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Human Tendencies

IN the annals of the British Association there will be found not one but many landmarks in the history of science. The Blackpool meeting of 1936, it is probable, will stand out as a whole, certainly in popular memory, as the one meeting above all others which from the inception of the Association up to that date has endeavoured to address itself on a united front to a diagnosis of the current ills of human society. The presidential address, no less remarkable for its controlled imagination than for its keen insight into and power of analysis of complex social phenomena, set the keynote of the meeting; and it was a striking testimony to the sense of responsibility to the community which is felt by the men of science of to-day that the lead given by the president of the Association was followed not alone by the sections dealing with the biological and humanistic sciences. Even a branch of study so academic, so apparently remote from the stress of current social problems as palæontology, afforded Prof. H. L. Hawkins in the presidential address to Section C (Geology), part of which appears in this issue of NATURE (p. 534), the material for pungent comment on current tendencies in human development.

It is possible, however, that on reflection there may appear no paradox in the fact that a science such as palæontology, of which the data are far removed from current events, should nevertheless provide a canon of criticism for tendencies of to-day. Although we may feel inclined to qualify Prof. Hawkins's dictum that our knowledge of the ancient Romans is at best equal to our knowledge of the trilobites, yet we may agree that as we can here view the beginnings, the prime, and the decay of long extinct species more clearly and more objectively than we can observe the rise and decline of the powers and empires of the past, so we may perhaps deduce from them more certainly the operation of biological laws which affect the evolutionary process in human affairs, no less than those which govern that process in the development of man himself.

Prof. Hawkins led his audience from stage to stage of evolution in organisms of the past to the emergence of man himself. It might seem a sorry commentary on his text for those who believe in the evolutionary process as a progression in perfectability to turn to the discussions and addresses in other sections, and to see what man has made of himself in the vast interval of time which has elapsed since that first emergence. There they would have found that man of to-day was being brought to the bar of judgment for handling the dangerous instruments of which scientific development has given him control with the mentality of a schoolboy, and as Lord Horder pointed out in the discussion on "The Strain of Modern Civilization", indicted as the subject of neuroses and auto-infection, because he has allowed himself to fall a victim to the organization which he himself has built up (see p. 529).

It is unfortunate that on the anthropocentric view imposed upon us by the condition of our being, the evidence of palæontology as an objective standard of progress should cease to be operative with the coming of man. When once man as such has evolved, palæontology can tell us little further of really fundamental and significant organic change. Unless mere size of brain be the criterion —in which event man may have surmounted the peak of his development with the passing of Neanderthal man, and modern man actually represent the entry on a phase of decline—on the coming of the modern man with his more highly

convoluted brain, that page of evolution is closed, in any event for the present, whatever the future may hold. From that point onward, throughout man's strenuous struggle to build up civilization, the evidence of change in man is indirect—and neither palæontology, archæology nor, except to a limited degree, history tells us what functional change may have accompanied his further development. Man as we see *ex post facto*, at the time of his emergence, is differentiated from his contemporaries of the animal world by the spirit, and by its achievement he should be judged. Less well equipped than any other animal approaching him in size with either protective covering or strength of tooth and claw, yet he is less at the mercy of his environment. Armed with the most powerful weapon of defence and destruction that Nature has forged, the human brain, he has conquered his environment so that not only has this otherwise defenceless creature made himself master of every quarter of the globe, irrespective of climatic and other environmental conditions, but also he is exterminating or subjugating all animal life, while exploiting all natural resources as well as conquering the air and drawing treasure from the depths of the sea. Hence man's progress in fact is commonly measured by his control of the material resources of the world.

It is scarcely necessary to stress the point to which this assessment of human progress in materialistic terms has brought us. A century of expansion and, on the whole, uninterrupted advance in every department of civilized life has now received a check. A prolonged period of economic depression and disturbed political conditions, international as well as in some instances internal, has dislocated what had come to be regarded as the normal flow of life, and has induced a wave of pessimism, which questions the values of what has hitherto been regarded as progress. Even the very fact whether man has progressed at all, at least since the early days of his emergence from barbarism, is brought into dispute. More grave, because more fundamental, is the judgment implied in the suggestion that 'progress', like Frankenstein's monster, has outrun the power of man to control it, and that therefore scientific investigation, which by its effect on production and therefore on labour is regarded as chiefly responsible, should be slowed down to enable consumption and employment to make good the lag rapidly forming a vicious circle from which extrication will be difficult or impossible. Although the British Association neither generally nor specifically in the meeting at Blackpool is legitimately to be regarded as the foster parent of pessimism, nor would be prepared to admit the ultimate sanity of any suggested check on scientific research or its application to practical affairs, yet the unanimity shown by the sciences in the recent debates, in diagnosing the underlying causes of the present situation as in some way or other involved in a lack of conscious direction, marks recognition of the gravity of the evil at the same time as it seems to point a way out.

The complaint that the strain of contemporary life is too great for human endurance is probably as old as the association of human beings in anything larger than a family group. Nor is it always the part of the *laudator temporis acti*. It certainly goes back so far as Horace when he longed for the quiet of his Sabine farm; it is familiar in the eighteenth century, as for example in the works of Smollett, and Sir Josiah Stamp quoted an apt example from the "Creevey Papers" in the reference to the "frightful" experience of travelling by rail at the rate of twenty-three miles an hour. These plaints, however, date from before the days of the machine, when individuality still had room for play. The more strenuous nineteenth century, with its doctrine of *laisser-faire*, encouraged the struggle of the individual, while imposing conditions upon labour and production against which it was the sense of the community that the worker should be protected. It is unnecessary to recapitulate the familiar story of the social and industrial development of the nineteenth and early twentieth century; but the principal trends which are germane to the present purpose are the growth of associations of both labour and employers, the application of scientific methods and results to all departments of production, as well as to the well-being of the worker, and the recognition by the community of its responsibility to see fair play as between employer and employed and the consumer and the producer, as well as generally to preserve so far as possible some balance between the rights of the individual and the claims of the group, whether trade organization or public authority.

The application of these principles to a large extent was opportunist, and so far as concerns the application of scientific methods and results to the problems of society and industry, was often more or less a consequence of pressure, frequently considerable, brought to bear on authority from

outside. Much has happened since then; and of all the lessons of the Great War, the most enduring and the most far-reaching have been the value of scientific research when applied to the problems and needs of practical life, and the impetus which can be imparted to concerted group effort under direction.

Of these two lessons the latter was already in principle familiar to the anthropologist. It is a form of the struggle for existence whereby man seeks to secure survival through combination in groups which ever increase in size and complexity. As a result of experience in the War, this principle has been transformed into a political dogma. It has produced on pseudo-scientific argument the totalitarian State, whether communist, fascist or quasi-constitutional under a virtual dictator.

The weakness of the totalitarian State is as obvious as its strength. It exalts the whole at the price of individuality, and in so far as it must in self-protection stamp the individuality of the many with the brand of the few, however wise and provident they may be, it will in the long run weaken the whole. For the group to survive must survive through the quality of its individual components. The problem of future research in the biological and humanistic sciences is to solve the equation of group interest and individual well-being. As Sir Josiah Stamp indicated in his presidential address to the British Association, the crisis in world economics and politics has forced it on our attention that there is a vast field in the constitution and character of man, his heredity, his training, his social and economic relations, more especially in relation to changing conditions, which await investigation. However intense and far-reaching may be the efforts of research directed to the improvement of material conditions, the result may be, who can say, perhaps more harm than good unless we understand more clearly than we do at present the whole nature of man and his reactions both as a unit and in the group. In the long run, the race will be to those who solve this problem.

A Text-Book of Unapplied Biology

Why Keep Them Alive?

By Paul de Kruif, in collaboration with Rhea de Kruif. Pp. vii+293. (London: Jonathan Cape, Ltd., 1936.) 10*s*. 6*d*. net.

DR. PAUL DE KRUIF is a writer better known, unfortunately, in his own country than in England. Beginning life as a bacteriologist, he soon abandoned academic science and research, and devoted his talents to the vulgarization (in the French sense) of scientific and medical discoveries—becoming, in his own words, "a sort of human loud-speaker, a barker", telling the world at large about some of the wonders of biology. In "Microbe Hunters" (1926), "Hunger Fighters" (1928), "Men against Death" (1932), he has already related, in colloquial American language, various outstanding 'triumphs' of bacteriology, nutritional physiology, and medicine. All these books are distinguished by the accuracy of their scientific and historical data, though these are often presented in a picturesquely overdrawn manner and from a national point of view not always appealing to a more stolid English audience.

As our author has already employed his scientific knowledge and literary gifts to good purpose, we turn to his latest work in confident expectation that he has again some arresting news to announce. And he has. He has discovered that the scientific and medical marvels which he formerly chronicled so dramatically and so hopefully are not being properly used for the benefit of humanity. Despite all our new knowledge—which he has already been at such pains to broadcast—about microbes, vitamins, and hormones, he finds that American citizens are still dying off like flies from starvation and avoidable afflictions. So he asks with righteous indignation why this is so. If we have not the sense to keep even our innocent little children alive and well in a world of knowledge and plenty—to stop them dying from starvation, and from preventable and curable diseases—why in Heaven's name do we let them live at all?

Both the contents and the temper of this disturbing book can be briefly indicated by the titles of its chapters (I almost said "the texts of its sermons"). (1) Why should they die? (2) Discovery that children are forgotten. (3) Discovery that it's dollars or children. (4) The power of science without money. (5) The people's death-fight. (6) Drouth is a blessing. (7) Who owns our science? (8) Observation of children of the shadows. (9) Should children eat? (10) Children can live! These headings give but a faint idea of the variegated and confusing pattern of the whole: yet the reader who conscientiously follows

the author to the last page—undeterred by his seeming inconsequence, verbal exuberance, and eccentric punctuation—will find that the game is worth the candle. He will find that he has incidentally acquired much exact information not only about infant mortality in the United States, the diagnosis and cure of consumption in Detroit, and the horrors of drought in Wisconsin and of the slums in Cincinnati, but also about such apparently irrelevant matters as the discovery of the tannic acid treatment of burns and the birth of the famous Dionne quintuplets in Canada.

From this wealth of detail it is not always easy to disentangle the main argument; but de Kruif appears to be trying to enunciate and solve, for a special case, a general problem of supreme scientific importance. How is it that Man, a supposedly intelligent animal, is still unable to use his painfully earned knowledge properly for the good of his own species? His scientific knowledge is already immense, and adequate for most of his specific needs; yet he has hitherto discovered no way to disseminate it for the benefit of all mankind, nor even to prevent its prostitution for human destruction. (This dilemma is, of course, familiar to readers of NATURE. So recently as July 18, an editorial article noted that "Nothing could be more unscientific than the contemporary armaments race, and the existence of widespread poverty and malnutrition in a period of unparalleled development of the technique of production, and the study of the science of nutrition".) But it makes de Kruif's blood boil when he sees people famishing in one of his United States while 'surplus' food is being destroyed in another: and he is driven almost to frenzy by the sight of children dying of starvation and preventable and curable diseases for lack of the money which his Government could find, if necessary, to kill another nation's children in warfare. He wants to know who is to blame for this sinful situation—and make him suffer for it.

Every man of science must sympathize with de Kruif in his indignation, and must share his passionate desire for reform. Nevertheless, it must be confessed that he himself appears to have found no solution of the fundamental problems which he attempts to formulate; and one may well even doubt whether any solutions are possible by his emotional method of approach. There are passages, it is true, in which he appears to favour some form of communism as a remedy for our present economic, social, and scientific disorders; but he is too great an individualist to pursue that line of argument very far. Moreover, when the question of guilt arises, he has an uncomfortable feeling (haven't we all?) that even he himself may not be entirely blameless—for isn't it *his* duty to do something about it? So he takes refuge in the thought that, after all, he is "only a reporter": it is not his job to put things right. When everything else fails, he seeks eternal truth by fixing his eyes on the horizon of Lake Michigan—just as the monks of Mount Athos formerly did (if we may believe Gibbon) by contemplating their navels.

Such consolations are not for everyone, however, and the question of responsibility for the non-application and misapplication of science has got to be faced more scientifically. In a sense, of course, the blame rests upon all mankind—including men of science themselves: but the excuse that "I am only a reporter" (or "only a man of science", which is equally valid) is surely but an echo of the voice of Cain—"Am I my brother's keeper?" Is it likely to be more acceptable? Yet no man engaged upon research in pure science—a whole-time job—can attend to the proper application of his discoveries (if any) at the same time. Though de Kruif now says in the heat of the moment that "science for science's sake" is "balderdash", he knows full well that science must be made before it can be applied, and that no man can serve two masters.

While reading this just indictment, I have been repeatedly reminded of a more famous work published two centuries ago—"A Modest Proposal for Preventing the Children of Poor People in Ireland from being a Burden to their Parents or Country, and for making them beneficial to the Publick" (Dublin, 1729). In this little tract Jonathan Swift, as everyone knows, answered de Kruif's question. He was equally appalled by the wastage of child-life in his own day, and in this shocking satire endeavoured to stir public opinion by the outrageous advocation of cannibalism. The Dean of St. Patrick's is not noted for the terseness of his style: but in this tract he appears almost a Tacitus in comparison with de Kruif, whose prolixity and varied repetitions and seeming contradictions often obscure rather than stress the points in his argument. His feelings—obviously very noble feelings, inspired by well-authenticated facts—too often overpower his thoughts. Indeed, the very title of his book—commendably short in comparison with the Dean's—typifies this defect. His question is merely rhetorical, and appears to be scientifically unanswerable: at all events, de Kruif is not really concerned with its answer. At the beginning (p. 25), it is true, he postulates that "Children must live"; but clearly this is no satisfactory logical reply to the question why they should be kept alive.

But it is much easier to criticize and compare this challenging diatribe than to answer the numberless questions which it raises. Some of

these—though not that asked in the title—are really urgent: they concern all mankind at the present moment. Consequently, I hope that de Kruif's latest utterance will reach the widest possible audience, and will not be dismissed as merely local propaganda: for it is far more than this, and deserves serious consideration by everyone who is not content with modern misuses and non-uses of science and scientific method.

I have referred throughout to Paul de Kruif as "the author" because this book is written in the first person singular, though admittedly the offspring of marital collaboration. (All Paul's earlier books, moreover, were dedicated "To Rhea".) If I now look somewhat askance at their newborn child—still a raw product, whose future development no man can predict—it is surely with no ill-will. Indeed, I sincerely hope that this child may escape the fates of those pitiful other babes about whom its parents write so feelingly, and that it will live to lead a long and useful life in the service of all humanity. CLIFFORD DOBELL.

Atomic Spectra

(1) Introduction to Atomic Spectra
By Prof. H. E. White. (International Series in Physics.) Pp. xii+457. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30*s*. net.

(2) The Theory of Atomic Spectra
By Prof. E. U. Condon and Dr. G. H. Shortley. Pp. xiv+442. (Cambridge: At the University Press, 1935.) 42*s*. net.

THE experimental study of atomic spectra has a long and distinguished history. Even the descriptive analysis of spectra in terms of series and term values—the systematic botany of spectra—has a history of some sixty years. It is only, however, since Bohr's explanation of the hydrogen spectrum in 1913, and still more since his further work in 1921 explaining the structure of the periodic table of the elements, that any fundamental theory of atomic spectra has been available, or any rapid advance in observation or systematics has been made. Indeed no such advance was previously feasible, even on the experimental side, for the experimenter did not know what to look for. The field of atomic spectra provides in fact a perfect example of the way in which experiment and theory can react fruitfully on each other, yielding advances in our understanding of the field at a rate which could scarcely have been anticipated even by the most optimistic. Since 1921 the advance has been so rapid that it is fair to say, as Condon and Shortley do in their introduction, that the interpretation of atomic spectra is now finished in broad outline. All known features of atomic spectra have been at least semi-quantitatively explained in terms of the nuclear atom, strictly according to the laws of quantum mechanics. The period of fruitful research in atomic spectra is not thereby closed, for there remain many important details to be elucidated further, and the proper relativistic theory of the many-electron system to formulate. None the less an epoch is ended.

The growth of the theory of atomic spectra in its early stages was identical with the growth of the quantum theory. The empirically determined requirements of the hydrogen spectrum, including the Stark and Zeeman effects for that spectrum, with assistance from the spectra of the alkalis and alkaline earths, led by themselves to the formulation of Bohr's correspondence principle. From this principle to quantum mechanics the climb, severe as it proved until led by Heisenberg, is short and inevitable. The study of the tremendous field of more complex spectra played only a comparatively minor role in this development, although the first successful systematizations of these spectra preceded it. Once quantum mechanics had been formulated, it was soon found that the whole body of spectra fell together into one consistent scheme, the unforced immediate interpretation of which remains one of the chief glories of quantum mechanics—an achievement sufficient by itself to convince the most sceptical. It is this complete interpretation which is presented in the two books here under review, in White's from the point of view of the experimenter, in Condon and Shortley's from that of the mathematical physicist.

(1) After an introduction covering the history of investigations on atomic spectra, and the developments made by the old quantum theory, and giving some account of Schrödinger's equation and the Dirac electron, White's book gives a general account of atomic spectra in terms of the vector model. This account is in every way admirable from the point of view of the experimenter, or of the intelligent student who may prefer or be forced to approach the subject with little knowledge of mathematics. All the results of quantum mechanics are stated in the form of rules, for which the vector model provides a reasonable unity of appearance, and are elaborately applied to actual spectra, but the readers of the book are not primarily concerned with the

derivation of these rules from any general theory.

Theirs not to reason why
Theirs but the rules to ply,

and this is certainly a good, possibly the best, attitude in which to begin the study of atomic spectra.

The various rules such as the branching rule, the intensity rules, Lande's g-rules and Γ-rules, the permanence rule for the g- and Γ-sums, can all be presented quite simply and fairly systematically in terms of the vector model, adapted to quantum mechanics by taking the square of any angular momentum vector L to be $L(L+1)$, so long as one is prepared not to worry overmuch about the reason provided by quantum mechanics for the procedure specified by the rule. This is the attitude adopted by White, and it results in a most successful book, which can be heartily recommended to the readers for whom it was written. Some of them may even feel that the presentation could just as well have been even less related to the underlying theory, and that some part of the description of the old quantum theory could perhaps have been omitted.

One of the best features of White's book is the obvious glee with which the author writes of features of the more complex spectra, such as "the great calcium triad". Enthusiasm is infectious, and the reader is conducted willingly through fields which might well have proved arid. His willingness is rendered all the greater by the profusion and excellence of the diagrams and plates. Some of the most beautiful of these are the electron cloud photographs which demonstrate the relationship of the Schrödinger's wave functions to the orbits of Bohr's older theory.

(2) Condon and Shortley have written a book which is as different from White's as two books on atomic spectra could well be. They are concerned almost exclusively with the strict derivation from quantum mechanics of the rules of the vector model and other general features of atomic spectra. The space devoted to comparisons between theory and actual observations has been necessarily reduced to a minimum. Such comparisons can be found elsewhere, notably in White's book.

Many methods of presentation are open to an author setting out to expound the mathematical theory of atomic spectra. The main classes of presentation will be determined by whether one admits or excludes the explicit use of certain branches of pure mathematics, notably group theory and matrix algebra. Condon and Shortley admit matrices and exclude groups. They explain that in their opinion, in which the reviewer concurs, the explicit use of group theory would make too great demands on the mathematical equipment of too large a proportion of those mathematical physicists who might be expected to read such a book on the theory of atomic spectra. Not long ago, the same might have been said about matrices, and even to-day the matrix algebra which dominates large portions of the book may prove a difficulty to some readers, though probably only to the older ones. Even such readers, however, will probably put the book down convinced that matrix algebra has come into the subject to stay, and that to attempt to write the mathematical theory of spectra without this compact and powerful language would be retrograde if not impossible.

It will now perhaps be useful to survey in rather more detail the contents of this book. The introductory matter consists of a résumé of Dirac's exposition of quantum mechanics and his theory of observables, of the matrix algebra of angular momenta and of the classical radiation theory. With this background the argument proceeds to a complete discussion of one-electron spectra, which is then extended to many-electron spectra in great detail. An admirable feature of this part of the discussion (both in Condon and Shortley's and White's books) is that both Russell-Saunders and j-j coupling are considered separately on an equal footing. Both are almost equally important limiting cases, and in Condon and Shortley's book there is an instructive chapter tracing theoretically the transition from one to the other through the various stages of intermediate coupling. Having thus completed the theoretical background used in the systematic description of all ordinary spectra, the authors bring X-ray spectra into the optical scheme in a most satisfactory way by a discussion of the properties of almost closed configurations, of which both X-ray terms and many optical terms in the rare gas spectra are equally examples. The book continues with an excellent account of Hartree's method of the self-consistent field, and of the accurate calculations by the Rayleigh-Ritz method of the normal state of helium-like structures, and another of the interaction between different atomic configurations leading to perturbed series and many-electron jumps. The closing chapters describe the Zeeman, Stark and nuclear effects on atomic lines.

No one but an habitual worker in the field of atomic spectra could hope usefully to criticize in detail an exposition such as the present, and the reviewer can make no such claim. Its power and thoroughness leave the general impression of a work of the first rank, which successfully unifies the existing state of our knowledge, and will prove for many years a starting point for further researches and an inspiration to those who may undertake them.

R. H. F.

Compression Ignition Engines

(1) High Speed Diesel Engines:
with Special Reference to Automobile and Aircraft Types; an Elementary Textbook for Engineers, Students and Operators. By Arthur W. Judge. Second edition, revised and enlarged. Pp. xi + 347 + 41 plates. 15*s*. net.

(2) Maintenance of High Speed Diesel Engines:
a Practical Handbook for Diesel Engine Fleet Owners, Maintenance Engineers, Operators, Drivers and Mechanics. By Arthur W. Judge. Pp. vi + 192 + 32 plates. 10*s*. 6*d*. net.
(London: Chapman and Hall, Ltd., 1935–36.)

(1) THAT a second edition of this book should be called for within two years is a tribute alike to the widespread interest in the subject and to the manner in which Mr. Judge has dealt with it. No doubt most of its readers are interested principally in the application of the compression ignition engine to road vehicles and in a lesser degree to the more difficult field of air transport.

The rate of growth of road usage has been remarkable, as the London streets alone bear witness; but the prospect of there being produced an attractive engine for aircraft operation is still one of 'Jam to-morrow' rather than of anything more immediate. Reliability for road usage has been achieved; but the pursuit of this elusive quality for engines with the lighter scantlings necessary for aircraft has proved arduous. So far, the undoubted merit of freedom from the worse forms of fire risk has been balanced, and rather more than balanced, by the disadvantages of greater weight and less dependability. Indeed, reasonable freedom from forced landings is an essential to any air service which depends on the patronage of the public; whilst for military use the petrol engine gains greatly in any comparison by its lighter weight.

One of the virtues of the compression ignition engine is always held to be the freedom it gives from all the complications attendant on the electric ignition system but, as Mr. Judge's pages bear witness, the alternative complications of fuel pump and fuel piping show that there is little to be gained by this exchange.

In the large-scale use for motor transport, there has been shown to be a large saving in fuel costs, and, in Mr. Judge's view, even the present fuel tax will not cause this to disappear. The general utility of the engine in this field, where high crank-shaft speeds are essential, has been won in no small measure by attention to the production of turbulence in the air close to the fuel inlets. The bearing, on this factor, of ingenuity in cylinder head design is fully brought out by the author.

The book is very practical, and it will find many engineers who will value its possession as a really up-to-date guide on a subject which such a vast number of them have to deal with in their daily work. It is true that it is a compilation of work done by others rather than an exposition by a master, but the latter it does not profess to be.

(2) Mr. Judge's second volume relates solely to care and maintenance, and does not call for special remark. It appears to be a thorough compendium of useful experience and practical hints. It will no doubt find its circle of readers.

Down to Earth:
an Introduction to Geology. By Carey Croneis and William C. Krumbein. Pp. xviii + 501 + 64 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1936.) 17*s*. 6*d*. net.

IT is unusual, in Great Britain at all events, to find a book of elementary science enlivened with facetious illustrations. Such, however, is the case in "Down to Earth", a volume of nearly five hundred pages by Croneis and Krumbein, published by the University of Chicago Press. There is a large number of figures of which one may be cited as a sample of many. It is entitled "Earth has not yet answered the question of her origin" and Earth is represented as a girl in a straw hat, short skirt and apron scratching her head, and is being pointed at by three stars in top hats and walking sticks. In addition to the many figures there are sixty-three plates which at first sight look as if they had been taken from some weekly illustrated magazine. Yet the book is a very good one. The plates, each one made up of several good photographs or on occasions diagrams, convey a great deal of sound information on various aspects of geology, palæontology and their applications to modern life. Not all the text figures are humorous; many are the more usual form of diagrammatic illustration, portraits or reproductions of historical medieval text figures. The text is good and conveys a great deal of information. A school boy or girl might perhaps be attracted by the lighter aspects of the volume to absorb the more solid parts, which in fact form the larger part of the work.

