NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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NATURE

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LEADERSHIP IN RECONSTRUCTION

ONE of the most encouraging features of Prof. K. Mannheim's admirable study "Man and Society in an Age of Reconstruction" is the vista he opens out before us of the possibilities in the use of the study of society along scientific lines in the actual task of reconstruction. With a right conception of planning and the wise use of the appropriate technique, it should be possible to plan and to build a social order in which are preserved the freedom essential for creative work and moral and intellectual development and the harmony essential if men are to live together in an ordered society.

Prof. Mannheim's conception of planning, as of freedom, is dynamic. Man's needs change no less than the form in which those needs are expressed or served. Our task in this time of crisis and change is the dynamic one of bringing creative thought and constructive effort to bear, so that the organization of society is not left to chance or irrational forces but guided with the inspiration which comes from bringing all our available scientific energy and insight to bear on the understanding of the situation and the control of the determining factors.

The records of the War of 1914–18 show that we were able to look forward, even amid the preoccupations of some of its darkest years, and to plan and build for the future with such measures as the Education Act, the Representation of the People Act, the Sex Disqualification (Removal) Act and others of a like type, to which an admirable broadsheet of P E P (Political and Economic Planning) has directed attention. To-day the disturbance to the social and economic life of the country is even more profound. At the same time, the opportunities of reconstruction are opening up before us still more freely and widely. Democracy has a greater chance than ever of demonstrating its enduring value, its link with the imperishable elements in our moral heritage, by taking the expedients temporarily forced upon us by war, and with the necessary adjustments building them into the permanent structure of our mode of life. In the same way, advantage can be taken of the opportunity afforded by the crumbling of prejudice or privilege under the demands of war economy to make advances which in peace-time have long been delayed by vested interests. In the working out of new and dynamic conceptions of freedom and discipline, a final reply can be given to the totalitarian taunt of effete or decaying democracy.

The elaboration of a complete programme at the present time is both premature and undesirable. To arouse a general awareness of the opportunities, to stimulate a creative and adventurous outlook, so that in our thinking about immediate problems there is awareness and subconscious, if not deliberate, thought about the way in which they can be linked up with the post-war problems, is sufficient. If only this be done, a vital part of the preparation for further advance will have been carried out, the lack of which was a main hindrance after 1918. Without the adequate preparation of public opinion, the creation of a Ministry of Reconstruction by itself could achieve little. New forms of freedom will always be rejected until, as Mannheim points out, men have been prepared spiritually for them and ceased to think in terms of an earlier phase of social existence.

Reference has been made from time to time in these columns to some of the possibilities in regard to nutrition and health and the standard of living which might flow from a far-sighted food policy, embracing production, distribution and storage,

agriculture and horticulture, initiated primarily to meet our war-time requirements. Another complex problem which should not be approached from the point of view of war effort alone is the most effective utilization of man-power in production and in the armed forces. The immense powers of the Minister of Labour and the Minister of Supply in regard to the control and dilution of labour, the utilization of skilled or professional labour of all kinds, the introduction of women and of part-time labour, the deflection of production and labour from non-essential industries, if wisely exercised in connexion with adequate short-term and long-term training policies, should make an important contribution to the solution of the unemployment problem.

This point is the central theme of a recent pamphlet "Post-War Poverty and Unemployment can be Prevented" by T. W. Wyatt and D. Caradog Jones (J. Woolman and Sons, Dacre Street, Birkenhead. 6*d*.). If economic depression and unemployment, can be temporarily cured by war, a better and more radical cure must be possible under conditions of peace. Pointing out that to all intents and purposes the War is being paid for as it is waged, that under war conditions money is not the essential consideration, and that the great mass of production and service utilized for war purposes is supplied in Great Britain, the authors argue that if the situation is properly handled by the Government, a repetition of the economic depression and serious unemployment which followed the War of 1914–18 is not inevitable. It should be possible, when peace comes, to change over from war production to peace production, and so make use of our vastly increased capacity for creating new wealth.

To utilize effectively the immense potential power of production, a carefully thought-out plan is essential, co-ordinating all forms of industrial activity. Messrs. Wyatt and Caradog Jones consider that their aims can be achieved under the present economic system, where private enterprise has free play, subject only to the appropriate Government control. Demobilization, for example, should be carried out gradually and systematically, and all who have given their service to the country should continue to receive full pay until they are absorbed again into industry. The aim of those directing affairs should be so to adjust spending, whether by taxation or rationing, that supply keeps step as nearly as possible with demand. If private enterprise proves insufficient within a reasonable time to absorb all demobilized men and women and to maintain consumption, public works should be instituted. There is no limit to work of this kind that might be done. Roads and transport, forestry, town- and country-planning, water supply, and electric power distribution provide innumerable opportunities, and no consideration of cost should interfere with the Government programme, provided only that the work undertaken is thoroughly and efficiently executed.

Discussing the possibility of inflation, Messrs. Wyatt and Jones believe that an expansion of currency for such purposes is safe until our resources of man-power and machinery are fully and adequately employed. They make the further point that in this new order we must school ourselves to a greater willingness to contribute gladly from our surplus income for social purposes. A planned economy is also essential because in due time it will be necessary to regulate the speed of production. The primary aim of the Government should be to adjust its financial policy so that an expanding market is always available for the goods produced. They further consider that by a systematic and continuous increase in production we can raise the standard of living all round.

To meet the new situation intelligent organization and administrative ability are the gifts which will be most in demand. Skilled workers will also be required for key positions ; they may not be immediately available in sufficient numbers, and some may have to be trained. If, however, the problem is attacked on scientific lines and an honest attempt made to utilize fully the available resources, these needs can be met.

A constructive postscript to the pamphlet by J. R. Bellerby suggests that the post-War period will be marked by five fairly distinct phases. An initial phase of momentary depression is likely to be followed rapidly by one in which labour is fully employed in capital reconstruction, and Government action in this phase is of the utmost importance. The transformation of the Ministry of Supply into a Ministry of Reconstruction with specific powers to guarantee priority in the requisition of raw materials, machinery and services for the most vital consumptive goods, to control demobilization, adjust the flow of gratuity payments to the Forces, and postpone public or semi-public works, would be vital contributions. This phase would, if managed well, merge into a third phase in which there would be no serious shortage of essential consumable goods. In this stage an additional amount of deferred pay and gratuities to the Forces could be released. These three phases,

throughout which the national budget is likely to remain unbalanced, would be followed by a fourth phase, characterized by a lack of consuming power, and at this stage the Government would have in reserve all the public and semi-public works it had been able to postpone. The real post-War test, however, would come at the fifth stage, when these schemes had been exhausted and the true remedy must lie in the unconventional and the costly. We have to learn the methods by which a controlled economy can be worked, and create a race of men and women as competent to administer British industry in the general interest as their grandfathers were to administer the other functions of the State.

We must, it is true, temper this note of optimism and hopeful view by the realization that there are still backward and recalcitrant elements in our midst. Even in regard to food, it is a damning indictment of the management of hospitals and other institutions, calling for immediate and drastic action, that the Ministry of Food should need even to issue a suggestion that the present abundant supplies of fresh fruit and vegetables should be used in place of drawing on reserves of canned supplies. Widespread uneasiness has also been caused by Mr. Bevin's recent disclosure in the House of Commons that some employers have failed to respond to his appeal regarding training of men at the higher and lower levels of skill. The reluctance of the Government to use its powers of compulsion has been the subject of as much criticism as its apparent absence of any clear policy in regard to the introduction and training of women, the industries or sources from which they are to be drawn and the equally important problem of utilizing on war work the labour compulsorily evacuated or transferred from defence areas.

These disturbing signs are evidence that one of our greatest tasks to-day is that of finding leadership of the requisite competence and integrity in politics, in industry, in finance, in art, in journalism, in the Civil Service. The raw material of leadership is as abundant as ever, but we can no longer claim that our social system is selecting and throwing up ability with the same outstanding efficiency and success as in the past. For this reason alone a thorough overhaul of our educational system is a vital necessity.

A prominent feature of the present situation is indeed that in general outlook the community is often far ahead of its leaders. In one field after another, in finance, in criticism of the budget or of labour, in the utilization of part-time services, alike for munitions production or in civil defence, the cry is that enough is not being demanded of us, insufficient guidance is being given, and inefficient use made of willing service. This feature has implications the importance of which can scarcely be overstressed.

In the planning to which we have referred we are in essence outlining a Bill of Human Rights embodying the minimum requirements for decent living, including the basic guarantees of the individual, such as freedom of speech, writing and religion, the right to a fair trial, the subordination of all government to the rule of law, the establishment of minimum standards of housing, food, education and medical care ; and the provision of security against unemployment, accident, widowhood and old age. The presence of this widespread spirit of service in the community is one of the strongest safeguards against any undermining of the sense of individual social responsibility in the process, which Prof. Mannheim remarks must be carried out before planning can work smoothly, of abolishing the more blatant differences in wealth and opportunity.

It is of vital importance that this spirit of service should be canalized into some more permanent form. The counterpart to a Bill of Human Rights should be, as a recent leading article in *The Economist* has suggested, a Bill of the Duties which the citizen owes to the community of which he is a member. The minimum of rights will be the more cherished if it is paid for by a minimum of duties. Out of the fabric of relations involved in civil defence and the like, we may well evolve a new conception of the 'good neighbour'. We must now think of the community, the commonwealth, to which we give, from which we receive, of which we are all members, rather than of the State as an impersonal dispenser of free doles, or hard levier of taxes.

Here indeed is an ideal which should receive whole-hearted support. We are beginning to realize that we must plan the whole of our society and not merely parts of it, and that in planning parts we must have regard to the fate of the whole. We are learning individually to take a progressively longer view, and in the process the faculty of considered judgment is inculcated. Widespread evidence to-day shows that more and more men and women are becoming fit to share the responsibility for planning the whole course of events in the society in which they move.

MEDICAL SERVICE IN WAR

Organization, Strategy and Tactics of the Army Medical Services in War

By Lt.-Col. T. B. Nicholls. With Chapters by Air-Commodore A. S. Glynn, Col. A. R. Laurie and Col. F. G. Lescher. Second edition. Pp. xvi + 496. (London : Baillière, Tindall and Cox, 1940.) 15*s*.

IT is difficult, in these troublous and anxious days, to divert one's thoughts to any subject other than the ever-present War. Having listened to the wireless, read the daily paper and completed the daily duties, one desires to have mental relaxation with some form of light literature.

Consequently, when one takes up a book connected with the subject of war, one is rather prone to lay it aside with a feeling of distaste. The reviewer confesses that he experienced some such feeling when he recently took up the present volume written by Lieutenant-Colonel Nicholls with chapters by Air-Commodore Glynn and Colonel Laurie. First impressions are often fallacious and in this case proved to be markedly so. Having commenced to read the book, the chief difficulty was to put it down ; one went on from page to page and, having attained the end of the final chapter, one's chief desire was to read the book again and grasp facts more thoroughly.

Tempora mutantur, nos et mutamur in illis ; this is very certainly true with regard to the medical services of the Army. How vastly conditions have changed since the War of 1914–18. Changed in every way : mechanization of units, those of the medical services in common with other branches, new weapons, the immense increase in the air arm, the huge size of opposing forces, the speed with which they move and consequently the rapidly varying situation and the changing aspect of the battle from hour to hour. All these factors tend to an enormous increase in the number of casualties, and it is inevitable that the problems of collection, evacuation and treatment of the wounded are vastly more difficult than has ever previously been the case.

Another difficulty which presents itself in modern warfare is that a present-day campaign is not merely one of opposing military forces ; the civilian populations have to be taken into consideration and the casualties among them may probably be very heavy. Coping with them, in addition to those of the fighting forces, will prove no easy matter.

Prior to the War of 1914–18 we were guided, in estimating the probable number of casualties, to a great extent by Cron's formula, but even then Cron's formula was found to be to a great extent fallacious and not to be relied upon, and this will be infinitely more so now. It is highly probable that, in the present War, we shall have to revise our ideas to an enormous extent.

The real essentials of successful medical organization in a modern campaign are elasticity, a power to appreciate rapidly changing situations, to make quick decisions and to acquire an ability to organize rapid—indeed instantaneous—improvization. The book under review brings these facts very forcibly to notice. The whole subject of evacuation from the front to the base is very thoroughly dealt with. The manifold duties of a regimental medical officer might perhaps have been more fully explained with advantage. Every battalion is not constantly in action and, important as are the duties of the regimental medical officer during actual fighting, yet during the periods of 'rest' (so-called) his duties are onerous and of great value to the unit to which he is attached.

It is laid down in Regulations that the first duty of the medical service is the preservation of health, the professional care of the sick and wounded coming second. While the actual responsibility for the preservation of the fitness of troops rests with the commander of those troops, it is the duty of the medical officer to watch matters carefully and to give judicious and timely advice to the commander as to what measures are advisable regarding preservation of health and how these measures had best be carried out. Such advice will be received and acted upon, in fact will frequently be eagerly solicited ; the reverse is fortunately very much the exception.

If the regimental medical officer takes his duties really seriously, he will find that he is an extremely busy man even during a period of 'rest'. The closer the co-operation between the commander of a battalion, the adjutant and the medical officer, the better the health and fitness of the battalion will be.

The chapter on the casualty clearing station is very important and interesting ; this unit is the first place in the line of evacuation in which actual hospital accommodation is provided and where full surgical treatment can be carried out. The casualty clearing station is really the pivot in the line of evacuation.

An extremely interesting section is that which deals with the transport of casualties by air and

also with the many ways in which aircraft may be of inestimable service in the conveying of medical personnel, supplies, etc., both in peace-time and in war. A striking instance of this is that of the 'flying doctor' service in Northern Queensland and other parts of Australia. Anyone who is acquainted with this service is well aware of the untold benefits it has conferred on sick or injured people in out-of-the-way parts of the country. For example, a case of acute appendicitis may occur in an 'out-back' station ; the nearest surgeon is one hundred and fifty miles away, bad roads and flooded creeks intervening. A telephone message to the service headquarters will result in the very speedy advent of a surgeon, removal of the patient by aeroplane to hospital and operation, the whole procedure taking a few hours. Another example was furnished when the terrible earthquake occurred at Quetta a few years ago ; a medical unit, a large number of medical officers and nurses, more than half a ton of medical stores and food, and about two tons of clothing were rapidly conveyed to Quetta by aeroplanes from Peshawar, Ambala, Karachi and other stations ; the benefit was incalculable. These are but two examples of the value of the air service in medical work ; the present War will doubtless furnish many more.

A point which has been wisely stressed is that of the precautions which are necessary with regard to the storage and use of radium in war-time. Naked radium might be liberated as a result of high-explosive action, and the consequent results might be extremely serious ; the practical precautions which should be taken in order to avoid such risks are clearly and practically indicated.

Part IV is devoted to the "Emergency Medical Service". This section will be of very great value, not only to medical officers of the fighting services, but also to civilian medical men and women throughout the country. The present War is a 'peoples' war' and affects everyone ; civilian casualties may quite possibly be immense in number and severity, and dealing with them will present a problem which will tax the resources of all medical and nursing personnel, civil and military. Casualties in bombed cities and towns will require rapid collection, treatment and removal to hospital ; the selection of the most suitable site for a 'casualty hospital' for such cases will be no easy matter. Trueta, who had very considerable experience of air raids in Barcelona and elsewhere, points out that these hospitals are often from necessity in a vulnerable area, and perhaps the safest are those in districts with modern anti-aircraft defences, such as balloon barrages, anti-aircraft guns, etc.

This book which we have been considering has been written by Army men for Army men, and the information which it contains should conduce to the efficient medical treatment and welfare of the soldier. Presumably the present War will be followed, as was the last, by a spate of post-War literature. After the War of 1914–18, many books of reminiscences and numerous novels were written ; some of these were of real interest and presented a true picture of the lives of officers and soldiers in war-time. Other books (fortunately in the minority) were simply abominable and portrayed the British soldier in utterly false colours. The present reviewer, in setting forth his very definite and positive views regarding the British soldier, feels quite satisfied that he is stating nothing but the simple unvarnished truth—truth which nobody with real knowledge can controvert —and his opinions are the result of a life-time's experience. The term 'British soldier' does not here refer only to the men of these islands ; it is intended to include soldiers of the British Commonwealth all over the world—Canadians, Australians, New Zealanders, South Africans, Indians and many others. With all of these the reviewer has served, he has worked with them and played with them, and without a shadow of doubt or hesitation he feels most strongly that there are no finer men in the whole world than the fighting men of our Empire, brave, cheery, patient in suffering, steadfast in adversity, loyal and big-hearted.

Such men deserve the very best we can give them and the very utmost we can do for them. Believing all this, the reviewer cannot but feel deeply resentful and angry when he reads articles or books in which the soldier is sneered at or vilified by authors who probably have but little real knowledge or experience of him, who do not understand his life, his trials, hardships and suffering, and who themselves could scarcely hope to attain to his standard of courage, endurance and self-sacrifice.

