the holder to surrender them to a rival after a year or two, perhaps after some not very determined fighting. A complication—and, from what the reviewer learnt of Anuak affairs before Dr. Evans-Pritchard's investigation, it was this complication that presented the chief difficulty to the Government—was that though every Anuak ruler belongs of necessity to a particular clan with patrilineal descent, he does not become a *nyiye*, eligible for kingship, unless he is invested with the insignia of kingship, nor can the son or descendant of any man not so invested ever become 'king'. Thus every *nyiye* has in fact been king, if only for a few hours. There is no special word for king (unlike the Shilluk), and all nobles display identical signs of rank and are saluted and buried in like manner. When therefore a few years ago, after some rather mixed fighting, the then king withdrew across the Abyssinian frontier taking the insignia with him—at a time before the *nyiya* system was understood by the Government—the possibility of serious political trouble was not far distant.

There is a considerable cult of dead kings at their tombs, and trees that spring up in the immediate neighbourhood are regarded as sacred. Dead kings manifest themselves as snakes, as also do nobles. Sacrifices are made, and the old kings are thought to come from their tombs in their snake form to acquaint themselves with their successors.

In conclusion, it may be emphasized that this volume demonstrates what a capable anthropologist with a general knowledge of the ethnology of an area can learn in a few months by intensive inquiry on particular matters, even when he does not speak the language of the people concerned. During the ten weeks spent on this investigation much time was occupied in actual trekking, 400–500 miles of difficult country being covered on foot, while the average length of stay in each village was about one day. Moreover, the author's serious illness restricted inquiries in the Pibor area. Arabic was the medium of most of the interpretation, though, speaking Nuer, Dr. Evans-Pritchard could sometimes make good use of this language.

C. G. SELIGMAN.

ALPHABETICAL CHEMISTRY

(1) Kingzett's Chemical Encyclopædia
A Digest of Chemistry and its Industrial Applications. Revised and edited by Prof. Ralph K. Strong. Sixth edition. Pp. x + 1088. (London : Baillière, Tindall and Cox, 1940.) 45*s*.

(2) A New Dictionary of Chemistry
Edited by Dr. Stephen Miall. Pp. xv + 575. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1940.) 42*s*. net.

IN the preface to his "Dictionary of Chemistry", published in London in 1795, William Nicholson remarked that "the form of a Dictionary, though, for many years, in high estimation with the world in books on every subject, is confessedly inimical to the natural order of things". Macquer had justified the alphabetical arrangement in his earlier dictionary on the ground that chemistry was then little more than a collection of facts, scarcely entitled to the name of science, or capable either of synthetic or analytic explanation. While pointing out that the progress of chemistry in the interim had been uncommonly rapid, Nicholson urged that "the science of Chemistry possesses little system", in consequence of which "the utility of a dictionary to the Learner will more than compensate for the offence given to the Masters of the Science".

This apology for the chemical dictionary makes strange reading in an age that is able to survey the truly remarkable systemization of chemistry, following the introduction of the atomic theory at the beginning of the nineteenth century and the consequent development within the same century of precise ideas concerning molecular structure and classification of the elements, together with the later ordered expansions into the fields of electronic and sub-atomic chemistry.

Systemization is the keynote of modern chemistry ; and this highly organized branch of science not only tolerates, and indeed demands, the general dictionary serving the needs of the modern analogue of Nicholson's "Learner", but it calls also with equal insistence for specialized dictionaries designed for the successors of his "Masters of the Science". Nor does the chemical specialist confine his attention nowadays to compilations of this second class. Although he makes full use of such specialized dictionaries as Richter's formula-index and Heilbron's name-index of organic compounds, he is equally at home among the pages of Thorpe's "Dictionary of Applied Chemistry" or Ullmann's "Enzyklopädie der technischen Chemie".

Some eighty years ago, Dr. Sheridan Muspratt produced the best-known general chemical dictionary, in the English language, of that age. Of him it was written by "the distinguished phrenological artist", Bally : "You have one of the largest brains in proportion to your size, which constitutes a strong mind . . . great energy—indomitable perseverance ; you possess love of fame or approbation in a very high degree . . . the moral faculties are very good". From this intriguing diagnosis it appears that even in the childhood of modern chemistry the chemical lexicographer had to be a man of parts, animated by powerful incentives. At the present day the domain of chemistry is so vast, and the consequent task of selection has become so onerous, that even a modern Muspratt might well hesitate at the foot of the mountain from which he has to produce his mouse. It is therefore not surprising that the compilation of such works has become increasingly dependent upon the co-ordinated activities of teams of experts, and that some of these alphabetical expositions of chemistry have started as modest dictionaries and grown into encyclopædias in their later editions. The distinction between chemical dictionaries and encyclopædias is not clear, but it would seem to depend mainly upon conciseness.

(1) "Kingzett's Chemical Encyclopædia", by virtue of its wide range and fairly detailed treatment of individual items, is perhaps better

described as an encyclopædia than a dictionary, although either title could be reasonably applied to a work of this scope. "Kingzett" is now something of a household word among chemists. It first appeared in 1919, and the aim of the author, as expressed in his own words, was "to prepare an epitomized digest of chemistry and its industrial applications, in a form which should be useful as a work of reference by all classes of the community". As mentioned by the late Sir Gilbert Morgan in a foreword to the present edition, the production of this work was a labour of love to which Mr. Kingzett devoted most of his leisure towards the close of a successful industrial career. Some time before his death, Mr. Kingzett entrusted to Sir Gilbert Morgan the revision of his annotated fifth edition ; but eventually this important duty was transferred to Prof. R. K. Strong, professor of chemistry and chemical engineering at the Rose Polytechnic Institute, Terre Haute, Indiana, who became editor-in-chief of the sixth edition.

Prof. Strong has performed his task admirably. Kingzett's "Encyclopædia" has constantly improved since its original appearance, and in its latest form it contains much new material, including numerous graphs, diagrams, charts, and tabulated data. The treatment of physical chemistry and engineering chemistry has been extended, and the economic aspects of chemistry receive more emphasis than in the earlier editions. That a liberal view of the province of such a work has been adopted is further shown, for example, by the inclusion of a special article of seven pages on bacteria. Copious references to special sources are given at the end of important articles : this is a valuable feature of the work. To choose a few entries at haphazard, here the inquirer will find reliable information on such diverse subjects as chemical plant, colloid chemistry, electricity, heavy hydrogen, gassing, glyptal, nitrogen fixation, paints, petroleum, sherardizing, 'Staybrite', tung oil and wave-lengths.

(2) There is no difficulty in classifying Dr. Miall's new work as a dictionary, rather than an encyclopædia, of chemistry. With the help of numerous experts, whose names are given, he has produced an alphabetical treatment of remarkable conciseness, comprehensiveness and clarity. As a measure of the book's conciseness it may be noted that an average page may contain from about five to fifteen entries. The chemical elements and their important derivatives and minerals, together with a large and representative selection of organic substances, are assigned separate headings. Chemical change and individual chemical reactions of importance are treated from various points of view. Diagrams have been used sparingly, but there are copious structural formulæ and many valuable tabular statements. The humanistic aspect of chemistry finds an expression in brief accounts of noteworthy chemists of these and former days, interspersed in the alphabetical sequence. References to other sources of information are sometimes given in individual articles, besides which there is a list of representative books dealing with the main divisions of chemistry. The volume also contains a convenient table of physical constants of nearly two thousand organic compounds described in the text.

As Dr. Miall recognizes in his introduction, omissions and errors are inevitable in a work of this kind, particularly in a first edition. Up to a point also, the selection or rejection of individual items must be determined by arbitrary decisions. In following out a specific inquiry we found, for example, no entry under the headings of antiseptics, bacteria, disinfectants, germicides, or sterilization ; nor could we discover any note on 'Nylon'. The structural formulæ are impressive in their neatness, but we notice that quinquevalent and tervalent carbon atoms—those ineradicable weeds in the garden of organic chemistry—rear their familiar heads in the representations of α-cadinene and phellandral. Menthone is wrongly described as an aldehyde, and it is only partly converted into isomenthone under the conditions mentioned. The odour of piperitone resembles peppermint rather than camphor. Some of the biographies (for example, the first two on p. 320) call for revision.

There is no need to multiply allusions to the fine detail of the work. Viewed as a whole, it forms a really valuable addition to the literature of general chemistry. Dr. Miall and his collaborators have produced a very handy and attractive chemical dictionary, which by reason of its simple and concise style, interesting presentation, and neat format will be welcome to a great variety of users ranging from teachers and students, engineers, pharmacists, medical men, and the intelligent layman in general, to chemical technicians and specialists. It is a work that will inevitably be found in a well-thumbed condition upon the shelves of reference libraries of all kinds.

It may be added that Dr. Miall's expressed intention of enlisting the help of American chemists in bringing out a revised edition of this work at a later date appeals strongly to a reviewer who has held for many years that increasing Anglo-American co-operation in the field of general chemical literature should be a primary aim of all English-speaking chemists.

JOHN READ.

ARCTIC AND ANTARCTIC

(1) Two Men in the Antarctic
An Expedition to Graham Land 1920–1922. By Thomas Wyatt Bagshawe. Pp. xxi + 292 + 33 plates. (Cambridge: At the University Press, 1939.) 15*s*. net.

(2) Greenland Journey
The Story of Wegener's German Expedition to Greenland in 1930–31 as told by Members of the Expedition and the Leader's Diary. Edited by Else Wegener, with the assistance of Dr. Fritz Loewe. Translated from the 7th German edition by Winifred M. Deans. Pp. xx + 295 + 47 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 12*s*. 6*d*. net.

(3) Arctic and Antarctic
The Technique of Polar Travel. By Colin Bertram. Pp. xii + 125 + 13 plates. (Cambridge: W. Heffer and Sons, Ltd., 1939.) 7*s*. 6*d*. net.

THESE three books together touch most sides of polar interests and in some ways each is complementary to the other two. Two of them are accounts of expeditions, one to the north, with abundant modern equipment, the other to the south with a minimum of outfit and even of preparation. The third volume looks objectively at the whole game and is a discussion of the technique of polar travel. They are all books of interest and value, written by travellers of wide experience.

(1) Mr. Bagshawe with Mr. Lester were two of the four members of a much-noised expedition to Graham Land in 1920, that held out promises of great achievement. But the expedition fell short of all hopes, and when the leader returned with the whaler that carried his men, these two decided to stay. They were not made of the stuff that gives in. In a hut built of a boat and packing cases, with a few stores and much penguin and seal diet, they survived the winter in good health. True, they were in one of the mildest parts of Antarctica, the west of Graham Land, and it was equally true that, through lack of equipment, they attempted no long journeys. Thus they made few discoveries, though their meteorological and biological observations were of value. The chief place, however, that the venture will take in the story of the Antarctic is the proof it affords that men of resource can survive in the Antarctic on little beyond the produce of the sea. It is a spirited, buoyant narrative, written in vivid chapters and well illustrated.

(2) The second volume, which is translated from the German, is by the widow of Dr. Wegener, the well-known geographer who lost his life in the German expedition to the ice sheet of Greenland in 1930–31. It is a composite book, incorporating the narratives of various members of the expedition. It supplements previous volumes on the subject. The expedition was planned with great thoroughness and foresight, and had serious scientific aims. The thickness of the ice sheet was to be measured by sonic soundings; deep shafts were also to be cut for temperature observations, and gravity determinations were to be made at various stations. Lastly, the climate of the interior of Greenland was to be studied with the help of a winter station in the interior at a height of about ten thousand feet. On the west coast on Umanak Fjord and on the east coast on Scoresby Sound there were also to be stations. Much of the work was successfully carried out, but the difficulties were great. The mechanized transport that was to be used to carry the hut and stores to the interior proved unreliable. Moreover, the surface was worse than had been expected, and the Greenlanders did not prove good travellers on the ice-sheet. With great difficulty the central station of Eismitte was founded, 250 miles from the coast, but it was little more than a series of deep holes in the ice. However, two men survived the winter in its chilly depths and did their work. Dr. Wegener, the most experienced member of the party, lost his life in a journey from Eismitte to the coast, and other members suffered severely. But the work was done and the book, apart from its thrills and tragedies, is a record of great achievement and embodies many facts of value. There are good maps and illustrations.

(3) Mr. Bertram's book strikes a new note. With experience in the Arctic on Bear Island, that desolate spot in the Barents Sea, and in East Greenland, he joined Mr. Rymill's three-year expedition to Graham Land. Thus he is fully qualified for his task. The book is not long, but it covers the ground adequately and is written in a fresh and direct style, singularly free from the customary conventions of books of polar travel. Here is the truth as regards not merely equipment, food and transport, but more important still the reaction of the individual to the polar environment. The book is all the more vivid for having been written, at least in part, in sledge camps in Graham Land. Trial and error are at the base of all polar technique, but tradition has tended to clog progress and not enough attention has been paid to the lessons that Eskimo can teach. Science, of

course, has minimized the chance of disease and has done much to improve transport, but perhaps the greatest advances in polar technique in recent years have been due to the extreme youth of many recent polar travellers. In happier days the Arctic at least became almost a holiday ground for the youths of our universities, and they were ready to throw aside tradition and try new methods, often with great success. This is one of the most interesting polar volumes of recent years, and is admirably illustrated by drawings and photographs. R. N. R. B.

THE THEORY OF GROUP REPRESENTATIONS

The Theory of Group Representations
By Prof. Francis D. Murnaghan. Pp. xi + 369. (Baltimore, Md. : Johns Hopkins Press ; London : Oxford University Press, 1938.) 22*s*. 6*d*. net.

FELIX KLEIN'S famous enunciation—"Given a manifold and a group of transformations of the same, to develop the theory of invariants relating to that group"—not only describes the spirit of geometry but also reveals that the concept of a group dominated at least one important branch of mathematics. In the fundamental structure of other branches, however, groups are to be found, and the general concepts developed during the latter half of the last century both by Klein and his student friend, Sophus Lie, were responsible for the far-reaching influence which the relevant theory has had on modern mathematical thought. It is not always easy to discover the first important application of a newly developed theory but it is probable that the formulation of the mechanics of the atom made by Heisenberg in 1926 by the application of the theory of matrices—the invention of Cayley in 1858—is a fair illustration of the excursion of that theory into the practical domain.

In 1926 also, Herman Weyl wove the group theory into the fabric of quantum mechanics. Indeed, the revolution in modern physics may be said to have begun in that year by the work of Heisenberg, Dirac and Weyl. The vast theory of differential equations, and especially the Hamiltonian equations of higher dynamics, became far clearer under the lens of continuous groups, the theory of which was almost exclusively the work of Lie. As Prof. E. T. Bell aptly remarks : "The far-reaching power of the theory of groups resides in its revelation of identity behind apparent dissimilarity. Two theories built on the same group are structurally identical. The more familiar is worked out ; the results are then interpreted in terms of the less familiar".

Bearing in mind this brief outline, it is instructive to turn to Prof. Murnaghan's treatise. In the preface of this book the author states that he has "attempted to give a quite elementary and self-contained account of the theory of group representations with special reference to those groups—particularly the symmetric group and the rotation group—which have turned out to be of fundamental significance for quantum mechanics, especially nuclear physics". Special attention has been given to the theory of group integration, as developed by Schur and Weyl ; to the theory of two-valued or spin representations ; to the symmetric group and the analysis of direct products ; to the crystallographic groups, to the Lorentz group and the concept of semi-vectors as developed by Einstein and Mayer.

The text begins with a lucid treatment of the group concept leading to its representation. Matrices are thus introduced and canonical forms discussed. Then follows a general chapter on reducibility in which Schur's lemma on irreducible collections of matrices, the theorems of Burnside, Frobenius-Schur and Auerbach are considered. The Kronecker product and powers form the substance of Chapter iii ; the symmetric group and its characters, the alternating group and linear groups occupy Chapters iv–viii, and the remaining five chapters are concerned chiefly with group integration, the orthogonal group, spin representations of the rotation group, the crystallographic and the Lorentz groups.

The mathematical development of the theory has been skilfully carried out with clarity and rigour, whilst the printing—by no means simple—is a model of efficiency and painstaking care. There are no exercises nor applications although the author points out that, with the co-operation of Prof. J. A. Wheeler, a chapter on the actual applications of the theory to the concrete problems of nuclear physics was originally planned for the volume, but, unfortunately, space considerations prevented its inclusion. This is undoubtedly a disadvantage for it would have added greatly to the interest of the student. However, the author has promised to deal with these important applications in a future publication, and this will be a welcome sequel to the present treatise. It may be added that four pages of references to relevant books and papers are given at the end.

F. G. W. BROWN.

SCIENTIFIC ORGANIZATION OF WORK

A Chance for Everybody

A Liberal Basis for the Organization of Work. By Hyacinthe Dubreuil. Pp. xvi + 270. (London : Chatto and Windus, 1939.) 7*s*. 6*d*. net.