Biologie der Tiere Deutschlands
Herausgegeben von Prof. Dr. Paul Schulze. Lief. 37. Teil 26 : Orthopteroidea II, Phasmodea, Saltatoria. Von Max Beier. Pp. 233–415. 16.50 gold marks. Lief. 38. Teil 9 : Acanthocephala, Kratzer, von Friedrich Bock ; Teil 31 : Hemiptera III, von Herman Weber. Pp. 9+209–355. 16.50 gold marks. (Berlin : Gebrüder Borntraeger, 1934–1935.)

THE first portion contains two chapters, one dealing with the Phasmids (stick insects and their allies) and the second the Saltatoria (locusts, crickets, etc.). While other forms are mentioned in the first chapter, it is largely built round *Carausius morosus*. It includes a good account of the anatomy and histology, particularly of the sense organs, but all dealt with in correlation with function. In addition, the reproductive activities and the reactions of the animal are adequately discussed. The second chapter, which deals with the subject matter in the same manner, actually treats of a number of different species and so has a wider basis.

The second portion deals with two separate groups, the Acanthocephala and certain Hemiptera. The structure and life-histories, including the relationship between parasite and host, are very clearly set forth in some of the better known Acanthocephalids. In the introduction, the classification employed is given, and a few pages farther on is a useful list of fifty-eight worms with their final hosts and, where known, the first and second intermediate hosts also. From this it is clear that in many instances the individual species of parasites show a very wide choice of hosts.

The section on the Hemiptera is subdivided into the Aphids and the Coccids. After a satisfactory review of the morphology of the group illustrated by reference to a series of types, there follows a very useful discussion of the life-cycle of these interesting insects. Much of the information is set forth in the form of diagrams, which facilitate comparisons between the different life-histories. While the part relating to the Coccids is somewhat shorter than that relating to the Aphids, it nevertheless covers the ground adequately.

A good feature of all these contributions is the close correlation between the morphological and functional aspects of the problems. The animals are treated as living units so that the series well merits its title of 'Biology'. All the illustrations are well chosen and well reproduced ; the information is up to date and the several chapters are furnished with good bibliographies.

Geometrical Optics
By Dr. H. T. Flint. Pp. ix+266. (London : Methuen and Co., Ltd., 1936.) 7*s*. 6*d*.

DR. FLINT has accomplished a task which leaves teachers of optics very much in his debt. He has produced an elementary treatise which begins at the very beginning of the subject, expounds a rule of signs lucidly and fully, and, after discussing in sufficient detail the topics associated with an intermediate course in optics, goes on to treat of thick lenses, combinations of lenses, aberrations of various kinds, apertures, photometry and optical instruments. Under the last heading are given brief but adequate discussions of the microscope and telescope, the eye and its defects, eyepieces, resolving powers, and various photographic objectives. Those of us who were trained in the optics of a generation ago will recognize the debt that the author owes (and acknowledges) to Drude, whose treatment of the one-to-one correspondence between points in the object- and the image-space is, in general, followed.

That Dr. Flint is the author is sufficient guarantee of the clarity and elegance of the treatment of the subject, and one of the chief virtues of the book is that it leaves the student with nothing to unlearn, whatever may be the direction of his subsequent studies in optics.

Here and there are examples of treatment concerning which divergencies of opinion are permissible. Thus, in discussing focal lines the author very naturally bases his treatment on the properties of lines of curvature—it is the method of approach natural to the mathematician. So far as the average student is concerned, the reviewer finds that method of approach most useful which is based on the properties of the caustic ; this, however, is a very minor matter.

If a suggestion may be made, it is that, in a future edition, a few *laboratory* exercises might with advantage be added, and that, in the exposition of the properties of the cardinal points, the Bravais points should not be forgotten.

The book may be unreservedly recommended to students in the final or junior honours grade in the universities.

Physical Chemistry for Colleges :
a Course of Instruction based upon the Fundamental Laws of Chemistry. By Prof. E. B. Millard. (International Chemical Series.) Fourth edition. Pp. ix+524. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 21*s*.

WRITTEN, for the main part, in terms of the classical thermodynamic and statistical theory, the fourth edition of this book, nevertheless, gives adequately the facts of recent discoveries. Chapters involving numerical work are pleasingly free from ambiguity, so that the student should find little difficulty in working through the excellent assortment of problems appended to these chapters, although these exercises would probably be more helpful if the answers were provided.

In his treatment of modern physico-chemical theory, Prof. Millard is sound rather than provocative. Thus, while the existence of activated molecules is deduced as a result of the breakdown of the kinetic theory of reaction, their position in the electro-chemical theory of valency is only briefly mentioned. In the same way, heterogeneous reactions, treated largely as an application of the Phase Rule, might well have been correlated with the modern theories of adsorption and catalytic activation. Minor drawbacks of the book include the lack of formal definition, for example, of heat of reaction, order of reaction, etc., and the ambiguous use of the terms atomic weight, gram-molecular weight, etc.

The Strain of Modern Civilization*

By the Right Hon. Lord Horder, K.C.V.O.

FROM the early days of the primitive curse, life has always imposed its strain upon mankind. It is the penalty we pay for living at all. Philosophers have always assured us that we cannot have life without it. Indeed, they have assured us that some degree of strain is good for us. There is, however, implicit in the title of this discussion the suggestion that the stress of modern life has new elements, and is excessive. In the street, the trained eye detects in the physiognomy of the people the early stages of that concern which, in the consulting room and in the hospital ward, shows itself so frequently as the more established picture of 'anxiety neurosis', unloading itself upon the digestion, the circulation and other bodily functions, which are really more sinned against than sinning. 'Functional' diseases, as against 'organic', have increased, whether in the field of the nervous system proper, the heart and blood vessels or the internal secreting glands. I must not stay to expand, or even to justify, these statements ; few, if any, medical men will contest them. In case after case, a tactfully conducted pursuit after fundamental causes removes the screen of headache, insomnia, indigestion and fatigue, and the anxiety factor is revealed.

In the sphere of microbic infections, as I have pointed out elsewhere, we have new diseases for old. Preventive medicine has freed us from many of the severer epidemics, as also from many fulminant sporadic infectious diseases. Tuberculosis has come largely under control. But in place of such plagues as these, there is an increase in the incidence of those more subtle germ diseases which we call "sub-infections", in which the virulence of the microbe is low, whilst the susceptibility of the host is high. In many of these diseases the germ comes from within and not from without : "a man's foes" are "they of his own household". In short, we are becoming the victims of our own saprophytes. And the only reason we can assign for all this is a 'give' on the part of our own resistance to auto-infection—a 'give' which seems to follow a lowering of the control exercised in health by the nervous system. Such control is, in a strict scientific sense, only a postulate ; it lacks proof ; but is it likely that, with nerve control of so many other functions proved, we shall find that the important function of immunity is an exception ?

So much for some of the effects of nerve strain. What of the causes ? It is almost platitudinous to speak of the anxiety connected with the competition of living, and now with the equally grave and increasing sense of international insecurity ; of the pace at which we live ; of the precariousness of life itself in the streets, so that we seem in these days to live by accident rather than to die by it ; of the monotony and drabness inherent in many workers' long hours of physical and mental effort ; of the lack of air and of exercise and of sleep ; of the exciting nature of our amusements, whether the immediate demand for them be normal relaxation or a dope ; of noise—needless, stupid, provocative, ill-mannered, selfish noise. . . . Platitudinous, and yet, on reflection, the major premise holds good in respect of all these factors.

There is a notion afoot that, in the last analysis, science is largely responsible for the extent and persistence of much of the strain of modern life. I want to say, at once, that I regard this unloading upon science as mere pusillanimity. I hold the view that it is not too *much* science, but too *little* science, that has helped to get us into this trouble. Or rather should I say, not enough interest *in* science and not enough direction given *to* science. What interest does the average individual really take in science and to what extent is he prepared to encourage it ? The answer is, almost nil. Which is odd when we reflect that he recognizes quite fully—as how can he fail to do ?—that at the present time both politics and economics—and some would add even religion—regarded as systems existing for human betterment, seem to have failed him, and science alone is not bankrupt. Science has, indeed, loaded man with benefits, but he has shown an indifference to them, or a carelessness and a prodigality in his use of them, which is quite pathetic.

A Spanish writer says in this connexion that, speaking for himself, . . . "the disproportion between the profit which the average man draws from science and the gratitude which he returns—or, rather, does not return to it : this is terrifying. I can only succeed," he continues, "in explaining to myself this absence of adequate recognition by recalling that in Central Africa the negroes also ride in motor cars and dose themselves with aspirin".

Not only ungrateful in thought and attitude, but ungrateful in mishandling the benefits accruing from scientific endeavour. Blame science ? We need not drive a car so fast that it kills, or make

* From the introduction to a discussion in Section I (Physiology) of the British Association at Blackpool on September 15.

a loud-speaker so loud that it deafens. Science was made for man, not man for science, and the one thing that matters is control. Are we going to drive the machine, or are we going to let it drive us? Mr. H. G. Wells, in one of his inimitable word pictures, portrays civilization as a high-powered motor-car gathering momentum on a precipitous hill, a quaking, gibbering monkey at the wheel, impotent to check its increasing speed. Not complimentary, but terribly suggestive.

Who cares about the direction along which science produces her gifts to mankind? We have an astronomer royal, but we have no biologist royal, still less a psychologist royal. Is this a survival from the days when we thought the stars controlled our destinies? But if "the fault . . . is not in our stars but in ourselves, that we are underlings", as I believe it is, should we not 'do something' about this? Hygiene of the body—the idea seems, at long last, to have been grasped; 'mental hygiene', after a long and painful labour, is, I think, being born. What of spiritual hygiene, the hygiene of temperament? I believe that the spirit of man is fundamentally as amenable to scientific investigation, if not to control, as is his body and his mind.

Amongst the remedies for the ill effects of the strain of modern life, I place first more science, and especially science directed towards the study and development of the mind and the spirit of man. Then it behoves us to guard and support all those amenities which are actually in existence or which are struggling for recognition: leisure for the artisan, the factory hand, the labourer, the shopman and shop woman, the housewife—and for "all who grunt and sweat under a weary life"; slum clearance; playing fields; national parks; the National Trust; physical training; adult classes; pictures; poetry; music; museums; libraries; architecture; quiet for the brain worker and others. Whether our outlook be mainly that of the eugenist or that of the environmentalist, we must not "cease from mental fight" until we have, by these and other means, "built Jerusalem in England's green and pleasant land". I risk platitudes once more but again the major premise holds.

The critic may, however, be saying: "that's all very well; you are only dealing with the individual; it is the mass for whom you must prescribe, the mass that is arising here, and there, and that will determine the trend of civilization in the near future, and even determine whether it continues to exist or not". But, personally, I see little hope for the people of Great Britain through mass movements. Fascist or Communist, when individual freedom has been sacrificed, I see no chance of achieving that control in the spiritual sphere through which alone, I believe, salvation can come to the human race. What matters the colour of men's shirts if these are soon to be their shrouds? Or what matters their numbers? The falling birth-rate in Great Britain is causing some people concern. As a disciple of Francis Galton I am much more interested in the quality than in the quantity of our people. When the clash comes, if come it must, between these two hordes of the new barbarians—civilized barbarians if you like—it may well be that the salvaging of the world, or its doom, may depend upon whether Northern and Western Europe, and America, have been able to preserve an individualized society, or, like the two opposed masses in the dictator countries, have yielded to the tremendous pressure of what may prove to be a bastard civilization and have caught the infection of despair. If our own individualities refuse to be tub-thumped, or intimidated, into a pulp, all may yet be well and the clash may be averted. Meanwhile, "'a plague on both' their blouses!" We had troubles enough of our own with which we were busily, and not altogether unsuccessfully, coping: the loud-speaker next door, the roar of the sports-model car up the street (night-silence for hooters notwithstanding); and now comes another fire-eating speech from a dictator on tour, or an account of one of these orgies of human sacrifice by which an executive hopes to maintain its precarious control. No wonder our nerves are kept on edge.

Much of what I have just been saying may sound like a statement of my own views on international affairs rather than the contribution of a doctor towards the treatment of a disease. But I wanted to emphasize my opinion that remedies that depend upon parading or dragooning patients in the mass are spurious remedies, and are, therefore, unlikely to be finally effective in freeing the world from the strain that it is suffering.

Recently we have been witnessing the invasion of medicine by mass methods, by direct action, by force. The results have been very disappointing. Too often we have had to admit that many of these therapeutic efforts did little more than demonstrate the triumph of technique over reason. We had to start all over again, working out the particular case, and following the indications carefully. That is, we did this if the direct action method still left us a patient to treat. We remembered—what we never should have forgotten—that it is only by this segregation and study of the individual, and attention to his particular needs, that we have any good chance of restoring him to health. It is for this reason that I have dealt with mass movements as efforts towards restoring that sense of security which is essential to national and to international well-being. The analogy from medicine is all against treating the crowd, and all in favour of treating the individual.

It may, however, be advanced that what may not succeed in Great Britain may succeed in Russia or in Germany. Of this it behoves us to hold an open mind. But it also behoves us to be vigilant lest we sell the birthright of our national characteristic, which is individual freedom and poise, for one or other of the vaunted panaceas that are offered us from outside. I say all this at the risk of being charged with egregiousness—a common charge against Britons.

There is another characteristic in a British patient: to treat him successfully he must be treated through his intelligence and through his will, not through his emotions. He responds badly to the '*ça passe*' method.

Nor shall we, if we be wise, listen seriously to the various panaceas offered to us from within. There are several of these. In respect of the worrying menace of war, and the perpetual anxiety it creates, there is the doctor who says: "sign a post-card *against* war, say you won't *have* war". Which sounds reminiscent of that old story, attributed to President Coolidge, who laconically summed up the preacher's sermon on sin by the statement, "he was against it". Or as who should say, "I don't hold with cancer". But who does? This sort of thing doesn't help anybody. Whereas the sentiment implicit in the soldier-poet's question, "Who lives if England dies?" *does* help, nor is the man or woman who is braced by such sentiment necessarily a jingo or a blatant patriot. Ideals are essential for us all, and are invaluable tonics, but the British patient does better on a practical and an attainable ideal than on one which is, in this present world, too visionary. "The test of truth in matters of practice is to be found in the facts of life, for it is in them that the supreme authority resides."

Then, just as we get the hypochondriac in matters of the body and of the mind, so there is in some quarters, or so it seems to me, a tendency to spiritual hypochondriasis. There are folk who, to use Carlyle's significant simile, spend much of their time looking at their own navels, and even comparing them with those of their friends: much too subjective an occupation to be healthy. We break up the hypochondriac situation by exhorting the patient to be more objective in his outlook and to leave his body alone. His body troubles him less when once he effects this orientation. If for 'body' we read 'soul', the same result may be safely predicted from the same treatment. Following a medical thought, I regard these panaceas as being of the nature of quack remedies, because I do not think that they really deal with the facts inherent in the situation. We are asked if Soviet Russia can change human nature. Frankly, I doubt if it can, because I think the change must come from within and not from without. And if we are given time, and given freedom from paralysing fear—fear, the arch-enemy—we can reduce these strains of modern life by effecting a better adjustment in ourselves to the rapidly changing conditions of our times, reducing the pace at which we live, and achieving control. Given time to meet, and to know each other better, we can pool our various national traits. In the last analysis, we are mostly good fellows with similar needs and probably with similar destinies.

When Browning makes Paracelsus say, "Make no more giants, God, but elevate the race at once", he seemed to subscribe to the element of charlatanry with which tradition debits that romantic figure. As I have already said, I do not think the cure will come that way. I believe that only "man can elect the universal man". But I have faith that the human heart *is* "made of penetrable stuff". I do *not* think that "damned custom" has "braz'd it so, That it is proof and bulwark against sense", though at this moment a morbid Hamlet, were he looking on, would doubtless take that view.

I think, rather, that there are still enough people, "whose blood and judgment are so well commingled that they are not a pipe for Fortune's finger To sound what stop she please"—enough of these sturdy folk to check the disease and to re-establish health. The treatment is the treatment of the individual by the individual. Any physician who can inspire "Gentleness, Virtue, Wisdom and Endurance" will help to hasten and establish the cure. Any physician who cannot prescribe these remedies obstructs the cure, and should stand aside.

Is it permissible, in an assembly of scientists, to end on a transcendental note? If so, I would remind myself that the spirit of man, though often needing comfort and reassurance, and perhaps never more than now, is still the dominant factor in all the experiences that it meets, be those experiences in the bodily, mental and spiritual health of the individual or of the race.

"The Lords of life,
I saw them pass,
In their own guise,
Portly and grim—
Surface and dream,
Some to see, some to be guessed,
They marched from East to West:
Little man, least of all
Walked about with puzzled look.
Him by the hand dear Nature took,
Dearest Nature, strong and kind,
Whispered, 'Darling, never mind!
To-morrow they will wear another face,
The founder thou; these are thy race!'"

Evolution of the Solar System

SIR JAMES JEANS opened a discussion on the evolution of the solar system on September 10 at the Blackpool meeting of the British Association. Prof. A. Holmes described the geological evidence concerning the age of the system; Prof. E. A. Milne discussed its dynamical aspects from the point of view of his recent work on the foundations of dynamics and gravitation; in the absence of Mr. R. A. Lyttleton, his binary star hypothesis of the origin of the system was described by Prof. W. H. McCrea; Prof. V. Bjerknes spoke on some hydrodynamical aspects; Dr. Harold Jeffreys stated some problems raised by the chemical composition of the planets, and summed up the discussion. Some of the points raised are summarized here.

No theory of the origin of the solar system has yet gained general acceptance. Indeed, until quite recently, none existed which satisfied all the following simple general tests: it should explain (i) the production of satellite systems as well as the planetary system; (ii) the regularities in the sequence of the planetary masses, of the ratios of the masses to those of the largest corresponding satellites, and of the numbers of corresponding satellites, when the planets are arranged in order of distance from the sun; (iii) the birth of the system at an epoch when the physical constitution of the sun was not greatly different from what it is at present; (iv) the large amount of angular momentum possessed by the outer planets.

Arranging the chief theories in order of the number of bodies involved in the birth of the system, we have first Laplace's nebular hypothesis. The origin is sought in the cooling, and consequent shrinkage and speeding up of the rotation, of a single nebular mass of gas extending initially beyond the orbit of the outermost planet. The planets are supposed to be formed from rings of matter thrown off in the process of shrinkage; but there is a failure to explain how such rings could condense into planetary form, or how they could possess the observed amount of angular momentum even were the condensation achieved.

Laplace's theory is found, in fact, to involve an insufficient number of adjustable parameters. So various subsequent theories (Buffon, Proctor, Bickerton, Chamberlain and Moulton, Jeans, Jeffreys) have appealed to the intervention of a second body. Some twenty years ago, Jeans proposed his tidal theory, which at the time was the most successful in this category. A second star was supposed to have described a hyperbolic orbit about the sun and it was shown that, if the approach had been sufficiently close, the tides raised in each body by the gravitational pull of the other would have become unstable and grown into a great filament of gas in the space between the two. The gravitational instability of this gas would cause it to condense into planetary masses, some of which would be retained in the gravitational field of each of the two stars. This theory is particularly successful in explaining the regularities noted under (ii), but, as Jeffreys and H. N. Russell have pointed out, and as its author admits, it again encounters difficulties with regard to the peculiar distribution of angular momentum. Some of the difficulties Jeffreys has tried to remove by imagining a still closer encounter of the two stars than Jeans had postulated.

Russell was the first tentatively to suggest that three bodies had been concerned in the production of the solar system, by supposing that the sun was originally a double star, and that the planets were formed by an intruding star encountering, not the sun itself, but its original companion. The actual production of planets by the encounter would be supposed to proceed as on Jeans's theory, but it would now clearly be possible to account for their large angular momentum about the sun, or, what comes to the same thing, their large distance from the sun. Russell himself saw difficulties in explaining how the companion and intruder could both escape from the sun after the encounter, and still leave the planets entangled in the sun's field. R. A. Lyttleton, however, independently put forward the same hypothesis, and at the same time showed that these difficulties are not inherent in it. He has demonstrated that, for ranges of real values of the initial velocities of the bodies involved, it is possible for the encounter of the companion and the intruder to communicate velocities to them which carry them both "to infinity" in different directions, while parts of the tidal filament formed between them, and endowed with velocities intermediate between those of the escaping stars, would have velocities insufficient to get away from the sun's gravitational field. Further, this may happen for initial velocities of the intruder relative to the sun of the same order of magnitude as the observed relative velocities of stars in the same neighbourhood of the heavens.

The theory can be developed to account for the similar sense of revolution of the planets round the sun, for their rotations, and for the existence of satellites. The latter are supposed to be formed by tidal encounters of pairs of planets when, in their revolution round the sun, they both arrive

back simultaneously in the same neighbourhood as where they were originally formed. That they should do so before they have had time to condense appears improbable, and this is one of the objections that have been raised against the theory. Nevertheless, so far as Lyttleton's theory has been worked out—it is still in its early stages—it does seem capable of accounting for all the *dynamical* features of the solar system.

Geology cannot say anything about the origin of the earth, but from radioactivity data it can set a well-established lower bound to its age. The generally accepted theory of the formation of rocks has indicated where the oldest exposed examples are to be found, and the lead-ratio method has shown these to be about 2,000 million years old, but their constitution shows them to have been made, by weathering and fusion, out of still older rocks. However, combining this information with that got by Paneth concerning the age of meteorites as given by their helium content, we are led to the figure of about 2,700 million years as the age of the solar system. Geological evidence based on seasonal effects preserved in the structure of the varved clays, and on the recurrence of glaciations, shows further that there have been no large changes in the dynamical and thermodynamical relations between the earth and the sun for something like 2,000 million years.

A study of the chemical composition of the planets leads to many grave difficulties, as Jeffreys has emphasized. For example, in the case of the outer planets, the order of increasing mass is the order of decreasing density, which seemingly admits the explanation that when the masses were gaseous the stronger gravitational fields were better able to prevent the lighter elements from diffusing away into space. But now for the inner planets, Mercury, Venus, Earth, Mars, and also the moon, the order of increasing mass is the order of *increasing* density, which is inconsistent with any such simple explanation. Again, the earth consists of a rocky shell of mean density about 3·3 and a central liquid (probably iron) core of mean density about 12. The mean density of the whole moon, on the other hand, is about 3·3, so that it evidently does not possess a heavy core. This suggests that, if the moon was formed by the breaking up of a planetary mass, then it took place after the heavy elements in the latter had had time to settle down towards the centre, indicating that the formation of the satellite took a considerable time. However, most theories of the formation of satellites require them to have been formed very early in the history of the planets. Also it is difficult to explain how the earth retained any light elements unless its crust solidified very quickly, and it is then difficult to see how the moon could have been formed after solidification. In fact, in the present state of the theory, any explanation of one feature of the chemical composition of the solar system appears to be contradicted by some other feature.

The difficulty about the angular momentum of the system has been mentioned. Lyttleton's theory is the most successful attempt hitherto made to resolve it on the basis of ordinary mechanics. There may still be other ways; for example, E. W. Brown has pointed out that the theory of the perturbation of one planet by another might lead to an exchange of angular momentum between them, if it were carried to a higher degree of approximation than is usually done. But a much more fundamental resolution of the difficulty is now put forward by E. A. Milne on the basis of his recent work on the foundations of dynamics. In this work he starts from observers' immediate consciousness of *time*, and their description of motion based thereon, and is able to derive the forms of the laws of dynamics and gravitation from purely kinematical considerations. He postulates the equivalence of observers in regard to their observation of each other and of the rest of the universe, but he does not need to appeal to experience for any empirical 'laws of motion' or of 'gravitation'. His results are derived first in terms of *kinematical time* t. He then finds that they pass over into the local empirical Newtonian forms on transforming to *dynamical time* τ, where $\tau = t_0 \log (t/t_0) + t_0$, and t_0 is the present value of t obtained from the expansion of the universe. The value of t_0 is about 2×10^9 years, which is also about the age of the solar system given by radioactivity data.

So this would place the origin of the solar system at about the singular epoch $t = 0$ occurring in the kinematical theory. If the correspondence were exact, then, since $\tau \to -\infty$ when $t \to 0$, the age of the system, reckoned by dynamical events such as the revolution of a planet round the sun, would be infinite. In other words, in dynamical time the solar system never had a beginning. This suggests a reconciliation between the 'short' and 'long' time scales, which have presented inconsistencies in connexion with many cosmological problems.

Another consequence of the theory is that angular momentum is not a time invariant, but the angular momentum of any local system grows at a rate proportional to itself. Thus small initial differences of angular momentum tend to be magnified as time goes on. This would remove difficulties connected with the rotation, not only of the solar system, but also of spiral nebulæ, in which the amount and distribution of angular momentum has long been a puzzle. It should be added, however, that this theory also has yet been given only in a preliminary form. W. H. McC.