Few branches of the Army have the privilege and honour of being able to do more for the welfare of the rank and file than have the Army Medical Service ; this Service has done much for the soldier in the past and will do even more in the future. It is evident that the writers of the book under review have the interests of the British soldier at heart ; it is also very evident that they have studied carefully the many and difficult problems of medical organization and administration in war. The book is the result of hard work and careful study, and will be of great assistance not only to officers of the medical service of the Army, but also to the many thousands of physicians and surgeons who in the onerous days ahead will be engaged in war work.

HISTORY AND SCIENCE

History and Science

A Study of the Relation of Historical and Theoretical Knowledge. By Hugh Miller. Pp. xi + 201. (Berkeley, Calif. : University of California Press ; London : Cambridge University Press, 1939.) 12*s*. net.

THIS is a valuable and interesting, though somewhat difficult, book of which the avowed purpose, as we are told on the cover, is to "free empirical science from the ghosts of the rationalistic past which still haunt and mislead its progress". It is well worth reading for the variety of thoughts which it expresses, although one is bound to say at the end that the solution offered is not as clear as the apprehension of the difficulties which surround its approach.

The author explains his theme in a short biographical introduction in which he says that from the earliest years he has been perplexed by the opposition of the two sorts of thinking which are constantly presented to our minds ; one he calls theoretical science and the other historical science. (One must note, by the way, that his habitual use of the word 'theoretical' in this restricted sense rather adds to the difficulty of reading his book.) But the main gist and purpose are clear enough. We have on one side a body, let us say, of conclusions or doctrines of which mathematics seems to be the most perfect, which stand firm and rise above the tide of historical change. Thus the equality of two and two to four is apparently a fixed and unalterable truth (the author would say a 'theory'). On the other side we have the constantly changing facts of organic life, of which he ascribes the discovery rather too exclusively to Darwin. Man is the highest product of these, and we have to assume that the mind of man which is his highest—or at least most peculiar—feature has also changed through the ages. How then are we to reconcile the eternity and permanence of what he calls "theoretical science" with the infinite change and growth of the organic side of the universe which is best represented to us in man ? It is a pretty problem, and Prof. Hugh Miller follows it through three books and twelve chapters with great persistency and a good deal of enlightenment. He cites numerous philosophers from the earlier Greeks down to Bergson and, if it were not for a confession of faith in the preface, one would be inclined to say that the historical or changeful side of thought wins all the way. In fact the closing words of the last chapter are a moving appeal to history. "Action is our last honesty. Let us act—we have surmised enough—and show what our hearts are bent upon. Let us allow the appeal to history and in the name of history, fight".

This appeal goes home to the heart of the present reviewer, who has always held that history—especially the history of science—was the most important part of intellectual progress and should be made a leading feature in our educational courses. Science has grown and is constantly changing and we—outside Nazi Germany—are trying to keep pace with it. In that sense above all we would echo the eloquent epilogue of Prof. Miller and "in the name of history, fight".

Yet one cannot turn one's back on all the great conclusions of the thinkers of the past ; one must still believe that two and two make four, even though our earliest ancestor may have thought the same thing. The answer to the whole dilemma is clearly a compromise, as the author indicates in his preface. There are certain constant structures of fact and thought which stand firm throughout the evolutionary process. Just as every animal form needs some food to sustain it, so it is constantly true that two and two make four. On these and a good many other permanent truths the mind feeds and grows.

We have in the present state of knowledge a long perspective of the past evolution of life which has given us an entirely new orientation towards history. All life is history, and this historical life has from the first and throughout a basis of non-evolutionary science. The living side now includes geology ; it cannot be said to include either physics or astronomy, although we are always on the track of some evolutionary explanation of the heavenly bodies. Mathematics, however, in its foundations appears unaffected by the changes of organic life. Man discovers transcendental numbers but he does not create them. The mathematical foundation of our universe of knowledge appears to come from a distinct source from that of life. Is it—as Sir James Jeans has suggested—that God, as the mathematician, has working with him a co-adjutor or another side of His being which comes to its highest force in men's minds ? The mathematical foundations remain secure while life develops in infinite richness of variety.

It is these and similar thrilling questions which Prof. Hugh Miller raises in his thoughtful book.

F. S. MARVIN.

ANIMAL BEHAVIOUR

(1) Die tierischen Instinkte und ihr Umbau durch Erfahrung

Eine Einführung in die allgemeine Tierpsychologie. Von J. A. Bierens de Haan. Pp. xi + 478. (Leiden : E. J. Brill, Ltd., 1940.) 8 guilders.

(2) Animal Behaviour

Impulse, Intelligence, Instinct. By Dr. Johann A. Loeser. Pp. x + 178. (London : Macmillan and Co., Ltd., 1940.) 10*s*. 6*d*. net.

(1) DR. BIERENS DE HAAN'S book is well described by its extended title ; it surveys the whole field of instinctive behaviour and its modification through learning, and constitutes an admirable introduction to the study of animal psychology. It is, as the author claims, the first general treatise on animal behaviour to be written from a purely psychological point of view. Dr. Bierens de Haan holds that the true science of animal psychology begins where behaviourism in its various forms leaves off ; the facts of behaviour require interpretation in terms of the animal's subjective experience, in terms of knowing, striving and feeling, at least in their elementary forms. That instinctive behaviour is rooted in life, and cannot be understood without reference to the normal ecological conditions of the species the author freely admits ; but he has concentrated his attention mainly on the psychological aspects of animal behaviour. That is the special key-note of the book. It is appropriately dedicated to the late Prof. Wm. McDougall, whose hormic point of view he shares.

Dr. Bierens de Haan, whose laboratory is in the Zoological Gardens at Amsterdam, is, of course, well known in Great Britain as a leading worker in the field of animal psychology, and he has made us all his debtors in providing this up-to-date survey of the subject. Great progress has been made of recent years, especially on the Continent, in the study of animal behaviour, and there is real need for a book like this which brings the facts together and indicates what they mean. With its full bibliography of thirty-five pages, and its three indexes, the book will be extremely useful, and indeed indispensable, to the serious student, and must find a place in his library.

A good half of the book deals with instinctive behaviour, and especially the simpler forms of it, which the physiologically minded call taxes and tropisms. While no attempt is made to cover the whole immense field, the numerous examples chosen from the modern work on the subject are highly interesting and instructive, and there is no better treatment of the general subject extant.

Like McDougall, Bierens de Haan draws a distinction between instinct and instinctive behaviour, defining the first in purely psychological terms. His definition (p. 34) closely resembles the well-known one proposed by McDougall—"an inherited or innate psycho-physical disposition which determines its possessor to perceive, and to pay attention to, objects of a certain class, to experience an emotional excitement of a particular quality upon perceiving such an object, and to act in regard to it in a particular manner, or, at least, to experience an impulse to such action". Bierens de Haan's definition is somewhat fuller, and brings out the important point that specific perceptions and feelings may also be aroused by specific drives. While instinct is a purely psychological activity, instinctive behaviour is also a biological phenomenon, showing characteristics which require definition in biological terms. In particular, instinctive behaviour is usually purposive in a biological, but not in a psychological, sense—the animal acts instinctively, in normal conditions, in a biologically adequate way, but without knowledge of the end pursued ; it "knows how" to act, but not why it acts ; as Spaier has well said, it shows "savoir-faire" but not "connaissance".

In the second part of the book, the effect of experience and learning in modifying behaviour is fully and adequately discussed, in the light of modern work and the author's own extensive researches in this field. Here the important point is made that the role of learning and intelligence is secondary, that the instincts remain the essential factors in behaviour, though extended, modified and illumined by intelligence, Special attention is given to the higher forms of animal intelligence, where the animal shows what Bierens de Haan describes as a "concrete understanding" of spatial and causal relations.

(2) Dr. Loeser's book falls into a different class. In it he gives expression, in a popular way, to a particular view about instinct, which he published in a more technical form in 1931 (not 1939, as stated in the foreword) under the title "Die psychologische Autonomie des organischen Handelns". The circumstances in which this English version came to be issued are sympathetically explained in the foreword by Mr. L. J. F. Brimble, who has well carried out the arduous

task of preparing the book for publication after the tragic death of the author while a refugee in Great Britain.

Dr. Loeser would have us give up the notion of instinct altogether, and substitute for it that of small voluntary acts, strung upon a base of biological purposiveness or adaptedness, which he assumes to be given by the physical constitution of the animal. "Each 'instinct'," he writes, "such as bird migration, the honeycomb-building of the social Hymenoptera or their complicated system of caring for their young, can be divided up into a number of 'small' voluntary actions. These 'small actions', combined with a specific physical constitution, which becomes effective in the animal's natural surroundings, unite to produce *one* biologically purposive action" (p. 174). There is no rigid and automatic connexion between impulse and reaction; in any given situation the animal does the best it can, according to the "pleasure principle". From this point of view Loeser attempts to explain, or explain away, many of the classical examples of instinctive behaviour, as, for example, nest-building in birds' migration, egg-laying and care of young. Most people will find his interpretations rather far-fetched and unconvincing. In biological matters he is not a wholly reliable guide; there are too many sweeping general statements of doubtful accuracy. He writes as a psychologist, and is not free on occasions from the error of anthropomorphism.

The book has, however, its merits, and it deserves to be read for the unconventional and provocative nature of the views expressed. Loeser is undoubtedly right in emphasizing the psychological character of instinctive behaviour, in refusing to treat such behaviour as mechanistic or rigidly determined; he is right also in stressing the simplicity and proneness to error of the psychological processes involved; but he fails to see that the biological adaptedness or purposiveness of instinctive behaviour lies in the instinctive impulses themselves, as part of the inherited psycho-physical constitution of the animal.

E. S. RUSSELL.

POTASSIUM COMPOUNDS

Gmelin's Handbuch der anorganischen Chemie Achte vollig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 22: Kalium, Lief. 6, Schluss der Verbindung. Pp. 1075–1230. 21–75 gold marks. Lief. 7: Techniche Darstelling der Kalisalze. Pp. 1231–1338. 16.50 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1938–39.)

PART 6 of the volume on potassium in "Gmelin's Handbuch" terminates the account of its compounds and deals chiefly with such compounds as contain also either lithium or sodium. Whereas the chlorides of lithium and potassium give merely a eutectic mixture, the system between the two sulphates is complicated by the fact that each of the two latter is dimorphous. A liquid alloy of sodium and potassium was known to Sir Humphry Davy. The compound NaK has not been isolated, but its existence is inferred from its band spectrum. It is chemically more active than either of the two metals.

Phase-rule studies of various combinations of salts of potassium and sodium, including the tartrate, are described. Particular attention is devoted to Rochelle salt on account of its remarkable properties, the most outstanding of which are its marked piezo-electric effect and the anomalous dielectric properties in the direction of the crystallographic a-axis. The two properties are closely inter-related, but the anomalies disappear not only above 24° C. but also below −18° C.

Part 7 contains details of technical processes in the production of potassium salts. It is just a hundred years since boring was first undertaken at Stassfurt with the object of finding the origin of certain natural brine supplies. The importance of the rock salt which was discovered was not at first realized owing to the presence in it of 'undesirable' potassium and magnesium salts, and many years elapsed before the potash industry was established. A three-page table shows the gradual development of the industry in various countries between 1861 and 1936.

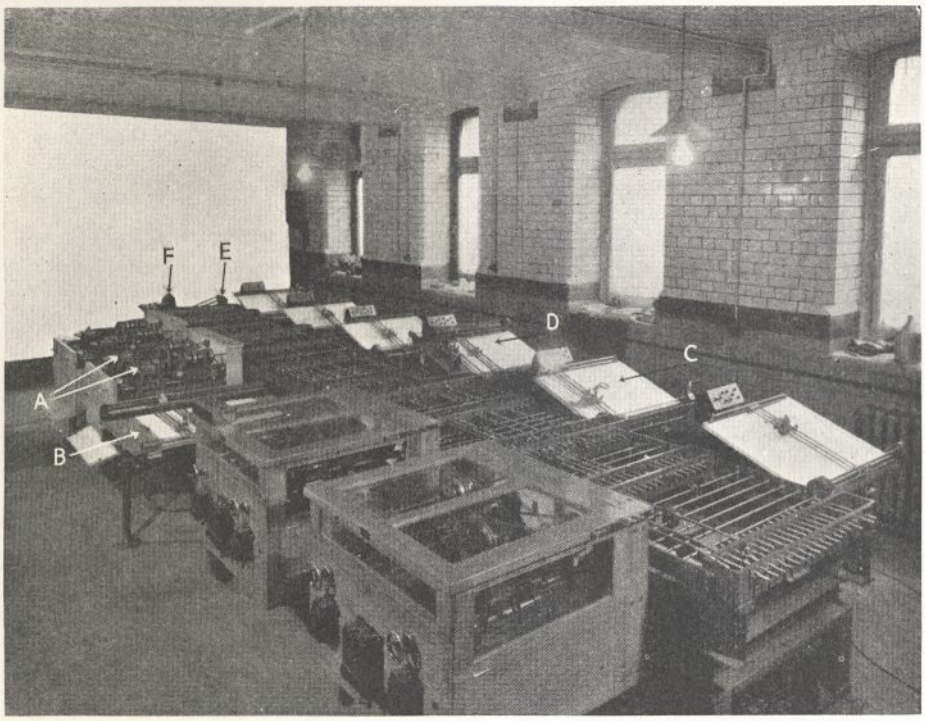
After the War of 1914–18 the important deposits in Alsace passed into the possession of France and other sources have been discovered in Poland, Spain and America. An international agreement was reached in 1925 for the regulation of production and supplies. An account is also given of many other technical processes such as the extraction of potassium salts from seaweed, from sea water and from the waters of certain inland seas, and of the separation of potassium chloride from carnallite and also of potassium salts from borax.

THE BUSH DIFFERENTIAL ANALYSER AND ITS APPLICATIONS*

By Prof. D. R. Hartree, F.R.S.,
University of Manchester

IN the application of mathematics to problems both of pure and applied science, there often arise differential equations which have no formal solution, or none convenient for numerical evaluation, but for which numerical values of the solutions are required. Though there are numerical methods of dealing with such situations, it would often be advantageous, as an alternative, to have mechanical means of evaluating solutions of differential equations, and this is the purpose of the 'differential analyser' of Dr. V. Bush, of the Massachusetts Institute of Technology.

The general idea of a machine for evaluating the solutions of differential equations is not new. Integrating mechanisms have been known for more than a hundred years, and the idea of connecting several such mechanisms together, in such a way that the combination of them would evaluate solutions of differential equations, was stated clearly by Kelvin[1] in 1876. But the whole credit for designing a machine which could be constructed in practice, and which would work accurately when built, must be given to Dr. V. Bush and his team at the Massachusetts Institute of Technology, where the first such machine was built about ten years ago[2]. The first machine of this kind in operation outside the United States was the one, with which I have been closely connected, at the University of Manchester (Fig. 1). This machine was built by the Metropolitan-Vickers Electrical Co., Ltd., and I must acknowledge the generosity of the late Sir Robert McDougall, who defrayed the cost of the machine to the University, and the friendly help I have had



[*By courtesy of the Institute of Electrical Engineers*

Fig. 1.

General view of differential analyser at the University of Manchester. Photo by Metropolitan-Vickers Electric Co. Ltd.

* From a Friday evening discourse at the Royal Institution delivered on May 17.

from Dr. Bush himself and from Dr. A. P. M. Fleming and all those members of the Research Department of Metropolitan-Vickers who have been engaged on its design, construction, installation and maintenance. Without the help, in various forms, which I have had from these sources, the installation of this machine would not have been possible. Through the interest of Prof. J. E. Lennard-Jones a second such machine, also built by Metropolitan-Vickers and including improvements in detail suggested by our experience at Manchester, is in operation also in this country, at Cambridge. There are now, so far as I know, altogether seven or eight full-size machines in operation in the world. There are also, in Great Britain, several smaller and less accurate model versions of the machine, of which the first was built, originally for demonstration and instruction purposes, by Dr. A. Porter and myself[3].

General Idea of Differential Analyser

The differential analyser consists of a number of units, each of which can carry out one of the operations which may be involved in the mechanical solution of a differential equation. The essential units are the integrating mechanisms, each of which is a precision form of continuously variable gear. There are eight of these, in cases in pairs (Fig. 1, *A*). These can be interconnected in various ways, either directly or through other units of the machine, by shafts and gearing. There are two sets of shafts; cross-shafts driving or driven by the various units of the machine, and longitudinal shafts by which connexions are made between different units. Each shaft represents one of the quantities occurring in the equation; the rotation of the shaft measures, on a chosen scale, the magnitude of that quantity.