THE essential idea which M. Dubreuil expounds in this book he has already put before scientific workers in Great Britain in papers presented before the Department of Industrial Co-operation of Section F (Economics and Statistical Science) at meetings of the British Association in 1931 and again in 1934. His advocacy of co-operative contact work by autonomous workmen's teams was further discussed at recent management conferences at Oxford. M. Dubreuil now gives us not merely a fuller exposition of his detailed ideas but also something of the philosophy which has led him to offer this solution to the problem of mechanization, particularly in large organizations.

M. Dubreuil starts by asserting that scientific organization of work will only complete its evolution when it succeeds in bringing into play not only the physical capacities of the worker but also all the intellectual and moral forces that a man can develop when he works in a state of perfect freedom. It is in this sense he speaks of 'chance'—not merely opportunity but scope, the chance to try one's luck, to reap the fruits of the application of one's intelligence to life's infinite possibilities. Only as industrial organization opens before every worker this vista of 'chance' does M. Dubreuil believe it is possible to eliminate the frustration and depression with which mechanization has afflicted many of the workers in modern industry. The real problem is in the transformation of the relations that men maintain among themselves, and not the relations between a man and his tools.

This is the key idea in M. Dubreuil's scheme : it is not enough to improve material conditions by measures of protection and assistance : we must also supply the means by which the workers can attain to the combination of satisfactions that makes life worth living. If undoubtedly education has a part to play here, M. Dubreuil believes that work can and should be organized to permit the expression in it of human personality, and that such expression should not be confined merely to leisure hours.

On this ground alone, M. Dubreuil's plea for the study of the functions and possibilities of the small unit or group deserves attention. To concentrate, as has been the tendency of late, on leisure as providing the sole source of expression of personality or creative capacity for the majority of workers, even if the tendency towards increasing leisure were unchecked, is to doom men to drudgery for a large part of their waking hours. At best it is a defeatist attitude. At the worst it may rob mankind not merely of moral and intellectual satisfaction but even of technical achievements and possibilities of material advance because men are denied the opportunity of giving expression to their innate abilities.

The weakness of other systems, the reason why large organizations fail to achieve the expected results, the failure even of workers' ownership of factories and their control of purchases and sales, M. Dubreuil attributes fundamentally to the payment of wage earners by time and the apparatus of constraint which the clocking-on system involves. The inner urge towards constructive thought and action can only operate when men are assured that the fruit of their ingenuity will be theirs without restriction.

M. Dubreuil does not claim to be the originator of his basic idea of functional autonomy. His debt to J. B. Godin is freely acknowledged. But in his firm rejection of the wage system because it excludes the idea of chance and discourages the worker from putting forth all the effort of which he is capable, he takes Godin's ideas further and enunciates four fundamental rules or principles for the application of his system. These rules or principles are :

(1) Free recruitment of workers by their collective unit, constituted as a co-operative labour group.

(2) Collective undertaking of specified work for a price agreed between the employer and the delegate of the co-operative labour group.

(3) The workers grouped in the collective undertaking themselves choose their leaders and freely organize the execution of the work entrusted to them.

(4) Distribution of the total price of the work among workers according to the method of sharing judged by them to be suitable.

M. Dubreuil believes that such groups organized within a large undertaking by some species of molecular change could revivify them and avert some of the inertia which is liable to overtake them. Not only is each member of the group interested in giving the highest possible value in his own contribution, but he is equally interested in a similar raising of the standard on the part of all the others, and consequently in helping them

when the opportunity arises. This form of co-operative group, moreover, avoids the obstacle which severely impedes the promotion of manufacturing co-operative societies. It demands neither the administrative capacity nor the capital which the workers usually lack and requires only their personal capacity for work, knowledge and tradesmen's competence—the only capital they can be expected to put into a common pool.

M. Dubreuil's arguments are supported by interesting examples of collective payment on these lines, and his proposals are not to be lightly dismissed either by those embedded in the traditions of existing organization or by the socialist equalitarian. Whether or not this idea of autonomous groups is capable of general application it is at least highly suggestive, and many scientific workers themselves could corroborate the accuracy of some of M. Dubreuil's arguments and suggestions. At least the idea deserves careful exploration, for we can afford to miss no opportunity of releasing those forces or capacities of the individual which the modern industrial age does so much to atrophy. Scientific workers have their own particular problems on which M. Dubreuil's ideas have their bearing and they may well be grateful to Mr. R. J. Mackay for this admirable translation and the excellent note which he contributes to introduce the volume to a British public.

R. BRIGHTMAN.

DUAL-PURPOSE COWS

Dairy Cattle and Milk Production

By Dr. Clarence H. Eckles. Third edition, revised by Ernest L. Anthony and Prof. Leroy S. Palmer. Pp. xv + 520. (New York: The Macmillan Company, 1939.) 18*s*. net.

THIS is a work of great merit, and can be recommended to all interested in agriculture, both farmer and student, in the United States of America and also in Europe. It has been written in a practical vein, but the fullest use has been made of the findings of the research worker of recent years, and there is the feeling that the latter and the practical agriculturist are in certain respects brought closer together.

The distribution of the material among the thirty-three chapters is good, with the result that a great deal of ground is usefully covered. Chapters iv–x, dealing with the breeds of cattle and to some extent with their classification, are on the whole excellent. The British agricultural student might be forgiven for criticizing some of the material in Chapters ix and x, and it is unfortunate that use is still being made of the term 'dual-purpose' in reference to cattle. It is among the most dangerous of words, particularly when used in conversation with a student. No two breeders ever have the same thing in mind when they use the word. The definition of the term at the beginning of Chapter x appears a little unconvincing to the writers themselves, and is undoubtedly so when read with preceding and following pages.

Under the heading of dairy temperament on pp. 26 and 27, we read "The cow that shows these characteristics to a marked degree—*the ability to fatten naturally towards the end of a milking period* —is said to have a good dairy temperament". If there is one quality that characterizes a Shorthorn more than another it is precisely this quality. Notwithstanding this, we find this breed discussed in Chapter x under 'dual-purpose cattle'.

My chief objection, however, is to the use of the term at all with reference to a breed. There are cows in every breed, including Jersey and Guernsey, with all the defects which are alleged to make up a dual-purpose breed. Fig. 6 on p. 27 illustrates this. Finally, students are always in doubt as to the merits of a cow in late lactation or when dry if she carries a good deal of flesh at that time. Such a cow will in nine cases out of ten be described as a dual-purpose cow, when she is probably a first-class dairy cow.

There are dairy breeds and beef breeds, both of which fit in with specific and often widely differing systems of farming. There are other systems of farming less well adapted to the ideal requirements of these breeds. Any breed farmed under these conditions for a long enough period tends to develop those characteristics which to-day we speak of as dual-purpose.

The use of the word has up to now been badly misunderstood in its application to cattle, and it would be better if it could be abolished. Among breeders of dairy cattle it is all too often a term of abuse, whereas any breed that can from generation to generation stand up to conditions not ideally suited to maximum production is a breed that must play an important part in the agriculture of many parts of the world.

The authors are to be congratulated on a good piece of work.

K. W. D. CAMPBELL.

MATERIALS OF CONSTRUCTION

(1) Materials of Construction
Their Manufacture and Properties. By the late Prof. Adelbert P. Mills. Second, third and fourth editions, edited by Harrison W. Hayward. Fifth edition, rewritten and edited by Prof. Lloyd F. Rader. Pp. xii+564. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24*s*. net.

(2) Johnson's Materials of Construction
Rewritten and revised by Prof. M. O. Withey and James Aston. Eighth edition. Pp. xxii+867. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

FOR many years each of these two books has been recognized as a standard work on the subject of the materials used in engineering construction, and these new editions have therefore to be judged not by the criteria applied to new and untried works but in order to see how far they have been brought into line with current knowledge and practice. Though they deal with the same subject, the two books bear the stamp of individuality which may be traced to the impress of the original authors.

(1) In the fifth edition of Prof. Mills's book, his successors have retained his original purpose of providing a text-book covering the manufacture, properties and uses of the more common materials of engineering construction. His plan was to put the information in a concise and thoroughly modern manner, and though intended primarily for use as a text-book of a somewhat elementary character, the treatment was in many respects sufficiently detailed for the book to serve as a work of reference for the practising engineer.

Herein is to be found one reason for the success of this book, for it is essential that every engineering text-book without exception should have this practical orientation. If the subject is not presented with due attention to its applications in the best engineering practice, the book becomes merely a scientific treatise and must fail to find acceptance as an engineering text-book. Thus, properties of materials are not merely exhibited and discussed, but are also related, on one hand to qualities of the raw materials and to the nature of the manufacturing processes and treatments and, on the other hand, to the wide range of possible uses to which they may be put.

This valuable mode of treatment which provides the student and the inexperienced engineer with the means of weighing the pros and cons and of making the right use of new and improved materials, properties and qualities, has been well maintained though the matter has undergone considerable change. The fundamental properties of materials are treated and the methods of testing described in the early part of the book, where also such subjects as slip, progressive fracture under repeated stress, creep and corrosion are discussed.

Besides the usual range of information regarding the properties of metals, stone, concrete, timber, etc., the subjects of metallography and the constitution of metals, now recognized to be of great importance to the engineer, have received greater prominence. Of the more recent materials to come into use, the bitumens, the plastics and the protective coatings have received attention.

(2) The second of these two books has had a much longer history, having been originally published in 1897 and having had a total issue of thirty-seven thousand copies. Its author, Dean J. B. Johnson, clearly realized the importance of accurate knowledge of the mechanical properties of materials in the rational designing of any kind of construction. At that time the investigation of the properties of materials was in its infancy, and this knowledge can only be obtained by patient, expensive and competent research. It is also to be noted that the field of investigation extends, as it were, in three dimensions by the introduction of new materials, by the evolution of new qualities of these and by the extension of the conditions under which they have to serve.

Thus the outlook to-day is much wider than forty years ago, and in order that this book should be as fresh in its attitude and as enlightening in its presentation as it was then, the assistance of experts has been called in so that the information given is as thorough as it is reliable. Taking timber as an example, there is a chapter on the characteristics, properties and uses of wood, in which one section deals with the identification of different kinds. The next chapter treats with deterioration and preservation of timber, while a third gives its mechanical properties, including comparative figures for green and air-seasoned woods. Here also a section gives particulars of the strength of nails, screws and spikes in use with timber.

With similar thoroughness the other materials are presented, the treatment in this volume being in all cases more complete than in the former. Both, however, are excellent within the limits of their scope and may be accepted as fully maintaining the high reputation they have already merited.

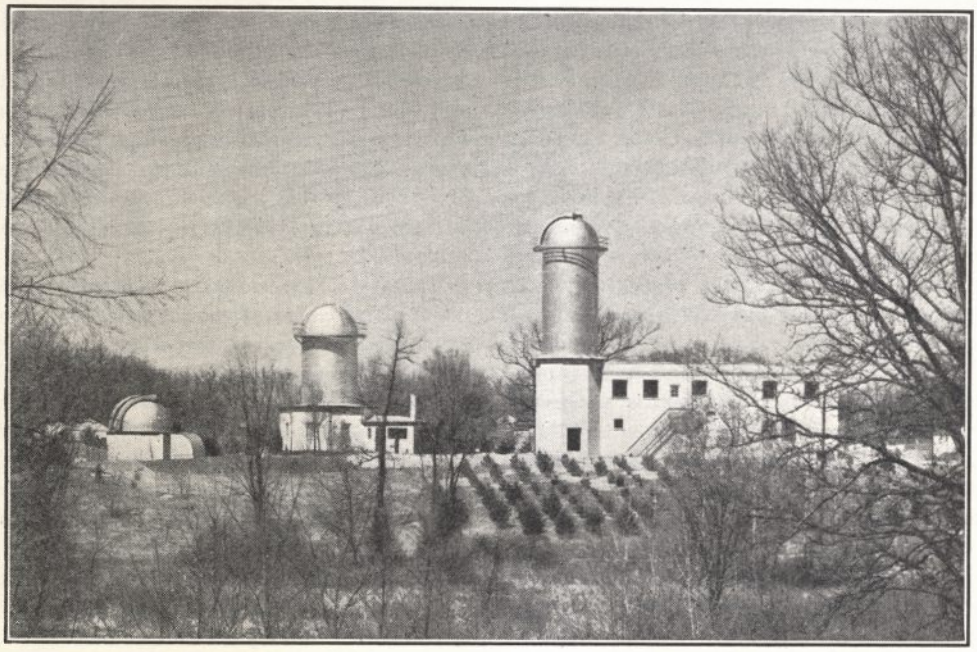
THE McGREGOR BUILDING AND TOWER TELESCOPE OF THE McMATH-HULBERT OBSERVATORY

By Dr. Robert R. McMath

WITH the dedication of the new McGregor Building and Tower Telescope on May 25, 1940, the McMath-Hulbert Observatory of the University of Michigan became perhaps the most complete and powerful installation on earth for the study of the sun. This new addition brings to a total of three the buildings of the Observatory, located at Lake Angelus, Pontiac, Michigan; and besides affording opportunities for studies of the heat, magnetic, and other energy conditions of the solar surface, gives the Observatory much-needed working and office space together with a beautifully equipped modern machine and instrument shop.

The new building is two stories in height, covering an area of 5,600 sq. ft., with the tower forming part of the building at the south. On the first floor is a drafting room, the machine and instrument shop, small film storage, cutting, and dark rooms, and a long laboratory room. The offices are on the second floor, as well as a measuring room, a large dark room with unusually complete equipment for photographic work, a second long laboratory, and the library with a projection booth for showing motion picture films of solar phenomena for study.

To minimize any risk from vibration, the tower and its foundations are of unusually massive construction throughout. Actually, the tower consists of two steel shells, one within the other. The outer tower carries the dome, the floors and other structural elements, and an electrically driven steel elevator which rises in the space between the two towers to carry apparatus to the dome-level. The inner tower carries only the telescopic light-gathering mechanism (cœlostat), which receives the light from the sun and sends it vertically downward in the inner tower and through the various optical parts of the tower telescope proper. Openings in the two steel towers at the levels of the first and second stories make it possible to send the sunlight gathered by the cœlostat mirrors horizontally in to the various pieces of apparatus in either of the two long laboratory and observing rooms which form lateral extensions of the tower. The machinery of the cœlostat in the dome and for other optical parts is not yet in place, but will be made in the instrument shop where any delicate piece of apparatus, large or small, can be quickly constructed.



McMath-Hulbert Observatory from the south-east. The new McGregor Building and 70-ft. lower telescope is at the right.

The promise of these facilities for further progress in the studies of the sun is very great. Previously, the Observatory had been impeded by lack of working space. The McMath-Hulbert Observatory was started as an amateur undertaking in 1929 by Robert R. McMath, the director; Judge Henry S. Hulbert; and the late Francis C. McMath. At that time there was only a 10½-in. reflecting telescope, housed in the smallest and lowest of the present domes. This was presented to the University of Michigan in 1931. Soon after this, a spectroheliokinematograph was attached to this 10½-in. reflector; the first successful motion-picture of a solar prominence, though now regarded as rather crude in comparison with more recent results, was secured in early August 1932, and it was soon evident that many short-lived solar phenomena could be photographed, the existence of which had not been hitherto suspected. As a result, in 1936, the 50-ft. tower telescope was erected exclusively for solar studies. During the past four years, more than 400,000 individual pictures or 'frames' have been taken with this powerful instrument, and have yielded results of great interest and value. But most of the work of design and the study of results had to be carried on in the basement of Dr. McMath's residence. This will be overcome with the greater convenience and efficiency secured through adequate facilities in the new building.

The true purpose of the new unit, however, involves even more technical considerations. The work done in the 50-ft. tower has yielded many films of motions of solar prominences through the development of an ingenious motion picture technique by Dr. McMath. The results have been in two dimensions, and from them a vast amount of evidence has been accumulated as to the character of the motions and changings on the turbulent surface of the sun, but a full study of these motions and of the forces producing them requires much more. During the past year, by means of small shifts in the lines of the spectrum due to velocities in the line of sight, motions in the third direction, that directly toward or away from the earth, have been recorded.

Many questions still remain unanswered, however. It is hoped to determine the temperatures of the streams of flaming materials, speeds of which have been discovered to be so great as ten to fifty or more miles per second. Of even greater importance, more accurate knowledge is sought of the magnetic and electrical conditions accompanying these solar storms, for the manifestations may have a connexion with such familiar phenomena as the aurora, magnetic storms, and interference with radio reception. Other considerations to be studied are the discovery of the heat changes, degree of electrical and magnetic force involved, and the determination as to whether or not the sun's output of ultra-violet light increases at such times. The instruments to be installed in the McGregor Building and the 70-ft. tower telescope will thus be much more in the field of physics than astronomy.