Palæontology and Humanity*

By Prof. H. L. Hawkins

PALÆONTOLOGY gives no direct evidence as to the origin of groups, of whatever taxonomic grade; its scope is limited to records of the later stages in the careers of groups already in existence. This is not to deny that the presumptive evidence for the birth of new types is overwhelmingly strong; but actual tangible proof of their parentage and generation is lacking. A palæontologist is more of an undertaker than a midwife.

Again, fossil evidence cannot give convincing demonstration of the origin of structures in organisms; its scope is restricted to observation of the fate of those structures after they have appeared. There must always be a theoretical quality in attempted explanations of the development of new characters; there are facts recording what happens to them in course of time.

The only language which adequately expresses the nature of morphogeny is that used in description of individual life. Structures, once originated, pass through stages of development, modification and amplification that are closely analogous to the phases of personal history, both physical and psychological. There is a continuous duplicity, in that intrinsic characters are involved with external requirements; environment is educative but not creative. There is a limit to the response to environment possible for any structure; if that limit is exceeded, disaster results. Every character of an organism, like every complete creature, is more responsive to environmental influence in its early history than later. Directions of development induced or encouraged by environment become gradually ingrained; just as practices oft repeated become ineradicable habits. In contrast with modern municipal tendencies, trolley-buses are transmuted to trams.

The several characters of an organism are at once independent and inseparable; each can follow its own line of development, but unless a balance is kept within the whole series, collapse is certain. Just as different groups of organisms show very different evolutionary speeds, so the various structures in a single organism become modified at varying rates. The attainment of mature perfection from a stage of immaturity can never be more than a transient phase on the way to a fresh disproportion comparable with senility.

Structures, and with them the organisms to which they belong, grow old, exhausted or hypertrophied by their own intrinsic expenditure of evolutional 'effort' amid an ever-fluctuating embarrassment of circumstance.

We come to the conclusion that the oracular recommendation to know ourselves is a guide to the secret of evolution. Physically and (in the human case) psychologically, we live our lives as compromises between hereditary tendencies and environmental requirements. As we grow older our accumulated load of compromise becomes an obsession, reducing our capacity for further efforts of the kind; and our environment never tires in its changefulness.

If we consider these principles in the light of the struggle for existence, we find that those types which can attain the most perfect harmony with their environment will flourish proportionately. But their success brings Nemesis in its train; for speedy evolution towards dominance implies continuous speed; the perfection point is passed by the same momentum that reached it. Undoubtedly the victor in the struggle for existence wins the prize; but the prize is death.

When we attempt to apply to human affairs the principles of evolution as shown in palæontology, many difficulties appear. Not the least of these is the impossibility of a dispassionate outlook; we are proverbially unable to see ourselves as others see us. Another serious difficulty arises from the shortness of the time during which our species has existed, and the paucity of trustworthy evidence that it has left of its history.

At the outset we must admit that the basis of our analysis of mankind will be on a different plane from that which we employ in the case of other organisms. Morphological and physiological characters change so slowly that we cannot expect to find much alteration during our brief career; and in any event there is practically no evidence of that sort available. But if the conclusions already reached as to the universality of the law of evolution are accepted, it matters not a whit which particular attribute of an organism we select for study. Behaviour is but an expression of the reaction between the qualities of an organism and its environment, and civilization is a kind of behaviour. This argument is not so specious as it may appear, for the evidence available to check its validity is ample.

* From the presidential address to Section C (Geology) of the British Association, delivered at Blackpool on September 14.

Before following that line further, it will be well to attempt an estimate of the qualities of the human species as they appear to a palæontologist. This is a dangerous task ; for I am bound to omit, for the time being, reference to many human attributes. I must appeal for patience ; I am fully aware of the incompleteness of the analysis I am about to make ; later, in a desperate attempt to arrive at a happy ending, I propose to give consideration to those qualities in man that truly differentiate him from other animals.

If it be asked how a student of 'lower' orders of organisms (and those defunct) can presume to include the human race in his purview, a plea of justification can be made on two grounds. Mr. Tony Weller gave it as his opinion that "the man as can form a ackerate judgment of a animal can form a ackerate judgment of anything". This generalization, like all others, may be debatable ; but the course of human history, in so far as it is known, shows features typical of the course of evolution revealed by palæontology.

The outstanding physical peculiarity of the human species is its upright posture, a feature to which many of its bodily structures are far from completely adapted. In spite of its relatively large size, the human body cannot be claimed as exceptionally capable. A man stripped of the instruments of his devising, left to compete on equal terms with the other occupants of his restricted environment, would stand no better chance than they. It is true that he could perform most of the actions expected of land animals, but none of them superlatively well. Were he compelled to rely on his bodily characters alone, there would be little more reason to single him out for special consideration than there would be the capacity to do so.

The mental powers of man are those that place him in a category apart from other creatures. By the exercise of his wits he can find compensation for structural shortcomings, and challenge, defeat and control all other living things. With the help of the machines that he invents, he can project himself successfully beyond the normal range of terrestrial animals, transporting his body and his habits over the sea and through the air. He can, within fairly wide limits, overcome the influence of environment.

With no intent to belittle the mechanical achievements that have brought man to his commanding position, we must admit that few of them can be claimed as original. They are copies, often improved editions, of devices that already existed in the animal creation, coupled with applications of natural forces that are as old as the world. Man's capacity for generalization has enabled him to foresee the effects of his inventions, and so to reduce the time that would otherwise have been spent on the costly method of trial and error. He can transmit his experiences to his own and following generations, so preventing (for those who listen) a wasteful repetition of mistakes. The speed with which he has beaten all other creatures at their several games is commensurate with the degree of his success. Paradoxically he has become supremely generalized by the exercise of a highly specialized faculty.

It is difficult to find any type of animal behaviour in which man cannot excel. Whether in the strictly mechanical processes, such as locomotion or building, or in the more subtle qualities of affection and aspiration, he stands revealed as an exaggerated animal. There are no activities, constructive or destructive, and no habits, pleasing or loathsome, in which he cannot outdo the most accomplished animal.

This analysis leads to a somewhat equivocal result. On one hand, the high cerebral specialization that makes possible all these developments, and the extraordinary rate at which success has been attained, both point to the conclusion that this is a species destined to a spectacular rise and an equally spectacular fall, more complete and rapid than the world has yet seen. On the other hand, the wide range of directions into which the specialization extends, and the measure of control over environment that it entails, seem to suggest a peculiar kind of plasticity that might pass for generalization, with the consequent hope of a long time-range. In this uncertainty we must look for such facts as are available, facts of history which are at least comparable with the record of palæontology. But first we must estimate the relative value of the evidence afforded by human history.

Fossils and historical documents alike give but a fraction of an account of the matters of which they treat. In both cases the story of the early stages of racial progress is imperfect and often mythological ; the episodes of decline and fall are more fully documented. But, in contrast to palæontological evidence, human accounts are always suspect. Written records of events represent an impression made on one, or at best a few, minds ; they may—indeed they must—be tainted with prejudice and ignorance even when they are not deliberately falsified. The impious rebellion of one writer is the glorious revolution of another. Whatever may be the criticisms levelled at the transcribers of natural history, no doubts can be cast on the essential truth of the record they try to interpret. As an academic proposition, it may be debated as to whether a misread fact is preferable to a misread falsehood ; but there is at least a chance of finding the truth in the former case.

Again, the bulk of human history is the record of the performance of a few actors on a specially selected stage; palæontology, with all its imperfections, gives a picture of events in fairer proportion. The parts of human history usually recorded represent the activities of man the intensified animal, rather than of man the half-fledged angel. The behaviour of the animal is the more rational, and so easier to remember and describe. But from very early times another factor has entered into human affairs—a factor illogical and wayward, but every bit as real to a man as his animal qualities. This factor, which we may call 'altruistic', makes human actions often unintelligible in the present, and still more so in the past. For example, it is easier to find a rational explanation of the presence and characters of a *Micraster* in the Chalk than to form a plausible hypothesis as to the meaning of the Stonehenge that men erected over it. Man can safely claim to be unique, for he is the only irrational creature in the world. A palæontologist may be excused for looking askance at a record of creatures like that written by one of themselves.

Nevertheless, man leaves other traces of his activities besides written screeds, and many of these records are as revealing, and as unintentional, as the shell of a mollusc. By piecing together archæological materials, and fitting documentary accounts into the plan of this mosaic, a conception of human history can be gained that comes within measurable distance of scientific evidence. We have more established knowledge of the Belemnites than of the Incas, but perhaps we know almost as much about the Romans as about the Trilobites.

It would be wearisome to reiterate the various features wherein the history of human affairs corresponds with the course of evolution in other groups. Whether we consider individual lives, dynasties or empires, the same depressing story applies. Some races, once dominant in their particular sphere, have disappeared entirely; others, fallen from high estate, linger in inglorious decay. But all those brave civilizations and empires of which we have records seem to have shown a succession of similar histories. They have risen from obscurity through possession of successful attributes, and have reached the peak of their power only to pass it. Some have rotted away quietly, others have fallen before the onset of less rotten stocks or perhaps of extra-human disaster. Many of the early empires were on so small a scale that their rise and fall had merely local effect; others have been more comprehensive, and their dissolution has spread havoc over wide areas of the world.

Until comparatively recently, there has been a persistent proportion of 'backward' types, unaffected by the civilizing influence of the progressive powers. These have remained as a quiet background to the transient pyrotechnics of the others. They remained to provide a new upstart when the current one had crashed. To-day there are few races of this kind left; almost all mankind has encountered civilization and either perished or been transmuted. The fatal complexity of civilization grips the whole species, crushing it into unity.

The specific causes of the collapse of once dominant races are doubtless varied; but there is general agreement that one universal factor in disintegration is complexity, an aspect of over-specialization. The units of an empire, be they individuals or factions, tend to work together in harmony during the period of upward struggle; but when a position of dominance is won, they continue to struggle. When there are no new worlds to conquer, they begin to fight among themselves. Selfish aims replace patriotic ones, and the community becomes discordant.

The correspondence between this state of affairs and the morphogenetic trends in other races of animals is so close that it needs no elaboration. Those who deny that human institutions are subject to the laws of organic evolution know either no history or no palæontology. Many proverbs give epigrammatic statements of the principles of evolution in imaginative terms.

> "Ill fares the land, to hastening ills a prey,
> Where wealth accumulates and men decay."

The history of extinct empires, which should be studied as a cautionary tale, is commonly regarded as providing an example to be followed. Human nature has the curious trait of gambling against the laws of cause and effect. We always hope that the fate that befel our predecessors will pass us by. Babylon, Egypt, Rome, Spain all traversed the same track; and to-day we follow in their footsteps hoping to reach some different goal.

If this were all, man's outlook would indeed be dark. According to temperament we might as well sit with folded hands in a darkened room awaiting the inevitable end, or meet the crash with ribaldry and riot. Our peculiar quality of superior mentality seems but a suicidal acquisition, hastening and intensifying the imminent doom. But the human mind is more than a fabricator of evanescent institutions. It can transcend utilitarianism (wherein it but exaggerates animal qualities) and can form idealistic conceptions.

Ideas of chivalry, honour and self-sacrifice have no place in the struggle for existence; but they are inherent in all but hypersophisticated minds. Among ordinary folk, conceptions such as these are stronger incentives to action than animal

impulses, as even the most rascally demagogue knows. Learning, philosophy and art are realities to which men will devote their lives, creating rather than copying, with no ulterior or mercenary aim. The arts and virtues bring a new and incalculable feature into the story of evolution. Some, at least, of their achievements outlive kingdoms and empires, seeming immortal.

Men are, for the most part, enthusiastic admirers of virtue, even to the extent of devising laws to ensure its maintenance. Very many of them are actual exponents of virtue in their personal relations; but in public affairs and in the mass they are often content to behave as animals rather than as men. "Manners makyth man" is perhaps the most concise specific diagnosis ever published. But there is only one law of evolution, common to individuals and races alike. If mankind as a whole neglects its "manners", it abandons any claim it may have to qualitative difference from other animals. There is no doubt of man's ability to become the most successful type of animal that has ever existed; but the reward of success in that direction is death.

The love of truth, greatest of all virtues, is especially an attribute of men of science. In this we are idealists, for the truth is unattainable, however worth the seeking. We know that all the progress that our species has made, in material as well as in mental affairs, is the result of the search for truth. We find ourselves strangers in a world riddled with more or less blatant deceit; but we still follow our ideal, confident that all other paths are blind. We recognize in the conception of truth something eternal, not subject to the laws of change and decay.

We know that idealism is the goal and incentive in all actions that can truly be described as human. To the idealist, environment is something to be overcome or adapted into service; the story of human progress is one of triumph over circumstances. The self-styled 'realist', who advocates acceptance of, and submission to, his temporary environment, is less than a man; he follows in the tradition of the beasts that perish.

To idealists palæontology has no message, save to welcome them as something new in Nature. To realists, who seek material success in the struggle for existence, palæontology, with millions of years of history as its authority, declares emphatically, "You have been warned."

Obituary

Mr. C. Fitzhugh Talman

WITH the death on July 24, at the age of sixty-one years, of Mr. C. F. Talman, the U.S. Weather Bureau loses one of its best known members.

Talman was born at Detroit on August 31, 1874, and joined the Weather Bureau in October 1896. From 1898 until 1899 he was in charge of the meteorological stations maintained by the United States in South America and the West Indies; afterwards he was attached to the Weather Bureau Library, where he found his true vocation. He received the official title of librarian in 1908, and though he became junior professor in 1912, professor in 1914 and meteorologist in 1922, he remained in charge of the library throughout. He was intensely interested in bibliographical work, and his knowledge of meteorological literature became almost unique. In addition to the annotated lists of new books and papers which he compiled regularly for the *Monthly Weather Review*, he delved deeply into the history of meteorological terminology, publishing his results in semi-popular articles on "The Language of Meteorology", "The Meteorological Isograms" and "The Vocabulary of Weather". The last, which was reprinted in the *Quarterly Journal of the Royal Meteorological Society* for 1925, ends with the words: "I have been gathering wind-names from the literature of all countries, ancient and modern, for many years, and endeavouring to elucidate them from both the etymological and scientific standpoints. . . . It is a fascinating occupation and I only regret that I have, apparently, the whole field to myself".

Another outcome of Talman's hobby was his selection as meteorological adviser for the "Standard Dictionary" in 1910–11. He had a pleasant literary style, which also found expression in two popular books "Meteorology, the Science of the Atmosphere" (reprinted in 1925 as "Our Weather") and "The Realm of the Air" (1931) and in numerous newspaper articles, but his interest was the collector's rather than the author's, and he published only a small part of his material. It is greatly to be hoped that means will be found for editing and publishing his notes.

WE regret to announce the following deaths:

Dr. J. B. E. A. Charcot, the well-known French explorer of the Antarctic, on September 16, aged sixty-nine years.

Mr. J. W. Gordon, K.C., honorary secretary of the Optical Convention in 1912, and author of "Generalized Linear Perspective, with Special Reference to Photographic Land Surveying", on September 21, aged eighty-two years.

Mr. Ernest Payne, a pioneer in X-ray research work, on September 20, aged seventy-six years.

News and Views

Problems of Present-day Astronomy

In connexion with the recent meetings of the British Association, Sir James Jeans delivered a public lecture at Southport on Friday, September 11, on "Some Problems of Present-day Astronomy". He confined his attention to theoretical astronomy, and dealt almost exclusively with large-scale problems concerned with the character of the universe. After a brief survey of the general structure of the stellar universe, Sir James described the various kinds of nebulæ, directing attention in passing to Kuiper's recent discovery, in a planetary nebula, of "what may well prove to be the smallest of all known stars" —a body with a radius about half that of the earth, a surface temperature of about 2,800° C., and an average density about 36 million times that of water. The theory that the extra-galactic nebulæ were formed by condensation out of an originally unstable continuous mass of gas filling all space next claimed attention, and Sir James remarked that mathematical investigation shows that condensations in such a medium would be "on something like the scale of the observed nebulæ, and would be at something like the same distance apart".

Sir James then turned to problems concerning the character of space. Relativity taught us that the total volume of space was finite—a statement apparently at variance with a later suggestion that the curvature of space might be negative and with Einstein and de Sitter's demonstration that it might be zero—but the latest observations disclosed no thinning out of distant nebulæ to indicate that we have yet explored an appreciable fraction of its extent. The systematic separation of the nebulæ from one another was described from two points of view—first as a movement of bodies in a structureless space and secondly as a system of drifting 'straws' revealing the motion of 'currents' in a space whose character the motions served to indicate. For knowledge of the original and present size of space we are dependent on theoretical arguments, and Sir James gave in this connexion a brief description of the theory of Sir Arthur Eddington relating the expansion of the universe with the mass of the electron. According to this theory, the radius of the universe was originally about four times the distance of the farthest nebulæ now known, and has since expanded about tenfold. This consideration would seem to call for further elucidation of the earlier remark that the theoretical separation of the condensations in the primeval universe is about the same as that of the observed nebulæ. The lecture was liberally illustrated by lantern slides.

Preservation of English Scenery

Several important aspects of the preservation of English scenery were mentioned by Dr. Vaughan Cornish in an address to Section E of the British Association at Blackpool on September 14. In the first place, insisting that a scene from which Nature has been expelled is no fit dwelling place for man, he urged the brightening of towns by rebuilding schemes which give higher buildings, and that in a smaller area accommodate the same number of people, and so leave land free for gardens and boulevards. Dr. Cornish went on to insist that the mere preservation of monuments of antiquity is not enough. It is necessary to preserve a contemporary background as in the case of Stonehenge, the Roman Wall, and the ancient earthworks of the Downs. In these respects, however, the danger to natural amenities is less great than in the threat to the cliff-lands of England and Wales. A considerable extent of our five hundred miles of cliff-land is in danger from bungalows, hotels and other buildings. Before it is too late, the last of these cliffs should be acquired and preserved as national parks. This would necessitate the acquisition of a strip little more than 100 yards in width. Several stretches of Cornish cliff-land are specially suited for national reservations, but it will have to be accomplished soon or the builder will have damaged them beyond redemption. The concluding part of Dr. Cornish's address was devoted to a plea for the recognition as national parks of the New Forest, the Forest of Dean, the Pennine Moors and the Lake District. Cliff-lands, woodlands and mountains would then be represented, these being the three types of English scenery of special importance.

Angiolo Filippi (1836-1905)

October 23 marked the centenary of the birth of a leading Italian medical jurist, Angiolo Filippi, the son of a distinguished medical practitioner of Florence. He studied medicine at Pisa, and directly after qualifying gained some useful knowledge for his subsequent career first as a prison doctor and afterwards in the campaign with Garibaldi, where he acquired considerable experience of gunshot wounds. In 1865 he distinguished himself by his devotion to the sufferers from the cho era epidemic at Ancona, San Severo and Apricene. In 1875 he became assistant to Prof. Bellini, who occupied the chair of legal medicine at Florence, and succeeded him in 1884. His "Manual of Forensic Medicine", of which the first edition appeared in 1889 and the fifth in 1919, was the first of its kind to be published by an Italian expert, and proved an indispensable work of reference to the medical and legal profession in Italy. His other works were "A Manual of Thanatology and Traumatology" (1877) and "Medico-legal Exegesis of the Method of Giving Evidence" (1882). He founded a laboratory for medico-legal research in Florence, and his methods of investigation were followed in other Italian schools of medical jurisprudence. He died on December 30, 1905.

British Commonwealth Scientific Conference

A CONFERENCE was opened by the Right Hon. Walter Elliot, M.P., Minister for Agriculture, and attended by representatives of the Governments of all portions of the British Commonwealth, on the morning of Monday, September 21, in London. Its chief function is to examine the work and future of a number of scientific organizations established on a co-operative basis to perform a common service in various branches of agricultural scientific research. As a result of the Imperial Agricultural Research Conference of 1927, the several Governments of the Empire agreed to establish bureaux or centres of information in eight branches of agricultural science, financed by contributions from all parts and controlled by a council representative of all parts of the Empire. To these, the supervision of two older institutes was added in 1933 on the recommendation of the Imperial Committee on Imperial Economic Consultation and Co-operation. In addition, the Conference is considering the future of certain research schemes to which several parts of the Empire now contribute, and also further methods of the interchange of information and closer collaboration in scientific work.

AFTER the opening meeting on Monday, the Conference inspected the bureaux and centres of information which deal with mycology, soil science, animal health, animal nutrition and genetics, plant genetics (non-herbage and herbage), fruit production, and agricultural parasitology. The Conference re-assembles in London on October 2. The Executive Council of the Imperial Agricultural Bureaux, of which Sir Charles Howell Thomas is the chairman, is responsible to all Governments of the Empire equally for the administration of these common services, and in conformity with the resolution of the Imperial Conference of 1926 is constituted on a basis of equality of representation. It was decided by the Governments in 1933 that where such common organizations are formed, their activities should be subject to detailed examination at periodical conferences. This Conference serves that purpose.

Species in Foraminifera

THE veteran palæontologist, Frederick Chapman, who has retired from the National Museum at Melbourne and is now consulting palæontologist to the Commonwealth of Australia, has contributed to the *Melbourne Age* (under the initials F.C. and under date February 8, 1936) a column headed "The Species Nightmare: an Absorbing Scientific Problem". One of the oldest living authorities on the Foraminifera, trained under H. B. Brady, W. Kitchen Parker and W. Rupert Jones, whose assistant he was until his appointment to Melbourne, he deals with this difficult question, quoting Mr. Heron-Allen's communications to NATURE of July 14, 1934 and November 16, 1935. Frederick Chapman deals with it in connexion with other branches of palæontology, and deplores what Heron-Allen termed "the commercialisation of Protozoology", and his article, which is worth the serious attention of all systematists, but is too long to quote adequately, should receive careful attention. Mr. Heron-Allen is consulted by many of the rising school of petroleum geologists at the Natural History Museum, and, regard being had to the deplorable fact that their lists of species are now regarded as a 'trade secret' not to be divulged for the information of rival petroleum merchants, his advice to these young men is to adhere to the genera established by the great nineteenth century school, both in England and on the Continent of Europe, and to distinguish their species, for their own reference and guidance, only by numbers, or by letters of the alphabet, ignoring the thousands of names given to minor varieties by the American School. By this means they can save themselves an immense amount of labour and brain-fag, and their tabulated results are quite as useful as they would be if they were overloaded by a vast nomenclature which it is impossible —and unnecessary—for the human brain to retain.

Invention and the Modern State

THE externals of modern civilization are the products of invention, and a scientific analysis of invention, what it is, what causes it and whither it is leading us, is long overdue in England. In such an analysis the statistical method must predominate and the easy generalization will have no place. It may require research of a difficult and unusual kind, but unless we know, for example, accurately and in detail, the origins, the training and the methods of successful present-day inventors, we do not know the sources of the real progress-making inventions of to-day, and while we are ignorant of that vital fact the recital of a short list of so-called workingman inventors of the eighteenth century is not merely valueless but also misleading. Mr. C. W. Marshall has just concluded in the *Inventor* a series of articles on "The Science of Invention". In them he attempts to interest and guide inventors of various degrees of proficiency, but, although the trend of recent patent applications can be learned from them, the articles are entirely devoid of statistics. As a consequence of this and of the very diverse standards of the inventors to whom the articles are addressed, their total effect is confusion. At one place advice is being given as to the "psychological factor"; for example, "a camera idea, may be submitted to manufacturers in the autumn so as to be ready for the spring sales". Shortly after this we learn—or do we ?—that the "price of inventions used to vary from £1,000 for 'gadgets' to half a million for inventions such as refrigeration and automatic photo machines". Again, "There is a ready market for inventions which cheapen production of exclusive products. By introducing mass-production machines and an entirely re-designed, simplified product the early Fords were able to tap the potentially great motor-buying public".

No one, it would appear, would care to challenge Mr. Marshall's contention that "so keen is the competition, so deep the technical advance now, that the

principle of hit or miss, except perhaps in the gadget class of invention, is not applicable, and the complete inventor is a development of the scientific researcher". But to such a man, the suggestion that he would find it worth while studying Max Planck, Einstein and Eddington would come rather late, while that suggestion, even if accepted, would have no utility to the 'gadget' producer. The high hopes raised by the receipt of a treatise with the title "The Science of Invention" remain unfulfilled by Mr. Marshall's series. An authoritative examination of the position of invention in the modern State is still needed. In such an examination the commercial aspect may well prove to be insignificant, although research by one man or one set of workers may have to be restricted to the material inventions, leaving such things as modern systems of government, the most striking development of man's inventive faculty, to the historian or the alienist. From a calm investigation of the uses of material advances it may be found that they follow social changes and are called forth by them : but research is necessary to discover the vital facts of modern invention and, in Great Britain at any rate, there is little evidence that such research is being carried out. Is it fantastic to believe that if it is ever adequately made, we shall have general consent to the idea of complete control by the State of the inventive faculties of its members ?