It is often necessary to supply to the machine

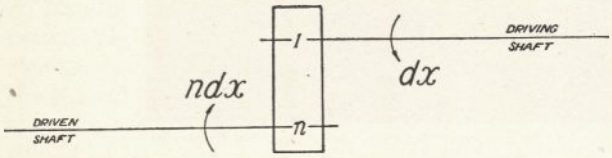


Fig. 2.

Continuously variable gear as integrator.

information concerning a relation between two of the quantities occurring in the equation under investigation; for example, in calculating the scattering of electrons by an atom, it is necessary to supply the machine with the relation between the potential of the atomic field and the distance from the centre of the atom. This is done from an input table (Fig. 1, *C*), of which there are six. A graph, expressing the relation to be supplied to the machine, is drawn beforehand and placed on one of the tables, and is followed by an operator as the solution proceeds.

There are also means of recording the solution either in the form of a graph on an output table (Fig. 1, *B*), or numerically by recording the readings of a set of revolution counters (Fig. 1, *E*).

Integrators

Any continuously variable gear will serve as an integrating mechanism (Fig. 2). Let a driving and driven shaft be connected by any mechanism such that the driven shaft runs n times as fast as the driving shaft; then for a small rotation dx of the driving shaft, the rotation of the driven shaft is

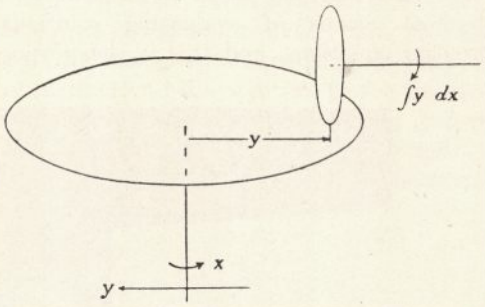


Fig. 3.

Principle of the Integrator.

ndx, so that if the gear ratio n is varying as the driving shaft is rotating, the total rotation of the driven shaft is $\int ndx$. For the present purpose we require a form of continuously variable gear which can be set accurately to any gear ratio n within its range, and this range must include zero and negative values of n without any mechanical difficulty. A convenient form (Fig. 3) consists of a wheel the plane of which is fixed, driven by the rotation of a disk of which the axis is carried in a carriage so that the distance of the wheel from the centre of the disk can be varied. Alteration of this distance alters the gear ratio between the shaft driving the disk and that driven by the wheel, and the gear ratio is proportional to the displacement of the disk from its central position.

Each integrator is provided with a servo mechanism, by which the driven shaft is made to rotate at the same speed as the integrating wheel, but with greatly increased turning force or 'torque', whence the name 'torque amplifier'. The principle in which this operates is much the same as that of the capstan. The shaft carrying the integrating wheel and the shaft to be driven are fitted with arms, which are connected by bands running over two drums driven in opposite directions by a motor. When the integrating wheel starts

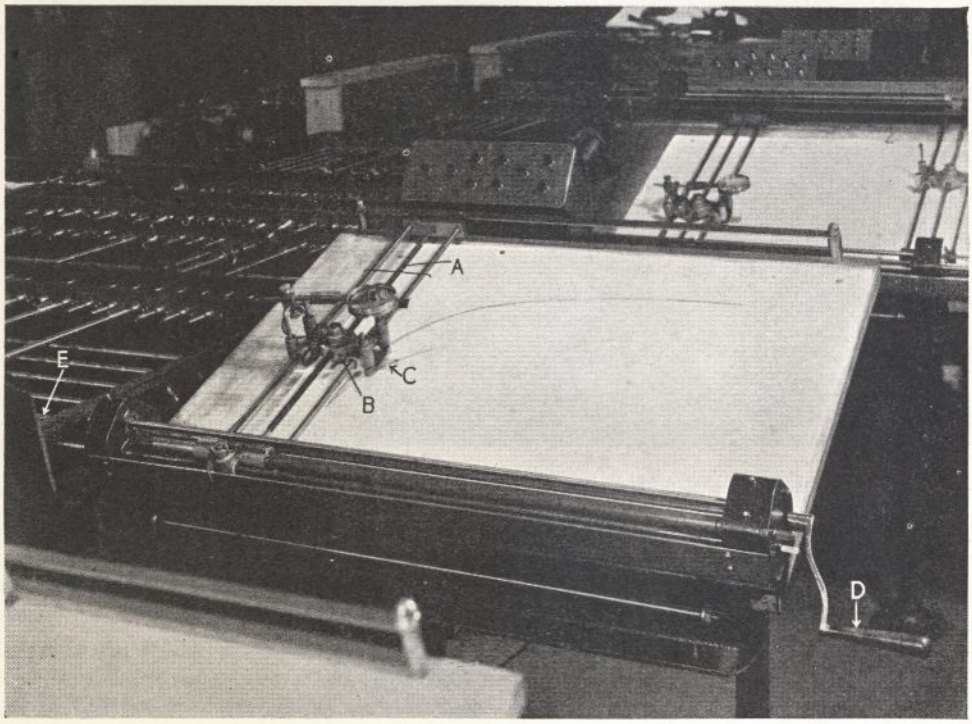
to turn, one band tightens and the other loosens ; the tightening of the one band increases the friction between it and drum ; this tightens it further, so that the tension builds up exponentially along the band, and the driven shaft is pulled round with a much greater force than that applied by the input arm. In effect, the rotation of the integrating wheel does not directly drive the output shaft, but controls the supply of power to it from the motor driving the torque amplifier drums.

Input and Output Tables

Each input table (Fig. 4) consists of a bridge (*A*) spanning the table, the bridge being movable perpendicular to its length and supporting a carriage (*B*) which can be moved along it by the rotation of a handle (*D*), and the carriage carries a pointer (*C*). The table carries a graph, drawn beforehand, expressing the information to be fed to the machine. The bridge is moved along the table by the operation of the machine, and as it moves over the graph, an operator turns the handle so as to keep the pointer on the curve. The handle also drives one of the cross shafts (*E*) of the machine, from which the information expressed by the graph can be fed into the machine wherever required. It is possible to replace the human operator by an automatic curve follower operated by a photo-cell ; one such has been built by Hazen[4] at the Massachusetts Institute of Technology, and another working on a different principle suggested by Blackett and developed by F. C. Williams[5] has been tried successfully in an experimental form at Manchester.

Occasionally, if a quantity is varying with time, its rate of change at any moment may depend not only on its value at that moment, but also on the value it had at some previous time. To deal with such a situation a special input table can be used ; this has two bridges, one carrying a pencil and the other a pointer. Both bridges move along the table, with an interval between the pencil and pointer. The pencil draws a curve and after an interval the information expressed by this curve is fed back to the machine by an operator who keeps the pointer on the curve already drawn by the pencil. This unit (Fig. 1, *D*) was first developed at Manchester in connexion with some work on the effect of time lag on automatic temperature control in industrial plant[6].

The output table is similar to an input table, but in place of the pointer of an input table which is kept on a curve by an operator, there are two pencils which are moved along the bridge by the machine, so that graphs of two quantities occurring in the equation can be recorded simultaneously. Sometimes such a graphical record of the solution



[*By courtesy of the Mathematical Gazette*

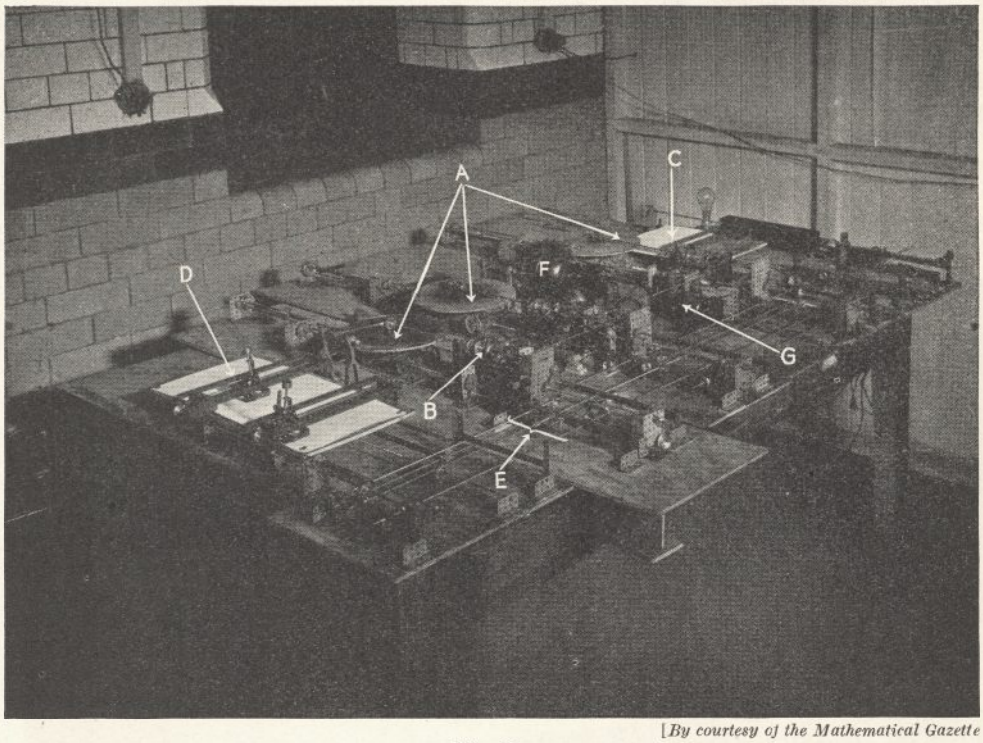
Fig. 4.

Input table. Photo by Metropolitan-Vickers Electric Co. Ltd.

is the most convenient form of result, but when accurate numerical values are required, it is better to record the results directly in numerical form. This can be done by having a set of counters driven by the machine, and recording their readings either by a printing mechanism or photographically by a camera (Fig. 1, *F*).

OTHER UNITS

There are various accessory mechanisms: adding units each of which is similar to the differential gear of a motor-car, epicyclic gear trains for compensating backlash which are therefore called 'frontlash' units, and gear wheels for connecting the various shafts. The longitudinal and cross-shafts are connected by cross-drives, each formed by a pair of helical gear wheels. By these, any longitudinal shaft can be connected to any cross-shaft. The great variety of different inter-connexions of the units of the machine thus made possible is the secret of the very wide range of equations to which it can be applied.



[*By courtesy of the Mathematical Gazette*

Fig. 5.

MODEL DIFFERENTIAL ANALYSER AT THE UNIVERSITY OF MANCHESTER, MAINLY CONSTRUCTED FROM STANDARD MECCANO PARTS. PHOTO BY GUTTENBERG.

A. Integrators. *B*. Torque amplifier. *C*. Input table. *D*. Output table. *E*. Longitudinal shafts. *F*. Motor driving torque amplifiers. *G*. Motor driving independent variable shaft.

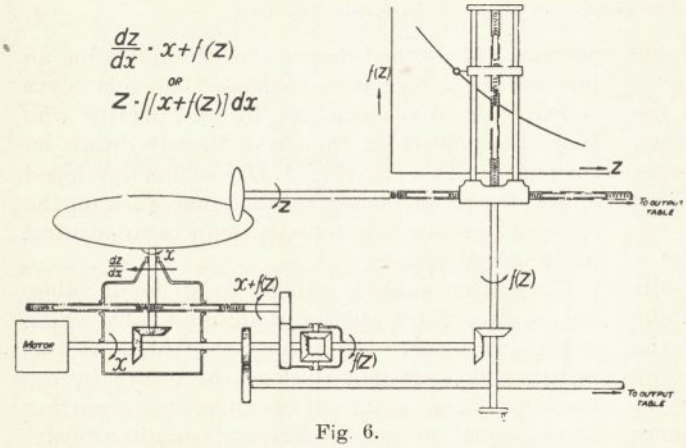


Fig. 6.

APPLICATION OF INTEGRATOR TO A SIMPLE EQUATION.

SMALL-SCALE MODELS

The first photographs I saw of Dr. Bush's machine gave me the feeling that someone had been enjoying himself with a super-Meccano set, and this gave me the idea of trying to build, so far as possible from standard Meccano parts, a model to illustrate the principles of the machine.

This was originally done more for amusement than with any serious purpose, but the first results were successful beyond my expectations, and suggested that it would be practicable to build such a model to do serious work on problems for which high accuracy was not required in the results. Largely with the help of Dr. Porter, such a model was built, and proved successful for such work[3] (Fig. 5). It has also been useful for demonstration purposes, for trying in an experimental form new ideas such as the special input table.

Use of the Machine

As already explained, the quantities occurring in the equation are represented by the rotation of various shafts. These shafts have to be connected, through integrators and other units of the machine, so that the relation between their rotations is a translation into mechanical terms of the equation to be solved.

Consider, for example, the equation

$$\frac{dz}{dx} = x + f(z)$$

(Fig. 6). To see how the machine handles an equation, it is often best formally to integrate once, which in this case gives

$$z = \int [x + f(z)]\, dx.$$

This shows that, at any value of x, the integrand (that is to say, the displacement of the integrator) is made up of two contributions, one x itself, and the other depending in a definite way on the value which the integral z itself has reached. Suppose we can supply the integrator with such a displacement (how this is done will appear shortly) and suppose we rotate it by a drive from the shaft whose rotation represents x. Then the rotation of the integrating wheel will be z. Let a drive from this wheel be taken to displace the bridge of an input table on which is placed a graph of $f(z)$ against z. If an operator (or automatic curve follower) keeps a pointer on the curve, the rotation of the shaft driving the pointer measures the value of $f(z)$ (on a suitable scale and from a suitable zero). If we take a drive from this shaft and one from the x-shaft to an adding unit, the output from the adding unit will be $x + f(z)$, and this is just what we want to furnish to the integrator as a displacement. Thus if the adding unit is connected up to displace the integrator, then the rotation of the x-shaft, which is driven by a motor, will drive the rest of the mechanism in accordance with the equation. (The 'mechanism' here includes the operator who follows the curve.)

Applications

This differential analyser handles a mathematical situation, namely, that expressed by a differential equation, without reference to the particular scientific or technical problem from which that situation arises. Such a situation does arise very frequently and in a very wide range of problems, and the range of application of the machine is correspondingly wide.

It has been applied[7] to calculations concerning: (1) Structure and some properties of atoms, molecules, and atomic nuclei; (2) at the other end of the scale of size, on structure and stability of stars; (3) paths of electrified particles in the field of a magnet (aurora and cosmic rays); (4) energy exchange between a gas and a solid; (5) some examples of fluid flow round solid bodies; (6) potential distributions in cylindrical valves, both of steady-state and for rapidly varying conditions; (7) a number of examples of currents in electrical circuits, and on transmission lines, involving elements with non-linear characteristics or time-varying impedances; (8) starting characteristics of synchronous motors; (9) effect of time lag on automatic control systems; (10) train running times; (11) temperature rise and distribution in insulating material in alternating fields.

In conclusion, there is one thing I want to emphasize about the differential analyser, namely this, that despite its range and its capabilities, it is no substitute for a study of the formal mathematical theory of differential equations. Necessarily it can only evaluate particular solutions of particular equations; whereas if a formal solution is available, it will usually give the general solution of a whole class of equations, which is much more extensive, and often much more useful, information. The differential analyser is only to be regarded as a last resort when the formal theory gives no useful results. But so often in practical problems the last resort is the only resort, and it is then that the machine shows its scope and power.

[1] Thomson, Sir W. (Lord Kelvin), *Proc. Roy. Soc.*, **24**, 269 (1876).
[2] Bush, V., *J. Franklin Inst.*, **212**, 447 (1931).
[3] Hartree, D. R., and Porter, A., *Mem. and Proc. Manchester Lit. and Phil. Soc.*, **79**, 51 (1935).
[4] Hazen, H. L., Jaeger, J. J., and Brown, G. S., *Rev. Sci. Inst.*, **7**, 353 (1936).
[5] Blackett, P. M. S., and Williams F. C., *Proc. Camb. Phil. Soc.*, **35**, 494 (1939).
[6] Callender, A., and others, *Phil. Trans. Roy. Soc.*, A, **225**, 415 (1936); *Proc. Roy. Soc.*, A, **161**, 460 (1937).
[7] For detailed references to applications, and further references to the differential analyser, see Hartree, D. R., and Nuttall, A. K., *J. Inst. Elect. Eng.*, **83**, 643 (1938); Hartree, D. R., *Math. Gazette*, **22**, 342 (1938).

EVOLUTION OF THE GALAPAGOS FINCHES

By DAVID LACK,
DARTINGTON HALL, TOTNES

INTRODUCTION

THE land faunas of oceanic islands have always excited considerable evolutionary speculation, and, starting with the "Origin of Species", the Geospizinæ, the endemic Galapagos finches, have probably featured in as many evolutionary discussions as any group of animals. They differ from almost all other land birds of oceanic islands in that there is more than one species on each island. Further, some of the species seem to grade into each other, and others are linked by freak specimens. Some workers have supposed that some quite peculiar method of evolution must have been involved.