These are all matters relating to the actual nature and cause of solar activity—to the sources of energy and possible terrestrial effects of the movements shown on the solar films. The ways and means of research into these problems are by no means perfectly clear. Unforeseen difficulties may arise. But whatever the results, a powerful instrument is needed for the purpose of studying, through the most advanced techniques of modern physics and astronomy, these energy relations, and searching for the real reasons behind solar phenomena. What discoveries will be made no one knows, but they are sure to be of great scientific interest and value, perhaps even with a more practical terrestrial application.

The McGregor Building and Tower are so named in memory of the late Tracy W. McGregor, founder of the McGregor Fund, which has provided funds for the construction of this powerful research plant and has also made a grant for part of the support of this work during the coming five-year period.

ULTRA-VIOLET AND ELECTRON MICROSCOPY*

By Prof. L. C. Martin,
Imperial College of Science, London

THE compound microscope has now been known to science for about three hundred and fifty years, but the development of the instrument has been curiously spasmodic in spite of its admitted importance. The earliest models were perhaps looked on as little more than toys, and it was not until the publication of Hooke's "Micrographia" that the possibilities were better appreciated. Even so, it seems as if the optical design of the microscope remained for a hundred years largely as Hooke left it.

It became evident during the development of

* Substance of a Friday evening discourse delivered at the Royal Institution on May 24.

the instrument that the use of single lenses set such limits to the definition as to preclude the effective observation of smaller and smaller objects. The very diminution of the aperture of the objective, though it undoubtedly reduced the aberrations and improved the image to some degree, could not be carried too far without causing a loss of definition due, as we now know, to diffraction of light and of course to loss of illumination. We know nowadays how to build lenses which for all practical purposes are free of chromatic and spherical aberration ; but still the image is not perfect. If the object be a point source of light the image is not a perfect point but is spread into a disk surrounded by faint diffraction rings in accordance with the light-distribution first calculated on the basis of the wave-nature of light by Sir George Airy in 1834.

At this stage it was understood that the only way to diminish the diffraction spreading is to admit the widest possible cone of light from the object into the objective. In order to control the chromatic and spherical aberrations of the objective, a highly complex construction with various kinds of glass is required. The eyepiece now consists of two or more lenses and is free from lateral chromatic aberration. With the most perfect arrangements the limit of close approach for two points in the object, consistent with the possibility of distinguishing their images, is known to be given approximately by :

$$\text{Resolving limit} = \frac{0{\cdot}5\ \lambda}{N \sin U},$$

where λ is the wave-length of light, N is the refractive index of the medium in which the object is situated, and U is the angle between the axis and the most oblique ray from an axial object point which can enter the objective and reach the image.

If the optimum resolution is required, the object is now mounted in some medium with a reasonably high refractive index, such as Canada balsam. The angle U may reach 60° or more and the product $N \sin U$ may be about 1·3 or even higher. The formula was known to be justified in the expectation that violet light ($\lambda = 0{\cdot}45\mu$) will resolve finer structures than red light ($\lambda = 0{\cdot}65\mu$). The precise limits of resolution depend somewhat on the nature of the object and its illumination, for example, whether the object manifests variations of opacity or merely variations of refractive index ; whether bright-field or dark-field illumination is used ; nevertheless, it may be taken that the formula represents fairly well the limit of possibility. What possibilities does it show in the reduction of the resolving limit ?

(1) We may try to increase N by such means as embedding the object in a medium of high refractive index like ethyl cinnamate, and using a very dense flint front lens for the microscope. There are clearly great difficulties in doing this with biological objects as a general practice, although it offers possibilities in metallography.

(2) We may try to increase sin U and take in wider and wider cones of rays. The chief difficulties encountered are concerned with the optical design of the lenses. We cannot make much progress along that road before the losses exceed the gains.

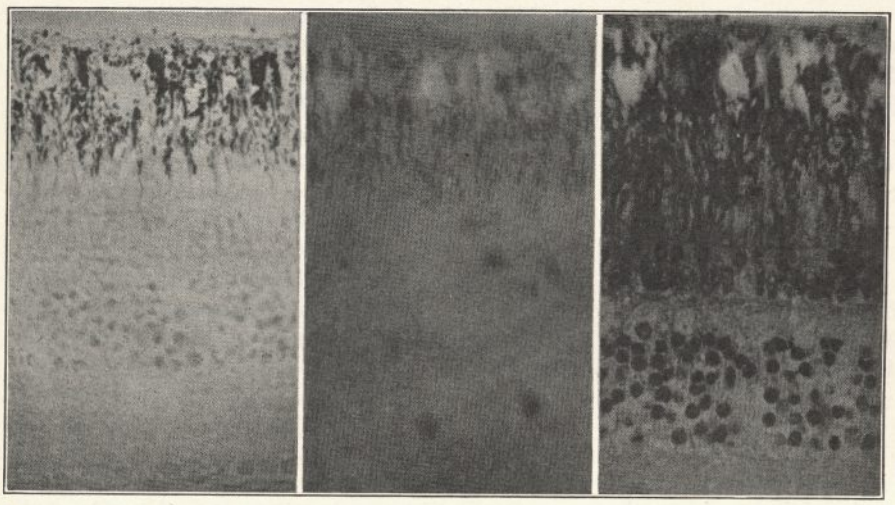
(3) We may diminish λ. The first ultra-violet microscopy of practical import was due to von Rohr and Kohler thirty-five years ago ; they devised a lens (monochromat) which would give an image with light of wave length 2749A. or $0{\cdot}2749\mu$, thus allowing a theoretical resolving limit one half of the amount for visible light. The light was derived from a cadmium spark, the spectrum of which contains a number of bright lines well isolated and homogeneous, so that if the light of a single spectrum line is employed there is no need to make the lens achromatic. As a result the design of the monochromat, though appearing unusual, is such that the aberrations can be kept beautifully low, and if the lens can be properly constructed its performance should be very good indeed. Fused quartz is used as the material.

The method was little applied in practice until the work of Mr. J. E. Barnard in Great Britain directed attention to its potentialities in the field of research on the filterable viruses. Barnard transformed the technique, with the aid of the firm of Messrs. R. & J. Beck, Ltd., so that ultra-violet photomicrography became relatively easy to carry out. Further studies on the technique were carried out by Mr. Johnson and myself at the Imperial College with the view of teaching, and regular instruction has been given ever since 1928.

The use of ultra-violet has many important advantages, however, even if the extreme limit of resolution is not sought after. One is that when using the ultra-violet we can employ a smaller numerical aperture, that is, use a lens taking a narrower cone of light ; then, while retaining equally good definition as with the ordinary lens, we can obtain a somewhat greater depth of focus and get a better picture with a comparatively thick object than with visible light. Again, when 'transparent' objects have to be examined under the microscope, the usual method is to stain them with various dyes which are usually taken up differentially by the various parts of the structure ; but it has been found that differing biological structures vary greatly in their relative opacity to

ultra-violet light. Most become opaque at some wave-length, but some will transmit farther into the ultra-violet than others. This can be illustrated by a photograph showing how the structure of a microtome section of the retina of the eye of an owl can be brought out by using various ultra-violet wave-lengths (Fig. 1).

In addition to the low-power monochromat lenses which have been available for some years, achromatic systems made in fused quartz and lithium fluoride have been designed by Mr. Johnson at the Imperial College. These have extraordinarily small variations of focus with wave-length, so that it is possible to focus in visible light and photograph with the ultra-violet; and moreover it is possible to employ a range of wave-lengths for illumination, so that a mercury lamp with suitable filters can be used in place of the usual condensed spark and monochromator system.



A — $\lambda = 0{\cdot}45\mu$ (violet) × 340

B — $\lambda = 0{\cdot}362\mu$ (ultra-violet) × 400

C — $\lambda = 0{\cdot}275\mu$ (ultra-violet) × 400

FIG. 1.

SECTIONS OF OWL RETINA PHOTOGRAPHED IN VISIBLE AND ULTRA-VIOLET LIGHT. (B. K. JOHNSON) 8 MM. MONOCHROMAT. THE SPECIMEN IS UNSTAINED; NOTE THE DIFFERENTIATION OF THE STRUCTURE DUE TO THE EMPLOYMENT OF DIFFERING WAVE-LENGTHS.

We must mention the difficulties preventing the use of shorter and shorter wave-lengths to secure an indefinitely small resolving limit.

With the shorter wave-lengths: (1) both figure and polish of the surfaces must be increasingly perfect; (2) the homogeneity of the optical materials must be increasingly perfect; (3) air does not transmit radiation beyond $0{\cdot}18\mu$, and vacuum or nitrogen-filled instruments become necessary; (4) with still shorter wave-lengths, the usual refracting media become opaque; this requires reflecting instruments, *but* the difficulties in item (1) above then become more severe; errors in reflecting surfaces cause about four times the effect of equal errors in refracting surfaces; (5) for the same numerical aperture, the depth of focus of ultra-violet lenses becomes increasingly small.

The cumulative effect of such difficulties was enough to make it seem probable, a few years ago, that the limits of resolution represented by the ultra-violet immersion monochromats would never be greatly surpassed; we should remain unable to resolve points closer together than about $0{\cdot}1\mu$ or 10^{-5} cm. The discovery of X-ray diffraction by crystals, thirty years ago, mitigated this trouble by providing a means of examining the structure of crystal lattices and quasi-crystalline material. This was supplemented about 1927–28 by the discovery of electron diffraction. It had been known for many years that cathode rays could be deflected by electric and magnetic fields. Already in 1926 it had been shown by Busch that electron streams could be focused by axially symmetrical magnetic or electrostatic fields, much as light is focused by a lens, and the theories of de Broglie had introduced the idea that the motion of the electrons might be associated with a system of waves, which, however, are not to be confused with the electro-magnetic wave motion of light. Prof. G. P. Thomson's diffraction experiments permitted the calculation of the wave-length, which was found to agree with the relation

$$\lambda = 10^{-8}\sqrt{150/V},$$

where V is the potential difference (in volts) causing the electron velocity. Thus if the accelerating potential is 15,000 volts, the wave-length will be 10^{-9} cm. as compared with the $0{\cdot}5\times10^{-4}$ cm. for visible light, and about $0{\cdot}25\times10^{-4}$ cm. for the ultra-violet. At this stage it might have been clear that a powerful new technique of microscopy was possible. It was not, however, until 1932 and onwards that experiments in this direction were begun by Knoll and Ruska in Berlin.

Suppose that an electron is moving in an

equipotential enclosure with uniform velocity v_1 and is incident on a bounding surface at an angle i_1. It escapes, through apertures, into a region with its bounding surface parallel to the first, where its velocity is i_2. Since the only acceleration it can experience in passing across the boundary layer is perpendicular to the surface, the component of the velocity parallel to the surface is unchanged, that is :

$$v_1 \sin i_1 = v_2 \sin i_2.$$

If we compare this with the law of refraction of light

$$n_1 \sin i_1 = n_2 \sin i_2,$$

we see at once that there is an analogy between the velocity of the particle and the refractive index (n) of a medium.

Now in traversing an axially symmetrical electrostatic field the electron experiences differences of velocity corresponding to the potential from point to point of its path. Thus it will traverse a path similar to that of a ray of light passing through a medium with axially symmetrical variations of refractive index. The crystalline lens of the human eye is an example of such a case in optics. Though the theory is more complicated than that of ordinary lenses, it can be shown that the image formation and its defects are subject to closely similar laws.

Electron optical focusing systems with electrostatic fields have been largely employed for a study of the thermionic emission of metallic and other surfaces, an image of the cathode being produced on the screen or plate. This is analogous to the microscopy of self-luminous objects. On the other hand, magnetic fields have offered the most direct means for the microscopy of biological specimens.

We copy the early steps in ultra-violet microscopy and use monochromatic radiation ; in this case an electron beam of extremely perfect homogeneity. Even so, transmission through the object and supporting film produces some disturbance of the homogeneity.

Analysis shows that though spherical aberration can be controlled to some degree, we cannot entirely remove it. Consequently we have to copy the earliest step in ordinary microscopy and employ a small stop at the objective, just as was done in Hooke's microscope. We now meet precisely the same difficulties as was the case in those days. We must cut down the aperture to remove the excessive effects of spherical aberration and secure sufficient contrast in the image, but we cannot proceed indefinitely in this because of the loss of intensity and the increasing effects of diffraction.

Suppose that rays passing through the object plane diverge at an angle δ with the axis and pass the objective at an axial distance y. A formula given independently by Parnum and von Ardenne expresses the resolving limit ($R.L.$) in the object plane due to the presence of electrons with a range of velocity potentials dV, considering axial chromatism only :

$$R.L. = y\frac{dV}{V}$$

If therefore $y = 0{\cdot}0025$ cm. and we take a value of dV/V which can be obtained without unduly expensive electrical apparatus (4×10^{-4}), we obtain $R.L. = 10^{-6}$ cm. The approximate focal distance of the objective when working at a high magnification may be about 5 mm. Hence the angle δ will be about 0·005 radians. We have every reason to believe that if the lens system could be free from aberrations, the resolving limit would be represented for some objects at least by the Abbe formula

$$R.L. = \frac{0{\cdot}5\,\lambda}{\delta} \text{ approximately.}$$

Taking the previously calculated value of λ, namely, 10^{-9} cm., we get $R.L. = 10^{-7}$ cm.

On the other hand, a formula has been calculated by Rebsch for the resolving limit set by spherical aberration (when minimized so far as possible). This gives :

$$R.L. = 0{\cdot}1\, f\delta^3$$

Thus $R.L. = 0{\cdot}625 \times 10^{-8}$ cm. in our case.

Considering the three limits above, it would appear that we might improve matters by increasing the homogeneity of the beam and increasing the aperture until the spherical aberration increases to a value comparable with the Abbe limit. There are, however, other considerations which do not appear to have been dealt with in any of the papers hitherto published abroad.

Every optician knows the importance of centring in an optical system ; in a telescope or microscope it is secured by the assembly of lathe-turned and centred parts, but in the electron microscope this cannot be so readily done, because the real symmetry required is that of the magnetic fields. Irregularities of the windings of the coils, variability of the air gaps between coil sheathings and pole pieces, lack of homogeneity of the material of the sheathing and the disturbing effect of the earth's magnetic field ; all these may be present to disturb the perfect symmetry of the arrangement.

If such irregularity is present, there may not be any part of the image which can be said to be truly axial in the optical sense, and consequently all the image points may be subject to lateral chromatism in addition to axial chromatism. The lateral chromatism is likely to produce a one-sided

streaking of the image, and represents one of the chief difficulties in working with a cold cathode discharge. Better homogeneity can be secured by a hot cathode and filter circuits to eliminate ripple of voltage. Comparatively recently Bruche and Haagen have used electrostatic focusing, in which the variations of the focusing field potential follow those of the cathode ; this should overcome 'chromatic' error.

The chief technical difficulties appear to have been largely overcome by Ruska and his colleagues at the Siemens Works laboratory, although full details of their methods are not yet available.

The objects have to be mounted on collodion films in a vacuum ; though the resolving limit is very small, the extremely narrow pencils of rays render the depth of focus fairly large even in comparison with the optical case. This means that the electron optical method is capable of giving a sharp outline picture, even of objects which are of the same order of thickness as ordinary microscopic objects.

What are the chances of lowering the resolving limit drastically enough to render possible a fairly exact measurement of the diameter of the protein molecules ?

The above calculations of spherical aberration related to lenses free from axially symmetrical space charges, but control of space charges (for example, we may instance the new technique of phase focusing) is now being better understood. It does not appear to be impossible that spherically corrected electron lenses may ultimately be produced. If so, the history of early microscopy may repeat itself and yet another world be opened up to vision.

THE MEASUREMENT OF ART

By F. Ian G. Rawlins,
National Gallery

IT is conceivable that art cannot be measured. Nevertheless, there have been many attempts to do so, and it is not a little remarkable that these efforts are characteristic of the age of the Greek philosophers in much the same way as they are being made now, alongside the rapid progress of theoretical physics.

Whatever branch of art is considered, it has become clear that there are at least two categories of æsthetic experience, the formal and the connotative. The first relates to such properties as symmetry, balance, harmony, and so forth, the second to significance or meaning. Thus, a supreme picture will be perfectly composed in design ; its function, however, will not be completely fulfilled until its intention (meaning) has exerted its maximum effect. This effect is probably unique. Evidently, the proper enjoyment of art depends upon some degree of formal and connotative training.