Viability of Plant Structures

THE question of the length of the period of viability in seeds and other plant organisms is constantly cropping up, and, although a great deal has been written about it, there is still much to be discovered with regard to the actual length of time seeds and spores can remain viable. Reference was made to this problem in NATURE of May 2, 1931, p. 675, and an article on the subject was published in the *Kew Bulletin* of 1933, p. 257. In that article, all the cases of longevity that have been definitely authenticated were brought together. Possibly the oldest case is that of *Nelumbo* (the Japanese lotus) recorded by Ohga in the *Botanical Magazine* of Tokyo, 1923. Seeds of *Nelumbo nucifera* were found in a peat bed buried under 2 ft. of loess in Southern Manchuria. The seeds all germinated and it is estimated that they were at least 120 years old and may have been as much as 400 years. It is well known, of course, that poppy seeds and charlock can retain their viability for very long periods, but for how long one cannot say definitely. According to an announcement in *The Times* of August 19, M. P. N. Kaptereff has succeeded in reviving plant organisms which have lain in the earth for thousands of years. It appears from this account that it is only spores which have shown signs of life, and it seems quite possible that spores of some of the lowly algæ could have survived in a frozen condition for a very long time. From the account it appears that blue-green algæ may be some of the plants which have developed —possibly some of the unicellular green algæ also. As to the grass-like plants which are mentioned, they might well have retained their general appearance in a frozen condition for a very long time, as the ice would preserve the form perfectly well. One would not expect them to have any life in them and this does not appear to have been the case.

Native View of Baganda Institutions

AN account by an African of his own institutions must normally, though not invariably, have an exceptional value for the ethnographer. Being as a rule a spontaneous production, it avoids the great danger of the usual method of inquiry, in which there is the risk of biasing the sources of information. Sir Apolo Kagwa, the *Katikiro* of Uganda, who produced in 1918 an account of Baganda history and institutions in his native language, was exceptionally well qualified for this undertaking. A man of considerable intellectual power, he had been associated with the royal household from his early youth, and when in 1897 the young Daudi Chwa, an infant, one year and six months old, was appointed king on the abdication and flight to German East Africa of his father, Mwanga, Apolo was made regent and prime minister. He thus had a personal and intimate knowledge of the critical times which led up to the intervention of the British forces in Uganda and the institution of a protectorate. His authority on State affairs and ritual is beyond question. One of the most valuable records he has preserved is that of the officers and queens of each ruler from the beginning of the line with the semi-legendary founder Kintu. The Rev. J. Roscoe, when collecting information for his book "The Baganda", derived a great deal of his material from the *Katikiro* ; and, in fact, Sir Apolo's book, which is an invaluable, and indeed a necessary, supplement to Roscoe, was written to expand and correct what he considered to be open to criticism in the work of the latter. The fact that Sir Apolo wrote in Luganda has proved a drawback ; but this has now been remedied in a translation by Ernest B. Kalibala, edited by May Mandelbaum (Edel) (*Columbia University Contributions to Anthropology*, 22, 199. 4 dollars). For the convenience of students the mere repetitions of Roscoe's information are omitted, but references to "The Baganda" are given here as well as where Roscoe is supplemented or corrected.

Safety in Mines Research

As in past years, the Fourteenth Annual Report of the Safety in Mines Research Board includes a report of the Health Advisory Committee, which forms in fact Part 4 of the Report, the previous parts being Part 1, General ; Part 2, Instruction ; and Part 3, Progress of Safety Researches. The Report, of course, begins with an expression of regret on the death of Dr. J. S. Haldane, who "had been a member of the Board since 1923" ; there is not a miner who will not re-echo the last sentence of the first paragraph in reference to Dr. Haldane—"His death is a severe loss to the whole mining community" ; whilst it also refers to the retirement of Prof. S. M. Dixon, who, as is well known, has rendered much valuable service in connexion with wire ropes used in mining. There is further a number of appendixes to the Report, one of which deals with protective equipment, and it is interesting to note that, generally

speaking, protective equipment has been largely adopted by the miners themselves. It is worth knowing that Great Britain is not the only country adopting protective equipment, the article by Leprince-Ringuet on miners' hats appearing in the *Annales des Mines* of Paris proving this point. The various representatives of the local committees are doing good work in popularizing the use of protective equipment, and the subject of falls of ground is making fair progress, considering the inherent difficulties of the subject.

Radio Relay Services

RADIO relay is much more common abroad, where it is regarded as a public service, than in Great Britain. In a pamphlet written by G. S. Lucas and E. S. Hall of the Research Department of the British Thomson-Houston Co., Ltd., a description is given of the radio relay equipment built and designed for the Midland Relay Services, Ltd. It is suitable for 300 subscribers but could easily be adapted to suit 1,000 or more subscribers. It has four radio receivers with their aerial equipment, and a short-wave receiver. The aerial equipment depends upon the locality and conditions of reception. For the installation carried out at Rugby, two vertical aerials about 25 feet in length are used for local reception. For long-distance work a horizontal aerial 100 feet long and 50 feet high is used. For use on short-wave reception a special *V* doublet aerial has been installed. Two of the receivers are suitable for B.B.C. transmission and two for long-distance Continental programmes. The advantages offered to the public by this service are the replacement of aerials by simple overhead wires. The installation of only a simple speaker unit in the house is required; no power supply or battery is necessary. The main control station is under constant supervision and the receivers are adjusted for the best working conditions. The radio relay station is capable of relaying two or three independent programmes to all subscribers. All the vital points of the system are duplicated and the organization can deal quickly and effectively with faults and complaints as they arise.

Telephone Development in Birmingham

A LARGE and imposing building called Telephone House has been built in Birmingham to accommodate the telephone equipment for the city and also the Post Office and engineering and administrative staffs. A description of the telephone equipment required for the trunk, toll and central exchanges which were installed by Siemens Brothers and Co., Ltd., of Woolwich, to the order of the Post Office, is given in the September supplement of the *Siemens Magazine*. The introduction of the maximum fee of one shilling for three minutes on all inland trunk calls made after 7 o'clock in the evening has made the trunk service very popular, and the more recent introduction of a half-crown maximum for a three minute trunk call between any two places on the mainland of Great Britain will still further increase the amount of trunk traffic. Outside London, Birmingham is the most important telephone centre in Great Britain. It is connected by direct trunk lines with all other zone centres and, in addition, forms an important link in the alternative trunk routes between London and other zone centres such as Liverpool, Manchester, Leeds, Sheffield, Nottingham and Leicester. The new trunk and toll equipment has been planned to meet the long distance (trunk) and the short distance (toll) traffic anticipated in the Birmingham district during the next few years. Since 1930 the development of the trunk traffic has exceeded all expectations. There have been installed in the building 367 switchboards, and in addition a centralized manual board for the whole of the Birmingham area. In the same building also a 5,700 line full automatic equipment for the central exchange is being installed. Two motor generator sets driven from the 400 volt 3 phase 50 cycle public supply mains, with an output of 1,600 amperes at 57 volts, are being used.

Research in Mental Diseases

THE Annual Report, 1935–36, of the Joint Board of Research for Mental Disease of the City and University of Birmingham contains an account of much painstaking and laborious work (Birmingham: The University, 1936). The occurrence and distribution of 80 named varieties of micro-organisms are tabulated; 6,565 specimens were examined. Somewhat optimistically the report claims to have solved the problem of the cause of mental disease, since "it appears that mental disorder cannot be classed as an infectious disease, nor as a metabolic disorder, but that it is a *clinical resultant* of infectious and metabolic disorders acting during any period of the ante- and post-natal life of the individual, thus determining the character and onset of the mental symptoms". Also, "The functional disturbances of the central nervous system responsible for the symptoms of mental disorder, can be clinically and pathologically associated with local disturbances of the vascular supply to certain vital centres of the brain". It is true that the pathology of some brain diseases that cause mental disorder is well established, for example, encephalitis, syphilis, tumours; but there still remains a host of disorders, ranging through hysteria and the anxiety and obsessional states to schizophrenic personalities, and cyclothymia or manic-depressive conditions and paranoia, that have so far defied the laboratory expert.

False Killer Whales in South Africa

DR. LEONARD GILL, in the Report of the South African Museum for the year 1935 (1936, p. 10), recounts another of those mass strandings of *Pseudorca crassidens* which have become so frequent since the reappearance of the species in the Dornoch Firth. The school came ashore at Mamre, about fifty miles north of Cape Town, and the occurrence was peculiar because of the large number of whales stranded, about three hundred, and because they came ashore not on sand but on jagged rocks. But a common feature of the strandings has been, as here, that the whales appear to have been trapped by a falling tide in channels cut off from the open sea by sand-banks. The Mamre stranding took place

towards the close of 1935, and seven years before, about the same time of the year, the first record of the species in African waters was made when about a hundred came ashore at Kommetjie, some sixteen miles south of Cape Town.

Canadian Reindeer Herd

THE introduction of a herd of reindeer to Canada as an addition to the food resources of the far north has met with success. Notwithstanding the severity of the winter, the herd on its winter range east of the delta of Mackenzie River in the Northwest Territories is reported by the Office of the High Commissioner to be in good condition, and to number about 3,000. Surplus males to the number of 200 were slaughtered during the autumn and the carcasses used for food, while the hides were used for moccasins, mittens and other items of wearing apparel. The herd, accompanied by its herders, undertakes a regular north and south migration, moving northward along the arctic coast early in April and southward again in late autumn, grazing by the way over the hills and valleys of its reserve of 6,600 square miles.

American Research Grants

PART 3 of volume 76 of the *Proceedings of the American Philosophical Society* contains the report for the first three years of its operation of the Committee on Research established by the Society. The Committee set apart 20,000 dollars in 1933, 45,000 dollars in 1934, 60,000 dollars in 1935, and 50,000 dollars in 1936. Ninety-eight grants have been made of the average value of 1,500 dollars: sixteen in zoology, fourteen each in physics and botany, ten in astronomy, nine each in geology and physiology, six in chemistry, five in archæology and smaller numbers in other subjects. These grants are more generous than those made by the National Research Council but are less than those made by some of the great foundations. The Committee proposes to hold each year an autumn meeting at which the reports of grantees as to the progress of their researches will be read. The Committee would welcome suggestions for improving its methods of aiding research.

Research Grant Board, South Africa

THE recently issued report of the Research Grant Board, Union of South Africa, covers the period 1918–35. The Board was established in October 1918 as a result of a recommendation of the Advisory Board of Industry and Science, which had been formed earlier that year from an amalgamation of the Industries Advisory Board and "a Scientific and Technical Committee". It was at first proposed that the Research Grant Board should be attached to the Department of Agriculture, but after forming a subcommittee of the Advisory Board until the dissolution of the latter in 1923, it was attached to the Department of Mines and Industries until 1933, when it was transferred to the newly-formed Department of Commerce and Industries. While attached to one Department, the Board is regarded as serving all branches of Government, recognition being given to this relationship by the presence on the Board of assessor members from other Departments. Initially, the Board's activities were confined to the encouragement of research in universities and museums, but its scope was speedily extended to embrace every branch of knowledge and to include the whole country irrespective of institutions.

ONE of the most important functions of the Board is the administration of Government grants in aid of research as well as research scholarships. It has also undertaken similar duties on behalf of the Carnegie Corporation of New York, which has allocated generous funds for research in South Africa. As at first constituted, the Board consisted of representatives of science and industry, together with the assessor members from Government Departments. When its scope was enlarged, members were added to represent other than scientific subjects. While ordinary members of the Board have been chosen with an eye to representation of all the interests concerned, they are regarded as serving wholly in their individual capacity and responsible only to the Minister. The success and efficiency of the Board are attributed largely to this arrangement and to the spirit of unity it engenders, and also to the excellence of its personnel and the unstinted manner in which they have given of their best to the work.

Carnegie Institution of Washington

THE report of the president of the Carnegie Institution of Washington for the year ending October 31, 1935, refers to developments in methods and organization of research in the Institution, particularly in the support of larger projects and the co-operation of fair-sized groups of individuals, as in the Geophysical Laboratory, Mount Wilson Observatory and the Department of Genetics. Its present organization is adapted not only to the advance of knowledge in new interlocking or overlapping areas of research, but also to bring back to each of the groups engaged upon special problems a wide range of materials otherwise not readily secured. Reference is made in the report to the progress of seismological research and of the investigations on terrestrial magnetism. Astronomical work has included study of the nova in Hercules, of stellar atmospheres, extra-galactic nebulæ, measurement of the velocity of light and observations of sunspot activity. Assistance has been given to research on cosmic rays and on the hydrodynamics of the atmosphere and major climatic variations. Numerous investigations have been carried out by the Department of Plant Biology, including the study of the influence of climatic environment on the life and development of living organisms, and by the Division of Animal Biology which includes the Department of Embryology, the Nutrition Laboratory and the Department of Genetics. Of outstanding interest are the activities of the Division of Historical Research, established in 1929, which has provided the opportunity to study history as science, art, culture, sociology and government in all phases with the application of scientific principles to the collection of materials and to the interpretation of the data

acquired. The rapprochement of scientific and cultural or human interests in this way is an outstanding achievement of the Institution.

Conference on College Hygiene

THE second National Conference on College Hygiene of the United States will be held in Washington, D.C., on December 28–31 under the joint sponsorship of the American Student Association, the National Health Council and the President's Committee of Fifteen on College Hygiene. There will be no formal programme, but the work will be divided into five sections devoted respectively to health service, health teaching, organization and correlation, special problems and relationship of college hygiene to training and secondary education. Dr. Livingston Farrand, president of Cornell University, from whom further information can be obtained, is chairman of the Conference.

Indian Science Abstracts

THE National Institute of Sciences of India has recently issued the first number of *Indian Science Abstracts*, an annotated bibliography of science in India, including abstracts of all papers published in India or abroad on work done in India or based on Indian material. The first part includes abstracts arranged tentatively under nine headings. To ensure continuity under each heading and to facilitate reference, the abstracts dealing with each science have been given a separate pagination with the serial number of the heading preceding it. The abstracts in each section are arranged alphabetically and numbered serially. The general editor is Dr. Baini Prashad, who is assisted by nine associate editors for different subjects.

Announcements

DR. HANS VON EULER-CHELPIN, professor of organic chemistry at Stockholm, has been elected an honorary member of the Association of German Chemists; the Justus Liebig Medal of the Association has been awarded to Dr. Gustav Hittig, professor of inorganic and analytical chemistry at the German Technical University at Prague; and the Carl Duisberg Memorial Prize to Dr. Rudolf Tschesche, of Göttingen.

A PRIZE of 1,000 dollars is offered by the Williams and Wilkins Publishing Company for the best work on a science subject presented before July 1, 1937. The work must be in English and the desired length is 100,000 words. Further information can be obtained from the Company, Mt. Royal and Guilford Avenue, Baltimore, Maryland.

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, Harpenden, Herts, and other members of the staff, are prepared to give a few lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. Among the subjects offered are: manures, fertilizers, soil micro-organisms (Bacteria, Protozoa, etc.), agricultural botany, agricultural chemistry, soil physics, entomology, and plant pathology. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

MR. W. J. HALL, of Walsall, who was formerly with the Wool Industries Research Association at Leeds, and later with British Celanese Ltd., has been appointed technical editor of the *Journal of the Textile Institute*.

MESSRS. ADLARD AND SON, LTD., presented to members of the British Association at Blackpool a handy pocket diary, the main part of which consists of a calendar (September 1936–July 1937) of the meetings of scientific societies. Copies of the little book can be obtained from Messrs. Adlard at 21 Hart Street, London, W.C.1, price 6*d*.

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

A principal of Llanelly New Mining and Technical Institute—The Clerk of the Education Committee, County Education Offices, Carmarthen (September 28).

An assistant lecturer in mathematics in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (September 30).

An assistant lecturer in metallurgy in University College, Swansea—The Registrar (September 30).

An assistant (Grade III) in the Air Ministry Scientific Pool, for service at the Royal Aircraft Establishment, South Farnborough—Chief Superintendent, Royal Aircraft Establishment, quoting Ref. A.248 (October 2).

An assistant keeper on the higher technical staff of the Science Divisions of the Science Museum—The Director, Science Museum, South Kensington, London, S.W.7 (October 12).

An assistant county dairy instructor for Hampshire—County Agricultural Organizer, The Castle, Winchester (October 12).

A chemist in the Aeronautical Inspection Directorate Test House, Kidbrooke (non-metallic materials section, oils and petrols sub-section)—Secretary, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2 (October 24).

A director of the Kanematsu Memorial Institute of Pathology, Sydney Hospital, N.S.W.—Secretary, Universities' Bureau, 88a Gower Street, London, W.C.1 (January 31).

Assistants to civil and mechanical engineers in the Ordnance Factories, E.D.(F.), Royal Arsenal, Woolwich, S.E.18—The Chief Superintendent.

A male junior assistant chemist at the Royal Gunpowder Factory, Waltham Abbey, Enfield Lock, Middlesex—Principal Clerk.

Temporary assistant civil engineers in the Air Ministry—Secretary (W.B.9), Room 712, Adastral House, Air Ministry, Kingsway, W.C.2, by post-card for form of application.

A male laboratory assistant (Grade II) at the Experimental Station, Porton, near Salisbury, of the War Department—Commandant of the Station.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 552.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Oxygen Content of the Stratosphere

AIR from different heights of the stratosphere was brought down by registering balloons by means of a new device for air sampling. As the apparatus was protected against the low air temperature in the stratosphere by a "Cellophane" case, it was possible to employ ordinary stop-cocks. At the desired heights the latter were operated by an electrical arrangement actuated by aneroids. The glass vessels for air sampling were constructed so that the oxygen content could be determined in them by means of heating metallic copper without it being necessary to change the vessel. Before and after heating the copper the volume was brought to the same level, so that the diminution of pressure divided by the initial pressure immediately gives the oxygen content.

The following table gives the values obtained for the oxygen contents :

Date	Height (km.)	Oxygen content (per cent by vol.)
24. 8.36	0	20·92 ± 0·02
19.12.35	14·5	20·89 ± 0·05
5.12.35	18·5	20·84 ± 0·02
18. 8.36	19	20·87 ± 0·02
5.12.35	22·2	20·57 ± 0·05
12. 2.36	24	20·74 ± 0·02
6. 5.36	28–29	20·39 ± 0·05

In approaching the height of 20 km. the oxygen content is diminished noticeably in comparison with the value at the earth's surface (20·90–20·95 per cent); above 20 km. the diminution begins to be more pronounced; at the greatest height there is a deficit of 2–3 per cent of the oxygen content. The values agree with the determination of the helium content of the stratosphere by F. Paneth[1], who at a height of 21 km. finds a helium surplus of 8 per cent.

It is remarkable that at heights greater than 20 km. the values differ rather considerably. This is probably due to the weather conditions. In air masses of polar origin it seems that the diffusive separation begins at lower heights than in equatorial regions where the top of the troposphere is remarkably higher. The insolation in equatorial regions is very much stronger, and the turbulence of the atmosphere reaches to greater heights. Lepape and Colange[2] also find that the content of helium plus neon in the stratosphere is slightly increased, and more variable than on the earth's surface. If my assumption is true, then the height of the ozone layer in the stratosphere should also be lower in polar regions than in equatorial regions, first, because the oxygen content in polar regions decreases with heights more rapidly than in equatorial regions, and secondly—which is perhaps of even greater effect—because the greater stability of the atmosphere in the polar regions tends to increase the diffusion of the heavy ozone downwards.

A more detailed report will be published shortly in *Luftfahrtforschung*.

E. REGENER.

Physikalisches Institut der
Technischen Hochschule,
Stuttgart.
Sept. 6.

[1] F. A. Paneth and E Glückauf, NATURE, **136**, 717 (1935).
[2] A. Lepape and G. Colange, NATURE, **137**, 459 (1936).

Absence of Cosmic Rays from Nova Lacertæ

THE appearance of Nova Lacertæ gave us a second opportunity of investigating whether the conclusion at which we arrived when investigating the relation of Nova Herculis to cosmic rays[1], namely, that no cosmic rays emitted from novæ are observable, was correct or not. For this purpose we have turned the centre line of the field of our apparatus (field of the apparatus : 40° in east-west, 10° in north-south direction ; 36 cm. lead between the counters) as soon as the outburst of the nova was signalled, into such a position that the centre line showed only an angle of 2° 09′ north of the nova at culmination. In such a position a set of measurements was performed from June 19 until July 17, 1936.

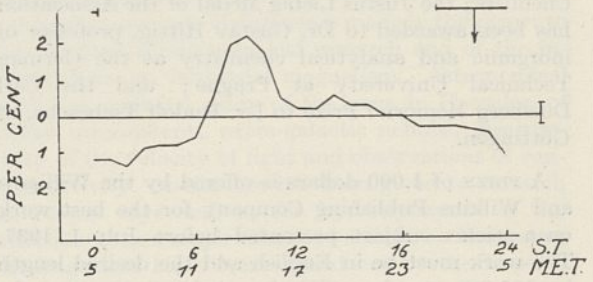


FIG. 1. Variation of cosmic ray intensity (average values) with sidereal time (S.T.) and Central European time (M.E.T.). The horizontal straight line above the diagram indicates the time during which Nova Lacertæ passed through the field of our apparatus, and the arrow the time of its culmination.

Fig. 1 shows the average variation of the intensity for the different hours of the day, as a percentage of the mean value. As can be easily seen, the curve indicates only the well-known diurnal variation, and no increase at the time of culmination of the nova. The assumption that no effect of the nova was detectable, because its cosmic radiation was of much shorter period than the duration of the measurement, cannot be maintained, for even the ratio of the

intensity during the culmination of the nova for a single day to the mean value of the daily intensity in no case exceeded twice the error of measurement.

This confirms our previous experience with Nova Herculis, as in neither case could an influence of undeflected cosmic rays originating in the nova be detected.

J. BARNÓTHY.
M. FORRÓ.
Institute of Experimental Physics,
University,
Budapest.
Aug. 13.

[1] J. Barnóthy and M. Forró, NATURE, **135**, 618 (1935). *Z. Phys.*, **94**, 773 (1935). NATURE, **136**, 680 (1935).

Resonance Levels for Absorption of Neutrons

WHEN a very thin layer of boron is irradiated with slow neutrons, the number of α-particles emitted can be represented by an expression proportional to $\Sigma n^i\alpha^i + P$, where the terms $n^i\alpha^i$ correspond to the nearly homogeneous groups of neutrons absorbed selectively in certain elements; n^i is the number of neutrons having kinetic energy E^i, and α^i is their coefficient of absorption in boron. The most important term represents the group of 'thermal' neutrons, called by Amaldi and Fermi[1] the group C. If we absorb this group in a thin sheet of cadmium, the number of α-particles emitted by boron diminishes by an amount proportional to $a^C n^C \alpha^C$, where a^C is the fraction of the group C absorbed by cadmium. Similarly, let us suppose that we absorb another group, J, in a suitable element; the corresponding decrease of the number of α-particles will be proportional to $a^J n^J \alpha^J$. If, therefore, the relative numbers of groups C and J and the fractions a are known, we can determine the ratio α^C/α^J, which is equal to $\sqrt{E^J/E^C}$. In this way the energy corresponding to the resonance level of the element J can be calculated.

I have used a boron-coated ionization chamber connected to a Hoffmann electrometer. The chamber was surrounded with paraffin wax and irradiated with slow neutrons from a source of polonium and beryllium equivalent in strength to 10 mgm. of radium. The ionization currents were measured (1) with unfiltered radiation; (2) with neutrons filtered through 0·5 mm. of cadmium; and (3) 0·5 mm. of cadmium and 0·1 mm. of silver. The results are as follows:

Filter	none	0.5mm.Cd	0·5mm.Cd + 0·1mm.Ag
Ionization	4·0465	0·3285	0·3145

Owing to the smallness of the effect due to absorption of neutrons in silver, a very great number of measurements has been made so that the statistical errors were about ten times smaller than the differences to be measured. We have

$$\frac{a^A n^A \alpha^A}{a^C n^C \alpha^C} = \frac{0{\cdot}014}{3{\cdot}718} = 0{\cdot}00376.$$

The relative numbers of groups A and C and their coefficients of absorption in cadmium and in silver have been determined by Fermi and Amaldi. As it was, however, to be expected that the numbers may depend on the geometrical arrangement, thickness of paraffin, etc., special experiments have been made in order to compare directly $a^A n^A$ and $a^C n^C$. The boron layer has been removed, and a silver foil of 0·05 thickness exposed in its place, all other conditions remaining unchanged. The activity of the foil, due to the isotope of 22 sec. period, was measured by means of a Geiger counter. If a is the activity obtained with unfiltered radiation, b that with neutrons filtered through 0·5 mm. of cadmium, and c that with neutrons filtered through 0·5 mm. of cadmium and 0·1 mm. of silver, then

$$a = 1490, \quad b = 1134, \quad c = 344.$$

If r^A and r^C are the fractions of the total number of neutrons absorbed in the silver foil, we have

$$\frac{a^A n^A r^A}{a^C n^C r^C} = \frac{1134 - 344}{1490 - 1134} = \frac{790}{356} = 2{\cdot}2.$$

The fraction r^A/r^C can be calculated using the known values of absorption coefficients of silver for the groups A and C. I find

$$r^A/r^C = 53{\cdot}6, \text{ and hence } a^A n^A / a^C n^C = 0{\cdot}041.$$

According to Amaldi and Fermi, $n^A/n^C = 0{\cdot}016$. Considering that $a^A/a^C < 1$, we see that under the conditions of my experiment, group A appears to be very prominent. This may be due to the special arrangement used, or to the fact that the brass walls of the ionization chamber absorbed a considerable fraction of thermal neutrons. For the ratio of the coefficients of absorption in boron, I find finally

$$\alpha^C/\alpha^A = 0{\cdot}041/0{\cdot}00376 = 10{\cdot}9;$$

and for the energy ratio

$$E^A/E^C = 117; \quad E \simeq 3 \text{ e.v.},$$

in good agreement with determinations of Preiswerk and Halban[2].