Assisted by grants from the Royal and Zoological Societies of London, I spent December 1938–April 1939 on the Galapagos investigating the breeding behaviour and ecology of the Geospizinæ, following this with a statistical study of museum material. Another object, to interbreed the different species, failed on the islands, but is being continued with captive birds brought to the California Academy of Sciences, San Francisco. The following is a brief summary of some general evolutionary problems. Full results will be published later[1] together with a list of the many persons who helped the expedition, the museum study, and in discussion.

SUBSPECIES

There are ten main species, each found on most of the islands. Some are divided into island subspecies, which differ mainly in beak size and minor plumage characters. The various Galapagos Islands present similar conditions for Geospizinæ, and no species show regular or parallel trends of variation on different islands. Hence I consider that isolation of small island populations has led to non-adaptive differentiation in the manner postulated by Sewall Wright[2]. That the two main factors in the formation of island subspecies are (1) degree of isolation, (2) size of population, is indicated by the fact that small isolated islands have a higher proportion of endemic forms (also a smaller total of species) than have either small central islands or large isolated islands. Large isolated islands have a higher proportion of endemic forms than the central islands, large or small. Another point, the two most variable species, *Geospiza magnirostris* and *G. fortis*, are significantly less variable in three measured characters (namely, wing, culmen from nostril and depth of beak) on small isolated islands than they are on large or central islands. (This relation did not hold in four other less variable species.)

SPECIES

Geospiza magnirostris (large), *G. fortis* (medium size) and *G. fuliginosa* (small) are three closely related species which do not differ at all in plumage but solely in size and relative size of beak, and to some extent in song. The beak is the chief specific character, the larger species having relatively larger beaks. There is no allometric relation between beak and body size within each species, but the ratio is too subject to individual variation to form a reliable specific character. These three species occur together in the same habitat on many islands, the food and feeding habits of the first two seem identical, and of *G. fuliginosa* closely similar, and they use similar nest sites. On some, but not all, islands *G. fortis* is so variable that the smallest individuals appear more like large *G. fuliginosa* than like the largest individuals of their own species, and the latter appear more like small *G. magnirostris* than like the smallest individuals of their own species. (There is no evidence for selective mating by body and beak size within *G. fortis*.) Yet normally the three species keep distinct, and on most islands there is no evidence for hybridization, though this cannot be completely ruled out. There is a small overlap between the species in all characters, but nearly all specimens can be safely identified. However, a few specimens are intermediate in several characters together and cannot be safely allocated.

Field study showed no adaptive significance for the inter-specific beak differences *except* that they are the major (but probably not the sole) factor in specific recognition. A male usually attacks a rival by gripping its beak; frequently a male started to chase a member of a different species from behind, but usually, though not always, it stopped on coming round in front where its beak was visible. Experiments with wild birds which attacked and courted stuffed specimens confirmed the use of the beak in specific recognition.

Camarhynchus psittacula (large) and *C. parvulus* (small) occur together on most islands and present a similar problem to the Geospiza species, while on one island occurs a third species, *C. pauper*, differing from *C. psittacula* solely in a smaller depth of

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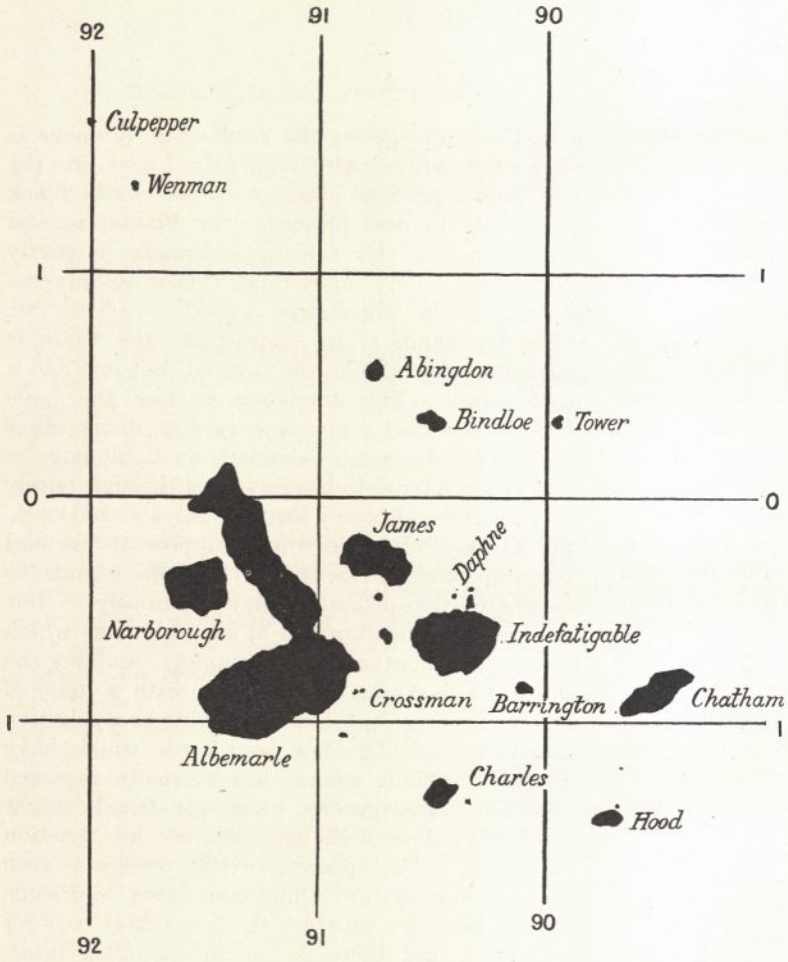
beak and in minor plumage details. In general, the closely related species of Geospizinæ are not usually separated by habitat, nest site, breeding season or any other geological factor. Geneticists seem agreed that isolation promotes inter-sterility, and I consider that these species have evolved via geographically isolated subspecies which later met on the same island and did not interbreed. The species differ from each other in the same characters which distinguish island subspecies, that is,



THE GALAPAGOS ISLANDS.

in beak and sometimes in minor plumage characters. When beak differences assist in specific recognition, they will be intensified by selection quite apart from their relation to feeding habits, since hybridization is at a selective disadvantage. It is extremely difficult to see any other significance for the specific beak differences, or to understand why, otherwise, they should persist. But the highly variable *G. fortis* still presents great difficulties in interpretation.

In two cases, the origin of a species via a geographical form seems clear. The *Camarhynchus psittacula* group is represented by one form on each main island except on Charles where two occur, *C. psittacula* and *C. pauper*. *C. pauper* was probably derived from the *psittacula* group via the form *affinis* on Albemarle to the west, as they are rather similar. *C. psittacula* on Charles is almost indistinguishable from *C. psittacula* on Indefatigable to the north, and probably colonized Charles from Indefatigable more recently, met *C. pauper* but kept distinct. Again, *G. fuliginosa* occurs on all the main Galapagos Islands except Tower in the north-east, where a rather similar species *G. difficilis* (formerly *acutirostris*) is found, which could have been derived from *G. fuliginosa* from Chatham to the south, and would probably have been classified as a subspecies of *fuliginosa*, but that it also occurs on Abingdon, to the west of Tower, together with a small form of *G. fuliginosa*, from which it keeps segregated.

Rensch[3] considers that, in general, most bird species have evolved via geographically isolated subspecies.

HYBRIDIZATION

Lowe[4] regarded hybridization as the main factor in species-formation in the Geospizinæ. The amount of hybridization has been greatly exaggerated. We saw no certain cases in the field. The occasional freak and intermediate specimens are not necessarily hybrids, and in any event have probably played little, if any, part in speciation. Hybridization may sometimes have occurred between two differentiated island subspecies of the same species which later met on the same island, but this is much more likely to result in a variable form of the same species than in a new species. However, in two cases a species-hybrid seems to have become established. On Culpepper in the extreme north occurs the highly variable *Geospiza conirostris darwini*, which shares characters of *G. magnirostris* (widespread on other islands) and *G. conirostris propinqua* (on Tower) and is probably of hybrid origin between these two. On the tiny islets of Daphne and Crossman (which are not near each other) occurs a highly variable Geospiza species intermediate in characters between *G. fortis* and

G. fuliginosa, and overlapping with both. Presumably it is of hybrid origin ; if so, here is the unusual case of two species which occur together over most of their range without interbreeding but which interbreed in two small isolated localities.

Adaptive Radiation

Island forms differ in non-adaptive characters and give rise to species which differ mainly in non-adaptive characters except in so far as these are recognitional. But, at a later stage, pronounced adaptive characters appear, and the main genera of Geospizinæ represent a minor adaptive radiation. *Geospiza scandens* is at an intermediate stage. It uses its long thin beak for feeding in Opuntia flowers, but these are seasonal, and much of its diet resembles that of other Geospiza species, which have finch-like beaks and eat mainly seeds. *Platyspiza crassirostris* eats mainly leaves. Camarhynchus species have beaks rather similar to Platyspiza, but eat mainly insects. *Cactospiza pallida*, clearly derived from Camarhynchus, has evolved in the direction of a woodpecker in both habits and beak. It also has the unique habit of holding a small twig or Opuntia spine lengthwise in its beak and probing insects out of cracks in trees, dropping this tool to seize the insect as it emerges. *Certhidea olivacea* is like a warbler in both beak and feeding habits. Despite their dissimilar feeding habits and appearance, all these forms have extremely similar breeding behaviour, which confirms previous anatomical findings as to their close relationship to each other.

Evolutionary Factors

The three main factors in the evolution of the Geospizinæ have probably been : (1) The almost complete absence of food competitors. A few other land birds now frequent the islands, but all except Nesomimus are so little differentiated from mainland forms that they probably colonized long after the ancestral Geospizid arrived. (2) The almost complete absence of predators. Worthington[5] shows the marked inhibitory influence of predators on adaptive radiation.

These two factors result from the extreme isolation of the Galapagos and the difficulty of colonization for birds. Both must diminish the intensity of selection.

(3) Equally important, the opportunities for temporary isolation of different forms provided by the existence of a number of islands. One species of Geospizid, *Pinaroloxias inornata*, occurs outside the Galapagos, on the extremely isolated island of Cocos, and is so differentiated that it has clearly been isolated a long time, but there is only one island and still only one species of Geospizid. In general, no bird groups have evolved similarly to the Geospizinæ on solitary islands, however isolated, but two parallel cases occur in isolated archipelagos. The two species of endemic finch, Nesospiza, in the Tristan da Cunha Islands differ primarily in beak[6], so here is Galapagos in miniature, and at the other extreme is the marvellous adaptive radiation of the Drepanididæ in the Hawaiian group[7].

Secondary Sexual Plumage

In Geospiza species the adult male plumage is black, but individuals frequently breed in the grey-brown juvenal plumage, or in partly black and partly juvenal plumage. In Platyspiza and Camarhynchus, the 'full' male plumage is partly black, and many individuals breed in juvenal plumage, the percentage greatly varying on different islands. In Cactospiza, the male is normally coloured like the juvenal, but one had a black head. This tendency to lose the male secondary sexual plumage occurs in many other land birds of oceanic islands. Such plumage is usually considered to have evolved through purely intra-specific selection, through threat and courtship display, and one would suppose threat and courtship were as essential on oceanic islands as elsewhere (Geospizinæ display vigorously). But there is a further function of such plumage which has relation to other species, namely, enabling the female to recognize and pair up with a male of her own species, hybridization being at a selective disadvantage. The few land birds which have colonized oceanic islands are normally removed from all related species which the female might possibly confuse with her own, so this function disappears. The opposite of this process is seen in some continental Gallinaceous birds, and some birds of paradise, in which the sexes meet only for copulation and there is not the complex interrelated pairing behaviour typical of birds in which both sexes raise the young. Probably correlated with this, hybridization is relatively common, and at the same time there is an extreme development of male secondary sexual plumage, each species being strikingly distinct.

To sum up, while the Geospizinæ present certain unusual features, there is no need to postulate some quite peculiar evolutionary agency. As on other oceanic islands, the almost complete absence of food competitors and predators has decreased the intensity of selection, so that peculiar types

or habits have a greater chance of persisting. The existence of a number of islands has promoted non-adaptive differentiation of island subspecies, from which species have been evolved when two such forms have later met in the same area and kept distinct. The genera show a minor adaptive radiation. The loss of male secondary sexual plumage is correlated with its ceasing to function in specific recognition.

[1] Lack, D., "The Galapagos Finches (Geospizinæ): a Study in Variation", *Proc. Cal. Acad. Sci.* (in the press).
[2] Wright, Sewall, "Evolution in Mendelian Populations", *Genetics*, **16**, 97–159 (1931).
[3] Rensch, B., "Zoologische Systematik und Artbildungsproblem", *Verh. deutsch. Zool. Ges.*, **35**, 19–83 (Zool. Anzeiger 6 suppl.) (1933).
[4] Lowe, P. R., "The Finches of the Galapagos in Relation to Darwin's Conception of Species", *Ibis*, 310–321 (1936).
[5] Worthington E. B., "On the Evolution of Fish in the Great Lakes of Africa", *Int. Rev. Hydrobiol. Hydrogr.*, **35**, 304–17 (1937).
[6] Lowe, P. R., "Notes on some Land Birds of the Tristan da Cunha Group collected by the Quest Expedition", *Ibis*, 519–523 (1923).
[7] Perkins, R. C. L., "Fauna Hawaiiensis", vol. 1, Pt. 4; Aves 368–466 (1903).

OBITUARY

Sir Oliver Lodge, F.R.S.

BY the passing of Oliver Joseph Lodge the world has lost not only one of its most distinguished scientific investigators, but also one who had unique powers of exposition able to make clear to minds of less ability than his own the nature of new scientific discoveries or novel scientific conceptions in lucid and original language.

Lodge was born at Penkhull near Stoke-on-Trent on June 12, 1851, where his father had a business connected with the pottery trade. His school education was gained at Newport, Staffs, and it was intended that he should enter his father's business, which he did for a short time at fourteen years of age. But he soon exhibited a keen interest in science and disinclination for a business career. By private study he acquired sufficient knowledge to matriculate in the University of London and then to pass the intermediate examination for the B.Sc. degree.

At that time the Science and Art Department had a scheme for giving promising students and elementary science teachers an opportunity of gaining practical laboratory training under distinguished men, and the science schools at South Kensington had been opened for that purpose in 1872 with Edward Frankland as professor of chemistry, Frederick Guthrie for physics and Thomas H. Huxley for biology. Both Lodge and I took advantage of this opportunity and thus commenced a life-long friendship. We were both more interested in physics than in pure chemistry. Crookes had then begun, and was continuing, his researches on electric discharge in high vacua. Clerk Maxwell published in 1873 his great treatise on electricity and magnetism and had translated into mathematical form Faraday's original ideas concerning the electromagnetic field. We were both extremely interested in Maxwell's conceptions on electromagnetic waves. To gain additional knowledge of physics and mathematics Lodge entered University College, London, to study under Carey Foster in physics and mathematics with Henrici, but his abilities soon enabled him to pass from the state of student to that of teacher. After taking his B.Sc. degree he became reader of natural philosophy in Bedford College for Women in 1875, and in 1879 assistant professor in applied mathematics in University College, London. In 1881 he was selected as professor of physics in the University of Liverpool and soon began to make a name for himself as an original investigator.

Lodge's powers of exposition led to invitations to give lectures or courses at other places. He gave a lecture at the Royal Institution on the discharge of a Leyden jar in which he pointed out the importance of resonance or tuning when dealing with electric oscillations. In a lecture course at the Royal Society of Arts he discussed the nature of lightning discharges and surmised that they might consist of high-frequency electric discharges. This study led him to devise experiments on the propagation of electric waves along wires and he came very near to anticipating the work of the German physicist H. H. Hertz on the production of Maxwell's electromagnetic waves in space.

Hertz's work was carried out at Karlsruhe and Bonn between 1885 and 1888. His masterly experimental work on this subject excited world-wide interest. Lodge threw himself with the greatest enthusiasm into the work of repeating and extending that of Hertz. Lodge devised experiments to show the similarity between optical effects such as refraction and reflection of light and those of electromagnetic waves. This prepared the way for his original work on wireless telegraphy. Hertz had employed as a detector of electric waves a simple ring of wire with spark balls inserted in it. But this was not at all sensitive. Lodge adapted for that purpose a tube loosely filled with metallic filings which in that condition was a poor electric conductor. But the impact of electric waves on it caused a coherence to take place between the metallic particles and hence Lodge named it a coherer. If given a slight tap the filings came back into the non-conductive state and accordingly Lodge made a self-acting tapper on the principle of the electric bell which continually restored the filings to a state of poor conduction.