Is it feasible now to go farther, and to set up a system of art-metrics, such that personal predilections and judgments may be somewhat disciplined, without doing violence to their essentially intuitive nature ? This article will discuss such a possibility in the light of some recent developments. The division of the whole subject into formal and connotative domains will be retained ; but it is clear that 'transitional' cases cannot be eliminated, intractable as they may be. It is not difficult to guess which of the two classes of æsthetic experience has been found to be the more amenable to analysis ; some writers have almost asserted that the connotative field is utterly unapproachable. This attitude seems doubly unfortunate, for not only does it discourage adventure (which nobody denies is hazardous ; but is probably all the more attractive for that reason), but also it denies the possibility of synthesis between the two kinds of experience. The existence of this no-man's-land has been suspected for a long time ; to explore it is very tempting.

Formal Experience

The aim here is to produce an equation, capable of ready numerical solution, which will enable objects within a given category (for example, tiles, vases, decorative designs, melodies, poems) to be arranged in order of æsthetic value. It is important to notice that no attempt is made to compare the relative merits of things in different categories (for example, a vase with a poem). From what has already been said, it will be seen that the basis of such an 'æsthetic formula', as Birkhoff[1] has called it, is largely geometrical, or, rather, the euvalation of a number of severely restricted geometrical properties. These 'elements of order' may not always be positive ; ambiguity seems likely to introduce a negative sensation into formal æsthetic experience. An example would be a rectangle which is nearly, but not quite, a square ; another would be a grouping of figures just too haphazard to balance, and yet not free enough to be natural.

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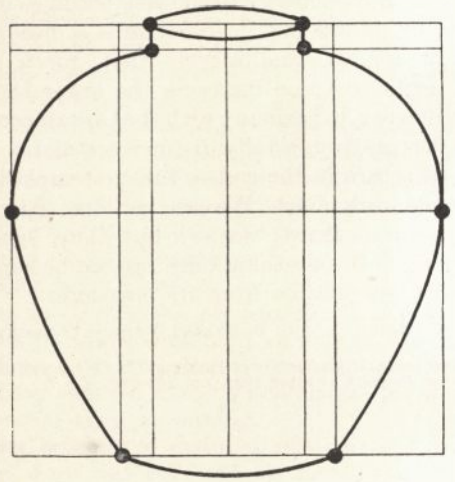
To express these formal factors, Birkhoff writes $M=O/C$, where M is the æsthetic measure, O is the order (symmetry, harmony), and C is the complexity of the object. This latter quantity is considered to bear a proportional relation to the preliminary effort of attention made by the beholder. Physically O and C are the observables, and from their ratio M is deduced.



T'ANG VASE. REPRODUCED FROM BIRKHOFF'S "AESTHETIC MEASURE", FIG. VIII OF PLATE XVII.

An example will make the method clear. The T'ang vase shown in the accompanying figure in outline is typical; such a two-dimensional representation may be called the 'symbol' of the vase. O is found in the following way: $O=H+V+HV+T$, where H is the number of independent quotients 1 : 1, 2 : 1, taken horizontally on the frame of reference (see figure). V represents the same taken vertically; HV refers to independent relations both horizontal and vertical, and T is the number of tangents defining certain characteristics of the 'symbol'. Further, the complexity C is the number of points, indicated by dots on the outline in the figure, upon which the eye would naturally rest in its attempt to follow the contour. For this vase we find $H=2$, $V=0$, $HV=1$, $T=0$. Therefore, $0\ (=H+V+HV+T)=3$, $C=8$, and hence $M=O/C=\frac{3}{8}=0{\cdot}37$.

The working has been very much abbreviated, but is perhaps sufficient to indicate the method, without embarking upon elaborate detail, irrelevant to the present discussion.

The point is this. The analysis, restricted and arbitrary as it appears, does enable a collection of vases to be arranged in order of (say) decreasing M; moreover, it is found that such a sequence corresponds reasonably with æsthetic judgment. It also seems to take some account of their functional appropriateness, which is interesting, since such a recognition is largely connotative. Modifications of the procedure are obviously needed for other classes of objects, but the general treatment is similar.

Connotative Experience

To approach this aspect of art measurement is far more difficult, and the results therefore are likely to be less convincing in themselves, and more slender in foundation. The whole outlook is far removed from that of 'safety first'. Nevertheless, an attempt has been made.[2] We recollect that the purpose now is a search for meaning and the possibility of assigning a value to it. This prompts the query: What kind of knowledge (or, perhaps, what science), incorporates an essentially integrative property of form with the basic element of significance? The Gestalt theory of psychology does this, and to such a theory it is natural to turn.

The vital pre-requisite is to obtain a functional relation, in the mathematical sense, between something that can be perceived (otherwise there would be no contact with formal experience) and some elemental property of the object in question, independent of the observer. It is here that the Gestalt concept may be what we need. Consider the doctrine of energy applied to a picture in the making. There is the creative energy of the artist E_c. Then there is the intrinsic energy E_i (at any stage) of the picture which he is painting, and finally there is the free energy E_f of the picture when it is finished, or, for that matter, at any moment of its evolution. Presumably—with certain limitations too complex for discussion here—the total energy of the whole system E is constant and equal to $E_c+E_i+E_f$ algebraically. For a great picture, sublimely conceived, and perfect in finish, E_f is numerically very small (theoretically, perhaps zero): E_c has supposedly decreased, but E_i may be very large. For the moment we are concerned with neither E_c nor with E_i. It is E_f which interests us, for it is a measure of our picture's (connotative) stability, of its power to give lasting satisfaction, in very truth, therefore, of its meaning. We look, then, for the condition E_f=a minimum.

In Gestalt theory, significance is connected with the 'psychological organization' ψ by the law of *prägnanz*, which states that such organization will always be as 'good' (that is, 'symmetrical', 'satisfying', 'stable', and so on) as the prevailing conditions allow. Thus, we are constrained to relate the free energy to the psychological organization, and to write the tentative equation $E_f=F\ (\psi)$.

That value of ψ corresponding to a minimum of E_f gives us the organization associated with connotative stability. This entity ψ clearly has a quasi-geometrical nature, which suggests a parallel with Birkhoff's 'order' O; in addition the function $E_f=F\ (\psi)$ contains implicitly the characteristics

of a potential in physics. It will be noticed, moreover, that the observer is not directly concerned in this equation ; in a sense, therefore, it is invariant in this respect.

The train of thought just followed has not resulted in establishing a calculus or test of significance in art ; perhaps such an outcome is entirely beyond us. It has, however, suggested a connection between the energetics of an object of art (somewhat akin to a closed system in thermodynamics) and a quantity called the organization. From this interdependence some estimate of the effort involved in creation may be obtained, and consequently a glimpse of the cost to be faced in the conveyance of meaning. To repeat : it is not meaning itself which has been measured ; it is the price of meaning to which a token value has been given. A sublime work of art, a statue by Michelangelo, for example, possesses vast intrinsic energy ; its majesty, however, resides in its (connotative) changelessness—or low free energy—a reminder of the creative energy outpoured in its fashioning.

An Attempted Synthesis

We are left with the two relationships, the explicit equation $M=O/C$ (Birkhoff), and the function $E_f=F(\psi)$ (Gestalt). Examination of the complexity C suggests that it has the dimensions $[mt^{-2}]$ which must also be the dimensions of O, since the æsthetic measure M is a numeric. If now E_f is interpreted as a surface density of free energy (rather than free energy itself) this becomes of like dimensions, that is $[mt^{-2}]$. Since M is a measure of merit, it follows qualitatively that, for a given order, æsthetic value increases the lower the free energy density, in harmony with the Gestalt concept, which derives from totally distinct postulates.

Let us return in the end to the contemplation of a supreme work of art. We can, perhaps, determine its æsthetic measure ; we can but dimly sense its free energy. Of one thing only can we be sure—of the strife inseparable from its creation.

[1] "Aesthetic Measure", by G. D. Birkhoff, Harvard University Press, 1933.

[2] "An Experimental Philosophy of Paintings", by F. Ian G. Rawlins, *Science Progress*, October 1939, pp. 263–276.

OBITUARY

Mrs. Tyndall

THE death of Mrs. Tyndall on August 19 removes one of the last links of the Royal Institution with the great era of Victorian science. Louisa Charlotte Hamilton, which was her maiden name, was born on August 3, 1845, and was the eldest of three daughters of Lord Claud Hamilton and Lady Hamilton. Her mother's maiden name was Elizabeth Emma Proby, and her only brother, Douglas James, who assumed the name of Proby in 1904, died in 1931.

Before her marriage, Mrs. Tyndall enjoyed the privilege of meeting in her father's house in London the great men and women—statesmen, writers, and leaders of thought—of a particularly interesting period of British history ; with the further experience of residence and travel in Ireland and abroad, where her father held diplomatic appointments. At a time when science and research were studies pursued by relatively few, she became one of an earnest group of women of high social position who followed the lectures on scientific subjects provided by the Royal Institution. It was in the winter of 1860 that she was taken by her mother to Faraday's juvenile lectures at the Institution. Tyndall had then been professor of natural philosophy there since 1853, having been appointed to the post on the recommendation of Faraday, whom he succeeded as superintendent in 1867, but it was not until later that she made his acquaintance when travelling with her father in Switzerland. His tribute to Faraday's genius and loveable nature was paid in his book "Faraday as a Discoverer", first published in 1868—a year after Faraday's death. To the fifth edition, which appeared in 1894, Mrs. Tyndall added a note saying that the preface to it was written a few days before his death.

It was on February 29, 1876, that Miss Hamilton became the wife of Tyndall ; and from that time she was, to quote her own words, "his companion in all things". She was a perfect hostess in the busy and intensely interesting years of residence at the Royal Institution, where the superintendent's apartments over the lecture theatre were their home. Here she received a warm welcome in the large circle of Tyndall's friends, which included the Rayleighs, Huxleys, Herschels, Lubbocks, Hookers, Tennysons, Pollocks, Herbert Spencer, and many others. In all Tyndall's investigations and activities, Mrs. Tyndall was his constant companion and an intelligent helper as recorder and amanuensis ; in his hard-earned holidays the best of comrades, while ever watchful of his health and untiring in her efforts to find food suited to his weak digestion, which had troubled him from early years.

So early as 1857, Tyndall had paid a first visit to the Swiss Alps with his friend, T. H. Huxley, to make a holiday study of glacier ice. The mountains fascinated him, and from then onwards all his holidays were spent in Switzerland. Soon after their marriage, the Tyndalls built a cottage on Bel Alp, high above Brieg, in the Canton of Valais, and there they afterwards spent their summers. Some years ago, with the ready consent of the local authorities, she erected nearby a simple monument, consisting of a single massive stone, to her husband's memory.

In 1885, the Tyndalls bought about one hundred acres of land on the summit of Hindhead, in Surrey,

then a wild heather-clad hilltop, where they built what Tyndall termed a "retreat for my old age". After Tyndall's retirement from the Royal Institution in 1887, most of their time was spent at Hindhead, and it was there that he, whose health had been failing for some years, during which his wife nursed him devotedly, died on December 4, 1893, as the result of an overdose of chloral accidentally administered by her.

The rest of Mrs. Tyndall's life was mainly devoted to the collection of material for Tyndall's biography, which they had jointly planned during his lifetime, and which she intended to write; but the work was constantly interrupted by the claims of her family and of friends and dependents, and especially of her mother, Lady Claud Hamilton, who died after several years' illness at Hindhead in 1900. Though she lacked the qualifications to deal with Tyndall's scientific work, she contributed an admirable memoir on him to the "Dictionary of National Biography", but owing to her intense admiration for him and devotion to his memory, she was unwilling to entrust the work to anyone else, and various proposals and suggestions as to the choice of a biographer, which might have resulted in the production of the work in her lifetime, came to nothing.

A vast amount of material relating to Tyndall's life and work was collected by Mrs. Tyndall, with the valuable assistance of several friends, among whom Miss M. Dodd (Mrs. Lewin) may be specially mentioned, with the result that when Mrs. Tyndall's health broke down five years ago, the greater part of the preliminary work had been completed. Since then, what was still needed in the way of arrangement and sorting of the material has been put in hand by her nephew, Mr. Granville Proby, and a biography of Tyndall, for the publication of which she provided in her will, is in course of preparation. In addition to Tyndall's scientific papers, the material includes thousands of letters, among them being a large foreign correspondence with Helmholtz, Bunsen, Clausius, Pasteur, and many others.

It is fortunate that, by her devotion to her husband's memory, Mrs. Tyndall was able to preserve so much material relating to his original scientific work, as well as of his advocacy of the use of scientific thought in other fields of inquiry, and his influence in extending general interest in advance in natural knowledge during a very fertile period of development. The biography will be a valuable record of this period and a long-needed memorial to one who did so much to shape it. Two other tributes to Tyndall's memory are the gift by Mrs. Tyndall, some years ago, of a fund of £1,500, administered by the Royal Society for the purpose of encouraging and furthering research in matters relating to mining, and a fine valley at Hindhead, known as Tyndall's Wood, which has become the property of the nation through the National Trust.

WE regret to announce the following deaths:

The Duke of Bedford, K.G., K.B.E., F.R.S., formerly president of the Zoological Society of London, on August 27, aged eighty-two.

Dr. J. Burtt-Davy, formerly University demonstrator in forestry and lecturer in tropical forest botany in the Imperial Forestry Institute, Oxford, on August 20, aged seventy.

Prof. C. F. Jenkin, C.B.E., F.R.S., emeritus professor of engineering science in the University of Oxford, on August 23, aged seventy-four.

Sir Oliver Lodge, F.R.S., on August 22, aged eighty-nine.

NEWS AND VIEWS

Daniel Solander

THE June issue of the *Anglo-Swedish Review* contains an address recently delivered at the annual meeting of the Swedish Academy of Science on Dr. Daniel Charles Solander, F.R.S., the Swedish botanist, in whose honour the Academy's commemorative medal has been issued this year. Solander was born in the small town of Pitêa in the north of Sweden on May 13, 1735. At the age of twenty he entered the University of Uppsala, where he studied medicine and became one of the most gifted pupils of Linnæus, who sent him to London in 1766 to encourage the study of natural history in England. He soon came in contact with Mr. (afterwards Sir) Joseph Banks and was made an assistant in the British Museum Library in 1763. In 1768 he was engaged by Banks to accompany him on Captain Cook's voyage in the *Endeavour* to Tahiti, and in 1772 visited Iceland with Banks. The following year he was appointed keeper of printed books at the British Museum.

Solander was not the author of any independent work, but in 1756 he edited Linnæus's "Elementa Botannica", in 1766 he described the fossils in Brander's "Fossilia Hantoniensia", and in 1786 arranged and described the material in John Ellis's "National History of Zoophytes". In 1764 he was elected F.R.S. and in 1771 was made hon. D.C.L. at Oxford. His name has been commemorated in the genus Solandra and in an island in the Pacific Ocean near the south coast of New Zealand discovered by Captain Cook in 1770. He died at the early age of forty-six of apoplexy on May 16, 1782.

Dr. Félix Gerlier (1840–1914)

DR FÉLIX GERLIER, a distinguished Swiss physician, was born at Ferney-Voltaire in 1840, the son of a local practitioner. He qualified in Paris in

1866 with a thesis on death from cardiac concretions in diphtheria, and then set up in practice in his native town, where he remained until his death on September 6, 1914, except when he served as a medical officer in the French army during the Franco-Prussian War. He was for several years mayor of Ferney, where the high esteem in which he was held led to his being created a knight of the Legion of Honour. Gerlier is best known for his classical description of epidemic paralysing vertigo, to which his name has been given. His first account of the disease was given in 1886 before the Medical Society of Geneva, of which he was a corresponding member, and was published the next year in the *Revue médicale de la Suisse Romande*, his subsequent papers on this subject appearing in this journal in 1888 and 1891 and in the *Archives générales de médecine* in 1899.

The disease has a very limited geographical distribution, being found only in the Pays de Gex on the Franco-Swiss frontier and in Japan, where it is called kubisagri and has been studied by Couchoud, who regards it as due to a small coccus. Outbreaks take place in May or June, reach their acme in the summer and come to an end in the autumn. The disease has been found in cats and fowls and appears to be causally connected with close contact with horses and cattle, although they do not contract the disease. The symptoms consist in sudden attacks of vertigo and generalized muscular weakness accompanied by diplopia and amaurosis, and lasting for about ten minutes. Nothing definite is known as to the pathology of the disease, and there is no specific treatment.

Antiquities from the Northumberland Collections

Two important and interesting specimens from the Egyptian and western Arabic collection of antiquities belonging to the Duke of Northumberland recently removed from Alnwick to be placed on loan in the British Museum have been described and figured by Mr. Sidney Smith (*Brit. Museum Quarterly*, 14, 2; 1940). Of these the first is an 'elegant vase' for cosmetics in the shape of a naked slave girl carrying a vase and walking on a pedestal. It was described many years ago by Samuel Birch, keeper of the Department of Egyptian Antiquities in the British Museum, in his catalogue of the collection. He did not, however, as Mr. Smith points out, fully appreciate the singular interest of the figure. Except for a wooden statuette in the Louvre, there is no other example of a similar treatment of movement of the body among such wooden figures. The material has been identified as a boxwood from the Lebanon, and while the Louvre male figure has been assigned to the Eighteenth Dynasty from its resemblance to Syrian figures depicted in the tombs, the figure of the girl is not likely to belong to the early part of the dynasty but is assigned to the reign of either Amenhotep III or Tutankhamen.