Similar experiments performed with gold have given $E^{Au} \simeq 4{\cdot}5$ e.v. In the case of iodine, using as absorber a sheet of potassium iodide of 1 gm./cm.^{2}, I could not find any diminution of the ionization current. This shows, in agreement with the determinations of other workers, that the resonance level of iodine is essentially higher than that of silver and gold. It should be noticed that Collie[3] has applied a similar method, but obtained definite results only in the case of indium.

J. ROTBLAT.
Laboratory of Atomic Physics,
Free University of Poland,
Warsaw.
August 10.

[1] Amaldi and Fermi, *Ric. Scient.*, **2**, 544 (1935).
[2] H. v. Halban, jun. and P. Preiswerk, NATURE, **137**, 905 (1936).
[3] C. H. Collie, NATURE, **137**, 614 (1936).

Destruction of Supraconductivity by Electric Current and Magnetic Field

BY any change of the magnetic flux through a supraconducting ring a permanent current T is induced, the strength of which can be calculated from the field intensity in the centre of the ring, taking into account the field deformation caused by the magnetic properties of the supraconducting ring.

In Fig. 1, T is plotted against the external field intensity H_s for a ring of tin. This curve, which limits the region of supraconductivity ($\rho = 0$), is given by the condition that the sum of the tangential component of the external field and the field caused by the current is equal to the critical magnetic field, either on the inside or on the outside periphery of

the ring, while the field is certainly smaller on the rest of the ring surface. Thus our experiments show that it is a necessary condition of supraconductivity, that the magnetic field is zero in the whole of the volume and its effective tangential component does not exceed the critical value at any point of the surface of the supraconductor.

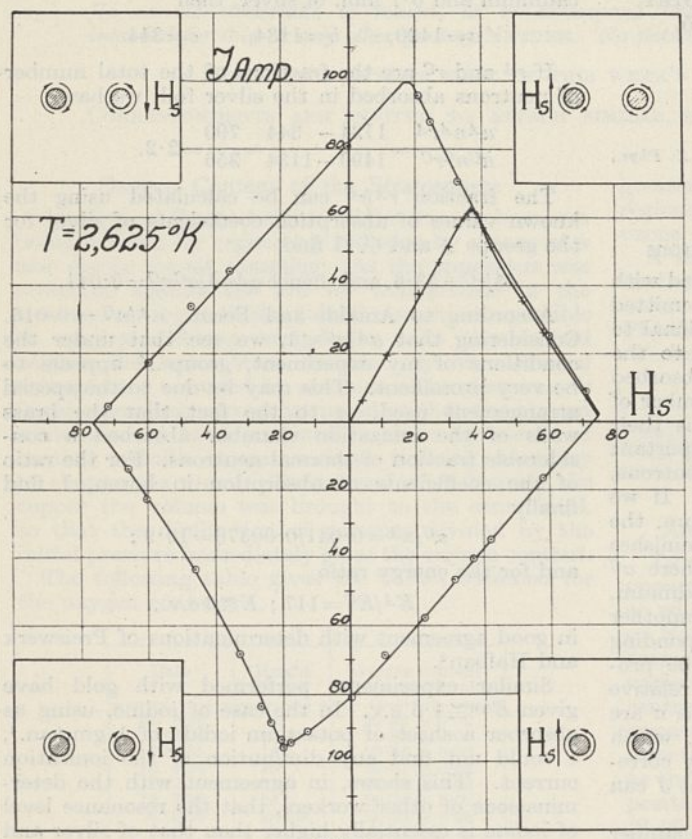


FIG. 1.

In a paper just published by D. Shoenberg[1], the results of measurements on a supraconducting ring of lead are given which are entirely in agreement with our results obtained with tin. But Shoenberg's conclusions are wrong, since he assumes that the decrease in current could be explained by a decrease in the supraconducting cross-section which leads to an unstable condition of current distribution. A more detailed paper on this matter is being published shortly[2].

L. SHUBNIKOV.

Ukrainian Physico-Technical Institute,
Kharkov.
July 15.

[1] D. Shoenberg, *Proc. Roy. Soc.*, A, **155**, 724 (1936).
[2] *Sow. Phys.*, in print.

Influence of Nitric Oxide on the Thermal Decomposition of Dimethyl Ether. Gaseous Catalysis

IN the course of an investigation on the thermal decomposition of dimethyl ether, alone, and in the presence of other gases, the reaction with nitric oxide was studied. We found that very small quantities of the oxide reduced the rate of reaction, represented by the equation,

$$(CH_3)_2O = CH_4 + CH_2O,$$

and measured by the rate of formation of methane, to a very small fraction of the rate observed in the pure gas. This is in accord with the results of Staveley and Hinshelwood[1] in the case of diethyl ether.

As the concentration of the nitric oxide in the reaction mixture is increased, the rate of reaction, which had become very small, increases rapidly. Staveley and Hinshelwood, writing of the reaction in the case of diethyl ether, refer to this process as one of catalysis. In the case of dimethyl ether, however, investigation by the method of detailed analyses shows that catalysis is not involved.

The CH_4–t graphs, representing the rate of primary decomposition of dimethyl ether, bend less sharply towards the t-axis than they should do if the decomposition process followed a normal course in accordance with the classical theory. The graphs show well-marked breaks, and the rate of reaction is diminished by increasing the surface of the reaction vessel. It appears to be an important fact that the process can only follow a single course, and there are no alternatives such as have been indicated in the case of other processes[2].

If a series of experiments is carried out, within the range at which the presence of nitric oxide increases the rate of reaction, such that the initial concentrations of the dimethyl ether and nitric oxide, and the temperature, are constant, and the time is varied, it is found that the whole process has no relation to the process involved in the primary decomposition of dimethyl ether alone. The products are methane, carbon monoxide and dioxide, with very little hydrogen, and, at high concentrations of nitric oxide, carbon monoxide is the dominant product. The form of the $x - t$ graphs is quite different from those recorded in the case of the primary decomposition of dimethyl ether alone. They are convex towards the t-axis, as in the case of the thermal decomposition of acetaldehyde. The processes involved are strongly accelerated.

The processes are obviously oxidation processes, and the observations now recorded support the suggestions put forward in the two letters to NATURE referred to above. It seems that the reaction of nitric oxide with dimethyl ether gives rise to processes, each of which results in the formation of a short-lived intermediate, which can decompose in two different ways. The oxidation processes can be represented by a series of equations, such as,

$$(1)\quad CH_3.O.CH_3 + O \rightarrow CH_3.O.CH_2OH \begin{matrix}\nearrow CH_4 + CO_2 + H_2 \\ \searrow CH_4 + CO + H_2O\end{matrix}$$

$$(2)\quad CH_3.O.CH_2OH + O \rightarrow CH_3.O.CH(OH)_2 \begin{matrix}\nearrow CH_4 + CO_2 + H_2O \\ \searrow CH_3OH + CO + H_2O.\end{matrix}$$

In a series of experiments in which a quantity of dimethyl ether was heated with increasing quantities of nitric oxide for 15 minutes, the proportion $(CO_2 + CO) = 2CH_4$ was reached.

Since the characteristics of these oxidation processes are almost identical with those of the thermal decomposition of acetaldehyde, it is not surprising that nitric oxide does not influence the rate of thermal decomposition of acetaldehyde in the manner observed in the case of dimethyl ether. The so-called catalysis of the thermal decomposition of acet-

aldehyde by nitric oxide is also probably initiated by oxidation processes. The inhibition of the thermal decomposition of dimethyl ether by nitric oxide is, however, a very important addition to those facts which we have enumerated, which serve to distinguish this process from the thermal decomposition of acetaldehyde. Taking all these facts together, it does not seem possible to distinguish either process as being the only one which is influenced by chain mechanism.

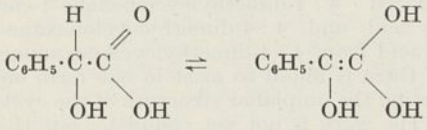
P. F. GAY.
Chemistry Department, MORRIS W. TRAVERS.
University of Bristol.
August 31.

[1] *Proc. Roy. Soc.*, A, **154**, 335, and *J. Chem. Soc.*, 812 (1936).
[2] NATURE, **137**, 906 (1936); **138**, 26 (1936).

Use of Deuterium as an Indicator in Stereochemical Investigations

1. IT is known that optically active compounds under different influences undergo racemization. Various theories have been put forward to explain the mechanism of these changes.

A. Werner[1] took the view that the extreme oscillation of the molecules led apparently to an unravelling of the tetrahedral configuration. Other authors assume that the racemization is brought about through the formation of an enol[2]. Taking as an example mandelic acid, it is assumed that the following equilibrium goes over from the keto-form to the enol-form; that is, there is a change from an asymmetrical to a symmetrical molecule:



The use of heavy water (D_2O) enabled us to decide experimentally between the various opinions, for we know from other examples[3] that the OH group of the enol-forms is exchanged with D_2O. If the racemization in heavy water takes place through the enol-form, then the racemized mandelic acid will show a corresponding high content of the D-atom.

In the control experiment, mandelic acid was recrystallized out of heavy water by heating to 60° C., an operation in which the optical activity is fully retained. The resulting mandelic acid contained, according to isotope analysis[4], $x = 1{\cdot}7$ D-atom (corresponding to $t = 1{\cdot}9$)[5], which corresponds to an exchange of two hydrogen atoms.

This result was confirmed by many experiments and is explained by the formation of the acid

$$\begin{matrix} & H & \\ C_6H_5C & \cdot & COOD. \\ & OD & \end{matrix}$$

In the racemization experiment, mandelic acid, dissolved in heavy water, was warmed to a temperature of 140° C. over a period of 51 hours. The acid isolated was optically completely inactive. The isotope analysis of the racemized mandelic acid, carefully purified, freed from all traces of benzoic acid, gave, however, $x = 1{\cdot}7$, $t = 1{\cdot}9$ also, corresponding to two interchangeable hydrogen atoms, although if we assume enolization, at least $t = 2{\cdot}7$ was to be expected. This result, accordingly, is in favour of the Werner-Hund conception of the mechanism of racemization.

A racemization experiment with a mandelic acid in a solution of NaOD also resulted after 16 hours heating at a temperature of 100° C. in a fully racemized acid. Purified and recrystallized from D_2O, the isotope analysis of this acid gives $x = 2{\cdot}06$, $t = 2{\cdot}34$.

Since the value of t here is again less than 2·7, it cannot be supposed that racemization and enol formation is the same reaction.

2. There exist the results of a series of experiments concerning the preparation of compounds of the type C.R′R″HD. These communications are partly of negative[7] content and partly positive[8]. In this paper we only want to report on two such experiments. We allowed benzene to react with the optically active compound

$$\begin{matrix} & Br & \\ C_6H_5\cdot & C & \cdot COOH, \\ & H & \end{matrix} \quad [\alpha]_D^{20} = -145° \text{ (benzene)}$$

in the presence of zinc; the resulting acid,

$$\begin{matrix} C_6H_5 & & \\ & \diagdown & \\ & & CH\cdot COOH, \\ & \diagup & \\ C_6D_5 & & \end{matrix}$$

was optically inactive.

Experiments in which an attempt was made to split up the acid with the aid of alkaloids have also not succeeded in obtaining one isomer from the separated alkaloid salt and its antipodes from the mother liquor. All observed rotation of the plane of polarized light could be traced to impurities. Further experiments are still in process.

However, we have shown with *l*-mandelic acid that the substitution of H by D in an optically active molecule can have an influence on the optical rotation. When *l*-mandelic acid, which is not subject to racemization at 60° C.[9], was allowed to react with heavy water at that temperature, it showed 1·7 D-atoms by the isotope analysis. The measurement of the optical activity of this acid (D) and of the original, untreated *l*-mandelic acid (H), both in dry acetophenone, gave the following results:

	H	D
$[\alpha]_D^{20}$	$-179{\cdot}10° \pm 0{\cdot}13$	$-173{\cdot}27° \pm 0{\cdot}13$
$[\alpha]_{Hg}^{20}$	$-216{\cdot}34° \pm 0{\cdot}13$	$-211{\cdot}43° \pm 0{\cdot}13$

The complete communication will appear in the *Helv. chim. Acta*.

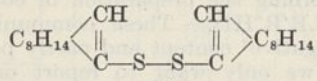
H. ERLENMEYER.
University, H. SCHENKEL.
Basel. A. EPPRECHT.
July 21.

[1] A. Werner, "Stereochemie", **49** (1904); see also F. Hund, *Z. Phys.*, **43**, 805 (1927).
[2] A. McKenzie and H. Wren, *J. Chem. Soc.*, **117**, 680 (1920); T. A. Smith, *Ber.*, **64**, 430 (1931); Th. Wagner-Jauregg, "Stereochemie" (Freudenberg), 858 (1933).
[3] See A. Farkas, "Orthohydrogen, Parahydrogen and Heavy Hydrogen", 200 (1935); H. Erlenmeyer, A. Epprecht, H. Lobeck and H. Gärtner, *Helv. chim. Acta*, **19**, 354, 543 (1936).
[4] H. Erlenmeyer and H. Gärtner, *Helv. chim. Acta*, **19**, 129 (1936).
[5] The difference from the value 2 is caused by the rates of dissociation; see *Helv. chim. Acta*, **19**, 354 (1936).
[6] W. F. K. Wynne-Jones, *Chem. Rev.*, **17**, 122 (1935).
[7] H. Erlenmeyer and H. Gärtner, *Helv. chim. Acta*, **19**, 145, 331 (1936); J. B. M. Coppock and S. M. Partridge, NATURE, **137**, 907 (1936).
[8] E. Biilmann, K. A. Jensen und E. Knuth, *Ber.*, **69**, 1031 (1936); J. R. Clemo and S. McQuillen, *J. Chem. Soc.*, 808 (1936); *Chem. and Indust.*, **55**, 441 (1936).
[9] Rothe, *Ber.*, **47**, 843 (1914).

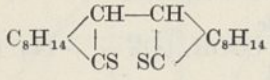
Synthesis of Two Isomeric *bis*-Thiocamphors

In continuation of his researches on thiocamphor[1] reported in this journal, and also published in the *Journal of the Indian Chemical Society*, Mr. D. C. Sen, working in my laboratory, has recently made some interesting observations which, with his views concerning the constitution of the compounds isolated, are reported below.

Bis-thiocamphor has been synthesized by the action of iodine on the sodio derivative of thiocamphor. It may be represented by either (A) or (B).



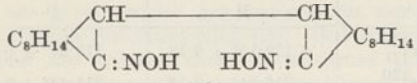
(A)



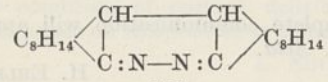
(B)

It has not been possible to synthesize this compound by Oddo's method[2] of synthesis of *bis*-camphor, namely, by the action of sodium or magnesium on β-bromocamphor, as β-bromothiocamphor could not be isolated in the pure state. Incidentally, the synthesis of *bis*-camphor by this method was also tried, but it resulted in the formation of β-iodocamphor instead of *bis*-camphor. *Bis*-thiocamphor has been prepared by the above method in two stereoisomeric forms (*l*- and *dl*-) from *l*-thiocamphor and *dl*-thiocamphor respectively.

dl-Bis-thiocamphor, m.p. 164°, forms a dioxine, m.p. 199° (*d*) and an azine, m.p. 176°, whereas *l-bis*-thiocamphor, m.p. 180°, also forms an azine, m.p. 200°, under similar conditions. These facts, along with the analytical and molecular weight data of the two *bis*-thiocamphors and their derivatives, lead to the conclusion that they contain two C : S groups, and that they are 1 : 4-dithioketones, and have the formula (B). The dioxines and the azines should therefore be represented by the structures (C) and (D) respectively.



(C)



(D)

On reduction with aluminium amalgam in moist ethereal solution, *dl-bis*-thiocamphor forms *dl-bis*-thioborneol, m.p. 148°, which decolorizes iodine and forms a yellow lead salt.

l-Bis-thiocamphor has a very high molecular rotation $[M]_D^{30°} = -1109{\cdot}5$ in benzene solution, whereas the molecular rotation of *l*-thiocamphor is $[M]_D^{30°} = -41{\cdot}3$ in the same solvent, and under similar conditions. This high exaltation in optical activity may be attributed to the presence of a potential conjugated system in *bis*-thiocamphor, which may be effective both in the thio- and thiol- phases.

Studies in absorption spectra in the visible region of *bis*-thiocamphor at different dilutions and the comparison of these with those of thiofenchone and thiocamphor have given interesting results. It has been noticed that a 5·4 per cent solution of bis-thiocamphor in benzene manifests a characteristic absorption band between 5270 A. and 4530 A., and that with dilution this band becomes shorter, and at 2·7 per cent concentration it gives a very short band, having the centre at 4950 A. Similar bands have also been observed in the case of *l*-thiocamphor and *d*-thiofenchone. This selective absorption band is therefore a characteristic property of the C : S group in cyclic thioketones, which is definitely chromophoric.

Further work in this line, which is in progress, will be published in detail in due course in the *Journal of the Indian Chemical Society*.

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[1] NATURE, **134**, 1010 (1934); *J. Indian Chem. Soc.*, **12**, 647, 751 (1935).
[2] *Gazetta*, i, **27**, 149 (1897); *ibid.*, i, **41**, 126 (1911); *Ber.*, **37**, 1569 (1904).

Non-Existence of Multiplanar Cyclohexane Rings

The work done by us, so far, has shown that it is possible to isolate only two forms of 4-methyl-, 3-methyl- and 2-methylcyclohexane-1-carboxy-1-acetic acids[1] and one form of 3 : 3-dimethylcyclohexane-1-carboxy-1-acetic acid[2]. In order to get more evidence on the point of the configuration of the cyclohexane ring, we have now synthesized 4 : 4-dimethylcyclohexane-1-carboxy-1-acetic acid and 4 : 4-dimethylcyclohexane-1 : 1-diacetic acid from 4 : 4-dimethylcyclohexanone. Each one of them is found to exist in one form only, thus supporting the uniplanar structure of the cyclohexane ring. The work is not yet complete, but this notice has been necessary in view of the recent publication of Miller and Roger Adams on the same subject[3]. The full details of the work will be published in due course.

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August 23.

[1] *J. Chem. Soc.*, 416 (1936).
[2] NATURE, **136**, 608 (1935).
[3] *J. Amer. Chem. Soc.*, **58**, 787 (1936).

Normal Erosion as a Factor in Soil Profile Development

In NATURE of June 6, Prof. G. W. Robinson directs attention to the effects of lateral transport of surface soil material, moved in the course of ordinary slow denudation, on certain soils in Wales. Erosive processes of this kind not only modify the development of particular soil profiles, but also may be found governing the zonation of soil types over wide areas. I offer an example from tropical semi-arid country.

The diagram (Fig. 1) represents, with the horizontal scale much compressed, a residual granite hillock and the soils around it, in the plateau region south of Lake Victoria. Primary soil substance is made among the rocks from the products of mechanical

and chemical disintegration of the granite surfaces, together with plant debris, baboon and hyrax droppings, and the like residues. A shallow skeletal dark grey loam (1) is so formed. This works downhill by creep and slow erosion, to serve at the hill foot as the parent material on which a deeper soil (2) of

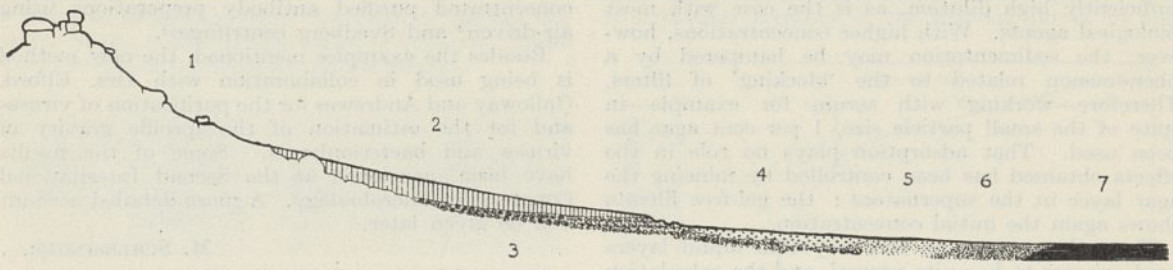

FIG. 1.

the red earth group develops. At the base of the red earth profile, where there is temporary accumulation of seepage in the wet season, a clinker-like horizon (3), coarse granitic grit in a black and rusty ferruginous cement, begins to form and may in time attain a thickness of a metre or more. In the meantime, occasional storm-water running over the surface is gradually paring off the top soil, and the spoil travels differentially according to particle size, so that by cumulative effect a zone of washed sand (4) covers the footslope below, silty or clayey sand (5, 6) lies beyond it, and a level clay floor fills the bottom-land—the *mbuga* (7). These deposits may, if we will, be looked upon merely as so much parent material, put there geologically by the denudation process; but at all stages, the erosion having been slow and non-catastrophic, they have borne their appropriate vegetation and have been developing towards maturity as soils. At a late stage, as erosion works down towards base level, the abrasion of the red earth profile ends in the emergence of the clinker-like horizon at the lowered ground surface, where (commonly under the misleading name of 'surface laterite') it resists further erosion like the sill of a waterfall in the profile of a stream.

A zoned distribution of soil types in relation to the high points in a generally low relief, somewhat as in this example, is found over a great part of the central plateau or elevated peneplain region of Tanganyika. According to the maturity of the topography, or because a new cycle of erosion has been initiated tectonically, or for lithological reasons, the character and proportionate extent of the different soils vary locally, but some six or seven of the main types are of sufficiently general occurrence in their characteristic positions on the contours to have given rise to a well-developed soil nomenclature in the Sakuma language. The complete sequence can be found under seemingly 'virgin' deciduous forest and bush, though there can be little doubt that man has at some time or other usually been in occupation and, as a soil-tilling animal, has expedited the erosive process. The case is not thereby removed from the scope of Prof. Robinson's subject of 'normal' erosion, for primitive man should not be excluded from his due place amongst the natural factors in soil formation.

Does not this example, incidentally, point to an anomaly in the use to which the word *profile* has been put by soil students? To the geomorphologist, geologist or engineer, the profile of the ground would be the outline of my diagram. To the pedologist the profile is what he finds in depth at a selected point. The language of soil description lacks a suitable term having a cross-country dimension, and the want of it is felt as soon as soils are discussed in relation to the lie of the land, as in this matter of erosion. To help in such discussions the word *catena* has been adopted (Provisional Soil Map of East Africa, 1936), to describe a topographic complex of soils such as is represented in my example.

G. MILNE.

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July 16.

Centrifuging in Rotating Hollow Cylinders

THE method described in this note provides a quick and efficient means for the fractionation of highly disperse systems—including the larger proteins—using relatively moderate centrifugal forces. Furthermore, all necessary information about the sedimentation rate and the sedimentation equilibria of these systems can be obtained, samples for examination being taken before and after spinning. Many important biological agents (viruses, bacteriophages, antibodies, etc.) remained outside the scope of the admirable methods developed by Svedberg because they are not susceptible to direct continuous optical observation, but they are within the range of the new procedure.

The principal points upon which the new method is based are (1) to have the system spread as a thin film on the inner surface of a hollow cylinder rotating with its axis vertical; and (2) to have this film subdivided in two concentric layers, the inner one being liquid, the outer one a gel of a structure sufficiently coarse to permit free motion of the single particles. Thus the distance which the particles have to travel before entering the gel or before reaching the equilibrium distribution can be reduced to a few tenths of a millimetre, whilst the gel-layer provides automatic separation of the 'sediment' from the 'supernatant', or of two levels of the equilibrium distribution, when the rotation is stopped.