Hertz died in January 1894, and in June of that year Lodge gave a brilliant lecture at the Royal Institution on the work of Hertz. No mention was made of electric wave telegraphy in that lecture; but, using his coherer, experiments were shown illustrating the production, detection, and properties of electric waves. In the autumn of that year Lodge

repeated the lecture before the British Association at Oxford and on that occasion he showed that with a deadbeat Kelvin galvanometer long or short deflections of a spot of light could be created by means of a Hertz radiator in a distant room. Thus Morse code signals and intelligence could be transmitted. By the use of a more powerful radiator, Marconi covered miles instead of yards. In a British patent taken out about this time, Lodge pointed out the necessity for syntony or tuning between the transmitter and receiver. This patent later on became of great importance and was acquired by the Marconi Company. In conjunction with Dr. Alexander Muirhead, Lodge worked out later on a complete plant for wireless telegraphy. He must therefore be considered as one of the pioneers of this important application of experimental research.

Lodge was, however, more interested in pure research than in its applications. He had a firm belief in the actuality of a space-filling ether and endeavoured by various experiments to prove a connexion between matter and ether, but without results. He expounded his views in various papers and books, for example, "Modern Views of Electricity", "Electrons", and "The Ether of Space".

In 1900 he was chosen as first principal of the University of Birmingham, where he remained for nearly twenty years, and by the breadth of his interests and personal character he made himself known and beloved by an extensive circle.

Lodge was knighted in 1902 and was the recipient of numerous honours, such as the Rumford Medal of the Royal Society in 1898 and the Albert Medal of the Royal Society of Arts in 1919. He was elected fellow of the Royal Society in 1887, and president of the British Association in 1913.

His personal appearance was impressive. He was 6 ft. 4 in. in height and in middle life had a strong facial resemblance to a former Lord Salisbury. He always commanded serious attention in any meeting at which he spoke. He was happy in his domestic life, and had a large family of six sons and six daughters.

Lodge became prominent as a leader in psychical research. In common with his friend F. W. H. Myers, he had a strong conviction of the survival of some part of the human personality after the death of the bodily organism, and he sought to prove it in various ways. The writer is not, however, qualified to evaluate Lodge's work in this region. His attention to it was not the outcome of mere scientific curiosity but of a firm belief in the value of human life and the eternal consequences of human conduct. Above all he did not consider the universe to be the outcome of an automatic evolution but the creation of a Supreme Intelligence. He had a serious and reverent outlook on human life and his wide and valuable work in numerous fields will ensure for his name an enduring recollection as well as an affectionate remembrance by many minds.

Sir Oliver Lodge died on August 22, at Normanton House, Lake, near Salisbury, where he had lived for many years.

AMBROSE FLEMING.

I FIRST met Sir Oliver Lodge about the year 1877 when he used to come to South Kensington for the May examinations of the Science and Art Department. At that time the Physical Society used to meet on Saturday afternoons, and the meetings were very different in character from what they became when the time of meeting was changed to Friday afternoon. They were less severe, and the friendly and almost chatty atmosphere of a tea party prevailed. Lodge was very much at home on these occasions, and he was always listened to with interest. His clear speaking and characteristic and musical voice and originality of view made his contributions to the discussions valued and attractive.

The subjects ranged over the whole field of the classical physics of that epoch. I remember in particular one source of much discussion—the seat of electromotive force in the voltaic cell. Lodge had a great deal to say on the apparently erratic behaviour of lightning, which did not seem to understand the clear rules of behaviour set out in the text-books. He devised and showed experiments based upon the idea, so far as my very imperfect memory goes, that the stroke came direct not from a great mass of cloud but from a region suddenly charged by a discharge from the cloud, which seems to approach the step-by-step action of the leader-s roke discovered by Schonland. It so happens that I have seen very little of Lodge during the last thirty years, but I was very glad, when my premises were visited by a peculiarly freakish flash (see NATURE, **131**, 765; 1933), to get him to come over and see what had happened. It may be worth while mentioning that the black Italian poplar tree struck is still doing well, having an edge of growing cambium encroaching over the stripped trunk four inches thick.

I do not know what attitude Lodge assumed towards games and sports in general. I remember, however, taking part in a game in his house in which he excelled. It is quite likely that he invented it. A string or tape is stretched across the hall to serve as a tennis net, and the players at very close quarters beat with their flat hands an ordinary child's india-rubber balloon over the net. This may sound a mild pat-ball style of game, but actually it is most strenuous. By giving well-directed glancing strokes the ball is made to spin and advance very rapidly, but owing to the rotation its motion seems as erratic as that of lightning—it may even loop the loop—and it is a very difficult matter to return it at all. I like to conclude this very short and imperfect personal note with the picture of Sir Oliver towering behind the net, with smiles all over his face, and with his long reach and his firm and well-directed slicing strokes enabling him to harass his opponent.

C. V. BOYS.

WE regret to announce the following deaths:

Prof. C. C. Caleb, formerly professor of physiology in King Edward's Medical College, Lahore, on August 26, aged seventy-nine.

Prof. W. Lash Miller, C.B.E., emeritus professor of physical chemistry in the University of Toronto, on September 1, aged seventy-three.

NEWS AND VIEWS

Sir J. J. Thomson, O.M., F.R.S.

PHYSICISTS and others will have read with much regret the announcement in the daily papers at the end of last week of the death on August 30 of Sir J. J. Thomson, whose name will always be associated with the discovery of the electron, the fundamental unit of electricity, and the basis of modern views on the structure of matter. So long ago as 1913, NATURE published an account of his work, written by Prof. Augusto Righi, in the series of "Scientific Worthies", and the intervening years have but served to emphasize the importance and significance of his work there described. The decision to accord him a national burial at Westminster Abbey was a fitting memorial to one whose name had passed into international usage. At a later date, we hope to print some personal appreciations of Sir J. J. Thomson, though unfortunately we are cut off from many who would otherwise no doubt have paid their tribute to him who will always be known affectionately as "J. J."

H.M. the King has sent the following message to Lady Thomson: "I am grieved to hear of the death of your distinguished husband, whom I remember so well from my Cambridge days. His loss will be deeply felt both in the University and the world of science, where he played so great a part. I send my sincere sympathy to you and to your family."

Les Français de Grande Bretagne

MONSIEUR ANDRÉ LABARTHE, director-general of the Department of Armaments and Scientific Research in General de Gaulle's Legion, addressed a meeting of "Les Français de Grande Bretagne" on August 31, at the Central Hall, Westminster. Courage, decision and tenacity begin to bear fruit, he said. The French Empire is awakening from its stupefaction, and coming back to life. It is rallying to that French flag which General de Gaulle has raised again, to that flame which he has known how to shield from all blasts of misconception, carping and discouragement. This is the meaning of the re-entry into the war of French Equatorial Africa, the Cameroons and Lake Chad Territory, a re-entry of which the importance, material and moral, strategic and political, no one can overlook. In France itself, the rulers have sought to save their country from destruction by begging for a shameful armistice, and have opened the way to the most disastrous concessions. On one hand, the Germans are methodically pillaging the richest and most productive parts of the country, on the other the flood of refugees and the scarcity of transport are creating chaos and famine. Workers have left their factories and hungry children wander along the roads. Bit by bit, defeated France is handed over to the tender mercies of the conqueror. She can no longer even remain neutral; she is being dragged into the war on the side of the Germans.

Faced by such a situation, the duty of Frenchmen resident in Great Britain is clear. Some of them have lived in Great Britain for a long time; others have arrived since the disaster. Let the former recall that they have enjoyed here the liberties of a great democratic country, and the prestige of their own native land; that they must now defend these liberties and restore this prestige. Let those who have lately arrived remember that, coming from a country which has betrayed the common cause, they have nevertheless been received here as friends, have been helped and comforted. There is now no time to hesitate or weigh the consequences. Let all become combatants in the cause of the British Commonwealth of Nations, which remains the cause of France. Gathered around General de Gaulle in the Association "Les Français de Grande Bretagne", bound in a common brotherhood with the British, let them ensure, by increasing work and propaganda, the persistence of that spiritual unity which, even more than race or territory, is the essence of France.

Prohibition of High-Frequency Apparatus

THE Home Secretary has made an Order in the interests of national security forbidding any person in the United Kingdom to use or possess high-frequency apparatus having a high-frequency output of more than 10 watts, except under permit from the Postmaster-General. Such permits may be issued only to hospitals, clinics, or other institutions providing medical or surgical treatment, which are provided by a local authority or supported wholly or partly out of any public funds or by a charity or by voluntary subscriptions; to manufacturers who require to use high-frequency apparatus; to makers of and dealers in such apparatus; and to persons in charge of laboratories used for purposes of research or instruction.

It is explained that the danger of interference at a vital moment to the wireless communications of the Services and to the radio control of our own aircraft is so great that it has been found necessary to issue the prohibition. The operator of this type of apparatus is nearly always unaware of the interference it is causing, and it is most difficult for the Service being interfered with to locate the source of interference. The Order came into force on September 2. Permits to use such apparatus may be obtained from the Engineer-in-Chief, Radio Branch, General Post Office, Harrogate, Yorks.

Smoke Abatement

THE National Smoke Abatement Society has issued the fourth war-time issue of its journal *Smokeless Air*. The Editor justifies this effort by the necessity for keeping in view the ideal of a cleaner atmosphere when the time comes for post-War reconstruction so that such an opportunity shall not be lost for want of forethought. Prominence is given to a recent

paper by H. H. Thomas and P. J. Askey describing work at the Liverpool Gas Co. on the production of reactive coke by alkali activation. For some years it has been known that a little sodium carbonate alters the mode of burning of carbon, making it blaze more freely. The quantity of alkali necessary can be replaced to a great extent by lime with a corresponding reduction of cost. The authors record results of a large-scale trial in which coal treated with 1·25 per cent lime and 0·5 per cent sodium carbonate was carbonized in normal gas retorts. The coke so produced over a period of seventeen months has been sold to Liverpool consumers for use in the fireplaces in normal use and to the general satisfaction. In ease of combustion the fuel compared favourably with low-temperature coke, with the advantage that it was made in standard gas-making plant at high temperature, without sacrifice of the yield and output of gas—factors of importance in ensuring economical working.

Malaria in Costa Rica

A. A. GUZMÁN discussed the problem of malaria in Costa Rica at the Eighth American Scientific Congress on May 17. Due to climatic variations because of altitude, malaria is distributed irregularly in Costa Rica, most of it being confined to the low coastal areas and the Nicaraguan frontier, although some high valleys are also infected. Since the greater part of the inhabitants live on the high central plateau, in the cities of Alajuela, Cartago, Heredia and San José, the incidence of malaria is lower than would otherwise be expected. In 1938 and part of 1939 more than 9,000 primary school children in 168 localities were examined for spleen enlargement, the results indicating that six times as much malaria occurred in areas less than 1,000 ft. above sea-level as in higher regions. Blood smears from every child with splenic enlargement, and from one third of the rest, were examined microscopically, 3,981 smears from 9,226 children (43 per cent) being examined. Giemsa stain was used. *P. vivax* and *P. falciparum* were found throughout the malaria region ; *P. malariæ* was most common on the Pacific coast and in the Province of Guanacaste.

The scarcity of funds for malaria control work resulted in a decision to begin by carrying out permanent work in two localities, and proceed on the basis of an annual appropriation to carry forward the work of draining centres of population, before attempting to deal with malaria in rural areas. The work was begun in 1939 in Liberia, capital of the province of Guanacaste, which had the highest splenic index among school children, with the installation of drainage ditches made of pre-cast concrete sections as used by Dr. D. P. Curry in the Panama Canal zone. At the same time the town of Las Cañas, similar in conditions to Liberia, was left unsanitated as a control. The splenic index in Liberia was reduced to one fourth of the original figure ; that in Las Cañas remained unchanged. Drainage work was then begun in Las Cañas in 1940. During 1939, 6,908 concrete inverts, 9,573 side slabs, and 145 sections of concrete pipe were made in the Liberia shop. By December 1939 slightly more than 4 km. of ditch had been laid in the Liberia area, at a total cost, including heavy equipment, of approximately 18,600 dollars, to which the Costa Rican Government contributed about 87 per cent and the Rockefeller Foundation 13 per cent.

Exposure to Fluorine in Industry

W. Machle and E. E. Evans (*J. Indust. Hyg. and Toxicol.*, **22**, 213 ; 1940) have reviewed the literature on the effect of industrial exposure to fluorine and record the following personal observations. They found that five years of intermittent exposure to concentrations of fluorine which were harmful to rabbits and monkeys were tolerated by a group of industrial workers without clinical or röntgenological evidence of damage and without injury to the blood as shown by hæmatological examination. Comparative examinations showed them that the exposure of the workers resulted in the absorption of more than three times the normal amount of fluorine. Experiments on animals indicated that this continuous absorption would result in the deposit of abnormally large amounts of fluorine in the teeth and bones, but clinical evidence of this kind has not yet appeared.

Pre-Columbian Burial in Panama

AN archæological expedition to Panama of the University Museum of the University of Pennsylvania, under the leadership of Dr. J. Alden Mason, has discovered the tomb of a chief or official in which the intrinsic value of the personal ornaments recalls the stories of the early Conquistadores of the wealth of the Central American caciques in precious metal, to which the finds of Dr. Alfonso Caso on Monte Alban in Mexico have also borne eloquent testimony. The find was described by Dr. Mason in a first report of the expedition before the Eighth American Scientific Congress in Washington, D.C. He described the burial, it is stated in a brief report circulated by Science Service, as a pit 11 ft. deep. In it had been laid the body of the chief, "resplendent . . . in shining gold". His ornaments included gold cuffs and anklets, great shining disks of this metal ornamenting his clothing, golden ear-clips, bells, and beads. From layers of broken pottery, Dr. Mason concludes that the mourners must have danced on or trampled pottery into the grave in some burial rite. This discovery was made in a vegetation-covered graveyard on a plantation in Coclé Province, one hundred miles west of Panama City. The origin of the people responsible for the burial has not yet been determined ; but the culture differs from that of both Maya and Aztec and points to South rather than North American affinities. The find is dated as belonging to the period 1300–1500 of our era.

Australia's Electrical Requirements

AN Australian correspondent writing in the *Electrical Times* of August 22 says that the rapid expansion of secondary industries in Australia has been particularly noticeable in the production of electrical machinery, equipment and appliances to

meet the needs of both heavy and light industries, in addition to the general electrical requirements of the Australian public. This is of interest to manufacturers who supply electrical products to the Commonwealth. The number of factories has increased during the last ten years from 231 to 360. It is of interest from the point of view of increased competition with overseas suppliers, apart from protective tariff duties, that the ratio per cent of salaries and wages to values of production has gone down from 68 per cent in 1930–31 to 55·6 per cent in 1938–39. Similarly, the value of output per person engaged increased during the same time from £A.529 to £A.652. The range of electrical equipment now produced in Australia, although far from being sufficient to meet domestic requirements, covers a fairly wide field; and there is quite an extensive range of radio-equipment for ocean-going vessels, aircraft beacons of the new ultra-high-frequency type and short-wave receiving sets, all of which are being manufactured in the Commonwealth.

Despite Australia's substantial production of electrical machinery and equipment, the annual value of which is now more than £A.7,000,000, the value of total imports from overseas countries amounted in 1938–39 to approximately £A.5,700,000. Of the products imported, a considerable proportion is made up of items which as yet cannot be economically produced in the Commonwealth and are required to meet the steady expansion of secondary industries and public utilities. With the majority of European suppliers, with the exception of the United Kingdom, now unable to effect shipments, and with the German occupation of Holland, Denmark, Belgium and France, it will be necessary for consumers to seek other sources of supply, particularly for urgent electrical requirements. Although certain electrical commodities may at present be prohibited entry to Australia from non-sterling countries, this situation is subject to alteration from time to time. In the event of such products being unavailable from the United Kingdom or within Australia, licences to import from British North America would no doubt be obtainable.

Lighting Installation of the Savoy Chapel, London

THE King's Chapel of the Savoy, Strand, London, which is all that remains of the Palace and Hospital of the Savoy, is the personal property of the King by right of his Duchy of Lancaster, of which the Savoy became the centre in 1351. His Majesty, at the time of the Coronation, placed the Chapel at the disposal of the Royal Victorian Order, to be regarded as the Chapel of the Order. Recent additions made have launched it on a new era of importance, and it can now be used for the first time for ceremonial purposes. The Chapel stands low and was approached by a narrow flight of steps. Its new approach consists of a stone parapet with broad sideways flights of steps which make robed processions possible. A robing room and a new cloister are other additions to the ancient building. In the Chapel itself space-saving ideas have been carried out to make more room. The Royal stalls have been designed as part of the new wall panelling where the old organ stood. A miniature electric organ, similar to the one in Canterbury Cathedral, has been installed. The beautiful ceiling of eighty-eight wooden panels has been cleaned and retouched to a parchment shade, and can now be seen to full advantage owing to the concealed lighting from the sills of the windows, which lights the whole of the interior of the Chapel, and in peacetime allows the stained glass to be seen from outside by transmitted light. The whole of the design of the lighting installation was carried out by G.V.D. Illuminators, Ltd.