The second exhibit described is a cylinder seal of hematite of a shape common in the fifteenth century B.C. and later. Its singular importance and unique character lie in the fact the men and bird depicted on it lie outside the known categories of themes on cylinder seals, yet the seal itself and some elements are normal in Syria about the middle of the second millennium. The men wear light waist-belts and a short kilt flounced, which resembles, though it is not identical with, the Cretan wear for athletes. Mr. Smith suggests that it is not a sufficient explanation of the seal to say that it shows Cretan influence, but that it looks as if a Babylonian seal-cutter was actually depicting men in Syria who wore something like Cretan dress, and copied for this purpose such figures as the running men from foreign art. If this be accepted, this seal and the Egyptian figures throw an interesting sidelight on the spread and distribution of artistic activities and motifs in the world of the ancient East in the second millennium B.C.

The Royal Asiatic Society of Bengal

A RECENT reorganization in the administration and installation of the Royal Asiatic Society of Bengal, which is set out in detail in the recently issued annual report (Year Book for 1939, 6; 1940) has already borne fruit, more especially in a speeding-up of publications which had been allowed to fall in arrear. It is possibly to be attributed to the same quickened interest in the work of the Society that the exhibits shown at its annual meeting on February 5, 1940, attracted exceptional attention, notably in anthropology and archæology, subjects upon which as studied in India criticism has recently been directed with no little vigour from more quarters than one. Of the ethnographical exhibits the most striking was a small collection of the wooden effigies erected in memory of the dead by the Red Kaffirs of the Hindu Kush. These effigies came from the village of Rambur and were collected by members of the Zoological Survey of India in 1929. One represented a man riding a horse and the other a woman wearing the characteristic horned head-dress of the Red Kaffir women. It may be of interest to note that it has been suggested that these figures may have some relationship to certain of the well-known Easter Island figures, of which the origin and purpose have been the subject of much discussion.

Another exhibit of considerable interest was a collection of human skeletal remains recently excavated by the Archæological Department of Gwalior State on a Mauryan site at Kumhar Tekri near Ujjain. With the exception of those found by Sir John Marshall at Taxilla, these are the only human skeletal remains of the Historical Period, which have as yet been brought to light by archæological excavation. It is noteworthy that the great development of the posterior parts of the skull characteristic of the big-brained races of the chalcolithic Indus Valley civilization is not found in the skulls of the Historic Period.

New Regulations for Pharmaceutical Examinations

NEW regulations governing the conditions prerequisite to pharmaceutical qualifications have been made by the Council of the Pharmaceutical Society. The work of revision began in 1936 and the sub-committee which was appointed for the purpose was assisted in its deliberations by representatives of the

Ministry of Health and the Department of Health for Scotland and by the external registrar of the University of London. The revised regulations, which affect both the Society's examinations and the curriculum of study, will come into operation in October, subject to the approval of the Privy Council. The syllabuses for the Preliminary Scientific Examination, to be known in future as the 'Intermediate Examination', have been simplified to some extent and the changes are in favour of candidates rather than otherwise ; for example, organic chemistry will not be taken at this stage in future. The physiology of heterotrophic plants has been deleted from the botany syllabus and saprophytism and parasitism have been added. The wording of the zoology syllabus has been modified with the object of limiting the knowledge which the candidate should possess of histology and otherwise of indicating that attention should be directed mainly to types and not to groups to which the types belong. More important, however, is the provision that the Council of the Pharmaceutical Society may require that the Intermediate Examination shall be passed before the student commences his practical training in a pharmacy or a hospital ; this provision is wisely conceived, for the present high percentage of failures clearly suggests that many candidates would be well advised to choose some career other than pharmacy.

With regard to the Qualifying Examination, there has been some unloading of the syllabuses, but this does not appear to reduce the general standard of requirements. In pharmaceutical chemistry the candidate's knowledge of tests for purity and of chemical assays will in future be limited to those of the British Pharmacopœia and, in pharmaceutics, the reference in the syllabus to the biological standards of galenical preparations has been deleted, as the principles underlying these subjects are more appropriately treated in physiology and pharmaceutical chemistry respectively. The changes affecting the Pharmaceutical Chemist's Examination include, in the pharmaceutical chemistry syllabus, the substitution of "adrenaline, thyroxine, vitamins A, B_1 and B_2, C and D" for the crystallizable hormones and vitamins and, in the pharmaceutics syllabus, the addition of the factors involved in transferring small-scale pharmaceutical operations to a large scale. The preparation of bacterial vaccines has been deleted, and disinfectants and the factors governing their efficiency have been added to the syllabus. Another addition is a knowledge of the physiological properties of vitamins. In the requirements for this higher examination, the object of the changes would appear to be directed to an adjustment to more recent developments in sciences allied to pharmacy.

British Birds in 1939

A NUMBER of local societies have recently issued their field records of bird-life in 1939. The London Natural History Society's Bird Report for 1939, issued separately from the *London Naturalist* for the fourth year, covers bird-life within twenty miles of St. Paul's Cathedral and notes more than 160 different species, including such uncommon visitors as the firecrest, great grey shrike, purple sandpiper and Iceland gull, a summary of the arrival dates of migrants for eight years and special accounts of the status of the goldfinch, stock-dove, sandpiper and redshank. The Merseyside Naturalists' Association's 1939 notes from Liverpool (*Ibis*, July) add the Kentish plover to the Lancashire list and the roseate tern to the Cheshire list, in addition to noting such uncommon visitors as the red-necked grebe, black redstart, velvet scoter and a mid-winter record of the little stint, as well as extensions of the nesting range of tufted duck, pochard and herring-gull.

In the home counties, the Oxford Ornithological Society notes the blue-headed wagtail at Slough Sewage Farm, Bucks, in May, June and July, as well as visits of grey plover, turnstone and knot, while in East Anglia, the Norfolk and Norwich Naturalists' Society Bird Report mentions two pairs of marsh-harriers at Hickling and Horsey but only one nest known to rear young, no Montagu's harriers and only about four pairs of bearded tits, a whiskered tern at Hitchling in June and a sight record of the Mediterranean Black Headed Gull in October. A pair of roseate terns nested at Blakeney and dunlin again at Clay, but the latter apparently not rearing young. The Cambridge Bird Club notes bittern, Montagu's harriers and black-necked grebes on Burwell Fen, but not nesting, nor was the black redstart again found nesting in its 1938 haunt. The Yorkshire Naturalists' Union report (*Naturalist*, 1940, pp. 7–18) notes the siskin nesting at Goathland, pintail at Skipworth, and the crossbill at Thornton Dale ; goshawk, water-pipit, an immature white-tailed eagle, ospreys and red-legged partridge were uncommon records. The nesting of the arctic tern at Spurn is believed to be a county record.

Public Health Progress in India

THE July issue of the *Asiatic Review* contains an interesting article by Sir Alexander Russell, formerly medical officer of health and professor of hygiene and bacteriology at Madras, on public health progress in India during the last forty years. Since 1911, research work under the auspices of the Indian Research Fund Association has been chiefly connected with India's public health problems and considerable achievements have been recorded, especially as regards plague, cholera, malaria, kala-azar and nutrition, while investigations on the indigenous drugs of India have done much to determine their therapeutic action. The Research Association has also supplied means for the training in research of a large number of Indian graduates of science and medicine. An All-India League was formed in 1921 to promote maternity and child-welfare throughout the country. In 1930 it became the Maternity and Child Welfare Bureau, and now in most provinces the work is carried on either through the official health departments or by voluntary organizations.

The Institute of Hygiene and Public Health provides a course of instruction and a diploma in maternity and child-welfare, while half a dozen

small provincial schools serve for the education of health visitors. Since 1929, considerable advance has been made in a campaign against tuberculosis. As regards leprosy, for many years the work was confined to the provision of a number of asylums for lepers, but about fifteen years ago scientific research showed that early cases were amenable to treatment, and in 1934 the British Empire Leprosy Relief Association was founded. In the following year an Indian Council for the Association was inaugurated, and research work was intensified, especially by the Calcutta School of Tropical Medicine.

Disease Among Natives of Alaska

IN a paper read before the Section on Medical History of the College of Physicians of Philadelphia (*Trans. and Stud. Coll. Phys. Philadelphia*, **4**, Ser. 8, 27 ; 1940) Dr. Joseph D. Aronson, associate professor of bacteriology in the University of Pen sylvania, remarks that though little is known of the occurrence of disease among the natives of Alaska prior to its discovery by the Russian explorer Khirikoff in 1741, the early reports and records indicate that diseases due to food deficiencies existed and that smallpox, syphilis and tuberculosis were unknown and were probably introduced by the white man. Smallpox, which was probably introduced by the Spaniards, caused more suffering and loss of life than any of the other diseases. The mortality was particularly high among adults and considerably less among children. It soon became clear that in parts where vaccination was employed the disease was brought under control and the mortality fell to 10 per cent or less, whereas in areas where the natives refused to be vaccinated the mortality ranged from 40 to 60 per cent. Syphilis was brought into the country by hunters, traders, and especially sailors, and became widespread. There is no record of tuberculosis either in its pulmonary or extrapulmonary form such as lupus or involvement of the bones or joints, until 1770 or twenty-nine years after the discovery of Alaska. Afterwards it spread rapidly, though it did not reach the epidemic proportions of smallpox.

The Illegitimate Child

IN a review of this subject in the July issue of the *Quarterly Review*, Mr. Claud Mullins, the well-known Metropolitan police magistrate, remarks that illegitimacy is not only a problem in itself but is also a big contributing factor in prostitution, abortion and crime. He points out that the absence of a father from the beginning of the life of the illegitimate child must have a big effect, as it is the father's function to implant in the child impulses which produce law-abiding citizens. Only too frequently the illegitimate child is a rebel not only against the conventions of society but also against criminal laws. Sometimes the dangers of illegitimacy are minimized by the child's early adoption into a normal and healthy home, but most psychologists agree that even with adoption there may be a trauma in the child's unconscious, and this trauma may result in a later hostility to society. Mr. Mullins suggests that there should be a new bastardy law in which the interests of the child should be uppermost, and that regular maintenance should permit decent arrangements to be made for its upbringing and education. In conclusion he recommends the substitution of the words "natural child" for "bastard", and "child maintenance" or "child paternity proceedings" for "bastardy proceedings".

Treatment of Juvenile Delinquents

IN his inaugural thesis (*Thèse de Paris*, No. 1105 ; 1939), Dr. H. Pitoux, who records five illustrative cases, states that of 98 inmates of the Fresnes prison under thirty years of age, 61 had committed their first offence before the age of twenty-one. He recommends that in order to enable a young offender to play a respectable part in society he should undergo a medico-psychological examination, and a careful inquiry be made into his previous social environment. He should then be classified and sent to a centre suitable for his psychical and occupational level. Institutions with a staff specially trained to give the young offender an intellectual, moral and occupational education are needed to enable him to return to society. At the present time only the first part of this programme, namely, the scientific and medico-psychological, has been realized in France, but as regards education much still remains to be done.

Bibliographical and Intelligence Services

THE *Proceedings of the British Society for International Bibliography*, **1**, Part 1–3 (1939) include a paper by J. E. Wright on the special library and information bureau established in connexion with the Post Office Engineering Research Station at Dollis Hill ; special reference is made to the use of the universal decimal system of classification in the indexing of literature and information relevant to the work of the Department. Dr. S. C. Bradford contributes a note on the co-ordination of documentation, in which the limitations of abstracting periodicals are indicated, and the lack of co-ordination between the abstracting services leading to incompleteness and inconvenience is criticized. Dr. Bradford again argues that abstracting should be organized from the point of view of science as a whole. The information service of the Imperial Bureau of Horticulture and Plantation Crops is described by D. Akenhead. In addition to *Horticultural Abstracts*, the Bureau has issued twelve technical communications and five occasional papers, one of the latter being an annotated bibliography on the biter pit of apples, and another the translation of conclusions reached by a Russian author on the manuring of fruit trees. Primarily, the information service is for research workers in the Empire, but inquiries from private individuals or from foreign research workers are often handled.

The organization of an industrial intelligence service in relation to documentation is discussed by S. G. Barker, who argues that industry requires a co-ordinating agency for the dissemination of information regarding current work, both published and

unpublished. It also requires, he considers, historical bibliographies of failures and successes and historical records leading up to and subsequent to them, as well as an intelligent observation of potentialities in regard to the future. These must be expressed to the business man and technologist in brief terse language, so that on straightforward reading he will readily grasp the essentials and be able to indicate to his subordinates and others what he requires in regard to detail. To do this effectively, co-operation, co-ordination and collaboration with other industrial information sources are essential, and this is the organization we seek.

Books to Read at College

THE Trinity College Bulletin, edited by Prof. H. T. Costello, which comes to us from Hartford, Connecticut, supplies a "List of Books for a College Student's Reading". This, first published in 1925, has now reached a third, revised edition, and deserves to be popular. The aim of the pamphlet is "to bring the best students and the best books together", helping them to avoid waste of time on inferior stuff. This is an excellent idea in view of the present over-crowded jungle of literature, the reduction of which by the stress of the War will, we hope, be permanent. The general reading course before us is well arranged. The List is divided into ten sections, and students are expected to read and write on something in eight of them. "Reading in the greater classics is likely to get special grade credit." This is as it should be. Early specialization pays to-day and interferes with that versatility which belongs to a liberal education. No censorship of ideas is attempted in the lists, and "books that may shock or annoy" are included. The short descriptions added to each item are expert and helpful.

Meteorites in the Indian Museum

A CATALOGUE of meteorites, with special reference to Indian falls and finds and to specimens in the Indian Museum, Calcutta, has been compiled by A. L. Coulson and published as Memoir 75 of the Geological Survey of India, 1940. An order of the Government of India lays down that all meteorites falling in British India are the property of the Government of India and as such should normally find a place in the Indian Museum under the care of the Geological Survey of India. Every effort is made by the Survey to obtain new falls, and these are carefully studied and the results published in the Records of the Survey.

The first catalogue of the collection was prepared by Thomas Oldham in 1864 and gave particulars of 21 stones and 26 irons. By 1914, when Coggin Brown's catalogue (1916) was compiled, the collection had grown to a total of 379, though some of the specimens included in this total have since been found to be identical, due to better knowledge of the various synonyms that have been used in the past. Recently there has been active exchange of meteorites with various British and foreign institutions and on August 1, 1939, the collection included 149 irons and 319 stones, a total of 468 falls and finds. The present catalogue deals primarily with Indian falls and finds, but also attempts to include all meteorites, whatever their locality. References to the most important literature dealing with Indian meteorites and a short résumé of the circumstances of fall or find has been given in every case. Other chapters deal with classification, dates of fall or find and geographical distribution.

A New Direction Indicator for an Aeroplane

ACCORDING to Science Service, Dr. David Luck has described before the U.S. Institute of Radio Engineers a new form of radio beacon for aeroplanes which has been developed after four years research under his supervision at the laboratory at Central Airport, Camden, N.J. It is called the omnidirectional radio-range beacon, and operates with ultra-high-frequency oscillations to reduce the effect of atmospherics to a minimum. Radio-beacons have been in use for several years, but they serve only to confine the pilot to a definite course. Some air lines have used in addition direction finders to show the direction of the transmitting station from an aeroplane, but these are not satisfactory when using ultra-high-frequencies owing to atmospherics.

Dr. Luck described the operation of the new device as follows. When the pilot has to fly around a portion of his course affected by bad weather, he can always 'see' the direction of the radio-station at a glance. If he wants to fly straight into or out from the beacon, he has only to hold the mark steady, at that course, against a scale on the instrument face. The operation of this indicator may be compared to that of a lighthouse sending out two kinds of light, one a beam which sweeps around steadily and the other a flash sent out in all directions the moment the beam points north. The interval is timed from the flash until the beam sweeps over the observer, and then the required direction from the lighthouse is found. In the new radio device, the radio-lighthouse is on the ground and the indicating instrument on the plane automatically times the flash and beam. All this is done electrically, and the lighthouse beam sweeps round sixty times each second.