In the experimental work done so far, the 'closed bowl' of the Sharples-Super-Centrifuge (inner radius 2 cm., height 20 cm., speed up to 32,000 r.p.m.) has been used without modification. A solution containing 1–2 per cent agar (in water, broth, etc., for simple fractionation, in the suspension itself when sedimentation measurements were intended) was introduced into the warmed bowl and allowed to set with the centrifuge running; the suspension was

then introduced, and the spinning continued. Two per cent agar was used for particles less than 20 mμ in diameter and 1 per cent for those less than 60 mμ in diameter.

The assumption of free entrance and motion of the particles in these dilute gels appears to be justified so long as the particles in question are present in sufficiently high dilution, as is the case with most biological agents. With higher concentrations, however, the sedimentation may be hampered by a phenomenon related to the 'blocking' of filters. Therefore—working with serum for example—in spite of the small particle size, 1 per cent agar has been used. That adsorption plays no role in the effects obtained has been controlled by mincing the agar layer in the supernatant: the gel-free filtrate shows again the initial concentration.

The sedimentation in the very thin liquid layers used appears to be quite normal, and the calculation of the rate of sedimentation requires no elaboration here.

When the sedimentation equilibrium is established, the value of k, equivalent to $\frac{N}{RT} \cdot V(\sigma-\sigma_1)g$, in Perrin's equation can be calculated from the measured average concentration, C_S, in the liquid layer, and C_W the average concentration in the whole system, liquid plus gel.

Now

$$C_S = \frac{1}{x_1} \cdot \int_0^{x_1} C_0 \cdot e^{kx} \cdot dx,$$

where x_1 = thickness of liquid layer.

x_2 = thickness of gel layer.

C_0 = equilibrium concentration when $x = 0$, that is, at the surface of the liquid.

$$C_W = \frac{1}{x_1+x_2} \cdot \int_0^{x_1+x_2} C_0 \cdot e^{kx} \cdot dx.$$

Hence

$$\frac{ek^{x_1}-1}{e^{k(x_1+x_2)}-1} = \frac{x_1}{x_1+x_2} \cdot \frac{C_S}{C_W}, \qquad (1)$$

(x_1+x_2) being considered very small compared with the radius of rotation.

If $e^{kx_1} \gg 1$, then the solution of equation (1) is with good approximation.

$$k = \frac{1}{x_2} \cdot \ln \cdot \frac{x_1+x_2}{x} \cdot \frac{C_W}{C_S}.$$

Otherwise the solution can be made very simple by arranging that $x_1 = x_2$, or that $x_1 = x_2/2$.

Working with the smallest bacteriophage, *S*13, for example, drops of 60–80 per cent in the concentration of the supernatant were found using 2·5 c.c. liquid and a centrifugal force of 10,000 × gravity, in 2–3 minutes time. This leads to a sedimentation constant of about $s = 5 \times 10^{-12}$. The 'molecular weight'—about $2\text{–}3 \times 10^6$—obtained for this phage from the estimation of the sedimentation equilibrium using centrifugal forces of 2,500–10,000 × gravity is in good agreement with the value derived from the sedimentation rate.

In experiments made with Dr. Elford on Type I-pneumococcus anti-serum (horse), 60–70 per cent of the antibody was spun down in thirty minutes (force, 20,000 × gravity); the drop in the total protein content determined refractimetrically was about 30 per cent. No further change was obtained by continued spinning. The calculation from this equilibrium leads to a value of about 4×10^5 for the 'molecular weight' of the antibody (corresponding to the globulin fraction of largest particle size). This confirms previous results obtained by Elford and his collaborators by filtration[1], and recent findings on concentrated purified antibody preparations using air-driven[2] and Svedberg centrifuges[3].

Besides the examples mentioned, the new method is being used in collaboration with Drs. Elford, Galloway and Andrewes for the purification of viruses and for the estimation of the specific gravity of viruses and bacteriophages. Some of the results have been mentioned at the Second International Congress for Microbiology. A more detailed account will be given later.

M. SCHLESINGER.

National Institute for Medical Research,
London, N.W.3.
Aug. 8.

[1] W. J. Elford, P. Grabar and W. Fischer, *Biochem. J.*, **30**, 92 (1936).
[2] J. Biscoe, F. Herčík and W. G. Wyckoff, *Science*, **83**, 602 (1936).
[3] M. Heidelberger, K. O. Pedersen and A. Tiselius, NATURE, **138**, 165 (1936).

Regeneration in Arachnida

DURING last year I noticed that Harvestmen (Opiliones) do not regenerate lost legs when they moult, and this summer I have determined that they do not regenerate pedipalpi either. It seemed possible that this surprising deviation from a general character of the Arachnida might be related to the contrast between the length of the limbs and the shortness of the cephalothorax, within which it would be impossible to develop a leg long enough to be useful when exposed by ecdysis, and that, if this were so, the same peculiarity might be shown by spiders with very long legs. A specimen of the spider *Pholcus phalangioides*, sent to me by Dr. W. S. Bristowe, has just cast its skin and shows no trace of a new leg to replace one which I removed four weeks ago.

Such failure to regenerate is, I think, a previously unrecorded feature among Arachnida, and it is intended to repeat the investigation with other spiders, such as *Phyllonethis* and *Tetragnatha*, which also have long legs.

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Sept. 2.

Chromosome Number of *Eucalyptus globulus* and *Eucalyptus Johnstoni*

WE have endeavoured to determine the chromosome numbers of certain species of *Eucalyptus*, using radicles, root tips and anthers. Although clear-cut mitotic figures were obtained with radicles and root tips, consistent with one another under different conditions of fixation and staining, we were not successful in determining the chromosome number with certainty, owing to the tendency of the chromosomes to remain attached to each other throughout the cycle.

Greater success was achieved with pollen mother cells, although here also the above tendency was to some extent troublesome. Diakinesis gave the most unambiguous results, but checks were obtained with metaphase I and anaphase I.

The haploid number for both *E. Johnstoni* and *E. globulus* is eleven. There appears to be an interesting tendency to secondary pairing in *E. globulus* which makes the determination of the number in metaphase I and anaphase I less certain than with *E. Johnstoni*; but the diakinesis figures seem conclusive.

Work is proceeding with the view of tracing the course of the whole meiotic series of changes. These show interesting variations from the normal.

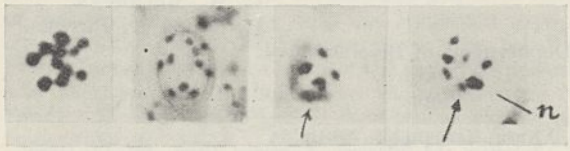

FIG. 1. (*a*) Metaphase I of *E. Johnstoni*. × 2000. (*b*) Late diakinesis of *E. Johnstoni*. Two photographs of the same cell, focused on different planes, are superimposed. The nucleolus has disappeared. × 1000.

(*c*) and (*d*) Two photographs of the same cell in early diakinesis (*E. globulus*). The nucleolus is seen in (*d*) in close conjunction with a chromosome (*n*). The chromosome marked by the arrow appears in both photographs. × 1000.

Figs. 1 *a* and *b* show a typical metaphase I, and a composite photograph of diakinesis in *E. Johnstoni*; figs. 1 *c* and *d* are two photographs focused on different planes in a nucleus in diakinesis in *E. globulus*.

Our best thanks are due to the trustees of the Science and Industry Endowment Fund for a grant, without which this work would not have been possible.

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F. D. CRUICKSHANK.
R. G. BRETT.

University of Tasmania.
July 10.

Carbohydrate Metabolism

EXPERIMENTS which have been in progress in this laboratory during the past six months have had results very similar to those described by Krebs[1] in a recent letter. The formation of α-ketoglutaric acid in the course of pyruvic acid oxidation was made very probable by my earlier results[2]. In recent experiments the formation of succinic acid from pyruvic acid, acetic acid and α-ketoglutaric acid could be demonstrated both anærobically in minced brain and ærobically in the minced brain poisoned with malonic acid. Two explanations of these facts are possible: (1) there are two alternative paths of succinic acid formation from pyruvic acid, one leading to α-ketoglutaric acid by the condensation of two molecules of pyruvic acid and subsequent decarboxylation[2], the other starting with decarboxylation of pyruvic acid to acetic acid and subsequent condensation of two molecules of acetic acid[3]; (2) α-ketoglutaric acid is formed by condensation of one molecule of pyruvic acid and one molecule of acetic acid. It has not yet been possible to decide which is correct.

The decarboxylation of α-ketoglutaric acid by brain slices under anærobic conditions depends on the presence of suitable hydrogen acceptors. The carbon dioxide evolution is increased on addition of a neutralized dye (Brillant cresyl blue) and reduced to the initial value as soon as the dye is decolorized (Fig. 1). The carbon dioxide evolution due to the reduction of the dye[4] is very small in the case of Brillant cresyl blue and can easily be allowed for. The amount of carbon dioxide given off by decarboxylation of α-ketoglutaric acid is almost exactly equivalent to half the amount of the added dye. Since two molecules of dye correspond to one molecule of oxygen, the *R.Q.* under these conditions is 1, the same as in ærobic experiments. Since the amount of hydrogen acceptor is the limiting factor of the

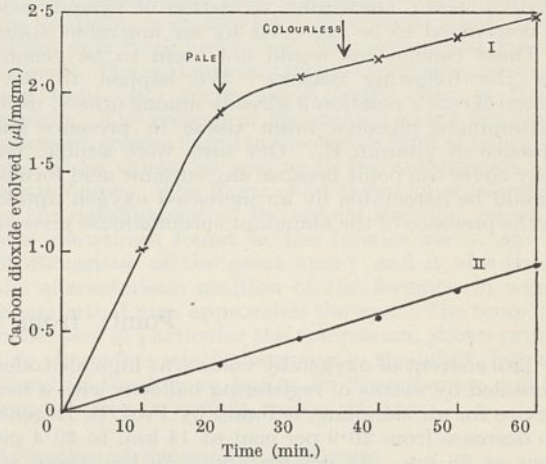

FIG. 1. Carbon dioxide evolution by slices of guinea pig brain in nitrogen in presence of *m*/50 α-ketoglutaric acid; I, after addition of Brillant cresyl blue (0·15 ml. of *m*/50 sol.; carbon dioxide corrected for the amount due to reduction of the dye); II, without Brillant cresyl blue.

decarboxylation, it is concluded that a dehydrogenation precedes the decarboxylation, thus excluding the possibility of an aldehyde as intermediate. In analogy to the oxidative deamination, the following mechanism of decarboxylation may be suggested:

$$R-CH=\underset{\text{Enolic form of keto acid}}{\overset{OH}{\underset{|}{C}}}-\overset{HO}{\underset{|}{C}}=O \xrightarrow{-H_2} R-CH=\underset{\text{Ketene}}{\overset{O}{\underset{\|}{C}}}+\underset{+CO_2}{\overset{O}{\underset{\|}{C}}}=O$$

$$\xrightarrow{+H_2O} R-CH_2-C\begin{cases}OH\\ \\ O\end{cases} + CO_2.$$

Carboxylic acid

Glucose, which provides suitable hydrogen acceptors, can replace the dye, as shown by anærobic succinic acid formation from α-ketoglutaric acid. Pyruvic acid liberates carbon dioxide and forms succinic acid anærobically even in absence of glucose or other hydrogen acceptors, no doubt because it acts itself as hydrogen acceptor, being partly reduced to lactic acid. The system β-hydroxybutyric acid⇌acetoacetic acid, quoted by Krebs, is only one of many reversible oxidation-reduction systems in the cell, which act as reserve hydrogen acceptors guaranteeing the progress of vital oxidations independently of the varying oxygen supply.

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Royal Victoria Infirmary,
Newcastle-on-Tyne.
Sept. 2.

[1] Krebs, NATURE, **138**, 288 (1936).
[2] Weil-Malherbe, *Biochem. J.*, **30**, 665 (1936).
[3] Thunberg, *Skand. Arch. Physiol.*, **40**, 1 (1920).
[4] Reid, *Biochem. Z.*, **242**, 159 (1931).

KREBS[1] stated recently that vitamin B_1 is a co-enzyme for two anærobic reactions, of which one is the following:

$$\alpha\text{-ketoglutaric acid} + \text{'ketonic' acid } (A) + H_2O \rightarrow \text{succinic acid} + CO_2 + \text{'hydroxy' acid} \quad (3)$$

where the reaction is common to carbohydrate metabolizing animal tissues, and where A can be pyruvic acid; the ærobic oxidation of pyruvic acid is considered to be preceded by an anærobic stage.

These conclusions would not seem to be general for the following reasons. We happen to have tested Krebs's reaction 3 already among others, using avitaminous pigeon's brain tissue in presence and absence of vitamin B_1. Our tests were ærobic, but they cover the point because any succinic acid formed should be detectable by an increased oxygen uptake in the presence of the abundant succinoxidase present. No increased (or decreased) vitamin B_1 effect was observed by adding α-ketoglutaric to pyruvic acid. Hence in our brain systems, the extra oxygen uptake catalyzed by vitamin B_1 in presence of pyruvic acid does not follow the lines of the above equation.

We are not yet in a position to make a statement about Krebs's reaction (1) as regards our system; but we can say that we have definite evidence against the view that the oxidation of pyruvic acid proceeds through the stage of succinic acid, which has been suggested for muscle[2] and for kidney[3].

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Department of Biochemistry,
Oxford.
Sept. 7.

[1] Krebs, NATURE, **133**, 288 (1936).
[2] Toenissen and Brinkman, *Z. physiol. Chem.*, **187**, 137 (1930).
[3] Elliott and Schroeder, *Biochem J.*, **28**, 1930 (1934).

Points from Foregoing Letters

THE content of oxygen by volume at high altitudes, obtained by means of registering balloons with a new device for air sampling, is found by Prof. E. Regener to decrease from 20·9 per cent at 14 km. to 20·4 per cent at 28 km. At heights above 20 km. there are relatively great variations in composition, due probably to weather conditions.

No increase in the normal amount of cosmic rays that could be attributed to the appearance of Nova Lacertæ was observed by Drs. J. Barnóthy and M. Forró between June 19 and July 17 on pointing their 'counters' towards the new star at its highest position in the sky.

The ionization current due to slow neutrons produced in a boron-coated chamber has been measured by J. Rotblat in absence and in presence of absorbers of cadmium, silver, gold and iodine. The diminution of the ionization current for each element is proportional to the number of neutrons selectively absorbed in this element, and to their coefficient of absorption in boron. Assuming that this coefficient is inversely proportional to the velocity of neutrons, and that the 'cadmium' neutrons possess thermal energies, that is 0·025 e.v., Mr. Rotblat finds that the 'silver' neutrons have an energy of about 3 e.v., the 'gold' neutrons about 4·5 e.v., and that the energy of 'iodine' neutrons is essentially higher.

By plotting the strength of the current induced in a supraconducting ring of tin against the field intensity, L. Shubnikov deduces, as a necessary condition of supraconductivity, that the magnetic field should be zero in the whole of the volume and its effective tangential component should not exceed a critical value at any point of the surface of the supraconductor.

Small quantities of nitric oxide reduce the rate of thermal decomposition of dimethyl ether, but larger quantities increase it. P. F. Gay and Prof. M. W. Travers find that the end products in the two cases are different, and they consider that the effect observed with nitric oxide cannot be attributed to catalysis. They postulate the formation of short-lived intermediates.

Mandelic acid loses its optical activity (becomes 'racemized') when heated at 140° in heavy water. Prof. H. Erlenmeyer, H. Schenkel and A. Epprecht find that the number of heavy hydrogen atoms which replace ordinary hydrogens in the mandelic acid molecule during this transformation supports the Werner-Hund conception of the mechanism of racemization. They also report the influence of the heavy hydrogen on the optical activity of the mandelic acid.

The properties and reactions of two sulphur-containing camphor derivatives (*l*- and *dl-bis*-thiocamphor), synthesized by D. C. Sen, are reported by Sir P. C. Rây.

An example of the effects of slow erosive shift of surface soil material on the zoning of soil types around high points in a region of peneplain topography is adduced by G. Milne from the central plateau of Tanganyika Territory. Comment is made on the use to which the word *profile* has been put in soil terminology.

Dr. M. Schlesinger describes the use of hollow cylinders coated with a thin gel layer, and rotating with the axis vertical, for the study of systems of high dispersity. The distance which the particles have to travel being reduced to a few tenths of a millimetre, the effect of a given centrifugal force is increased many hundredfold if compared with usual conditions. The use of the gel provides satisfactory separation of 'supernatant' and 'sediment', and the possibility of estimating sedimentation rates and equilibria on substances not subject to direct optical observation. The method is proving particularly useful for the study of biological agents (viruses, bacteriophages, antibodies).

Photomicrographs of pollen mother cells of *Eucalyptus Johnstoni* and *E. globulus* are submitted by Prof. A. L. McAulay, F. D. Cruickshank and R. G. Brett; they show that the haploid number of chromosomes for both those species is eleven.

Dr. H. Weil-Malherbe reports the formation of succinic acid from pyruvic, acetic and α-ketoglutaric acids by brain tissue, both under anærobic and ærobic conditions. It is claimed that decarboxylation is an oxidative process, with ketene as possible intermediate. The reversible oxidation-reduction systems in these reactions are held to function as reserve hydrogen acceptors, which may replace oxygen.

Research Items

Population of the Northern Plains Indians

DR. CLARK WISSLER has made a study of the size of certain American Plains Indians tribes during the period of the fur trade and under the reservation system (*Yale Univ. Publications in Anthropology*, No. 1). He reviews the available data in time sequence, dealing with the Blackfoot group, the Assiniboin, and the Western Cree, who became Plains Indians before the close of the fur trade period, and then wandered about, like the Assiniboin, in bands. The fur trade period is taken as extending from 1670 to 1870. Certain general conclusions emerge. There were repeated expansions into the area of the Northern Plains, largely by Algonkin speaking tribes, such as the Blackfeet, Arapaho, Gros Ventres, etc. These expansions seem to have had a common source. The Blackfeet, apparently, were the first. The Gros Ventre held most of the Saskatchewan area in 1754, but then began to retract, when the Assiniboin were expanding into the area. These reached their maximum in 1830. The great expansion of the Cree began about 1800 and culminated in 1875. The study of population suggests that these expansions were accompanied by an increase in population; and when the tribes retracted, population shrank. The expansions from the Lake country were not all in historic times and not all due to white pressure. The coming of the horse, firearms and the expansion of the fur trade were stimuli. Diminishing returns in buffalo and fur began about 1850. The disappearance of the buffalo and the taking up of reservation life were severe blows to numbers and culture. However, recovery set in at an early date, and a few tribes seem to have suffered little population loss. The reservation system may be considered a stabilizer, and saved many tribes from destruction. Instead of proving a quick method of absorbing the Indian, as was anticipated, it has proved the reverse. At present the national Indian policy is to conserve tribal culture rather than to destroy it.

Fossil Men of Engis

A RE-EXAMINATION by Dr. Charles Fraipont of the evidence relating to the discovery by Philippe Charles Schmerling in 1830 of two human skulls associated with a fossil fauna and flint implements in caves at Engis, near Liège, has established the fact that Schmerling was the first to discover an example of Neanderthal man (*Archives de l'Inst. Pal. Humaine, Mém.*, **16**). The first skull, the only one described hitherto, is well known as a member of the Cro-Magnon race, but of a less specialized type, belonging to the group Brnö, Vistonič and Combe-Capelle. The second, however, never previously described, is now shown to be the skull of a Neanderthal child. The association of the two different types in a single stratum is explained as due to an Aurignacian burial. The stratigraphy of the cave shows no trace of occupation after Aurignacian. The industry is Aurignacian overlying Mousterian. Associated with the Aurignacian implements were the bones, intentionally broken, of *Equus*, *Bos* and *Rangifer*, while in the stratum below, where an Aurignacian industry overlies Mousterian, the human remains were associated with *Elephas primigenius*, *Rhinoceros tichorhinus*, *Hyaena spelaea*, *Ursus spelaeus*, etc., belonging to Middle or Upper Quaternary. The age of the Neanderthal child of Engis, as indicated by the dentition, is probably less than seven years. None of the milk teeth had fallen. The molars had not yet erupted. The median permanent incisors are enormous and their pulp cavity much larger than in *Homo sapiens*. The enamel of the molars shows the characteristic creases found in the child's skull of Gibraltar and of La Quina, as well as in the anthropoids and *Sinanthropus*. The Engis child shows an acceleration in the development of the cranial skeleton, which is still sometimes found in the inferior races, and is characteristic of the great apes; and it also shows the characteristic position of the foramen in which Neanderthal man approaches the apes. The temporal bone, and in particular the tympanum, shows primitive characters which disappear in the adult, but are found in the human fœtus, in *Sinanthropus* and to some degree in certain species of apes.

Archæological Excavations in Moravia

SOME further important archæological discoveries have just been made, according to an announcement in the Central European Press, at Věstonice in the valley of the Dyje, Moravia, near the place where the 20,000 years old 'Věstonice Venus' was unearthed some six years ago. Large numbers of stone and bone implements, some of them of a unique type, have been unearthed. One of the objects is a spear, thirteen inches long, carved out of a horn from a diluvial stag in excellent condition, and, like the five-inch female figure of the Moravian mammoth hunters, testifies to the skill of the artists of that period. Handsome pendants and carved ornaments of mammoth bone, crystal spheres and implements chipped out of quartz, and a stone borer unique for the Moravian diluvium are among other interesting finds.

Swallows in Britain

FOR two years an inquiry covering many aspects of the life of the swallow has been conducted in Britain under the auspices of the British Trust for Ornithology. The results of the 1935 inquiry are summarized in *British Birds* (**30**, 98, Sept. 1936) by A. W. Boyd. It would appear that swallows in the Lowlands of Scotland and north England lay larger clutches and rear larger broods than birds breeding in the southern part of England, and the suggestion is made that the fact may be associated with longer hours of daylight in northern latitudes. But we surmise that amount of food must be involved, and that no increase of daylight in the absence of increase of food would affect the clutches. How many eggs do swallows lay in the extreme north of their breeding range? Heavier rainfall cannot be shown to have any adverse effect upon size of clutches. The average brood for the whole country is just over four; the normal clutch is five, but six eggs, usually found in the northern counties, are not infrequent. The density of swallows varies enormously, from 40 pairs to 1,000 acres in well-populated rural districts of Norfolk and Anglesey where nesting-sites are

common; to between 20 and 33 pairs in the cattle-raising districts of western England and Wales; and low numbers, 2 to 6 pairs, in industrial areas, in a large area of the Lake District, and on the downs of Sussex and moors of Suffolk.

The Migrations of Birds

A VALUABLE summary of the voluminous and scattered literature upon the migratory movements of birds in 1926–35 is given by Dr. A. Landsborough Thomson in the *Ibis* (p. 472, July 1936). The report classifies and groups the findings of field observations and experiments, and shows in what respects old theories must be modified to meet new knowledge. The portion which ought to make the greatest appeal to ornithologists in general is that dealing with recent experiments devised to elucidate the fundamental problems of migration, its purposes and origin, the stimuli which set migrants on their journeys, and the forces which guide them; for experimental evidence has greatly narrowed down some of these problems in recent years.

American Land and Freshwater Isopods

A MOST useful monograph recently published is Willard G. Van Name's "The American Land and Fresh-Water Isopod Crustacea" (*Bull. Amer. Mus. Nat. Hist.*, 71; 1936). The author gives a description and figure, or figures, of all species known from North and South America and the neighbouring islands, and also describes many new species. The introductory remarks on the general characters and relationships of the group are clear and simply written, enabling a beginner to benefit by them, and yet the whole is a handbook for any specialist to use. There are 254 land isopods, very nearly 75 per cent of which are found in that part of America which lies within or close to the tropics, including the West Indies as well as the continental areas, and there are 49 freshwater species, 17 being tropical. There are no freshwater isopods known from Bermuda, Galapagos and Juan Fernandez Islands, and the few land forms are largely species from the Old World and littoral forms, a few species being peculiar to the islands. It is satisfactory that the genus *Ligia* is used here instead of *Ligydia*, and we heartily agree that to upset and abandon so well established a genus as *Ligia* Fabricius on such insufficient grounds is unjustifiable.

Fasciation in Plants

A COMMUNICATION has been received from Mr. C. J. Bond, of Fernshaw, Springfield Road, Leicester, which raises the question as to whether the hæmagglutinating substance present in the watery extract of the seeds of the runner bean, *Phaseolus multiflorus*, but absent from the seeds of the broad bean, *Vicia Faba*, may have any connexion with a fasciation he has observed to occur when the axillary shoots grow out, after the amputation of plumule and cotyledon, in the runner bean but not in the broad bean. Mr. Bond finds that the hæmagglutinating substance is present in the cotyledons of the seed of the runner bean but not in the cotyledons of the seedling, which are 'exhausted' by the demands of the growing seedling. It remains for further work, however, to show whether this substance is causally connected with the fasciation of the axillary shoots forced into vigorous growth after amputation of the plumule and one or both cotyledons.