Hydraulic Structures Research in Canada

THE National Research Council of Canada has recently provided in Ottawa facilities for hydraulic structures research. The new laboratory, which is a part of the Division of Mechanical Engineering, has been planned to supplement the limited facilities which are at present available in Canada for work of this kind. The design of structures such as canal locks, dams, spillways, gates and power plant details can be investigated and work may be undertaken on river hydraulic problems of limited extent. Many pipe-flow problems are also within the scope of the laboratory. A feature of the laboratory is the large flow of water available which will be adequate for the largest models that can be accommodated. A complete description, with drawings, of the new hydraulic laboratory was published recently in the *Engineering Journal*. Reprints (N.R.C. No. 937) are available from the National Research Council, Ottawa.

Mr. F. C. Bawden

MR. F. C. BAWDEN has been appointed head of the Department of Plant Pathology at Rothamsted Experimental Station, in succession to Dr. J. Henderson Smith, who is shortly retiring, having held the post since 1932. Mr. Bawden was a scholar of Emmanuel College, Cambridge, and after taking a first class in the Natural Sciences Tripos and the diploma in Plant Pathology, he spent five years as research assistant at the Potato Virus Research Station, Cambridge, under Dr. R. N. Salaman. In 1936 he transferred to Rothamsted to take charge of the investigations on virus diseases of plants, in which he has been conspicuously successful. He was invited last summer to lecture in the United States on his investigations, but returned to Great Britain shortly after the outbreak of the War.

Agricultural Research Council: New Members

THE Committee of Privy Council for the Organisation and Development of Agricultural Research has appointed, to fill vacancies caused by normal retirement, Sir Robert Blyth Greig, and, after consultation with the president of the Royal Society, Prof. W. W. C. Topley, Prof. E. J. Salisbury and Prof. T. J. Mackie, as members of the Agricultural Research Council. Sir William Cecil Dampier and Mr. John Smith have been reappointed for a further term.

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.

Diffuse Reflection of X-Rays by Single Crystals

IN a recent letter, A. Taylor and D. Laidler[1] describe anomalous reflections to be found on photographs of graphite taken with cobalt $K\alpha$ radiation, and suggest that these may be similar to the diffuse spots to be found on well-exposed Laue photographs.

This is not possible; such diffuse reflections may indeed occur on a powder photograph, but only as a *background* and *broadening* of the Bragg reflections from the normal planes.

Since the experimental conditions governing the appearance of the diffuse spots found on Laue photographs do not seem to be clearly understood, it may be helpful to describe some of the results obtained from an investigation now in progress in this laboratory, during the course of which some thousands of such spots have been observed.

The principal crystals examined were potassium chloride, benzil, α-resorcinol, urea oxalate, urea nitrate, sorbic acid, hexamethylbenzene; a few photographs of diamond and of sodium nitrate have also been taken. The radiations used were copper, molybdenum and silver, both unfiltered and suitably filtered. Exposures varied from 70 min. using an ordinary gas tube, to 5 min. or less using the 5 kw. tube. With a monochromator, exposures of 1–3 hours were necessary. Various plate distances were used and for the low-temperature work the technique employed was similar to that previously described by two of us[2].

The main lines of investigation have been: (1) to take Laue photographs with a principal axis vertical, at 5° or 10° intervals over the whole rotational range, and/or at 1° intervals over a limited range; various axes have been investigated; (2) to take separate oscillation photographs having the "Laue" positions as the centres of the oscillations, various ranges being covered; (3) to superimpose oscillation and Laue photographs on the same film; (4) to take selected Laue photographs with strictly monochromatized radiation (copper $K\alpha$ only); (5) to take successive Laue photographs under otherwise similar conditions at room temperature, liquid air temperature and room temperature again.

A few experiments have also been made at elevated temperatures, and Laue photographs have been taken with the crystal surface completely covered with a drop of liquid in which it is soluble.

Briefly, the conclusions arrived at are as follows:

(*a*) The diffuse spots are due to characteristic radiation present in the incident beam. Continuous radiation gives radial streaks.

(*b*) When a principal crystal axis is vertical, the positions of most of the diffuse spots are nearly coincident with those of Bragg spots on the corresponding oscillation photograph covering a range of some 10°–15° on each side of the stationary position in which the Laue photograph was taken. Very well-exposed oscillation photographs show a diffuse background to each Bragg spot. This agrees with the observation that the diffuse spot pattern changes much more slowly than the Laue pattern on successive photographs at small angular intervals. Not all diffuse spots correspond to an oscillation about a vertical axis only, but *all* are accounted for by limited oscillations about other principal crystallographic directions also. Some photographs showed as many as 42 diffuse spots; all these could be assigned indices as being due to the reflection of characteristic radiation by planes of nearly normal spacing (that is, within 5 per cent of the usual spacing), displaced by less than 10° (or in the exceptional case of a strongly reflecting cleavage plane, less than 17°) from the normal lattice position. It follows that in a powder, where all crystal orientations are present, the diffuse monochromatic reflection would occur only as a broadening of each line so as to include spacings of up to ± 5 per cent of the normal spacing, the limiting intensity being very small.

(*c*) The intensities of the diffuse spots are dependent upon two factors: first, on the normal intensity of the corresponding characteristic reflection measured in its proper position and secondly, on the angular separation of the diffuse spot from the Laue spot due to the same set of planes.

(*d*) At liquid air temperatures, the diffuse spot pattern almost completely disappears, the Laue spot pattern becoming extremely clear and the background clean. (This has only been satisfactorily proved for potassium chloride, sodium nitrate, benzil and α-resorcinol.) These effects are *completely reversible*. Experiments at elevated temperatures confirm Preston's observation of a relative enhancement of the diffuse spot pattern.

(*e*) The diffuse spot pattern does not appear to be affected by covering the surface of the crystal with a drop of liquid in which it is soluble, provided that sufficient of the crystal remains to give a Laue photograph at all.

(*f*) A striking feature of certain of these photographs is the presence of diffuse streaks clearly marking out the layer lines. The result is that some of the spots in benzil photographs appear to be six-pointed stars, others in sylvine and sorbic acid appear as crosses. Laue photographs of benzil with *monochromatized* radiation show a beautiful and intricate pattern of spots and continuous streaks, none of which is radial. Even when the layer lines are not completely defined, isolated spots are drawn out into hyperbolic streaks, and sometimes non-radial streaks appear without any well-defined spot.

(*g*) The size of the diffuse spots shows that they are not given by small crystal units. Except in the case of diffuse spots corresponding to a cleavage or 'layer' plane, the half-maximum intensity width is not in general much larger than that of the corresponding Bragg spot. The shape of the diffuse spot is, in general, that of the corresponding Bragg spot and often differs markedly from that of the corresponding Laue spot.

Some of these conclusions confirm those previously reported by other workers; others are new. They will be published in detail elsewhere.

It is not our object in this communication to relate the experimental results to any of the existing divergent theories. The final test of any theory, however, must be based on detailed qualitative and quantitative experimental data.

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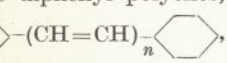
K. LONSDALE.
I. E. KNAGGS.
H. SMITH.

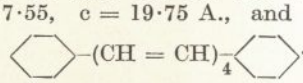
[1] NATURE, **146**, 130 (1940).
[2] Lonsdale, K., and Smith, H., *Phil. Mag.* (7), **28**, 614 (1939).

Dimorphism of Diphenyl Octatetraene Crystals

THE crystal structures of the diphenyl polyenes, having the general formula  , have been studied by Hengstenberg and Kuhn[1] by X-ray methods. They find that while the lower members of the series, with $n = 1$ to 4, crystallize in the monoclinic system, the higher members studied by them, for which $n = 5$ to 7, crystallize in the orthorhombic system.

Recently, in the course of some electrical and optical measurements on this important series of compounds possessing conjugate double bonds, we had occasion to study the crystal structure of one of them, namely, diphenyl octatetraene, corresponding to $n = 4$. On allowing this substance to crystallize from its solution in acetic ether, we found that in addition to some flaky crystals which were monoclinic and had the axial dimensions described by Hengstenberg and Kuhn, there also appeared in the same crop stout well-developed crystals which were orthorhombic. The chemical identity of the two types of crystals is verified by the observation that both types appear in the crops obtained by the evaporation of the solutions in acetic ether of either of them separately.

n	a	b	c
	in A.		
5	10·25	7·66	21·2
6	10·20	7·60	23·58
7	10·2	7·57	25·95

The orthorhombic crystal belongs to the bipyramidal class, and its unit cell has the dimensions $a = 9{\cdot}95$, $b = 7{\cdot}55$, $c = 19{\cdot}75$ A., and contains 4 molecules of  . These dimensions fit well with the dimensions of the unit cells of the higher members of the series—all of which contain 4 molecules—obtained by Hengstenberg and Kuhn, and reproduced in the accompanying table.

K. S. KRISHNAN.
S. L. CHORGHADE.
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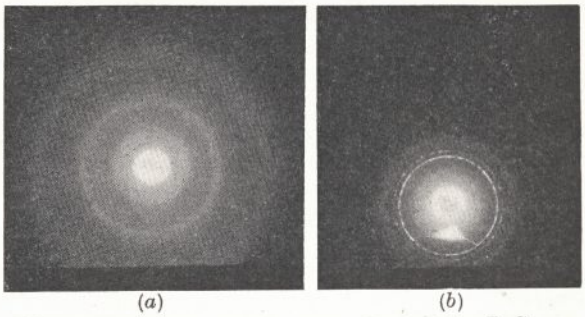
June 15.

[1] *Z. Kristallog.*, A, **75**, 301 (1930).

Study of Amorphous Films by Electron Diffraction

SINCE it is necessary to maintain the electron camera used in electron diffraction studies in a state of high vacuum, the investigation of solutions is in general very difficult. However, the desiccation of hygroscopic substances like zinc chloride does not take place very rapidly even in high vacua of the order of 10^{-6}~10^{-8} mm. mercury; as a matter of fact, the thin films of such substances give diffraction haloes as well as diffraction rings (see photographs). The purpose of this study is the determination of the inner structure of amorphous films of very concentrated solutions through the diffraction patterns obtained.



(*a*) (*b*)

ELECTRON DIFFRACTION PATTERNS FROM $ZnCl_2$-H_2O FILMS. IN (*b*) THE RINGS DUE TO $ZnCl_2$ CRYSTALS ARE BEGINNING TO APPEAR.

A platinum wire-gauze of about 0·5 mm.^{2} dimensions was previously washed with dichromic acid. After immersing the gauze in a saturated aqueous solution of zinc chloride for several hours, a thin film was successfully obtained adhering to every part of the gauze. The films thus obtained were so hygroscopic and had so remarkable a surface effect that they were not easily broken and served satisfactorily for the purpose in the electron diffraction study. Both diffraction patterns shown in the accompanying photographs were obtained by transmission of an electron beam through the $ZnCl_2$-H_2O film; whereas in *a* haloes are prominent, in *b* rings are conspicuous. By referring to X-ray data it was clearly verified that these rings were from $ZnCl_2$ crystals (hexagonal, $CdCl_2$ type); therefore, it is clear that the solution under examination is saturated, and its "base-body" is $ZnCl_2$.

If the lattice spacings determined by measuring the radii of haloes remain constant even when the wave-length of the electron beam is altered, it may safely be assumed that the halo pattern obtained is due to the diffraction grating characteristic of the thin film consisting of a saturated solution. The results of the experiment were positive in the several wave-lengths used, namely, 0·0756, 0·0807 and 0·0858 A.; the lattice spacings were respectively 4·5, 2·4 and 1·45 A. The haloes are not only sufficiently diffuse to be distinguishable from the sharp rings given by $ZnCl_2$ crystals, but also they appear in the pattern in positions where $ZnCl_2$ crystals cannot produce diffraction rings.

I am now endeavouring to build up a model of the grating characteristic of this film. This work has been conducted under the direction of Dr. Ichirô Iitaka.

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Adsorption of Malachite Green by Clays and Allied Minerals

THE malachite green stain test has long been used as a means of identifying kaolinite, dickite, and nacrite[1]. The quantitative aspect has not been dealt with adequately, and the method has never been applied with discrimination. Working on mineral separates obtained during the physical analyses of clays and soils, I have used staining quite extensively. Previously identified specimens of kaolinite, beidellite, etc., were used as controls, and the following represents the general colour reactions, after staining, drying, and mounting such separates.

Mineral	Colour of Stained Mineral	Pleochroism
Kaolinite	Deep-blue green	Marked
Anauxite	Light to deep blue-green	Not very marked, but variable
Montmorillonite	Marine blue	None
Pyrophyllite	Blue-green	None
Talc	Blue-green	None
Beidellite	Marine blue	None
Margarite	Not markedly stained	None

It was obvious after performing a few stain tests that these minerals adsorb different amounts of the dye, and take it with varying degrees of 'fastness'. For example, kaolinite is stained a deep blue-green colour in such a manner that no amount of washing with water, acid or alkali will remove the malachite green. The colour can be changed from blue-green in alkaline solution to a light red in acid conditions. It must also be noted that in the case of kaolinite and anauxite the birefringence is increased by staining from 1st order greys to 2nd order reds and purples.

Shand[2], in a paper on the staining of etched sections of feldspathoidal rocks, remarks that long contact with the staining solution is unnecessary. My work on clays has confirmed this, and the following figures indicate that ten minutes contact with a 0·05 per cent aqueous malachite green solution is sufficient to remove more than 90 per cent of the dye from it.[3]

KAOLINITE-RICH WHITE KAOLIN

Time of contact in min.	Adsorption of malachite green
1	85
5	89
10	92
60	93
120	93

In this case the dye is never completely removed, whereas bentonitic clays and fuller's earths adsorb the malachite green from much stronger solutions. So far, no accurate diagnostic values of the amount of adsorption for the various minerals have been found. In fact, anauxite, for example, has a range of values depending probably upon its composition. With the exception of some of the kaolinites, few of the minerals used in this investigation were uncontaminated by other minerals. Fortunately, in every case the main impurity was quartz, which does not take the dye.

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[1] Ross, C. S., and Kerr, P. F., U.S. Geol. Surv. Prof. Paper (1931).
[2] Shand, S. J., *Amer. Min.*, **24**, 568–573 (1939).
[3] Holmes, A., "Petrographic Methods and Calculations", p. 275 (1930).

Correlation between Egg-Carrying Setæ and Cement Glands in Decapod Crustacea

IN the Decapod Crustacea the female possesses characteristically long non-plumose setæ on many of the abdominal, and in some cases certain of the posterior thoracic, appendages. It is to these hairs that the eggs are attached when the animal is in berry. It has been further shown by one of us[1] that in *Homarus vulgaris* ducts from the cement glands, which occur exclusively in the pleopods of the female, pass into the interior of these specialized setæ, "circumstantial evidence indicating that the secretion is discharged through the sides of these". In other words a direct correlation was postulated between the setæ and the glands, the former providing the surface of attachment of the eggs and the latter the necessary binding cement.

Confirmation of this view has now been provided as a result of work on *Crangon vulgaris*. As already briefly noted by Havinga[2] and in more detail by Meyer[3], mature females alternate between an egg-carrying condition when these setæ are present, and what may be described as a 'neuter' condition when they are absent. Similar cyclical appearance of secondary female characters had already been described by Sollaud[4] in other Caridae, in species of Leander and Palæmonetes. This has recently been confirmed by Callan[5] in *Leander xiphias* and *L. squilla*. In *C. vulgaris* the female does not become mature until she attains a length of about 45 mm. Previous to this the ovary is small, the egg-carrying setæ are represented by no more than vestiges while cement glands are absent. But prior to the moult when sexual maturity is attained, the ovary develops rapidly, and after the moult the egg-carrying setæ are fully developed. With them appear cement glands, one or more being associated with each spine into the cavity of which their ducts penetrate. The animal is then capable of spawning, copulation taking place immediately after this moult if males are present.

After the liberation of eggs the female moults into the 'neuter' condition ; spines are then reduced, and cement glands absent. The ovary then increases in size, and in due course the animal moults into the egg-carrying condition with both spines and cement glands. This alteration of 'neuter' and egg-carrying conditions apparently continues throughout the remainder of the life of each female. A full account of this process will be published in due course by A. J. Lloyd.

This investigation reveals, therefore, that the egg-carrying setæ and the cement glands are in such intimate functional association that they may be regarded as a single secondary sexual character. The correlation between the condition of the ovary and the appearance of these structures provides further evidence in support of the previously expressed view[1] that they are controlled by a hormone produced by the ovary. Moreover, Callan[5] has recently demonstrated that the specialized setæ—and therefore also the glands—are not formed when Leander females are castrated with X-rays or when they are parasitized by Bopyrus.