Recent Advances in Electroplating

ACCORDING to the *Electrical Times* of August 15, the electroplating of chromium is finding a wide application for purposes other than superficial polish and protection. Recently a German technical paper published an account of the utilization of chromium plating for use with steel cutting tools and bearings. A cheaper grade of steel or even common iron may be employed. The working edge is then plated with chromium, which gives it a hardness comparable to that of diamond. The cutting edge may then be ground, for the chromium may be applied in any thickness, and the tool has all the best features of the hardest and most expensive high-grade steel, its life is multiplied by two or even ten, it wears away far more slowly, and will go through most hard metals as if they were cheese. Bearing journals left

rather too small as turned out by the lathe may be thickly coated and then turned up to the increased diameter required, thus also obtaining a skin which lasts a very long time. Worn-down tools, bearings, bushes, gauges, valves, and drills can be rendered better than they were when new.

Similar researches have been made with regard to nickel. All buffing and polishing can now be avoided by using a brightening agent in the electrolyte for plating with this metal. The surface can be taken straight out of the bath directly with all the lustre obtainable by polishing, buffing and tumbling. As these processes involve more work than the electroplating itself, the great advantages of the new method are obvious. Other metals, including chromium, are now the subject of research, and it appears more than probable that a high polish in chromium will shortly be obtainable in the same way. Zinc, for example, is already being successfully applied with a high polish on emerging from the bath.

Verifying Telephone Subscribers' Numbers

To avoid the incorrect recording of callers' numbers in a trunk exchange associated with an automatic telephone area, various expedients have been adopted, including the reversion of a certain percentage of originating calls to the use of an audible tone. The supersonic signal method is described in a paper by W. K. Brasher and B. P. Moss (*J. Inst. Elect. Eng.*, July). It was evolved for Palestine, a country in which the use of a number of languages made the problem more acute. It is usual to check a certain number of demand calls either by establishing a second connexion to the subscriber's line, independent of the first, or by 'reverting' the call, that is, recording the particulars of the required number and informing the caller that he will be rung. Both methods lead to delays. Messrs. Brasher and Moss give a full description with diagrams of the method, which is being evolved in Palestine and is now being installed. Demand positions are served by a 20 kc./sec. oscillator, the output of which can be connected to the operator's telephone circuit of each position. When the demand operator has received the particulars of the wanted and calling subscribers, she passes the call to the distant exchange and moves a dialling plug suitably. The basic principle of the use of a supersonic signal in an automatic telephone exchange has been proved by test to be a practical scheme, no disturbing effect on other circuits having been noticed in a 5,000-line exchange.

The Night Sky in September

THE moon is new on September 2, whilst full moon (the harvest moon) occurs on September 16. On September 20 at 21h. and 23h. U.T. respectively, the moon is in conjunction with Saturn and with Jupiter. Saturn, to which the moon makes the closer approach, may be rather overpowered by the moon's glare. On September 28, a lunar conjunction occurs with Venus. On September 22, an occultation (reappearance) of the 1st magnitude star α Tauri (Aldebaran) may be observed at the moon's dark limb. At Greenwich the reappearance of Aldebaran, then only 9° above the horizon, is due at about 22h. 3m.; at Edinburgh, where the altitude is more favourable, the time is 22h. 16m., at position angle 215° from the moon's north point. Jupiter and Saturn continue this month as a notable pair of bright planets to be seen throughout the night. On September 16, Saturn souths at 3h. 11m. and Jupiter at 3h. 14m. (add 1 hour to obtain Summer Time). Close groupings of Jupiter's four inner satellites may be seen at 1h. on September 8, 9, 16, 18, 25 and 26. Venus, unmistakable in its brilliancy, also continues as the bright and morning star rising between 1h. 12m. (September 1) to 1h. 50m. (September 30). On the former date, Venus is about midway between Procyon and Castor and Pollux and by the end of the month has moved to a position preceding Regulus. The darkening evenings of September (the autumnal equinox is on September 23) gives unrivalled aspects, when the moon is absent, of the Milky Way near the meridian. The main features of this half of the great stellar structure are easily recognized—the great rift or bifurcation commencing in Cygnus and extending along the galactic equator: the brighter eastern stream with its various star clouds passing southwards through Aquila, Scutum, Sagittarius to Scorpio, where it is partially united with the broken western stream. More than 100 years ago, Sir John Herschel at the Cape, "rummaging the recesses" of Scorpio, found it full of beautiful globular clusters. It was somewhere here that the elder Herschel found the 'hole' in the heavens, which modern astronomers now recognize as one of the numerous dark nebulæ found in the Milky Way. The Pleiades rise in the late evening as the precursor of winter nights and of brilliant stars in their well-known constellations.

Announcements

DR. PAUL C. MANGELSDORF, vice-director of the Texas Agricultural Experiment Station, has been appointed professor of botany in Harvard University and assistant director of the Botanical Museum.

DR. WILLIAM CRAMER, British delegate to the International Cancer Congress at Atlantic City in September 1939 and for more than twenty-five years a member of the Imperial Cancer Research Fund, London, has joined the staff of the Barnard Free Skin and Cancer Hospital in St. Louis.

A FURTHER modification in the terms on which enemy aliens can be released from internment was announced by Sir John Anderson in the House of Commons on August 23. In the White Paper setting out the conditions of release, scientific workers and others with academic qualifications were to be granted release if national work in their special fields was available for them. This qualification is now to be removed, on the recommendation of the Asquith Committee, which pointed out that "the benefits of science and learning were often indirect rather than direct".

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.

Reversibility of the Denaturation of Silk Fibroin

SILK, as it occurs in the silk-glands of the silkworm (*Bombyx mori*), consists of two distinct protein systems, and, during the spinning by the worm of the double filament which serves as a building material for the cocoon, these two systems are forced through small orifices in a manner such that they respectively produce a central core or medulla of fibrous material and an outer layer or cortex of gum-like substance. The cortical protein material (sericin) is readily dispersed by hot solutions of soap or mild alkali, while the protein material (fibroin) forming the core of the filament is insoluble in water and is resistant to relatively strong chemical reagents; it is these properties of the extruded filament that partly account for its use as a textile fibre.

The nature of fibroin present in the silk-gland has been examined principally by Foà[1], Hirazuka[2], and Ongaro[3]. These workers found that the protein material obtained directly from the isolated silk glands is readily dispersed in water but equally readily coagulated by shaking, addition of acid, etc. The coagulation by mechanical action apparently occurs during the passage of the secretion from the worm to the outside air. The coagulation of silk fibroin is considered by Ongaro to be irreversible, and this conclusion has not been contradicted by any experimental work up to the present time. Harris and Johnson[4] have obtained water-soluble preparations of fibroin by dissolution in concentrated salt solutions and subsequent dialysis, but these workers conclude that the preparation is one of chemically degraded fibroin.

During an investigation of the solubility of fibroin in various solvents, we found that solutions of fibroin in cupriethylenediamine reagent, neutralized by acetic acid to *p*H 7·5 approximately and treated with solid sodium chloride to about two thirds saturation, yielded a mucilaginous precipitate readily soluble in water. The aqueous solutions of fibroin thus obtained behave similarly to those obtained directly from the silk-gland by Ongaro. Thus coagulation occurs extremely readily on mechanical agitation or addition of dilute acid. An aqueous solution of concentration 2·2 per cent gave an optical rotation of $[\alpha]_D^{20}$ –42·7°; Ongaro found $[\alpha]^{24}$ –39°. It would therefore appear that the coagulation of fibroin can be considered as a process of denaturation and that the denaturation is reversible.

The reversion of heat denaturation in proteins has been accomplished to some extent by Michaelis and Rona[5], Spiegel-Adolf[6] and Wilhelm[7], while the conversion of fully denatured hæmoglobin into a water-soluble form to the extent of 80 per cent has been demonstrated by Anson and Mirsky[8]. The present method of renaturation is of interest owing to the well-defined conditions under which the reversion is achieved. Attempts to apply the method to heat-coagulated ovalbumin have so far proved unsuccessful.

Examination of the products afforded by the renaturation of fibroin of various origins indicates that the fibroin of commercial raw silk is heterogeneous in composition.

A detailed description of the above experiments will appear elsewhere in due course.

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Architecture of Colonies of a Pure Strain of Fibroblastic Sarcomatous Cells derived from a Dibenzanthracene Mouse Tumour

DURING the *in vitro* cultivation of a pure strain of fibroblastic sarcomatous cells derived from a spindle cell sarcoma originally induced by 1 : 2 : 5 : 6-dibenzanthracene in mice[1] a special architecture of the colonies of these sarcomatous cells has been noted. When grown in Carrel flasks in a hen plasma coagulum and fed with either Heparin hen plasma[2] or a hen serum–chick embryo juice–Tyrode mixture, in which the embryo juice concentration is kept low, the cells regularly show a tendency to grow out in close association with one another, and to form ribbon-like strands or even broad sheets which resemble very much the epithelial type of growth *in vitro*. These ribbons frequently arborize and their branches often join up with one another, forming loops and bridges enclosing the coagulum, as shown in the accompanying illustration. The sheet-like growth is found especially at the interface coagulum-glass, whereas the cell ribbons occur also within the clot. This architecture seems to be very characteristic, and has been maintained through frequent passages. It permits the diagnosis of such a sarcomatous colony with the naked eye, being vastly different from the architecture of normal fibroblast colonies; aided by the more highly refractive cytoplasm of the tumour cells it brings the whole colony much more into relief against the background of the coagulum so that, even for the naked eye or under low power, the entire edge of the colony is sharply and clearly defined.

These sarcomatous cells scarcely liquefy the hen plasma coagulum. If, however, the culture is fed with embryo juice instead of the above treatment the cells grow out in a more scattered way, forming long chains of cells arranged in what can aptly be described as 'head-tail' position, the individual cell having a very definite spindle shape. It is known that liquefaction of the clot is aided by the enzymes present in embryo juice. It is therefore suggested that the characteristic colony architecture described above is related to the inability of the sarcomatous cells to liquefy the coagulum, the individual cell, unless aided by embryo juice, being unable to penetrate the coagulum to any extent, but when joined with fellow cells to form a ribbon or a sheet, will do so at a relatively slow rate. This architecture does not seem to have been commented on by other

PART OF LIVING SARCOMA CULTURE (*Fl* 9869 *c*) AFTER 163 DAYS *in vitro*; 32 DAYS AFTER LAST TRANSFER (× 55).

workers who used similar culture material[3,4,5]. But Earle[6] in a paper dealing with strip-shaped explants gives a photograph of a methylcholanthrene sarcoma culture the growth zone of which bears some resemblance to the ones described here.

In the light of the difficulties which have been experienced by other workers,[4,5] in maintaining such sarcoma cultures over long periods, it is worth noting that the cell strain on which the above observations were first made was, in 1937, carried on *in vitro* for 131 days. The observations were confirmed in a new series of cultures which were started in January 1940 from the same tumour strain which was then in the 129th animal passage, its histological features being unchanged. These cultures, again of a pure 'fibroblastic' type, have now been carried on for 215 days so far, without impaired vitality. At intervals (after 134 and 181 days *in vitro*) some cultures were inoculated into mice (a single culture or part of such into each individuum), in some of which the original sarcoma was reproduced, that is to say, that in spite of the complete heterogenous medium in which the cells had lived and grown, they have preserved the property of forming a spindle cell sarcoma in mice.

Details of these experiments will be given elsewhere.

I wish to thank Dr. Woodhouse for supplying the tumour material. Thanks are also due to the Birmingham Branch of the British Empire Cancer Campaign for a grant which in part supported this work.

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Cultivation of the Agent of Fowl Leukosis *in vitro*

THE following is a brief account of the cultivation of the causative agent of fowl leukosis (hæmacytoblastosis strain *T*1, Engelbreth-Holm) in the presence of normal cells proliferating *in vitro*.

Experiments were conducted as follows:

(*a*) Bone-marrow and fragments of heart muscles of chick embryos or of adult fowls were cultivated separately in plasma of leukotic fowls diluted with Tyrode 1 : 2. Before being used, the plasma was freed from cell elements by thorough centrifugation. Cultivation was carried out in flasks according to the standard method of Carrel. The cultures were washed and fed every third day with normal plasma (method Parker-Fischer). After 2, 3 and 4 weeks cultivation, flask cultures as well as control flasks, containing the same medium as the experimental flasks, but without any tissue, were inoculated into young fowls. Inoculation of flask tissue cultures resulted in typical leukosis. Of 7 cultures inoculated after 2 weeks cultivation, 4 were positive; of 3 three-week-old cultures, 2 proved positive; of 2 four-week-old cultures, 1 was positive. Inoculations with the control flask material always gave negative results. Leukotic agent survives *in vitro* in the presence of fibroblast cultures as well as in the presence of bone-marrow cells. Half the above experiments were carried out with bone-marrow cultures, and half with fibroblast colonies originating from cardiac muscle. The proportion of takes was approximately equal in both cases. Although the above experiments demonstrate beyond doubt the possibility of survival of agent in the presence of proliferating normal cells, we undertook further experiments because of the irregularity of the above results.

(*b*) Colonies of fibroblasts derived from normal heart were planted in Carrel flasks after having been bathed for one hour in cell-free ultrafiltrates (Berkefeld filter *N*) of heart and spleen extracts of leukotic

fowl. Normal chicken plasma diluted with ultrafiltrates in proportion 1 : 2 was used as culture medium. Cultures were washed and fed with normal plasma. Altogether, four experiments were carried out, including a total of eight flasks ; the content of each flask was inoculated into two chicks. The fluid medium was injected intravenously, the solid material intramuscularly. Tissue-free control flasks were inoculated at the same time and in the same way. Of four cultures inoculated after two weeks cultivation and four cultures inoculated after four to five weeks cultivation all proved positive. Of sixteen chicks inoculated, fifteen died of leukosis. The fowls died twelve to twenty days after inoculation. Inoculations with the control flask material always gave negative results.

In further experiments, original cultures were transferred into fresh medium after thirty days cultivation. Up to date we have succeeded in maintaining such cell colonies for 86 days *in vitro*. Passages were made every second week. Cultures of first, second, third and fourth passage, that is, after 6, 8, 10 and 12 weeks cultivation, were each injected into two chicks. The washing fluid of these cultures, after passing through an ultrafilter, was inoculated at the same time as the cultures on two other chicks. Inoculations (into a total of eighteen fowls) gave positive results in all cases.

Our experiments show that under suitable conditions it is possible to cultivate leukotic agent in the presence of cultures of normal fibroblasts as well as in cultures of bone-marrow.

The fact that the agent which has the power to cause continuous multiplication of primitive blood cells in the body needs only the presence of non-specific mesenchyme cells for its reproduction *in vitro* need occasion no surprise in the light of the previous experiments with cultures of leukotic tissues. Contrary to Furth and Breedis[1], who were led by their experiments on cultivation of leukotic fowl tissues to conclude that "oncogenic viruses multiply *in vitro* only in the presence of cells on which they confer neoplastic properties", we were recently able to show in studies carried out on leukotic tissue cultures[2] that there is no relation between the infectivity of the culture and its cellular composition. Blood cell cultures and cultures of bone-marrow which, in the course of passages, are transformed into pure fibroblast colonies were in our experiments as pathogenic as blood and bone-marrow cultures in the earliest stages when they still contain numerous primitive blood cells. Furthermore, in confirmation of Ruffilli's[3] results, we proved that the cultures of myocardium of a leukotic fowl which we cultivated through 47 passages during a period of six months, and which already in the first passages are practically free of any round cells, retained their infectivity throughout.

Experiments with cultures of tissues from leukotic fowls did not, in our opinion, furnish sufficient proof that leukotic agent is capable of surviving and multiplying in the presence of non-specific mesenchyme cells because the possibility, however slight, that some primitive blood cells from the original leukotic tissues might survive in cultures could not be absolutely excluded. The experiments reported here furnish decisive proof of the fact that the agent producing leukosis in the fowls does not require the presence of primitive blood cells for its cultivation *in vitro* ; leukotic agent can be cultivated in the presence of common fibroblasts just like numerous non-carcinogenic viruses.

Details of our work will shortly appear elsewhere.

These investigations have been supported by a grant from the Lady Tata Memorial Trust.

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A New Cardiac Glycoside?

Asclepias curassavica is very common in Queensland and parts of New South Wales and has often been suspected of poisoning stock. On testing, it was found that the liquid extract obtained by macerating 2 lb. of the plant in cold water killed a 600 lb. steer in fifteen minutes.

Investigation of the plant has shown that the toxic principle is a mixture of glycosides of the cardiac type. This mixture can be resolved into a chloroform-soluble group and a water-soluble group ; from the chloroform-soluble group a crystalline glycoside m.p. 130° C. has been obtained—this glycoside gives with concentrated sulphuric acid an orange colour changing to purple on contact with air and in the Kiliani test the acetic acid layer becomes green, a purple ring developing at the junction of the two layers on standing. The water-soluble group consists of an amorphous mixture which is hygroscopic and very soluble in water—this material gives a deep emerald green colour with concentrated sulphuric acid. Positive Legal and Baljet tests are obtained with the glycosides of both groups. The glycosides of both groups when tested in very small dose on frogs caused death in half an hour, the ventricles being arrested in systole—characteristic heart tracings were obtained. The action of the plant enzyme on the glycosides of the water-soluble group has also been investigated.