Mosses of Fiji

THE strategic position of the Fiji Islands in connexion with the geographical distribution of flowering plants applies equally to the mosses. A strong thrust of typical south-eastern Malaysian species indicates a migratory current through the region. Mr. Edwin B. Bartram has recently dealt with two hundred numbers collected by Dr. A. C. Smith in 1933–34 on outlying islands, previously unvisited by a botanist, and difficult of access, and with a few small specimens separated from J. W. Gillespie's plants in the Herbarium of Bernice P. Bishop Museum ("Contribution to the Mosses of Fiji", by Edwin B. Bartram: *Bernice P. Bishop Museum Occasional Papers*, 11, No. 20, March 20, 1936). Additional records of nineteen established species and twelve new species increase the total of known mosses from Fiji to approximately two hundred and thirty-five.

Ecology of Alkaline Lakes of the Rift Valley

IN the final report on the work of the Percy Sladen Expedition to some of the Rift Valley Lakes in Kenya in 1929, Penelope M. Jenkin deals with the general ecology of the alkaline lakes in particular (*Ann. Mag. Nat. Hist.*, S. 10, 18, 133, July and Aug. 1936). The number of species in the alkaline lakes is small: 17 species of algæ, 11 of invertebrates, no fish or amphibia, but a large number of flamingos which come to feed upon the blue-green algæ. The paucity of the inhabitants is the more remarkable because in a neighbouring fresh-water lake, Naivasha, there were 89 species of algæ and 70 of invertebrates. The peculiar conditions of the alkaline environment apparently make for variation, since ten of the seventeen species of algæ and nine of the invertebrates were new to science. A characteristic feature of the alkaline lakes is a 'water-bloom' due to the seasonal rapid multiplication of the blue-green alga, *Arthrospira platensis*.

Paulin Aneroids

AN account of the aneroids constructed on the Paulin System appeared in NATURE of February 23, 1929 (p. 298). Since that time the instruments have been improved and their use has been extended. Their manufacture is now in the hands of a well-known Swedish firm, Telephonaktiebolaget L. M. Ericsson, of Stockholm, and their distribution in the United Kingdom is in the hands of C. E. Johansson, Ltd., 12 Queen's Road, Coventry. The null reading principle is retained. The total range of movement of the diaphragm of these aneroids is still restricted by stops to a maximum of 1/40 mm. The diaphragm is kept expanded by a spiral spring the tension of which is altered by a micrometer screw. The spring is set until the diaphragm is in a certain normal position which can be observed on a small scale marked with a zero line, and the movements of a pointer attached to the micrometer screw are read on a large circular scale graduated to give the atmospheric pressure, the variations of which are compensated for by the variations of the tension of the spiral spring effected by hand. It is claimed that the errors of hysteresis, which constitute the worst defect of the ordinary aneroid, are practically eliminated by this null method, and that great sensitivity is attained without the production of frictional errors of the size of those introduced when the movements of a diaphragm are greatly magnified by a system of levers. The

latest catalogue does not say how the problem of correcting this mechanism for changes of temperature has been solved, but states that such errors have been greatly reduced, and that the temperature coefficient is not only very low but also much more constant over the ordinary range of temperature than in the ordinary type of aneroid.

Cloud Chamber Observations of Cosmic Rays

C. D. ANDERSON and S. H. Neddermeyer (*Phys. Rev.*, **50**, 263; 1936) have taken a large number of Wilson cloud chamber photographs of cosmic ray phenomena on Pike's Peak at an elevation of 4,300 metres. The chamber was set off automatically by the cosmic rays through the usual coincidence counter control, and a magnetic field of 8,000 gauss was maintained by a solenoid. The tracks obtained are similar to those at ground level, but 'showers' are more frequent in relation to the general cosmic radiation. It seems furthermore that showers containing a large number of tracks increase more rapidly with altitude than smaller showers. Some measurements of the energy loss of fast particles going through lead plates in the chamber were made. A certain number of strongly ionized tracks were found, corresponding probably to 'heavy' particles and most probably to protons. They appear to be ejected in all directions, and to be secondary rays produced by nuclear disintegrations. The high energies of these particles show that they must be produced by the cosmic rays. A search at sea-level for protons made with a special ionization chamber by C. G. and D. D. Montgomery, W. E. Ramsey and W. F. G. Swann (*Phys. Rev.*, **50**, 403) showed that these did not exceed 5 per cent of the total rays.

Separation of Gaseous Isotopes by Diffusion

THE automatic multiple diffusion apparatus invented some years ago by G. Hertz has been studied in considerable detail by D. E. Wooldridge and W. R. Smythe (*Phys. Rev.*, **50**, 233; 1936). It consists of porous diffusion tubes with diffusion pumps arranged to collect the gas as it diffuses through and to return it to the appropriate part of the fractionation system. In order to examine the behaviour of the apparatus, it was used to separate mixtures of nitrogen and carbon dioxide. The separation obtained with an apparatus of twenty-four elements agreed well with theory. An apparatus with thirty-four elements was used to concentrate ^{13}C in methane and ^{15}N in nitrogen gas.

A Middle-Babylonian Chemical Text

C. J. GADD and R. Campbell Thompson (*Iraq*, **2** (1), 87; 1936) describe a cuneiform tablet from Tall 'Umar (Seleucia) of the reign of Gulkishar, not later than the seventeenth century B.C., written in an intentionally obscure way by a supposed member of a guild of glassmakers. This is much earlier than the well-known Assyrian chemical texts from Nineveh (seventh century B.C.), and contains the oldest known record of actual formulæ for making glazes. The cuneiform text, its transliteration, and an attempted translation are given. Two glazes, called "lead copper" and "Assyrian copper", are composed of specified amounts of *zukû*-glass, lead, copper, lime and *mil'u* (translated 'saltpetre'). The clay for the body of a pot is then steeped for three days in a mixture of vinegar and copper, which gives a 'bloom' (verdigris). The pot is fired, and then a melted mixture of the two glazes, together with some of a similar composition, is made. A sacrifice to the "incomplete dead" (perhaps the embryo) is made, the glaze is applied and the pot is fired twice, with an addition to the glaze of a composition as before but without lime.

Modern Treatment of Burns

IN the first-aid treatment of severe burns and scalds time is an essential factor, and the treatment applied in the early stages determines to a large extent the subsequent course of healing and recovery. The former almost universal first-aid treatment by the application of 'carron oil' seems likely to be superseded by the use of tannic acid. This agent, in the form of a 2·5–5 per cent solution, sprayed over the burnt area hourly for 8–12 hours, forms with the exudate a protective coagulum, allaying pain and preventing subsequent sepsis, which is so troublesome and dangerous. Various preparations of tannic acid have been compounded for immediate first-aid treatment, such as the "Tanna-Flavine Jelly" prepared by British Drug Houses, Ltd., Gresham Street, London, N.1. This is a non-oily preparation of tannic acid with the antiseptic dye 'acriflavine', which is put up ready for use in collapsible metal tubes suitable to form part of the equipment of first-aid outfits in works, schools and other institutions.

Electrically Driven Steering Gear

A PAPER read to the Institute of Marine Engineers by H. G. Leivesley on marine electrical installations in service is reprinted in the *Metropolitan Vickers Gazette* for August. Steam steering gear has the advantage of low initial cost over steering gear electrically driven. The steam consumption is high and is constantly taking place even when the helm is at zero. This is due to lag in the transmission scheme and to the failure of the valves to close fully. The lack of synchronism between the helm position and the steering engine and consequently the actual position of the rudder is improved by the provision of a rudder indicator. This device operated from the rudder post gives a reading on a large-scale instrument in the wheelhouse. This affords the helmsman a definite indication of the rudder's position. As rudder angle means steam consumption, this affords some means of correction, and the consumption of the steering engine can be reduced. In long steam lines the losses due to condensation still continue. Water rates taken on a general cargo ship of 3,000 h.p. showed that the steering engine was responsible for seven per cent of the total fuel consumption. In motor ships and passenger liners, steering gear of the electro-hydraulic type is now standard practice because of the overall economy and convenience. In large ships the steering equipment is run continuously in one direction and at almost the same speed throughout the load range. In this case the motor is not subjected to any heavy stresses consequent upon starting, putting on a sudden load or reversal. For cross-channel steamers the horse power of the steering gear is 10, for a cargo ship 15 and for a liner 40. Curves obtained by tests show the ability of the modern steering motor to deal with sudden and heavy overloads when putting the helm hard over from varying degrees of rudder angle under full power steaming conditions.

Science and the Glasshouse Industry

IN connexion with the Blackpool meeting of the British Association, Dr. W. F. Bewley delivered a public lecture on "Science and the Glasshouse Industry" at Blackpool South on September 11. Dr. Bewley prefaced his remarks by directing attention to the importance of protected crops in any scheme of food production which might become necessary if Great Britain should ever be faced with another war, and argued that new land should be broken with the plough and brought into the high state of fertility which is essential for the successful cultivation of vegetables. He also stressed the value of such crops in the diet of the people.

To form an accurate opinion of the way in which science has helped the glasshouse industry to overcome the pests and diseases which once threatened its very existence, and the way in which it has directed progress, it is necessary to consider the position prior to 1914, when organized research became possible through the establishment of the Cheshunt Research Station.

Dr. Bewley described the serious damage once caused by the tomato moth caterpillar *Polia oleracea* (£40,000 per annum in the Lea Valley alone), the white fly, *Trialeurodes vaporariorum* (£25,000 per annum), and the red spider mite, *Tetranychus telarius*. These pests were quickly controlled by measures devised at Cheshunt, and special note must be made of the importance of the chalcid parasite, *Encarsia formosa*, in controlling the white fly. Diseases such as 'damping off' and 'foot rot' caused by *Phytophthora* spp., which destroyed thousands of plants in glasshouses, *Verticillium* wilt of the tomato (*Verticillium albo-atrum*), tomato leaf mould (*Cladosporium fulvum*) and many other diseases of glasshouse plants, which once extracted an enormous annual toll, were also brought under control.

Dr. Bewley directed attention to the importance of using a clean water supply in connexion with glasshouse plants and described the work done at Cheshunt on this problem.

The 'damping off' work was the means of discovering a soil drench (Cheshunt compound) which has since been applied on a large scale for the purpose of destroying certain fungi in the soil without injuring the growing plant. A large amount of work has also been done in connexion with virus diseases, which have attracted much attention during the past ten years. Virus diseases of the tomato were described in detail, and methods for identification, prevention and control were discussed. The importance of using virus-free seeds was emphasized. It was stated that scientific research has been pursued so effectively that it is now possible to control most of the serious pests and diseases of glasshouse plants.

Passing to the question of fungicides and insecticides, Dr. Bewley paid tribute to the work of many investigators in research institutes, universities and chemical firms, whose labours have provided the vegetable growers with new sprays of greater effectiveness. He mentioned the importance of the new sulphonated oil wetting agents and the work which is being done with regard to the use of insecticidal and fungicidal compounds carried in emulsified oils.

Soil sterilization has played an important part in glasshouse work, and the processes of chemical and heat sterilization were described. Sterilization by heat is the most effective and widely used, because it destroys a wide range of organisms, whereas chemical compounds are specific in action and it is difficult to obtain satisfactory penetration of the soil in practice. The latest method of steam sterilization, by means of the 'Hoddesdon' pipe system, was described.

Work at Cheshunt has included the breeding and selection of better varieties of tomatoes and lettuce, and of tomatoes resistant to *Cladosporium fulvum*. The tomato variety E.S.1 was distributed ten years ago and is widely used, for it yields a heavy crop of good quality fruit. The work on resistant varieties has been in progress for nine years, and it now seems that the goal is in sight, for good types have been grown this year which possess a high degree of resistance to leaf mould.

The lettuce Cheshunt Early Giant is one of the triumphs of the Station. It fills a long-felt want, for it can be grown in heated glasshouses from September until March and produces large well-hearted lettuce, even at Christmas. It has provided the English growers with a splendid opportunity for beating their foreign competitors, by providing fresh well-hearted lettuce during the autumn and winter.

In glasshouse work the physical condition of the soil is of great importance. Clean straw placed in the soil with the haulms vertical has proved beneficial, as has also the use of peat either mixed with the top soil or applied as a rooting medium to the surface of the soil during the summer.

Dr. Bewley also discussed the latest methods for warming the soil by circulating hot water in pipes buried two feet below the surface. This is a new development which will no doubt become general practice in the future. Soil warming increases the rate of root production, provides large clean root systems and heavy crops. It also increases the weight of crop picked during the first few months.

The workers at Cheshunt have also investigated the use of artificial light during the propagation stages. Useful results have been obtained with cucumbers but not with tomatoes. This application of light is being held up because a suitable source of light has yet to be found. This is a task for the engineers. Engineering science has helped the glasshouse industry in the question of heating, and Dr. Bewley discussed the use of oil firing, automatic underfed stokers, gravity boilers and the steam-cum-water system.

Great importance is placed at Cheshunt upon the question of quality in vegetables of all kinds, and recently the question of tomato marketing packages was investigated. It was found that high temperatures cause the fruit to be disfigured by a yellow mottle known as 'high temperature mottle' and that bad ventilation causes softness. A new wooden box and perforated lining paper have been devised which allows the fruit to be adequately ventilated and kept in a cooler condition. It has been tested thoroughly during the past season and has given excellent results.

Chemistry and the Community

PROF. J. C. PHILIP'S presidential address to Section B (Chemistry) of the British Association delivered on September 10, on the function and training of the chemist in the service of the community, was of much more general interest than many recent addresses or discussions in this Section but was ill-rewarded by a rather smaller attendance than is usual at the presidential address to the Section. While this may be due in part to the counter-attraction of several other discussions of wide appeal taking place at the same time, the attendance at least suggests that chemists are a long way from being alive to the social implications of their work. Prof. Philip's address, however, received the strong support of the Section, and apart from its endorsement by subsequent speeches, the approval which met many of his pertinent remarks, such as those concerning the abuse of chemistry for destructive purposes and his criticism of premature specialization and the absurdity of a university department of chemistry finding it necessary to teach its students German, was plainly manifest. Sir Josiah Stamp, who was present, spoke briefly but emphatically in agreement with Prof. Philip's views.

Mr. M. P. Applebey, who followed, discussed the particular relations between industry and the profession of chemistry. In dealing with the scope of the chemist in industry, he quoted from the joint Report of the Chemical Societies of the North East Coast to the District Commissioner for the Special Areas, which forms such an admirable example of the way in which the profession can assist in handling social problems. Despite the wide scope of the chemist's work in industry his importance is not fully realized in some industries, and industry in Great Britain does not employ its due proportion of trained chemists. The chemist is most widely recognized as an analyst, but even for this purpose men of meagre qualifications are often employed, while some firms seem to consider that analytical work exhausts the possibilities of trained assistance from the chemist. As a plant manager, he has equally important functions, and chemical processes in operation require study by controllers who understand their scientific basis if efficiency and progress are to be secured. With the wider recognition of the value of technical knowledge in sales service, the chemist is finding another outlet for his services. Mr. Applebey also commented on the purchase of processes from abroad by firms in Great Britain, and pointed out that such a policy can never be a substitute for a research policy. In the absence of a research department, considerable sums may be spent on processes which prove to be impracticable, and even perfectly good processes may require much research to adapt them to the particular conditions or to acquire the intimate knowledge of their chemistry essential for successful operation.

Mr. Applebey went beyond Prof. Philip in his remarks about the place of the chemist in management, strongly maintaining that an education in chemistry or any of the exact sciences affords as good a mental training for management as some longer established courses of education. Turning to the relations between industry and chemical education, he urged that industry first requires strong and active schools of research engaged in the pursuit of knowledge and the discovery of principles from which applications may flow. Industry also looks to the schools of chemistry for a supply of suitably trained chemists to fill such posts as have been indicated. For this purpose a good honours degree is desirable, but the honours course in chemistry should be soundly based on fundamentals, giving a firm grasp of principles. Preferably the recruit should have had two or three years of advanced experimental work, usually research, designed to develop perseverance and resource as well as technique. An industrial basis in such research is neither necessary nor desirable. Industry's obligations to chemical education are best discharged by the subsidizing of research through research scholarships, by grants for special apparatus and chemicals and the support of fundamental work and of chemical publications, both directly and through encouraging its technical staff to become members of one or more societies and participate in their work.

Mr. C. J. T. Cronshaw prefaced his paper on "the Benign Gifts of Organic Chemistry" with an endorsement of Prof. Philip's remarks regarding the need for a broad scientific basis of training. The better chemists entering the organic chemical industry are acquainted with neighbouring and borderland sciences, the better fitted they are for their job. The chemist should understand the uses to which his products are put and be able to measure and assess such properties so as to be able to improve them. Early specialization is a danger; the study of science alone is liable to produce men lacking in general culture, with little literary ability and incapable of expressing themselves clearly. General culture, he suggested, may be improved by a study of history from the angle of the rise of industries in modern times under the influence of scientific developments. Finally, Mr. Cronshaw urged that the industrial recruit should cultivate the power of criticism and of co-operating with others in a team.

Mr. Cronshaw then gave a brilliant review of the development of industrial organic chemistry, commencing with the development of the dyestuffs industry and describing the myriad contributions of organic chemistry to our comfort and well-being to-day. The quest for colour, which in itself ministers to the need of many industries, has led the industrial organic chemist into many other fields, such as those of medicine in the provision of anæsthetics, and of remedies for sleeping sickness. As with dyestuffs, the tendency with progress is to advance from the general to the specific. The motor-car industry owes much to the organic chemist alike in the improvement of tyres, oil, petrol and the finishes used for it. Organic chemistry has given the textile industry two new fibres, and in its recent work on detergents and products for the control of pests and in the field of vitamins it is continuing to confer benefits on mankind.

Sir Henry Dale, in discussing the training of chemists for work in the fields of biochemistry and medicine, referred to the way in which chemistry in recent years has invaded the fields of functional biology and the sciences related to medicine. Even in the complex field of immunity, in recent years we

have seen the beginning of exact description in terms of organic and physical chemistry. In the last few years a whole series of hormones has been isolated chemically and several synthesized. Four or five vitamins have been identified chemically and at least three synthesized. Sex hormones, one vitamin, carcinogenic substances and heart tonics have been chemically related to the typically inert sterols. Already new substances have been synthesized which promise to give control over some of the most deadly infections of man, especially in the tropics. The whole orientation of therapeutics is being shifted from the effects to the causes of disease. Sir Henry Dale suggested that the greatest service of chemistry to the community lies in this new and increasing domination of biological and medical research by chemical methods and ideas. In urging the necessity for co-operation between the chemist and those trained primarily in biology and the medical sciences, he protested strongly against the neglect in Great Britain of the study of tropical diseases. While we control more of the tropics than any other country in the world, we have done comparatively little in attacking the problems of tropical disease. It is unlikely that we shall be able to justify permanently the possession of large sections of the globe, and depend on the efforts of other nations to make them habitable.

The Mediterranean Littoral

THE Consiglio Nazionale delle Ricerche has undertaken, through the agency of the National Committee for Geography in conjunction with the Institute of General Geography of the University of Pisa, an inquiry into recent conditions affecting sandy beaches along the Italian littoral, and in this connexion is publishing a series of monographs dealing with the coastline in ten regional sections, each of which is to form the subject of a separate volume. In this way, reviving the studies of eminent physiographers of the past, it is intended to present a chain of facts which will serve for a systematic research into the regimen of Italian beaches and so foster the advancement of scientific geography, at the same time aiding in the development of maritime engineering.

The opening volume of the series, forming an introduction to the whole subject, has been prepared by Signor Agatino D'Arrigo*, an engineer of acknowledged competence and merit, who has received the distinction of the award of a premium from the Royal Academy of Italy for his publications on coastline phenomena. He has produced an excellent historical review of the subject, giving an account of the earlier investigations of Italian observers from Leonardo da Vinci, Montanari, Marsili and Paleocapa to Cialdi and Cornaglia, including at the same time appropriate references to the facts recorded by writers of other nationalities. The first part of the volume is taken up with this disquisition, and is followed by certain deductions of a general order to which limitations of space do not permit reference in detail.

The second part consists of a series of comparative morpholithological studies of the regimen of various parts of the Mediterranean littoral, including the Nile Delta, the Delta of the Po and the adjacent Venetian region, the Delta of the Rhone, the Delta of the Tiber, the Bay of Taormina, the Algerian Littoral and the Argentarian Promontory, with a final chapter embodying the conclusions of the author.

The investigations are obviously spread over a wide field and while they serve as an admirable introduction to a further and more complete survey, their immediate value is perhaps best assessed, as stated by Prof. Toniolo in his preface to the volume, as a general confirmation of the hypothesis already advanced of the probable reversibility of the cycle of evolution of the Mediterranean littoral. For physiographers of other nationalities, the book contains a great deal of serviceable information, with useful references to the work of Italian investigators. The treatise, in fact, is commendably documented, and there is an excellent set of coloured charts showing coastline changes at various dates. B. C.

* Ricerche sul Regime dei Litorali nel Mediterraneo. By Agatino D'Arrigo. Pp. 172. (Rome: Stabilimento Tipografico "Aternum".) 50 lire.

Educational Topics and Events

WILD-BARFIELD ELECTRIC FURNACES, LTD., Elecfurn Works, North Road, Holloway, London, N.7, have prepared a series of lantern slides illustrating many types of electric furnaces for heat-treatment, together with notes regarding the various slides. These form the basis of a paper on such equipment, and sets and lecture are available for societies, technical schools or other interested bodies.

FORMAL education for marriage is advocated by Paul H. Landis of the State College of Washington in an article on "Control of the Romantic Impulse through Education" published in *School and Society* of August 15. The mounting divorce rate in the United States, now higher than in any other country, is, he suggests, attributable in some measure to the frequency of romantic marriages, and of this the chief cause is the mobility characteristic of contemporary American life, especially in the West, where the divorce rate is highest. "In most fields now we believe in giving experience vicariously through books and the school curriculum, yet in the field of marriage and the family we let youth learn by experience." We need courses in high school and college in eugenics and the essentials of happy family life, to set up new barriers to the free exercise of the romantic urge.

THE Education Act 1936 throws upon local education committees a heavy addition to their responsibilities. In persistently agitating for the raising of the obligatory school age, for which the new Act provides, they have, as an editorial in their official organ, *Education*, of September 4, points out, created for themselves a vast moral obligation. The issues involved in adjudicating upon applications for exemption closely concern the well-being of the community: the health and physical condition of the child; the 'beneficial' nature of the proposed employment, including its prospective benefit; the opportunities to be afforded of free education; the time available for recreation; and the case of each individual child will call for careful consideration. The grant of an employment certificate in respect of an exempted child is clearly intended to be a deliberate judicial act, not the routine application of a rough and ready test. An incidental advantage

of this procedure will be that members of the committees will be constantly face to face with the question—what is the content of this final year of compulsory schooling and what is its probable value in any particular case? It is, the article points out, in this connexion, that loyal and willing co-operation between the Board of Education, local authorities and teachers will be specially desirable. A series of articles by Dr. Percival Sharp, secretary of the Association of Education Committees, on the problems presented by the administration of the new Act, is promised.

THE 'brain trust' in American politics is symptomatic of that pronounced swing towards the social sciences which has been one of the most noticeable features of university life in the United States in recent years. Commenting on this movement, the president of Yale University in an Alumni Day address urged the frank and definite recognition by universities of the "preponderant importance for our day and for the immediate future of the crucial problems of the industrial and economic order and of the individual human life in all its physical, social and spiritual aspects". Failing such recognition and energetic fulfilment of the universities' correlative obligations to the social order, they may have to face "the destruction of all that we and our predecessors have given our lives to create". But the 'brain trust', in so far as it involves the exploitation of university faculties by Government departments, is obviously liable to abuse, and a public protest has, according to *School and Society* of July 25, been made by Mr. Walter Lippmann and eight other prominent alumni of Harvard against the consequential neglect by professors of their academic duties. In Great Britain, on the other hand, one doubts whether Government departments make sufficient use of the brains of university staffs and advanced students. In the Ministry of Labour's report for 1935, for example, there is no evidence of contact between the Ministry and university departments concerned with cognate matters, although these doubtless study the masses of statistics provided by the Ministry.