Department of Zoology, The University, Bristol. August 14.

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[1] Yonge, *Proc. Zool. Soc. Lond.*, A, **107**, 499 (1938).
[2] Havinga, *J. Con. Inter. Expl. Mer.*, **5**, 57 (1930).
[3] Meyer, *Zoo. Anz.*, **106**, 145 (1934).
[4] Sollaud, *Bull. Biol. France Belg.*, Supple., **5**, 1 (1922).
[5] Callan, *J. Exp. Biol.*, **17**, 168 (1940).

Somatic Mutations of the Straw Locus in Drosophila

A PRELIMINARY study of X-ray induced somatic mutations of straw locus in *Drosophila melanogaster* has yielded several points of interest, and as it is unlikely that this investigation can be extended in the near future it seems desirable to record the results even in their present incomplete form.

Pupæ of flies homozygous for straw-3 were irradiated (by Dr. D. E. Lea) with 25,000 r. units. The somatic mutations were sought in the wings. As is well known, each cell of the wing epithelia in normal flies bears a single hair. In straw-3 these hairs are very small, thin and straggly, with an appearance of being incompletely chitinized. Somatic mutations of one of the straw genes to wild-type cause the formation of hairs of approximately normal length. In flies emerging two days after the treatment, 7 isolated mutated hairs were found in 30 wings. Taking the total number of hairs per wing as about 17,000, this gives a mutation rate of 0·5 per r. unit per 10^9 genes; this is some ten times less than the rates recorded by Timofeeff-Ressovsky for a series of genes most of which are known to be somewhat more mutable than the average.

The fact that the normal hairs occurred in single cells shows that the mutations took place in the resting stage following the last mitosis which occurs during wing development. It also demonstrates that the action of the $+^{stw\text{-}3}$ gene can be exerted as late in development as two days before emergence. It was noted, however, that the hairs in mutated cells were somewhat smaller than normal hairs. This might be explained either by an inadequate length of time during which the mutated could act, or by a certain lack of autonomy of the gene; the action of the $+^{stw\text{-}3}$ gene may be to cause the appearance of some substance lacking in stw-3 cells and some of this substance may leak away from the mutated cells into the surrounding tissue. It would be easy to distinguish between these two possibilities in flies in which the mutation had occurred earlier, but in the present experiment the younger pupæ were killed, and no mutations affecting more than a single cell were obtained.

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Sclerotiorine, a Chlorinated Metabolic Product of *Penicillium Sclerotiorum*, Van Beyma

A STRAIN of *Aspergillus Terreus* (Raistrick and Smith, 1936) yields two metabolic products containing chlorine: geodin ($C_{17}H_{12}O_7Cl_2$) and erdin ($C_{16}H_{10}O_6Cl_2$). These compounds, crystallizing in fine yellow needles, and melting with decomposition, are the first recorded instances of chlorinated metabolic products of the lower fungi. More recently, the isolation of griseofulvin ($C_{17}H_{17}O_6Cl$) and caldariomycin ($C_5H_8O_2Cl$) (Raistrick *et al.*, 1939; 1940)—chlorinated products of *Penicillium Griseofulvin* and *Caldariomyces Fumago*, respectively—has been described.

The subject of the present communication, to which we propose to give the name sclerotiorine ($C_{20}H_{20}O_5Cl$), closely resembles the above in crystalline structure, but melts without decomposition or the formation of a sublimate.

The strain of *Penicillium Sclerotiorum* used was obtained from the Centraalbureau voor Schimmel cultures, and shows, under certain well-defined conditions of temperature, mycelial pigmentation, ranging from yellow, through orange, to red, which colour is particularly apparent in the actual sclerotia.

Sclerotiorine, which is very slightly soluble in cold dilute Na_2CO_3 and $NaHCO_3$ solutions, is obtained in 2 per cent yield by petroleum ether extraction of the dried mycelium, grown on standard acid Czapek Dox medium at 25° C. in the dark. The compound crystallizes from alcohol in very fine hair-like yellow needles, melting sharply at 206–207° C., and yielding the following analytical results:

C, 64·09%; H, 5·43%; O, 21·00%; Cl, 9·47%; Methoxyl, nil mol. wt., 364.

$C_{20}H_{20}O_5Cl$ requires:

C, 63·92%; H, 5·33%; O, 21·30%; Cl, 9·45%; mol. wt., 376.

Sclerotiorine sublimes to microscopic needles in a high vacuum and gives various colour reactions with aqueous and alcoholic alkalis. With sodium hydroxide and ammonia it behaves as an indicator, red in alkali, yellow in acid, with an interesting clouding of the solution around the turning point.

The properties of the pigment are being further investigated.

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Nature of the Feulgen Reaction with Nucleic Acid

SEMMENS[1] has recently suggested that the Feulgen reaction with chromatin may be due to the purine components of the nucleic acids. The argument rests on his observations that piperidine and pyridine restored to the Feulgen solution its "original" colour, and that certain purines gave "positive" colour reactions.

We have made tests to show that the effect of piperidine and pyridine is not chemically equivalent to the Feulgen (or Schiff) reaction, but is simply due to their basicity the effect of which was pointed out by Feulgen in 1924. We have likewise tested three of the purines used by Semmens, and in no case did any colour develop. We conclude that the Feulgen reaction is specific for the potential aldehyde groups of chromatin. Details of our experiments will be published elsewhere.

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August 13.

[1] Semmens, C. S., NATURE, **146**, 130 (1940).

RESEARCH ITEMS

Amerindian Crania

THE fourth catalogue of crania of North America in the United States National Museum collections by Aleš Hrdlička (*Proc. U.S. National Museum*, **87**; 1940) covers crania of Indians of the Gulf States. It includes 1,259 adult specimens, of whom 621 were identified as male and 638 as female, from Georgia, Florida, Tennessee, Texas, Louisiana and other adjoining States. Of these, 237 were deformed so that the measurements of the vault were affected, while the numbers of the specimens from each locality are uneven and sometimes inadequate. Their showing is of interest. The largest part of the peninsula is occupied by moderate to pronounced brachycephals. A narrower strain, characterizing the Seminole, originally formed a part of the Creek and Muskogean complex whose territories ranged from north-west Florida westward and northward. The Seminole type, both in the cranial index and in other respects, connects apparently with that of the south-eastern Algonkins. The prevalent broader headed and high-vaulted Floridian type connects in turn with that of Georgia and reaches, irregularly, so far westward at least as Mississippi. It deserves to be known henceforth as the Gulf type of the American Indian. Texas, in both its broad and its narrow cranial types, stands apart from the rest of the Gulf States—its skulls are but of moderate height. The size of the head in the Gulf States, with the exception of Texas, compares well with that of tribes of similar stature elsewhere on the North American continent. As regards height of skull the Gulf States stand out as a unit. With some of the Pueblos the measurement of this character is the highest in crania of similar breadth and cranial index on the North American continent, nor is there such a broad high-headed large human group elsewhere. This may be a regional development.

Disappearance of Serbian Gypsies

VARIOUS causes are stated by Dr. Alexander Petrovič (*J. Gypsy Lore Soc.*, Ser. 3, **19**, 3; 1940) to be responsible for the inevitable disappearance of Serbian gypsies. The nomad gypsy is free, and neither knows nor cares for birth-place, nor where he shall be buried. The world exists to provide him with food. But when a gypsy becomes sedentary there is a fundamental change in his point of view. He never steals in his own village. He knows where he was born and approximately his burial place. His interests are directed towards the village. Although gypsies still have numerous children, they are fast disappearing because they are gradually blending with the gentiles. First, on settling, a trade is sought, usually that of blacksmith, musician or farmer; but the assimilation is most rapid when they begin to do the same work as the villagers, such as agriculture or work in the factories. Then they forget Romani. Most gypsies are of the opinion that a man who does not speak Romani is not a gypsy. A final step is the assimilation of blood, brought about by the marriage of gypsy and gentile. In one village of eighty gypsy families, five, including the richest man, are married to Serbian girls of the peasant class.

Bark Canoe, Dugouts, and Plank-built Boats

JAMES HORNELL, while still convinced of the tenability of his conclusion that both types of the plank-built boat now in use in Europe, the clinker and carvel build, are derivative from the dugout, on further consideration regards the dugout as an intermediate stage only in the evolution of the plank-built boat from the bark canoe (*Man*, August 1940). That the bark canoe represents the earliest form of construction for purposes of navigation is inferred from the circumstances, tools and materials available in the primitive life of a nomadic hunter, and also from the constructional methods of the Australian. Examples of primitive methods of construction of bark canoes are cited from many parts of the world; but among the Australian aborigines all stages of construction leading up to the dugout may be observed. Of these the earliest or most primitive is the trough-shaped bark canoe in which the open ends may be closed with clay, or each end may be bunched together and tied in position with bast fibre or creeper stems. On these follow sharp-ended bark canoes either without internal stiffening, or stiffened by crossed ribs and gunwale poles, upon which follows the development of 'frames' of oblique rib-sticks and, then curved transverse frames of pliant rods. Typically sharp-ended dugout canoes show these transverse frames in ridges across the bottom and up the sides, which are left when hewing out the hull. In a further development these ridges disappear. Of plank-built canoes a primitive form is that of three planks without frames sewn together edge to edge, the prototype of the carvel build, or alternatively overlapped, the prototype of the clinker build. In the latter, inverted frames are tied to cleats on the inner side of the planks; in the former, frames are sewn directly to the hull.

Fungus Parasites of Nematodes

CHARLES DRECHSLER, U.S. Bureau of Plant Industry, describes three species of such fungi found in old agar cultures started from diseased rootlets or other decaying vegetable material (*J. Washington Acad. Sci.*, **30**, No. 6, June 15, 1940). The agar consistency being firm in these cultures, Drechsler points out that the cultures provided conditions approximating to terrestrial rather than aquatic conditions and the fungi described might therefore attack free-living nematodes under natural conditions in the soil. *Haptoglossa heterospora* (gen. et. sp. nov.) was frequently observed destroying enormous numbers of nematodes; it is characterized by the discharge of non-motile infective structures from non-motile sporangiospores and belongs to one of the zoospore-producing groups of the Phycomycetes. *Meristacrum asterospermum* (gen. et. sp. nov.) is a conidial fungus related to the Entomophthoraceæ and occurred in leaf mould from Wisconsin; it was observed destroying nematodes in agar plate cultures from this leaf mould. It is distinguished by its production of plural conidia, mainly laterally, on a multiseptate conidiophore. The last fungus described possibly did not attack healthy eelworms but only hosts already disabled by a protozoan endoparasite. It

is a species of Cephalosporium and is not assigned a name as it is thought that the cephalosporium stage described may only constitute an accessory reproductive phase in the development of the fungus concerned.

Magnesium Deficiency in Fruit Trees

T. WALLACE (*J. Pom. & Hort. Sci.*, **18**, 145 ; 1940) reports investigations on the magnesium status of leaves from various fruit plants growing in orchards on different soils. Symptoms of magnesium deficiency in apples, black currants, gooseberries, and plums were accompanied by low magnesia in the leaves. The importance of the base status is stressed. Data for healthy apple leaves show CaO between 1·5 and 2·4, MgO 0·42–0·49 and K_2O 1·1–1·9 as percentages of the dry weight. Minimum values for MgO and K_2O consistent with health are given as 0·4 and 1·0 per cent respectively. Symptoms of magnesium deficiency did not appear in conditions of potash deficiency. Leaves showing no symptoms at a given potash level showed definite symptoms when the potash content was raised, though no significant change in magnesium content occurred. Magnesium requirements were increased when liberal dressings of potash were given. Magnesium deficiency may occur in conditions of high or low lime. In the former case, dressings of kieserite or Epsom salts are advised, and in the latter magnesian limestone. In the same journal (p. 119), E. B. Kidston, *et al.*, describe symptoms of magnesium deficiency in apple leaves in the Nelson district of New Zealand. Appearance of the symptoms, brown blotching between the veins, and premature defoliation, were prevented by injections of magnesium sulphate. The deficiency symptoms were most severe where liberal use of potassic fertilizers had been made. High potash in the leaves was correlated with low magnesia. On leached acid soils, magnesium deficiency is presumed to be due to an unfavourable ratio of available potash to available magnesium.

Reproduction in Rubus

M. B. Crane (*J. Genet.*, **40**, 109–118 ; 1940) and P. T. Thomas (*J. Genet.*, **40**, 119–128 ; 1940) show that *Rubus nitidioides*, *R. vitifolius*, *R. thysiger*, *R. calvatus* and others may produce offspring by asexual means. Sometimes these asexual progeny showed segregation of characters. Some species may produce both sexual and asexual progeny. Thomas finds that the embryo-sacs degenerate in *R. nitidioides* and that apospory is probably general in this species. *R. vitifolius*, however, shows a more normal development although there are sometimes abnormalities in the differentiation of the embryo-sac nuclei. *R. nitidioides* regularly reproduces by apospory, while *R. vitifolius* pollinated with diploid *R. idæus* reproduces sexually, and pollinated with tetraploid *R. idæus* it may produce progeny by apomixis. Further, segregation may occur in this apomictic series. Thomas directs attention to the fact that the transition from completely sexual to completely apomictic reproduction is correlated with the transition from allopolyploidy to autopolyploidy and the related sterility phenomena.

New Plant Diseases

W. C. MOORE, of the Ministry of Agriculture's Plant Pathological Laboratory, Harpenden, keeps a watch over some of the minor maladies of plants as well as upon the major diseases. Three new examples of lesser-known pathology are described in a recent short paper (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 59–63, June 1940). *Lobelia syphilitica* var. *nana* is attacked by a fungus of the genus Septoria, probably *S. Lobeliæ* Peck. This causes irregular pallid blotches upon the leaves, which are ultimately killed ; the disease has appeared in America and Germany, and has only appeared yet as an isolated instance in Great Britain. Another species of Septoria also attacks *Campanula Raineri*, which unfortunate host is further parasitized simultaneously by *Ascochyta bohemica* Kab. and Bub. The third disease is a root and bulb rot of tulips caused by *Pythium ultimum* Trow., the pathogenicity of which has been proved by isolation and re-inoculation. This is, perhaps, scarcely one of the minor plant diseases, for it is probably more widespread than is commonly known. The present account discusses some of the environmental factors which affect the severity of attack. Plant pathologists should find this paper, and the earlier ones of the series in the same journal very useful in the identification of infrequent maladies.

Extreme Specialization of a Rust Fungus

THE very close specialization exhibited by many rust fungi is well known to mycologists, but *Uromyces Scirpi* appears to provide an extreme form of host preference. It is heterœcious, having uredo- and teleuto-spores on *Scirpus maritimus*, with spermagonia and æcidia on *Glaux maritima* or on *Œnanthe crocata* and other umbellifers. Grove and Chesters described the occurrence of the æcidial stage on *G. maritima* at Gorleston in Norfolk, though not on susceptible umbellifers in the neighbourhood, and also the appearance of æcidia on *Œnanthe crocata*, but not on surrounding *G. maritima* at Saltash in Cornwall. There seems to be a specialized host relation in the æcidial stage, and this conclusion is now reinforced in a detailed paper by Margaret Fort (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 98–108, June 1940). Infection experiments and cytological investigations were carried out with material from Fife where *S. maritimus* and *Œnanthe crocata* were natural hosts, and no æcidia were seen on the neighbouring Glaux. Œnanthe was repeatedly infected and re-inoculations to *S. maritimus* proved the life-cycle, but no inoculation of *G. maritima* was successful. Mycelium on *S. maritimus* was binucleate ; that on *Œnanthe crocata* uninucleate until after the production of spermatia, when binucleate cells appeared regularly in the base of the developing æcidium.

Earthquake Work at Toledo, Spain

DURING the first quarter of 1940, fifty earthquakes were registered on the Weichert seismographs at the Geophysical Observatory at Toledo (director, Enrique Barrios). Six of these were sufficiently well registered to have their epicentres determined. The first on January 6 was near New Caledonia (22° S., 170° E.). The second on January 17 was near the Mariana Islands (17° N., 148° E.). The third on February 7 was near the Aleutian Islands (52° N., 174·5° E.). The fourth on February 12 was near the coast of Chile (26° S., 71° W.). The fifth was on February 20 near Santa Cruz Islands (12° S., 167° E.) and the sixth on March 27 was near the Aleutian Islands (51° N., 180°). Some of the other registrations were confused by microseisms of which the report gives some information.

DIET AND NUTRITION IN COLOMBIA*

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IT is impossible to make a detailed study of the status of nutrition in Colombia and determine the exact diet of the people because of the lack of information on the subject. No statistics are kept of the production and consumption of food articles, with the exception of meat and sugar. Therefore nobody knows what quantities of milk, bread, eggs, cheese, butter, fruits, vegetables and legumes are consumed annually. These figures could easily be obtained in the larger cities, but not in rural sections where there are no facilities for so doing.