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Allopolyploid Nature of the Wild Tetraploid Watercress

THE geographical distribution and behaviour of diploid, triploid and tetraploid watercress was described some years ago by one of us (I. M.[1]). The triploid was shown to be a hybrid between diploid and tetraploid, but the origin of the tetraploid was unknown. It was thought to be an autopolyploid partly on account of its close resemblance to the diploid and also because of the absence of an obvious alternative, Nasturtium being now generally regarded as a monotypic genus. The absence of multivalents

from meiosis was thought to be due to the very small size of the chromosomes. That another interpretation must be put upon the facts regarding the tetraploid has now been shown by the following method.

In 1938 the original stocks used by Manton were communicated to Howard who treated young seedlings of the diploid with 0·5 per cent colchicine solution and thereby produced a genuine autotetraploid. It was at once apparent that this plant was not identical with the wild tetraploid. It showed all the features of darker colour, fleshier leaves and larger organs, characteristic of autopolyploids in general; but it did not show the slow growth, straggling habit and details of fruit shape that had been noted in the wild tetraploid. Moreover, its fertility was reduced and when crossed with the wild tetraploid the hybrid was highly sterile.

Investigation of meiosis by Manton has shown that whereas the wild tetraploid, as previously reported, forms 32 bivalents (the diploid forms 16), the real autopolyploid forms many quadrivalents, thus disproving the idea that their presence or absence has anything to do with chromosome size. The hybrid between wild tetraploid and the autotetraploid forms no quadrivalents but only trivalents, bivalents and a large number of univalents. The hybrid between wild tetraploid and diploid *Nasturtium officinale* (that is, the triploid previously described) forms, at least in the majority of pollen mother cells, 16 bivalents and 16 univalents. It is therefore clear that each gamete produced by the wild tetraploid contains 16 chromosomes (half its total complement) which are homologous with those of the diploid and artificial autotetraploid *N. officinale* and 16 other chromosomes which are non-homologous. The identity of the non-homologous chromosomes is not yet known, but it is expected that they will be found to belong to a species of the related genus Cardamine, particularly as the seeds in the wild tetraploid are uniseriate as found in Cardamine and not biseriate as found in diploid and artificial autotetraploid *Nasturtium officinale*.

In any event it is quite clear that 'wild tetraploid watercress' is not an auto- but an allo-polyploid, and in our opinion taxonomists would be well advised to treat it as a new species. It is hoped that a fuller account with illustrations will be published later.

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[1] Manton, I., *Z. indukt. Abst.-u. Vererbgsl.*, **69**, 132–57 (1935).

Shortage of Lavender Oil

IN NATURE of August 10, p. 193, in a note on "This Season's English Herbs", the statement is made—"a fair yield of English lavender oil may be expected for this season; more of the flowers will go to the still and less to Covent Garden in bunches for street vendors, and thus at least part of the shortage due to the lack of French oil will be made good".

When comparison is made between the acreage devoted to lavender cultivation in Great Britain with that devoted to a similar purpose in France, plus the acreage of the areas from which wild lavender is habitually collected for distillation—to say nothing of the acreage devoted to the cultivation of the hybrid lavandin—it is obvious that, quantitatively, increased distillation of English lavender will make good the deficit only to a very trifling extent. I believe that, normally, France distils about 150 times as much lavender oil as we do. Commercially, English lavender oil is also unable to make good the deficit because of the very high price it commands compared with the French oil.

Fortunately, in recent years lavender cultivation has been taken up in Kenya, and quite a good oil is produced at a price comparable with the French. Lavender oil is also distilled in Western Australia, and there is a *Lavandula Stoechas* oil of Portuguese origin available.

It seems certain, however, that the production of lavender water and other lavender-scented toilet requisites in Great Britain will tend to diminish and that prices will tend to rise. The sales tax will also tend to limit consumption. This is much to be regretted on grounds of public hygiene, since the antiseptic value of lavender oil, according to the well-known work of Cavel, is superior to that of phenol (carbolic acid).

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Formation of Protective Films

IN Prof. N. F. Mott's interesting article in NATURE for June 29, p. 996, he states that "in some metals, notably aluminium, oxidation stops altogether when the film has reached a thickness of the order of 10^{-6} cm., the protective films thus formed preventing further attack".

In measurements of the electrical resistance of such films[1] I obtained the following roughly comparative results:

Film resistance immediately after emery polishing under paraffin	1,651 ohms.
After 8 hr. exposure to moist air	2,501 ,,
Heating 8 hr. at 160° C. in air	4,511 ,,
Heating 65 hr. at 300° C. in air	8,381 ,,
Anodic oxidation film	26,300 ,,

These increases in resistance would seem to indicate closer packing made possible by recrystallization, and to show that the final film thickness on aluminium is not greatly affected, even by long exposures at higher temperatures; this is in accordance with Prof. Mott's theory.

There is further the interesting suggestion that the oxide films of aluminium and zinc will dissolve metal. This is in contrast to a cuprous oxide film, and a means by which it can be distinguished from the amorphous metal which, according to Finch[2], will dissolve metal crystals, whereas the oxide will not.

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[1] *Proc. Roy. Soc.*, A, **115**, 368 (1927).
[2] NATURE, **137**, 516 (1936).

RESEARCH ITEMS

Joking Relationships

THE custom whereby two people on meeting are required to joke, even to obscenity, with one another has been reported frequently from Africa, but is also well known as occurring among primitive peoples in other parts of the world. The general principles of this relationship have been examined by A. R. Radcliffe-Brown (*Africa*, **13**, 3; July 1940) who suggests that it must be taken in conjunction with the custom of avoidance. Frequently a man is on joking terms with his wife's brothers and sisters, but there may be partial or complete avoidance of his wife's parents. These relations then express states of social disjunction and conjunction set up by marriage. The basis of the distinction is the generation, and sometimes seniority within the younger generation. At the same time, while the preceding generation has to be treated with respect, very often the joking relation subsists between grandchildren and grandparents. It is to be noted too that the relation is found between nephew and mother's brother or other relatives, but the father's brothers are treated with respect. In addition to the tie of marriage affecting this relation, there is that of adoption and the alliance by exchange of goods or services which may also be connected with avoidance. An alliance by blood-brotherhood may be a joking relationship as among the Zande. The joking relationship in some ways is the exact opposite of a contractual relation. It must also be distinguished from the relations set up by common membership of a domestic group, a lineage or clan, each of which has to be defined in terms of a whole set of socially recognized rights and duties.

Gypsies of the Sárrét (Hungary)

IN an account by Istvan Nagy of Budapest (*J. Gypsy Lore Soc.*, Ser. 3, **19**, 3–4; 1940) of the gypsies of the Sárrét as they are to-day it is pointed out that the ubiquity of the gypsies in a village is no true index of their numbers. It is due to their volatile and active character in which they recall the activity and noisiness of the people of the south. Their life is entirely different from that of the peasant and causes mistrust, even though the peasant is extraordinarily tolerant. The house of the gypsy is wretched and small compared with that of the peasant. Mud-walled and clay-roofed, only in the newer dwellings are there even two rooms and roofs of reed or straw. The floor is of well-trodden earth, which is kept smooth and yellow with clay mixed with horse manure. The walls are whitewashed inside and plastered with chaffy mud outside. Heating is difficult if not impossible in winter, when the gypsies rarely leave the house but avoid intense cold by remaining indoors sheltering in their eiderdowns. When they gave up their nomadic life to settle in the villages, their traditional crafts disappeared largely owing to their lack of technical skill as compared with the trained smith or other worker. Now they engage in agriculture or horse trading. Their wealthiest men are horse traders, and to own a horse is matter for ostentation. Their standard of wealth is low, and they are improvident, squandering their earnings as soon as paid. Beside the horse they have no domestic animals. The favourite food is carrion-animals and poultry dead of disease, which they manage to obtain whatever the measures taken by the authorities to prevent them. In the matter of dress, their clothes bought secondhand and altered to suit their individual taste, are in this sense better in cut and original quality than those of the peasant. They are also brighter in hue. The women wear the most vivid reds and greens, and their hair is gay with ribbons and gaudy kerchiefs. In the hottest weather they wear three or four skirts.

Phenological Records in Great Britain

DESPITE the war-time difficulties of organized voluntary field work, both the Royal Meteorological Society and the British Empire Naturalists' Association are continuing to collect records of seasonal migration of birds, flowering of plants and similar events in Great Britain in the hope that the continuity of phenological work may not be broken. The British Empire Naturalists Association is summarizing the records sent in from its twenty-odd branches in a duplicated "Branch News", privately circulated. A new issue covering the first half of 1940 includes the rare marsh-sandpiper at Slough, Bucks., where a fairly constant watch also records such passage of birds as the wood-sandpiper, spotted redshank, Iceland gull, greenshank, whimbrel and sanderling. Bird migration began earlier than usual this spring, and there were many wild geese in the south of England. Unusual numbers of swifts were noted in Derbyshire, but fewer house-martins. In the south, the stag-beetles were very common, while the comma and white admiral butterflies have extended their range in the Sherborne district of Dorset. The Royal Meteorological Society has circulated to its numerous phenological observers a preliminary report on the 1939 field observations. With regard to hibernating brimstone butterflies, the date of emergence depends upon the accumulating warmth in their respective shelters, so that no general condition can be predicted; the males appear before the females as with most insects, but if the favourable weather conditions deteriorate they return to hibernation. The capricious appearance of these hibernated butterflies cannot form a reliable index to seasonal changes. A phenological organization is being set up in Canada, where the country has been divided into zones and selected species have been chosen for observation.

Note of the Anna Hummingbird

THE dive note of this American hummingbird, *Calypte anna*, is distinctive. It is produced by the male bird on the instant when it turns upwards after making a steep and rapid descent. The origin of this note has been argued about; but generally it is considered to be produced by flight or tail feathers. Thomas L. Rodgers has settled the point, as the 'drumming' of snipe was settled long ago, by simple experiments with various feathers (*Condor*, **42**, 86; 1940). Individual feathers and whole tails and wings were held in swift air currents, with the result that the only promising response came from the outer tail feathers, which are narrower than the rest, have

a stronger vane and are curved outwards for half their length. These feathers attached to a slender strip of bamboo, when whipped through the air, produced a note almost identical with that of the bird. Immature males were found not to produce the note, and examination showed that the outer tail feathers in juvenile males were broader, especially towards the tip, and had a softer vane. They did not produce a note with the bamboo whip. The experiments might be repeated with the feathers, adult and juvenile, stuck into a cork whirled at the end of a string, the method which demonstrated the 'drumming' of snipe.

Feeding Habits of the Japanese Beetle

THE Japanese beetle (*Popillia japonica*) was first found in the United States in 1916 at Riverton, N.J. It has, in the meantime, spread into six States, and by 1938 the areas continuously infested by this insect covered 15,100 square miles. Circular No. 547 of the U.S. Department of Agriculture (May 1940) by I. M. Hawley and F. W. Metzger enumerates 275 species of plants known to be fed upon to a greater or lesser degree by the adult beetle. In feeding, it normally eats out small portions of the leaf surfaces, leaving the veins untouched. The leaves thus skeletonized turn brown and usually fall from the plants. The beetle is gregarious and often collects in masses or 'balls' and feeds extensively on such preferred fruits as apples and peaches until only the core or stone remains. The feeding behaviour varies with atmospheric humidity and temperature. When the latter is below 70° F., feeding is light : it is heaviest between 85° F. and 95° F., but above 95° F. it is light. When relative humidity is below 50–60 per cent, the beetles fly actively but feed relatively little. Above 60 per cent humidity feeding is vigorous. The one known factor that makes many plants attractive to *Popillia* is the high content of reducing sugar in the part of the plant usually fed upon. Of the many plants liable to attack, severe injury results to many kinds of fruit trees, also certain Malvaceæ, soybean, elm, poplars and some kind of grape, etc. To many other plants injury is moderate or slight. Some plants such as geranium, castor-beans and bottle-brush buckeye are reported to kill the beetles after feeding on them.

Parasites of Chafer Larvæ in Africa and France

L. ANDRE MOUTIA, assistant entomologist, department of Agriculture, Mauritius, has recently discussed the above subject (*Bull. Entomol. Res.*, June 1940). He describes an extensive survey, lasting eighteen months, that was carried out in Zanzibar, Algeria, Morocco and parts of France. The object of the survey was to obtain a supply of parasites of Melolonthid larvæ or 'white grubs'—for furthering the control of these latter creatures in Mauritius where the species *Phytalus smithi* has been a long-standing pest of sugar-cane. In Zanzibar it was disclosed that white grubs are of no special economic importance and also their rate of infestation by parasites is very low. In Algeria no effective means of control of this pest was obtained, and in France control is mostly done by flooding. In Morocco, parasitism by a Tachinid fly *Dexiomorpha picta* Meig., averaged 1·5 per cent but ranged up to as much as 16 per cent locally. The bionomics of this parasite is fully discussed and the morphology of the various stages in the life-cycle are described and figured. Larvæ were transmitted to Mauritius and kept in cold storage at 4–6 C. and the survival rate was 49–80 per cent. The percentage of flies emerging from the parasitized white grubs ranged from 10 to 26·9. It appears that the Dexiomorpha is the only Tachinid worthy of further attention, and it is very desirable that importation of it in large numbers should go on so as to render available sufficient quantity for release in Mauritius. The species in question is stated to be the most promising parasite yet discovered.

Red Core Root Disease of Strawberry

IN recent years strawberry crops in Scotland have been seriously reduced by 'Lanarkshire disease', characterized by withered leaves, decayed roots, and a red colour in the central cylinder of the roots. A similar disease has been reported from the United States. Outbreaks of the disease have now been reported in various places in England, and the fungus responsible has been isolated in pure culture by C. J. Hickman (*J. Pom. & Hort. Sci.*, **18**, 89 ; 1940). The morphological and physiological characters of the organism have been described and its pathogenicity proved experimentally. The name *Phytophthora Fragariæ* has been assigned to it ; it differs from all previously described species of Phytophthora. The severity of the disease is closely related to soil moisture conditions, being worst where water content is high on account of impeded drainage. The strawberry roots become invaded at their tips, and the fungus passes backward through the central cylinder, which becomes reddened. This has given rise to the name 'red core disease'. The plant remains small during late spring and early summer, and the foliage wilts and finally dies. None of the common varieties grown in Great Britain is immune, though Pillnitz, Early Cambridge, and Oberschlesien are fairly resistant. Four new seedling varieties bred in Scotland have been found to be immune. The breeding of immune varieties promises to be the only reliable means of control, though there is some indication that the disease may be inhibited by soil alkalinity.

Evolutionary Chromosome Change in Sciara

C. W. METZ, of the Department of Embryology, Carnegie Institution of Washington, read a paper on this subject at the Eighth American Scientific Congress. On the assumption that evolutionary changes are initiated in the chromosomes, an attempt is being made to throw light on such changes by a study of both spontaneous and induced chromosome alterations in fungus flies of the genus Sciara. A comparison of the phenomena observed in Sciara with those found in Drosophila has revealed striking differences which may have evolutionary significance. As shown by the work of Dobzhansky, Sturtevant, Bridges and others, spontaneous chromosome changes in Drosophila, as detected both in wild strains and in species hybrids, consist mainly of gross chromosome rearrangements such as inversions and translocations of chromosome segments. Minute modifications are relatively rare. In Sciara, on the other hand, the situation seems to be just the reverse. Minute modifications, which appear to represent small deficiencies and duplications of the chromatic disks, are detected frequently in wild strains and in species hybrids, whereas gross rearrangements appear to be almost entirely lacking in the material studied (of four species and one species hybrid). These results suggest that

there is a difference in the underlying chromosome mechanism in the two genera and that evolution may possibly be following different trends in the two. Experimental studies on the nature of changes induced by irradiation are being used to throw further light on the problem. The latter, carried out in co-operation with R. D. Boche and Martha Lee Bozeman, have shown that in Sciara gross chromosome rearrangements are readily secured by irradiating sperms, but that few if any modifications are induced by irradiating eggs (at least in their later stages). In these eggs the chromosomes are in an apparently typical prophase condition, consisting of long threads (tetrads) which, from analogy with other organisms, should be sensitive to irradiation. A special effort is being made to ascertain what physical conditions in the nucleus are responsible for the resistance in the present case, in the hope that this may throw light on the mechanism underlying rearrangement or other modification of chromosome materials.

Genetical Studies on the Lady-Bird

Y. HOSHINO (*J. Genet.*, **40**, 215–228; 1940) shows that the spots and colour of the elytra of ladybird beetles are inherited as an autosomal multiple allelomorphic series. The varieties in this series are *succinia*, *axyridis*, *spectabilis*, *conspicua*, *forficula*, *transversifascia* and *aulica*. Heterozygotes involving *succinia* or *axyridis* can usually be distinguished from the corresponding homozygotes.