THE president of Columbia University, New York, Dr. Nicholas Murray Butler, in his recent "Commencement Day" address on "The Decline and Fall of Morals", quoted Thomas Jefferson's prophecy that the cult of the "almighty dollar" would lead to heavier and heavier shackling of the people's freedom "till our rights shall revive or expire in a convulsion"—an alternative which is, Dr. Butler declared, the one dominant question before the world to-day. With this question is also bound up the fate of morals, for the destruction of liberty would make morals impossible. He referred to the German people's once powerful influence in the intellectual and economic life of the world, forfeited for the time being under a self-confident tyranny that boasts (Dr. Goebbels, on March 19) "we do not have to appeal to the people, we have the army, the police, the wireless, the press, the Nazi organization". He noted the utter disregard by Japan and Italy of moral obligation and their recourse to mass murder, and the strange mutation of Mussolini's principles since 1913, when he rebuked his countrymen for the "stupid orgy . . . in which the Italian press is now letting itself go with mad exaltation. Strong peoples have some sense of measure. Italy, rationalist and militarist, shows that it lacks this sense . . . a miserable war of conquest (the conquest of Tripoli) is acclaimed as if it were a Roman triumph." Another university president, Dr. Sproul of the University of California, speaking on June 30 on "America's Answer to Youth's Appeal", similarly stressed the preponderant importance for our day of safeguarding "freedom and tolerance, respect for the individual, regard for the rights of minorities. . . ."

Science News a Century Ago

J. D. Forbes and Auguste de la Rive

THE enthusiasm shown at the Bristol meeting of the British Association in the experiments of Andrew Crosse, referred to in NATURE last week, was not shared by J. D. Forbes, who shortly after returning from Bristol, on September 26, 1836, wrote to Auguste de la Rive: "The subject of Mr. Cross is, I confess, rather a disagreeable one to me. You will readily enough conceive how much people more conversant with geology than electricity must have been struck by hearing most eloquently expounded a series of experimental discoveries, for they were perfectly original to Mr. Cross, silently prosecuted for many years by a retired country gentleman in Somersetshire, and only elicited by chance in the course of discussion. From the first moment that the matter was mentioned to me, and on every succeeding occasion, I really believe not less than fifty times, I have patiently vindicated the claims of Becquerel, which only require to be mentioned to be acknowledged. I own I felt somewhat indignant on the subject, because having seen Becquerel's magnificent preparations and conversed at great length with him on the subject, I had been led at various times, publicly and privately, for several years, to draw the attention of geologists to one of the very best things ever done for their science. . . ."

Medical Museum at King's College, London

ON September 30, 1836, *The Times* said: "The Society of Apothecaries has lately enriched the various collections in the medical school [of King's College] by the presentation of a large and beautiful series of specimens of the materia medica, being duplicates of those selected from their own collections at Apothecaries-hall. As much care is required in choosing the purest and best specimens, many of which it requires time to procure, it is not expected the collection will be quite complete for many months. A new room has been opened in the college for their now extensive museum of materia medica. The dormitories for the students, fully furnished, and abundantly ventilated, a new medical reading room, as well as dining-hall or refectory, to be opened early in October, are among the newest improvements in the college."

Sturgeon's *Annals of Electricity*

IN October 1836 appeared the first number of the periodical "The Annals of Electricity, Magnetism, and Chemistry and Guardian of Experimental Science, conducted by William Sturgeon, Lecturer on Experimental Philosophy at the Honorable East India Company's Seminary, Addiscombe, etc., and assisted by gentlemen eminent in these departments of philosophy". The greater part of the number

appears to have been written by Sturgeon himself. There were articles on the galvanometer, electro-chemical action exercised by simple metals in fluids, electro-pulsation and electro-momentum, a letter from Sturgeon to Faraday and a description of an electro-magnetic engine for turning machinery.

Sturgeon was undoubtedly one of the most industrious men of science of his day. He was born in a village near Kirkby Lonsdale, Lancashire, in 1783, and at thirteen years of age he was placed under a shoemaker who starved and ill-used him; at nineteen he entered the militia, at twenty-one became a private in the Royal Artillery and at thirty-seven left the army with a pension of a shilling a day. He had meanwhile taught himself mathematics, Greek and Latin, and begun his electrical experiments. On leaving the army he set up as a bootmaker at 8 Artillery Place, Woolwich. In 1823 he began contributing to the *Philosophical Magazine*, and in the following year, mainly through Olinthus Gregory, S. H. Christie and Peter Barlow, was appointed to the lectureship at Addiscombe. He was also connected with the Adelaide Gallery of Practical Science in Adelaide Street, London, and in 1840 removed to Manchester to superintend the Royal Victoria Gallery of Practical Science, an institution which, however, had but a short life. His writings were very numerous and to him we owe the construction of the first soft-iron electro-magnet. In his later days he felt the pinch of poverty, and a year before his death in 1850, he was granted a Civil List Pension of £50 a year.

Darwin's Reflections on Travel

On October 2, 1836, H.M.S. *Beagle* arrived at Falmouth after a voyage which had taken her round the world and had lasted nearly five years. In concluding his "Journal of Researches", Darwin gave a short retrospect of "the advantages and disadvantages, the pains and pleasures, of our circumnavigation of the world". In concluding this retrospect, he said: "it appears to me that nothing can be more improving to a young naturalist, than a journey in distant countries. It both sharpens, and partly allays that want and craving, which, as Sir J. Herschel remarks, a man experiences although every corporeal sense be fully satisfied. The excitement from the novelty of objects, and the chance of success, stimulate him to increased activity. Moreover, as a number of isolated facts soon become uninteresting, the habit of comparison leads to generalisation. On the other hand, as the traveller stays but a short time in each place, his descriptions must generally consist of mere sketches, instead of detailed observations. Hence arises, as I have found to my cost, a constant tendency to fill up the wide gaps of knowledge, by inaccurate and superficial hypotheses.

"But I have too deeply enjoyed the voyage, not to recommend any naturalist, although he must not expect to be so fortunate in his companions as I have been, to take all chances, and to start, on travels by land if possible, if otherwise on a long voyage. He may feel assured he will meet with no difficulties or dangers, excepting in rare cases, nearly so bad as he beforehand anticipates. In a moral point of view, the effect ought to be, to teach him good-humoured patience, freedom from selfishness, the habit of acting for himself, and of making the best of every occurrence. In short, he ought to partake of the characteristic qualities of most sailors. . ."

Societies and Academies

Paris

Academy of Sciences, August 3 (*C.R.*, 203, 353–392).

Emil J. Gumbel: The extreme periods between radioactive emissions. Comparison of theory and experiment for polonium. The good agreement between the frequencies found and the probabilities proves that the extreme periods between the radioactive emissions follow the theory of the greatest value.

S. Lechnitski: Some problems of elasticity of anisotropic bodies.

Kyrille Popoff: The solution of the differential equations of the pendular movement of a projectile.

Daniel Chalonge: A remarkable variation in the spectrum of γ-Cassiopeia. An appreciable increase in the brightness of this star was noted on the night of July 25–26 last: spectroscopic observations made on July 30–31 and August 1–2 showed a change in the spectrum mainly due to a large increase in the emission of Balmer lines.

René Rivault: Experimental researches on the propagation of short electric television waves ($\lambda = 41{\cdot}5$ metres, $\lambda' = 74$ metres).

Maurice Dodé: The thermochemistry of the nitrites of the alkalis and alkaline earths.

Basile Fedoroff: The conductivity of the double sulphates of the magnesium series in aqueous solution. Eight double sulphates have been studied. Except at very low concentrations, the double salt is always less dissociated than the simple salts.

Clément Courty: The increase of the magnetism of ferric oxide by ignition in the presence of ash-free filter paper.

Gabriel Bertrand: Observations on the preceding communication concerning the discovery of iron in plant ash.

Georges Jouravsky: The optical properties, densities and degree of corrosion of the alumino-magnesium titanomagnetites.

Henri Ringard and André Duparque: The microscopic characters of Courrières coals.

Fernand Jacquet: The middle Eocene with Nummulites of Senegal.

Yves Milon: The fossil *yardangs* of Saint-Pierre-la-Cour (Mayenne).

Conrad Kilian and Théodore Monod: The discovery in the western Sahara of fossil micro-organisms forming an indicator as regards age and marine nature of the Koundeloungou (Congo) series.

Lucien Cayeux: Remarks on the preceding note.

Jean Dufay: The Huggins bands in the spectrum of the blue sky and the temperature of atmospheric ozone.

Paul Budker: The destruction and fall of the mandibular teeth in *Squalus*.

Jean Jacques Bounhiol: Metamorphosis after ablation of the *corpora allata* in the silkworm (*Bombyx mori*).

Stig Veibel and Franciska Eriksen: The influence of aglucone on the velocity of hydrolysis of the β-glucosides by emulsine.

August 10 (*C.R.*, 203, 393–416).

Lucien Daniel: Acquired heredity in bulb producing leek.

David Belorizky: Some peculiarities of Nova Lacertæ, 1936. The radiation of this star is monochromatic and almost entirely concentrated in $H\alpha$ radiation.

MLLE. YVETTE CAUCHOIS : Observation and measurements of the $L\alpha$ satellites for the elements 68, 70 and 71.

HORIA HULUBEI : Observation and measurement of the L spectrum of radium (88) I.

JOSEPH CATHALA and JEAN CLUZEL : The spectrophotometric study of the hydrolysis of ferric salts.

ETIENNE VASSY : Spectrographic method for the study of the thermal decomposition of ozone.

LOUIS FAUCOUNAU : A new method for the preparation of catalysts. The Raney method of preparing active nickel by attacking a nickel-aluminium alloy with alkali has been extended to alloys of copper and cobalt.

HENRI COUPIN : The germination of pollen grains.

LOUIS GALLIEN and MARC DE LARAMBERGUE : Cycle and sexual dimorphism of *Lacuna pallidula*.

CHARLES DHÉRÉ and OSCAR BIERMACHER : The living geranium leaf emits a fluorescence radiation which extends in the infra-red to λ 830 mμ.

RENÉ WOLF, MAURICE RANGIER and MLLE. ANDRÉE BOURQUARD : The relations existing between the magnesium of muscle and chronaxy.

August 18 (*C.R.*, 203, 417–444).

VITO VOLTERRA : The principle of least action in biology.

HERMAN AUERBACH : The analytical representation of Lie groups.

CAÏUS JACOB : A gaseous jet.

JULIEN KRAVTCHENKO : The problems of conformal representation of Helmholtz.

GINO ARRIGHI : The movements of a deformable body associated with general electro-magnetic fields.

NY TSI-ZÉ and WENG WEN-PO : The absorption spectrum of potassium. In addition to the lines or bands already described by H. Kuhn and by Datta and Chakravarty, new lines or bands have been found, and these have been empirically classified in series.

HENRI LONGCHAMBON and GEORGES MIGEON : The sepiolites. Results of a physical and chemical examination of three specimens of sepiolite from different sources and remarkable for their purity and crystal formation. Reasons are given for not adopting the theoretical interpretation recently proposed for sepiolites by J. de Lapparent.

ROBERT LAFFITTE : The Neocomian in Aurès (Algeria).

MLLE. MARIA LEJEUNE : A means of isolating the micro-fossils included in flints. Attack by gaseous hydrofluoric acid under the conditions specified gives better results than the aqueous acid proposed by other workers in the same field.

THEODOR SOLACOLU and DEMETRE CONSTANTINESCO : The action of β-indolylacetic acid on the development of seedlings.

M. SUREAU and P. GRANDADAM : The spectrophotometric estimation of α-œstrone and its derivatives.

Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 6, 1936).

L. GODEAUX : A property of Green's first straight line of a surface.

P. GÉRARD : The significance of the terminal nerve according to observations made on *Polypterus Weeksi*.

C. PATERNOSTER : The advances and retardations of the transits of Mercury across the solar disk.

M. LINSMAN : The singularities of the elementary curves in finite geometry.

F. BACKES : R congruences.

T. H. J. LEPAGE : Geodesic fields of the calculus of variations.

C. PERELMAN : M. Gödel's antinomy.

J. PASTEELS : Analysis of the morphogenic movements of gastrulation in birds.

J. THOREAU : Crystalline calcic rocks of Kivu.

Moscow

Academy of Sciences (*C.R.*, 2, No. 5, 1936).

V. S. IGNATOVSKIJ : The Laplace transformation (2).

A. MITKEVITCH : Magnetic viscosity at different points of the magnetization curve.

A. A. GRÜNBERG and J. L. MICHELS : Determination of iridium by potassium ferrocyanide titration.

P. PANJUTIN, L. HINDIN and O. VASILJEVA : An investigation of the autoxidation of carbohydrates. (1) A new method for the quantitative analysis of peroxide compounds.

A. EBERZIN and O. VJALOV : An ancient Euxinian terrace in the environs of Tuapse.

I. SMORODINCEV and K. BEBESHIN : The glycogen content of ascarids. Ascarids contains twelve times as much glycogen as the higher vertebrates, but only one tenth of their lipoids.

N. A. ŠČIBRIA : Hybrids between the Jerusalem artichoke (*Helianthus tuberosus* L.) and the sunflower (*Helianthus anmius* L.).

M. A. SIZOVA : Structural changes in chromosomes induced by irradiation of physiologically modified cells.

L. V. MICHAJLOVA : (1) Reaction of the drumhead cabbage to lowering of temperature. (2) Light regime requirements of tomatoes.

N. V. NASSONOV : Peculiarities and causes of the development of additional growths in Amphibia.

(*C.R.*, 2, No. 6, 1936).

I. NATANSON : Some remarks on the theorem of Stekloff-Severini.

G. KRUTKOW : Statically indefinite systems. The ultra-definite system.

B. FESENKOV : Absolute photometry of the solar corona. A method is discussed that makes it possible to eliminate completely the influence of the atmosphere.

N. SELJAKOV : Some remarks on α- and β-ice.

S. RYTOV : The diffraction of light by ultrasounds.

N. DOBROTIN : Absorption of neutrons in silver and cadmium.

V. M. KATUNSKIJ : (1) Intensity of geotropic reaction as a quantitative index of the content of growth-promoting substance. Intensity of geotropic curvatures of the coleoptiles of oats and the seedlings of castor-oil plants varies directly as the quantity of growth-promoting substance. (2) Growth-promoting substance and the formative action of light on vegetation in plants.

A. I. GREČUŠNIKOV : The physiology of the incubation period in rust infections.

G. D. ADLER : New data on the geological structure of the region of the Taimyr folding.

S. S. ELIZAROVA : The influence of hydrogen ion activity and of salinity on the eggs of *Engraulis encrasicholus* L. (anchovy). The limits of toleration to the *p*H concentration and the salinity of water differ in the Black Sea and the Azov Sea races of the anchovy.

Rome

Royal National Academy of the Lincei
(*Atti*, **23**, 161–249; 1936).

L. TONELLI: A fundamental proposition of mathematical analysis.

G. ARMELLINI: Eccentricity of binary systems in the case of masses which vary with time.

G. GIORGI: Concerning electric and magnetic inductivities.

E. BORTOLOTTI: Non-linear relations: geometry of a system of equations with partial derivatives of the second order (3). Other intrinsic differential operators. Descriptive properties of the system.

G. SCORZA DRAGONI: Some theorems on Jordan's curves.

A. TERRACINI: Space varieties of ∞^1 spaces.

G. USIGLIO: New interpretation of propagation in the second medium in total reflection.

G. BERGAMI, P. BAER and E. BOERI: Variation of the excretion of allantoin by rats in relation to ketogenic and anti-ketogenic diets.

A. C. BLANC: Pleistocene beach with *Strombus bubonius* near Palidoro (Rome).

A. DESIO: New geological bases for search of phosphates in Lybia.

M. PITOTTI: Gastrulation of the egg of Lampreda (*Lampetra fluviatilis* L.). Displacement of substances during gastrulation.

M. LAPORTA and C. VACCA: Biological and chemical tests on the product of the irradiation of follicular hormone with ultra-violet rays.

A. CARTENÌ and C. VACCA: Chemical composition and energy value of diets consumed in two marine colonies.

C. GUARESCHI: Experiments with X-rays and with radium on the nymphosis of insects.

E. FAGIOLO: Researches on the pronephros in amphibia (2).

A. SPIRITO: New experiments on the influence of a continuous electric current on the meristems of roots.

A. CESARIS-DEMEL: Memorial lecture on Ettore Marchiafava.

Vienna

Academy of Sciences, June 25.

HEINZ TH. GRAZIADEI: Cosmic rays and solar activity. The correlation coefficient between cosmic ray intensity and activity of solar flocculi is $-0{\cdot}48$. There is a 27-day periodicity in the cosmic ray intensity.

L. KAHOVEC and K. W. F. KOHLRAUSCH: Raman spectrum of hydrazine and its hydrate. A Raman frequency of 1620 cm.$^{-1}$ occurs in hydrazine and its hydrate if the violet light be filtered out from the exciting light. This may be due to traces of diimide, HN : NH, which is decomposed by violet light.

K. W. F. KOHLRAUSCH and ROMAN SKRABAL: Vibration spectrum of cyclobutane.

W. FLEISCHMANN, H. GOLDHAMMER and S. KANN: Physiology of hibernation.

HANS PRZIBRAM and LEONORE BRECHER: Inhibition of the red coloration of the fore-legs of *Dixippus*.

ATMA MALABOTTI: Functional and histological behaviour of the stick insect (*Dixippus morosus* Br. and Redt.) after severing the nerves of the head.

RUDOLF KANITSCHEIDER: Evaluation of the magnetic data of the Austrian expedition to Jan Mayen in the polar year 1932–33 (2). The diurnal variation of the magnetic elements.

Official Publications Received

Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 38: The Standardisation of Photo-electric Cells for the Measurement of Energy. By H. H. Poole and W. R. G. Atkins. Pp. 363–379. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*. 6*d*. [318

Mines Department. Fourteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1935. Pp. 144+10 plates. (London: H.M. Stationery Office.) 2*s*. net. [19

London Shellac Research Bureau. Technical Paper No. 10: Fundamental Physical Properties of Lac. Part 4: Optical Properties. By Dr. L. C. Verman. Pp. 16. (London: London Shellac Research Bureau.) [19

The National Institution of the Boot and Shoe Industry (Incorporated). Bibliographical Index: Boots and Shoes, Leather, Rubber and other Materials. Pp. xv+97. (London: National Institution of the Boot and Shoe Industry.) [19

County of Armagh Education Committee: Portadown and District Technical Schools. Time Table of Afternoon and Evening Classes, Session 1936–37. Pp. 24. (Portadown: Technical School.) [29

Institute for Research in Agricultural Engineering: University of Oxford. Refrigeration for the Farm and Dairy. By C. A. Cameron Brown. Pp. 51. (Oxford: University of Oxford.) 1*s*. 6*d*. [29

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1688 (2202): Measurement of Profile Drag by the Pitot-Traverse Method. By the Cambridge University Aeronautics Laboratory. Pp. 46+14 plates. 3*s*. net. No. 1690 (2261): Stressing of Aeroplane Wings due to Symmetrical Gusts. By L. W. Bryant and I. M. W. Jones. Pp. 20+25 plates. 2*s*. net. No. 1692 (1940): Rolling Up of the Surface of Discontinuity Behind an Aerofoil of Finite Span. By F. L. Westwater. Pp. 16+18 plates. 2*s*. net. No. 1696 (1863): Heat Dissipation of Ethylene Glycol Radiators and Comparison with Water Radiators. By C. Anderton Brown and F. G. Barlow. Pp. 28+17 plates. 2*s*. net. (London: H.M. Stationery Office.) [29

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Resident Birds of the Bay Islands of Spanish Honduras. By James Bond. Pp. 353–364. (Philadelphia: Academy of Natural Sciences.) [288

Field Museum of Natural History. Zoological Series, Vol. 20, No. 13: Records and Measurements of Neotropical Bats. By Colin Campbell Sanborn. Pp. 93–106. 15 cents. Zoological Series, Vol. 20, No. 14: Descriptions and Records of African Bats. By Colin Campbell Sanborn. Pp. 107–114. 10 cents. Zoological Series, Vol. 22, No. 1: African Reptiles and Amphibians in Field Museum of Natural History. By Arthur Loveridge. (Publication 360.) Pp. 112. 75 cents. Anthropological Series, Vol. 24, No. 1: Egyptian Stelae in Field Museum of Natural History. By Thomas George Allen. (Publication 359.) Pp. 80+43 plates. 1.50 dollars. (Chicago: Field Museum of Natural History.) [288

Publications of the Astronomical Institute of the University of Amsterdam. No. 5: The Stark Effect of Hydrogen in Stellar Spectra. By S. Verweij. Pp. 48. (Amsterdam: J. F. Duwaer and Zonen.) [288

University of California Publications in American Archæology and Ethnology. Vol. 34, No. 4: Northeastern and Western Yavapai. By E. W. Gifford. Pp. v+247–346+plates 8–14. (Berkeley, Calif.: University of California Press.) [318

Annual Report of the Public Health Commissioner with the Government of India for 1934. Vol. 2. Pp. v+117. (Delhi: Manager of Publications.) 10 annas; 1*s*. [318

The Indian Association for the Cultivation of Science. Annual Report for the Year 1935. Pp. 44. (Calcutta: Indian Association for the Cultivation of Science.) [318

Indian Forest Records (New Series). Vol. 2, No. 3: A Stand Table for Chir (*Pinus longifolia*, Roxb.), Evenaged High Forest. Pp. iii+59–74. 12 annas; 1*s*. 3*d*. Vol. 2, No. 6: Zwei neue Callirrhipis mit ihren Larven (Sandalidæ, Col.). Von Fritze van Emden. Pp. ii+151–156. 4 annas; 5*d*. (Delhi: Manager of Publications.) [318

Summary Proceedings of the Thirty-second Meeting of the Indian Central Cotton Committee, Bombay, held on the 13th and 14th January 1936. Pp. 105. (Bombay: Indian Central Cotton Committee.) [318

Memoirs of the Geological Survey of India. Vol. 66, Part 2: Geology of the Northern Slopes of the Satpuras between the Morand, and the Sher Rivers. By H. Crookshank. Pp. viii+173–381+xx+plates 15–25. (Calcutta: Geological Survey of India.) 6.6 rupees; 10*s*. [318

Fiskeridirektoratets Skrifter, Serie Havundersøkelser. Report on Norwegian Fishery and Marine Investigations, Vol. 5, No. 2: A Study on the Life History and Migrations of the Norwegian Spring-Herring based on the Analysis of the Winter Rings and Summer Zones of the Scale. By Sven Runnström. Pp. 104+3 plates. (Bergen: A.s. John Griegs Boktrykkeri.) [19

Catalogues

Old Science and Medicine, comprising Astronomy, First editions of Tycho Brahe, Copernicus, Doppler, Galilei, Halley, Hevelius, Huygens, Kepler, Laplace, Sirturius, a Fine Collection of First Editions of Robert Boyle, Important Books in the History of Botany, Chemistry, Physics, Medicine, Anatomy, Embryology and Biology, Photography. (Catalogue 40.) Pp. 64+6 plates. (London: E. P. Goldschmidt and Co., Ltd.)

Marconi—E.M.I. Television. Pamphlet No. M.E.M.I. 1: The System of To-day and To-morrow. Pp. 21. (London: Marconi—E.M.I. Television Co., Ltd.)

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Arkadiev, V. Electromagnetic Processes in Metals. Part 2 : The Electromagnetic Field. Med. 8vo. Pp. 304. (Moscow and Leningrad : Obedinennoe Nauchno-Tekhnicheskoe Izdatelstvo Glavnaia Redaktsia Energeticheskoe Literatury, 1936.) 6.60 roubles.*

Brown, Frederick G. W. Mathematics for Technical Students. Part 2 (Second Year Course). Imp. 16mo. Pp. x +217–491 +xxv. (London : Macmillan and Co., Ltd., 1936.) 3*s.* 6*d.**

Driel, M.-J. van. Magic Squares of $(2n+1)^2$ Cells. Avec sommaire : Les Carrés magiques impairs. Med. 8vo. Pp. 90. (London : Rider and Co., 1936.) 10*s.* 6*d.* net.*

Hitchcock, Frank Lauren, and Robinson, Clark Shove. Differential Equations in Applied Chemistry. Second edition, revised and enlarged. Cr. 8vo. Pp. viii +120. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1936.) 7*s.* 6*d.* net.*

Hull, Gordon Ferrie. An Elementary Study of Modern Physics. Demy 8vo. Pp. xxv +457. (New York : The Macmillan Co., 1936.) 20*s.* net.*

Landolt—Börnstein. Physikalisch-chemische Tabellen. Fünfte umgearbeitete und vermehrte Auflage, herausgegeben von W. A. Roth and K. Scheel. Ergänzungsband 3. Imp. 8vo. Teil 3, Hälfte 1. Pp. xvi +1815–2352. Teil 3, Hälfte 2. Pp. 2353–3039. (Berlin : Julius Springer, 1936.) 188 gold marks.*

Lichty, Lester C. Thermodynamics : the Principles of Thermodynamics and their Application to Engineering Processes. Med. 8vo. Pp. 295. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 18*s.*

Perrin, Jean. Les atomes. (Nouvelle Collection scientifique.) Rédaction nouvelle. Cr. 8vo. Pp. xxiv +319. (Paris : Félix Alcan, 1936.) 15 francs.*

Chemistry : Chemical Industry

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