In spite of the little information available, it can safely be stated that the Colombian diet is deficient as regards quality, standards, and method of preparation; and that it is altogether too uniform.

The quality may be considered acceptable in many parts of the country. Bogotá and most of the higher cities have an abundant and wide choice of foods which are scarce in mild and hot climates, such as milk, bread, cheese, fruits, vegetables and legumes. The market-place in Bogotá is superior to those in European cities in its richness and variety; but this advantage is wasted because of the dietary habits of the people, who lean toward sugary foods and starches. The national diet is unbalanced, lunch and dinner consisting mostly of starchy products and ending with a sugary dessert which upsets the digestion.

The Colombian method of cooking is also primitive and deplorable. The food is heavily coated with lard or fat, generally from pork or beef, and very hard to digest. To make things worse, there are no sanitary regulations or inspections to control the sale of food which, if eaten when adulterated or spoiled, may have serious consequences. This explains why in some areas—out in the plains, for example—meat is sold and consumed in a state of complete putrefaction. The markets of Támara and Ten, large towns in the cattle-raising area, sell 'marisco', meat from wild rodents (mostly Echimys), piled up in thin slices. It is nothing more than albumin in a state of decomposition. The plains people also have no sense of the nutritional value of milk, which is a paradox, considering the fact that they are in cattle country.

The dietary standards of the rest of the country are no better. Ignorance and indifference prevail everywhere and, in brief, the following conclusions may be made with respect to the Colombian diet: (1) too many starches and sweets; (2) not enough albumin and fats; (3) not enough milk or milk products; not enough eggs; (4) not enough vegetables and fruits; (5) excessive consumption of alcoholic beverages in some regions; (6) not enough calories (should be at least 3,000); (7) poor quality of certain foods, and lack of drinking water in about eight hundred towns.

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

ORIGIN OF MAIZE*

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THERE have been three general theories regarding the origin of maize: (1) that it originated from pod-corn, *Zea mays tunicata*, which differs from normal maize primarily by a single dominant gene governing the development of a brittle, disarticulating rachis and the production of prominent glumes enclosing the seeds; (2) that maize originated from teosinte, *Euchlæna mexicana*, a wild grass native to Guatemala and Mexico, by direct selection, by large-scale mutations or by the hybridization of Euchlæna with a grass now unknown; (3) that Zea, Euchlæna and Tripsacum, the three American Maydeæ, have descended along divergent and independent lines from a remote common ancestor.

New evidence from cytogenetic studies at the Texas Experiment Station suggest that Euchlæna has had no part in the ancestry of maize, but is instead the product of natural hybridization of Zea and Tripsacum. Euchlæna, which is intermediate between Zea and Tripsacum in many characteristics, differs genetically from Zea primarily by four segments of chromatin, all of which have genes with Tripsacum effects. Hybrids of Zea and Tripsacum have shown that there is some association between chromosomes of the two genera and that interchanges of chromatin may occur. The combined data agree in pointing to the comparatively recent origin of Euchlæna as the result of natural hybridization of Zea and Tripsacum.

With Euchlæna eliminated from a role in the origin of maize, it is reasonable to assume that maize originated as a mutation from a wild pod-corn once indigenous, and perhaps still to be found, in the lowlands of South America. The primary centre of domestication probably occurred in the Andean region of Peru and Bolivia.

The hybridization of Zea and Tripsacum which occurred when the two genera were brought into contact with each other in Central America gave rise not only to the new genus Euchlæna, but also to new forms of maize which spread in both directions, almost completely replacing pure maize in all regions except the Andean. Cytological evidence on chromosomal knobs supports the view that almost all modern maize varieties are contaminated with Tripsacum.

The evidence from history, geology, palæobotany, archæology, ethnology, morphology, genetics, and cytology appears to be in harmony with this new interpretation.

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

DEVELOPMENT IN THE MONOTREMES*

NEARLY a hundred and fifty years have elapsed since the first descriptive account of the Platypus aroused the interest and stimulated the curiosity of the zoologist. Not only did its peculiar external features prompt the name of *Ornithorhynchus paradoxus* proposed for it by Blumenbach, but the general resemblance of its female reproductive organs to those of birds and reptiles rather than to those of mammals suggested its probable oviparous habit.

Very soon, its near congener, Echidna, in spite of its widely different outward appearance, was found to possess the same essential characters. These characters not only led to their classification in the same proposed natural order, Monotremata, but also to their recognition as the only known members of a mammalian sub-class, later named by Huxley Prototheria.

After much conflict of opinion, full scientific confirmation of the fact of oviparity was only finally secured by Caldwell in 1884, and was dramatically announced in a cable message to the British Association of its meeting in Montreal.

Previous to Caldwell's scientific quest, there are no records of the scientific collection of specimens of early embryonic stages of Monotreme development. Even the material described by Caldwell (1887) and by Semon (1894), and that available to Wilson and Hill (1907), was insufficient to reveal more than the outlines of the earliest processes of Prototherian egg development.

The appearance, therefore, of a substantial instalment of their work on Monotreme development by Profs. T. T. Flynn and J. P. Hill (December 1939) is to be warmly welcomed. That work is based upon a relatively rich collection of rare material accumulated by the authors over a period of many years. The present memoir deals with the earliest phases of development of the ovum in both Ornithorhynchus and Echidna, and includes a description of the processes of oogenesis, maturation, fertilization and early cleavage.

Following a brief account of the breeding season and of ovulation in Echidna, a description is given of the intrauterine egg, and then of the laid (pouch) egg in that species. In the great majority of cases one egg only is brought forth, whilst in Ornithorhynchus, as a rule, twin eggs are produced and the shells of these are usually adherent to each other. In Echidna both ovaries are equally productive, while in Ornithorhynchus the left ovary alone is functional.

Oogenesis. The structure and growth of the ovarian oocyte are followed in detail through a series of phases. In the first phase the differentiation of the cytoplasm into peripheral and central zones is visible. The zona pellucida originates as a product of the ovarian follicular cells; a later distinct "striate layer" within the zona may either have a like origin or be formed from the oocyte itself. During the succeeding phase the zona is well established and the origin of yolk-sphere primordia in the cortical cytoplasmic zone can be recognized. During the next phase, active formation of definitive yolk-spheres sets in, at first from the periphery inwards, in the cortical cytoplasm: with the establishment of a typical latebral yolk-zone the formation of definitive yolk-spheres progresses from the latter zone in an outward, peripheral direction. This yolk-forming function of the latebra is discussed at some length together with the corresponding phenomena of the avian egg.

The authors confirm Caldwell's observation of the layer enveloping the oocyte named by him the "pro-albumen" layer, but they reject his interpretation of it as a precursor of the definitive egg-albumen of later stages. They show it to be a secretion of the follicular cells and regard it as the homologue of the liquor folliculi of the Graafian follicule of other mammals.

On the question of the origin and nature of the true albuminous and other constituents of the secondary egg envelopes, which are formed during passage of the ovum through oviduct and uterus, the observations of Dr. C. J. Hill are cited and confirmed.

Maturation. In both Monotremes this appears to be typical: the formation of each of the two polar bodies is illustrated in a series of remarkable figures on plates XIII and XIV. It is noteworthy that the second polar body—given off within the oviduct—was apparently formed independently of fertilization.

Fertilization. Until completion of maturation the germinal disk remains circular, but with the occurrence of fertilization a definite bilateral symmetry is established in the now elliptical area. Towards one end of the longer axis of the area the germinal disk is richer in its content of fine yolk-spheres than at the other, and the conjugating pronuclei lie nearer to the yolk-rich end of the axis.

Conjugation of the pronuclei is fully illustrated in the fine series of figures (74–83). Polyspermy does not normally occur in the Monotremes, although it would appear to be the rule among the Sauropsida.

Early Cleavage. The remainder of the memoir deals in detail with the phenomena of early blastomeric segmentation, the pattern for which is, of course, typically meroblastic.

The first cleavage furrow is transverse to the long axis of the elliptical germinal disk, that is, to the axis of bilateral symmetry. It subdivides the disk into two somewhat unequal areas, of which the smaller is markedly richer in yolk-sphere content. The two areas resulting from the first cleavage are thus dissimilar both quantitatively and qualitatively. The second cleavage is approximately at right angles to the first and coincident with the long axis of the germinal area. The third furrows are more or less parallel to the first and the result is "an eight-celled stage consisting of two linear aggregates each of four cells, symmetrically arranged on each side of the long axis of the disc, i.e., of the second cleavage furrow".

After the 16-cell stage, the arrangement of the blastomeric segments tends to become irregular, but shows a striking resemblance to the Sauropsidan pattern.

Although the bilateral symmetry of the pattern in the eight-cell stage is so evident, the authors do not consider it possible to determine, in the Monotreme, the relationship of the long axis of the unsegmented disk to the polarity of the embryo.

* "The Development of the Monotremata. Part IV. Growth of the Ovarian Ovum, Maturation, Fertilisation, and Early Cleavage." By Prof. T. Thomson Flynn and Prof. J. P. Hill. *Trans. Zool. Soc., London*, **24**, Part 6 (December 1939).

Plates XVII–XXI of the memoir provide ample and brilliant illustration, both in surface and sectional view, of the earlier stages of blastomeric segmentation in the Prototheria, and lead one to anticipate eagerly the authors' future elucidation of the succeeding stages of development and above all of the beginnings of germ-layer differentiation.

Only those with some experience of the technical difficulties involved in the collection, preparation and sectioning of material at once both rare and refractory to treatment can fully appreciate the success with which those difficulties have been surmounted, as well as the excellence of the figures with which the memoir is so abundantly adorned.

UPWARD MOVEMENT OF SALT IN THE PLANT

Prof. D. R. Hoagland, T. C. Broyer and P. R. Stout of the University of California, Berkeley, read a paper dealing with the upward movement of salt in the plant, with special reference to the metabolic activities of roots, before the U.S. National Academy of Sciences at its annual meeting held during April 22–23.

Previous investigation has proved that accumulation of salt by the plant from the nutrient medium depends on aerobic metabolism of root cells. The relation of root activities in salt accumulation to movement of salt to the shoot has now been studied from several points of view. For certain purposes it has been necessary to conduct experiments over short periods of time with tracer elements, not initially present in the plant. Bromide ions and salts of the radioactive isotopes of bromine, sodium, phosphorus and potassium have been utilized. One of the authors (P. R. Stout) has developed technique for showing in graphic manner the general distribution of radioactivity in the plant by effects produced on X-ray films.

Several general cases of salt movement are recognized: (*a*) under influence of root pressure, (*b*) as affected by transpiration, (*c*) movement under conditions conducive to root injury produced by high salt (for example, sodium chloride) concentrations. Xylem exudates may build up very rapidly concentrations of salt much higher than those of the external solution. This may occur even before the roots have attained their maximum capacity for salt accumulation. The phenomenon is related to oxygen supply to roots, concentrations and kind of salt supplied, and indirectly to photosynthesis. Soluble organic nitrogen compounds and organic acid can also move in the exudate dependent on metabolic activities of the root and nature of salt supplied. The effects of $KHCO_3$ are particularly interesting in connexion with organic acid metabolism. Young active barley plants may absorb and translocate nutrient ions almost as readily in the dark as in the light, over brief experimental periods. Such plants may grow normally for some time with nutrients supplied only during the diurnal dark periods. With large plants, or those less capable of developing root pressure, rapid upward movement of salt depends on transpiration, which may thus indirectly influence absorption of salt by the root. Further evidence was obtained on the path and rate of upward and downward movement of phosphate by the use of radioactive phosphorus.

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

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LECTURER IN CIVIL ENGINEERING—The Secretary, Technical College, Sunderland (September 16).

GRADUATE TEACHER FOR SCIENCE SUBJECTS, preferably with PHYSICS as a main subject—The Principal, Luton Technical College, Park Square, Luton (September 17).

IRRIGATION ENGINEER for the Government of Ceylon Irrigation Department—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9394) (September 27).

ASSISTANT TO TEACH ENGINEERING DRAWING, ENGINEERING SCIENCE, etc.—The Registrar, Technical School for Boys, Wimbledon, S.W.19.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 16: (a) The Genetic Interpretation of Plant Breeding Problems, by J. B. Hutchinson; (b) Inheritance of Quantitative Characters and Plant Breeding, by V. G. Panse. Pp. 34. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [138

Medical Research Council: Committee on Traumatic Shock and on Blood Transfusion. M.R.C. War Memorandum No. 1: The Treatment of Wound Shock. (Instructions produced in co-operation with the Army Medical Service.) Pp. ii+20. (London: H.M. Stationery Office.) 4*d*. net. [218

Other Countries

Report of the Forest Department of British Honduras for the Year 1939. Pp. 22. (Belize: Forest Department.) [158

U.S. Department of Agriculture. Technical Bulletin No. 711: Economic Status of the English Sparrow in the United States. By E. R. Kalmbach. Pp. 66+3 plates. 15 cents. Technical Bulletin No. 723: Biology of the Seed-Corn Maggot in the Coastal Plain of the South Atlantic States. By W. J. Reid, Jr. Pp. 44. 10 cents. (Washington, D.C.: Government Printing Office.) [168

Field Museum of Natural History. Anthropology Leaflet 34: Ancient Seals of the Near East. By Richard A. Martin. Pp. 46. (Chicago: Field Museum of Natural History.) 25 cents. [198

Imperial College of Tropical Agriculture. Ninth Annual Report on Cacao Research, 1939. Pp. 52. (Trinidad: Imperial College of Tropical Agriculture.) 5*s*. [198

Bernice P. Bishop Museum. Bulletin 160: Ethnology of Easter Island. By Alfred Métraux. Pp. vii+432+7 plates. Bulletin 165: Zonitid Snails from Pacific Islands, Part 2: Hawaiian Genera of *Microcystinae*. By H. Burrington Baker. Pp. iii+105–202+plates 21–42. Bulletin 167: Report of the Director for 1939. By Peter H. Buck (Te Rangi Hiroa). Pp. 42. (Honolulu: Bernice P. Bishop Museum.) [198

Occasional Papers of Bernice P. Bishop Museum. Vol. 15, No. 15: Four New Microcryptorhynchus from the New Hebrides and Caroline Islands (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 167–174. Vol. 15, No. 16: A New Variety of *Ruppia maritima* (Ruppiaceae) from the Tropical Pacific. By Harold St. John and F. Raymond Fosberg. Pp. 175–178. Vol. 15, No. 17: Additional Notes on the Archaeology of Fanning Island. By Kenneth P. Emory. Pp. 179–190. Vol. 15, No. 18: Scolytidae and Platypodidae of the Mangarevan Expedition. By C. F. C. Beeson. (Mangarevan Expedition, Publication 30.) Pp. 191–204. Vol. 15, No. 19: Notes on the Morphology and Sexuality of the Terrestrial Nemertean, *Geonemertes palaensis*. By W. R. Coe. (Micronesian Expedition, Publication 4.) Pp. 205–212. Vol. 15, No. 20: Notes on Micronesian Rubiaceae. By F. R. Fosberg. (Micronesian Expedition, Publication 3.) Pp. 213–226. Vol. 15, No. 21: The Genus *Ficus* (Moraceae) in Southeastern Polynesia. By V. S. Summerhayes. (Mangarevan Expedition, Publication 33.) Pp. 227–228. Vol. 15, No. 22: Hawaiian Plants named by Endlicher in 1836. By Harold St. John. (Hawaiian Plant Studies. 8.) Pp. 229–238. Vol. 15, No. 23: Some New Species of *Araucaricola* Lea from the South Pacific (Coleoptera, Tenebrionidae). By K. G. Blair. Pp. 239–242. Vol. 15, No. 24: Thysanoptera from New Guinea and New Britain. By Dudley Moulton. Pp. 243–270. Vol. 15, No. 25: Synopsis of the Genera of Hawaiian Cossoninae, with Notes on their Origin and Distribution (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 271–294. Vol. 15, No. 26: The Isopod Crustacea of the Hawaiian Islands (Chelifera and Valvifera). By Milton A. Miller. Pp. 295–322. Vol. 15, No. 27: Mosses of Southeastern Polynesia. By Edwin B. Bartram. (Mangarevan Expedition, Publication 34.) Pp. 323–350. (Honolulu: Bernice P. Bishop Museum.) [198

Tanganyika Territory: Department of Agriculture. Fifth Annual Report of the Coffee Research and Experiment Station, Lyamungu, Moshi, 1938. Pp. 40. (Dar es Salaam: Government Printer.) 1*s*. 6*d*. [208

U.S. Office of Education: Federal Security Agency. Bulletin 1940, No. 4, Part 1: Elementary Education—What is It? By Helen K. Mackintosh. Pp. v+31. (Washington, D.C.: Government Printing Office.) 10 cents. [218

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