Plasticity Conditions for the Formation of Faults

THIS subject is considered further in a second paper by K. Sezawa and K. Kanai (*Bull. Earthquake Res. Inst.*, Tokyo Imperial University, **18**, Part 1; March 1940). They investigate mathematically the stress and strain distributions in a surface crustal block bounded by one original fault, the plastic condition being taken only in the sense of maximum shear stress. The idealized problem is, however, chosen only as a working hypothesis, and the treatment of a block bounded by many original faults may be a more general one; also a somewhat similar result may be possible with a folded crust. As a result of this and the preceding investigation (NATURE, July 27, p. 136) it appears that, although a normal fault is formed in a crustal block bounded by original faults, the origin of the reverse fault is not restricted to local conditions but is related to the deformation of the entire earth, particularly in its early historical stage. The authors conclude that whereas the faults found in the Japanese Islands would be of reverse or normal type, those that neighbour the Japan Trench, or large faults in the continent of Asia, would probably be of reverse type.

Japanese Earthquakes, January–June 1939

DURING the first half of 1939 there were no violent earthquakes felt in Tokyo and none which the Japanese call strong. (Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University, 1939, Part 1–2; January 1–June 30, 1939). Altogether there were 26 earthquakes felt in Tokyo during this period of which 23 were classed as slight, 2 as rather weak and one, on the tenth of March, as weak. This latter had an amplitude of 262 μ in Tokyo with a maximum acceleration of 0·19s. Its epicentre was 36·15° N., 137·91° E., to the west-north-west of Okiziku and north-north-west of Tokyo. With only three exceptions, the epicentres of the 26 shocks lie roughly in the shape of a letter L with the angle near the epicentre just mentioned, and the upright branch running roughly north-east. Both branches extend into the sea bed.

Earthquakes of the U.S. Atlantic Coastal Plain

THIS subject is discussed by N. H. Heck (*Bull. Seis. Soc. Amer.*, **30**, No. 2, April 1940), who states that the seismicity is definitely related to the geological structure of the region between the fall line and the coast. In this region earthquakes of Rossi–Forel scale intensity 5 or over are rare except near Charleston. Forty-five epicentres with repetitions and about 90 distinct earth shocks have been distinguished outside the Charleston-Summerville area though undoubtedly some have escaped notice in the past. The double epicentre Charleston S.C. earthquake of 1886 was one of the greatest which have occurred in the world. Since this great earthquake, shocks from the same epicentres have persisted to the present time with only 8 years when no shocks were recorded, though the numbers per annum of these have considerably fallen off since 1893. The author suggests that there should be an active seismological station set up in Virginia and at least one other farther south to assist in the location of the considerable amount of earthquake activity in the Appalachian region. In the absence of such stations, an appeal is made to geologists in the districts where earthquakes occur to send immediate information to the U.S. Coast and Geodetic Survey at Washington, D.C.

Photographic Proper Motions in the Præsepe Cluster

P. C. CHAUDHURI has investigated the proper motion of the members of the Præsepe Cluster (N.G.C. 2632) (*Mon. Not. Roy. Astro. Soc.*, **100**, 5; March 1940). Van Rhijn and Wassink have already discussed the proper motions of the members of the cluster, and the latter found that the centennial proper motion was 3·7″ in position angle 249°. Accurate proper-motion data have been obtained by the Radcliffe plates, which have the great advantage of a long-time interval of 30·1 years between the early and the new plates. The measuring machine is of the Repsold type and furnishes measurements in one direction only. The scale of the micrometer is such that one unit is equal to 0·00025 mm., that of the Radcliffe telescope being given as 1 mm. = 30″; hence the scale adopted in the present paper is one unit equal to 0·0075″ in 30·1 years. It was a simple matter to separate the cluster from the non-cluster stars. When the equatorial components of proper motion are plotted, the cluster stars show a marked concentration around a certain point while the non-cluster stars exhibit a scattered distribution. It was found that there were a hundred cluster stars in the region covered by the plates. Of stars brighter than magnitude 9 there was only one classified as non-cluster, and between magnitudes 9 and 11 there were 39 members and 13 non-members. There is a decided preponderance of brighter stars as members of the cluster. The proper motion components of the hundred cluster stars are shown in Table ii, arranged in eight groups according to magnitudes, and there is practically no magnitude error in the components. The centennial group-motion is 3·9″ in position angle 242·9°.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN AUSTRALIA

THE thirteenth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ending June 1939 (Canberra: Commonwealth Gov. Printer, 4*s*. 6*d*.). The Council was established in 1926 by the reorganization of the existing Institute of Science and Industry, and the powers and functions of the Council are defined by the Science and Industry Research Act, 1920–39. They include the initiation and carrying out of research in connexion with, or for the promotion of, primary and secondary industries, the training of research workers, the making of grants-in-aid of pure research, the testing and standardization of scientific apparatus and instruments, the carrying out of scientific investigations connected with standardization and the establishment of a Bureau of Information relating to scientific and technical matters. The report refers to progress in the erection of the National Standards Laboratory and the Aeronautical Research Laboratory. The erection and equipment of a laboratory for the Fisheries Section was completed during the year at Port Hacking, south of Sydney. Reference is made in some detail to investigations on plant introduction, pasture plant breeding and investigations on pastures. Other investigations of the Division of Plant Industry cover experiments planned for a period of five years on the root rot of wheat, as well as seed-bed experiments on the control of downy mildew of tobacco which refer to the successful results obtained with benzene vapour and also with Shirlan compounds and alum-lead acetate as cover dressings. Studies on the nature of the virus diseases of Australian potatoes have also been continued by the Division.

The Division of Economic Entomology records the successful introduction and establishment of some parasites of insect pests and of one insect introduced to control the weed lantana. Improved methods of controlling the common household pests, silver fish, meat ants and small black ants have been developed during recent years. During the year, sheep blowfly investigations have concentrated attention on the study of attractants and repellants, the investigation of poisons and examination of dressings. Investigations on orchard and fruit pests included a study of the oriental peach moth and work on phenothiazine and its derivatives to control the codling moth. Special attention has been given to the problem of the direct control of termites, and laboratory and field experiments have indicated some of the reasons, apart from their higher toxicity, for the superiority of arsenicals over silicofluorides. Investigations on weeds have included a study of the relation between certain physical properties of translocated sprays and their rate of penetration into leaves, involving a study of the wetting ability of a spray.

The Animal Health Research Laboratory at Belmont has continued its investigations on pleuropneumonia in cattle as well as on mastitis in dairy cattle, while the work of the McMaster Animal Health Laboratory has included investigations on the effect of nicotine sulphate on *Hæmonchus contortus*, as well as on the efficiency of anthelmintics, including phenothiazine. Other work has been concerned with studies on fleece chemistry including the wool fibre, the properties of wool wax, the suint and the dirt, as well as on the physical characteristics of wool, on the ecto-parasites of sheep, and sheep dipping and investigations on foot rot, coast disease of sheep, and cobalt- and copper-deficiency in ruminants. The work of the Division of Soils has included an investigation of the fertilizers used in Australia as well as studies in soil microbiology.

The Commonwealth Research Station at Merbein, Victoria, has continued its studies of soil preservation and reclamation; the work has included the preservation of soil fertility, studies in viticulture and fruit processing and examination of new fumigants. At the Irrigation Research Station, Griffiths, in New South Wales, studies on plant nutrition and also on the root system of plants with special reference to citrus fruits have been undertaken. Marked developments have also taken place in the work of the Division of Forest Products; a new Section for Veneers and Plywood and the completion and equipment of a laboratory for experimental pulp and paper studies are announced. A timber handbook has been prepared for publication to provide engineers and architects with tabulated data on the strength properties of Australian timbers in a form suited for the designer. Service tests have been continued on a large number of wood preservatives, and laboratory investigations have indicated that low concentrations of boric acid render susceptible sap wood immune to Lyctus attack, the lethal concentration being about 0·12 per cent. Details for commercial treatment have been developed and successful results obtained on commercial plants erected in Queensland. Other investigations have covered the glueing characteristics of Australian timbers and the testing of glues.

Investigations on food preservation have covered a wide range, from chilled beef and the use of ozone as a preservative in the ripening or conditioning of beef cuts to the completion of a survey of wastage of oranges in Australia and mandarins in New Zealand. The effects of maturity at picking time, district, application of boron to the tree and to the soil, delayed storage and temperature storage are being studied with Jonathan, Delicious, Democrat and Granny Smith apples, and factors associated with wastage in many varieties of pears in New South Wales are being investigated. The conclusion that gas storage can increase the storage life of less mature fruit, but may have a reverse effect on more mature fruit, has been drawn from experiments with pears as well as from experiments with peaches and plums. Other investigations of the Division have been concerned with the preparation and preservation of fruit juices and with can lacquers, and to discover corrosion-resisting, non-tainting lacquers suitable for internal application to tin-plate containers. The smoking of fish, the export and storage of eggs and the permeability to water of wrapping materials have all been handled by the Division.

Fisheries investigations have continued on tuna, as well as on pilchards, etc., and the determination of the sources and degrees of fish spoilage.

The report also refers to the work of the Radio Research Board, of the Commonwealth Prickly Pear Board, to ore-dressing investigations and to the work of the Information Section.

ECOLOGICAL BASIS OF LAND USE AND MANAGEMENT*

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LAND use and management involve a wide range of human adjustments to environment. This range extends from purely physical problems on into those of social relationship. The only scientific rubric embracing such a wide field is that of ecology. This is not to assume for ecology any greater authority than other sciences possess, but merely the right to try to develop a symbolism and method suitable to its approach.

The ecologist conceives of the living community as a highly integrated expression of solar energy. The measure of ecological or biological potential is in the degree to which such energy is stored and utilized before its final loss through entropic change. The degree of organization of the soil is a concomitant aspect of biological potential. Efficient natural communities and mature soil, therefore, afford norms for judging human culture patterns as they affect the landscape.

Modern science has been applied chiefly to elaboration of finished goods from raw materials. It needs also to be applied to the conservation of energy and materials, and to distribution. No sound programme of land use and management is possible except on this basis. For reasons other than abstract political theory, I believe that such adjustments can best be made within flexible regional communities, with considerable local initiative. The emphasis in such communities must inevitably be less on profit and more on design.

The basis of adjustment lies in ecological diagnosis. Through a study of physiographic processes, climatic pattern, soil development, biological stabilization, and the water cycle it can readily be determined whether the biological potential of a given landscape is being lost or maintained under the impact of a particular human culture form. Technical remedial measures are frequently obvious ; the necessary social changes more obscure and difficult.

The present trend of land use must be reversed to give a maximum of natural communities and a minimum of ploughland, the latter more carefully chosen and handled than at present. Intermediate areas, such as pasture, must be adjusted to actual need. Such a programme will eventually increase real wealth and the population capacity of the land. An important and immediate need is to lessen the pressure for cash income from land.

Studies are needed of mixed cropping plans which will simulate natural communities, and of methods of tillage and humus return which are less violent than those now in use and which more closely simulate Nature. A much wider strategic and incidental use of permanent vegetative cover in drainage ways, fence-rows, etc., is already discernible, and is justified ecologically. In the cultural realm much may be learned from the occasional human communities which have developed and maintained a sound working relationship with the landscape.

* Substance of a paper read at the Eighth American Scientific Congress.

CHANGES IN THE BRITISH PHARMACOPŒIA

THE first of the war-time emergency supplements to the British Pharmacopœia, which was outlined in NATURE of June 8 (p. 889), became official on June 15. It is not improbable that a second addendum will be published later containing monographs on certain synthetic drugs of the type known as new remedies, for the supply of which Great Britain has hitherto depended upon foreign sources which are not now available. There is also a need for a third addendum to supply formulæ for sweetening preparations for use in place of sugar compounds ; indeed, it seems desirable that standards should be laid down for such preparations as soon as it is convenient to do so, in view of the announcement by the Ministry of Food that no new permits to manufacturers to obtain sugar supplies can now be considered.

The addendum dealing with synthetic drugs would rechristen the products selected for inclusion ; pharmacopœial names will take the place of the original proprietary names ; thus "Doryl" will become "Carbachol" ; "Fouadin" will be renamed "Stibophen" and "Coramine" will be officially called "Nikethamide". The selection for inclusion in the addendum will be made only from such drugs as are now being produced, or will shortly be produced, by British manufacturers.

The problem of substitutes for sugar compounds is less easy than would appear at first sight ; it is not merely a question of sweetness ; it is also desirable that so far as is feasible the substitute should be of the same density as the sugar preparation and should possess, in certain cases, preservative properties. In many instances no doubt saccharin or glycerin would serve the desired purpose so far as the sweetening factor is concerned, and it is interesting to note that saccharin is now manufactured on a large commercial scale in Great Britain and that up to the present medicinal glycerin has been obtainable at the same prices as were quoted before the War began ; the

by-product of the soap industry has been ousted from the prominent position it formerly held in respect to the manufacture of high explosives. What appears to be a valuable suggestion was made recently by a member of the Council of the Pharmaceutical Society, Mr. J. C. Young, who, in an address on the subject to a branch meeting of the Society, suggested that manufacturers who introduced new compounds should not use sugar but some alternative for it. By this means there would be an avoidance of change of appearance and taste of the compound in the event of it becoming necessary to forgo the use of sugar.

ORIGIN OF THE SOLAR SYSTEM

R. A. LYTTLETON has now prepared a detailed defence of his theory of the origin of the solar system against various criticisms urged at different times (*Mon. Not. Roy. Astro. Soc.*, **100**, 7 ; May 1940). In the short compass of the present note it is impossible to consider in detail the contents of the paper, which should be read by all interested in problems of cosmogony. A few outstanding points are worthy of special attention.

It will be recalled that the theory was first put forward in 1936 (*Mon. Not. Roy. Astro. Soc.*, **96**, 559 ; 1936). Luyten criticized various features of the theory, and, *inter alia*, pointed out that hydrogen would readily escape at high temperature from the filament from which the planets were evolved. Lyttleton shows that, while the lightest elements would escape from the filament or primitive planet, such gases would not necessarily escape from the sun. They would form a tenuous medium, possessed with angular momentum, through which the planets would move. As the planets would pick up lighter gases after their initial formation from the heavier elements, the presence of hydrogen on the major planets is no objection, as Luyten believed, to Lyttleton's theory.

Another important matter is the amount of energy required to remove the planetary material. Luyten and Hill pointed out that the energy necessary to generate the planets from the companion to the sun must have been so large that the visiting star would have required a velocity of the order of 100 km. a second. In these circumstances the centre of the ribbon from which the planets were formed would have possessed a velocity far beyond the escape velocity relative to the sun. In the present paper, Lyttleton deals with some simple quantitative results and shows that in his reply in an earlier paper it was unnecessary to postulate so large a relative mass for the intruding star. In fact, there is no justification for assuming that the energy could be supplied only by a star of exceptionally high mass.

Other points are dealt with, such as the objection to the complexity of the theory, which, Lyttleton shows, is not a valid objection. Nor can the difficulties regarding the filament be urged as serious when it is remembered that the generally accepted views concerning the development of the filament were current before he propounded his theory, and hence he is not responsible for them. He admits at the end of the paper that, while his own theory is not really open to any objection, this does not preclude the possibility that other explanations of the origin of the solar system may be devised.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

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Other Countries

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Proceedings of the United States National Museum. Vol. 88, No. 3082 : Revision of the Chalcid-Flies of the Tribe Chalcidini in America North of Mexico. By B. D. Burks. Pp. 237–354. Vol. 88, No. 3084 : The Scolytid Beetles of the Genus *Renocis* Casey, with Descriptions of Nine New Species. By M. W. Blackman. Pp. 373–402. Vol. 88, No. 3087 : A Review of the Parasitic Crustacea of the Genus *Argulus* in the Collections of the United States National Museum. By O. Lloyd Meehean. Pp. 459–522. (Washington, D.C. : Government Printing Office.) [98

Memoirs of the Geological Survey of India. Vol. 70, Part 2, No. 2 : An Attempt at the Correlation of the Ancient Schistose Formations of Peninsular India. By Sir Lewis Leigh Fermor. Pp. iv+219–324+ plates 2–4. (Calcutta : Geological Survey of India.) 1.12 rupees ; 2*s.* 6*d.* [98

Memoirs of the Geological Survey of India. Palaeontologia Indica, Series 9, Vol. 3, Part 3 : The Jurassic Lamellibranch Fauna of Kuchh (Cutch). By Dr. L. R. Cox. Pp. vi+158+10 plates. (Calcutta : Geological Survey of India.) 9.10 rupees ; 15*s.* [98

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