Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3500 SATURDAY, NOVEMBER 28, 1936 Vol. 138

The Service of Unified Knowledge

JUST a century ago the library of that mighty book hunter, Richard Heber, came under the auctioneer's hammer, and two hundred and two working days were consumed in dispersing a hundred and twenty thousand volumes—a noble collection which yet did not represent more than a fragment of that portion of the world's thought heretofore collected between the covers of printed books.

What a change has come over the scene in the century that has passed! The staid astronomy over which Airy presided has expanded into a world picture wherein countless universes stream through space, and temperatures are reckoned in millions of degrees. The physical sciences are altered out of all recognition; their content has increased in an incredible ratio and, concurrently with an unprecedented increase in the technique of accurate measurement, has developed a doctrine of uncertainty which prescribes a limit to the accuracy of our knowledge. Theories of evolution have appeared on the scene, crossed the stage, and disappeared—possibly to reappear in modified form. Social systems, apparently stable, are in a state of flux; the father of sixty years since could train his son to a trade or profession with the reasonable expectation that the society in which he lived and moved would remain indefinitely stable; the father of to-day sees no such prospect. Youth is healthily critical of the fundamentals of our social system, and discourses copiously—sometimes perhaps a little superficially—concerning dialectical materialism and the Hegelian theory. And, if 'Whitaker' be a trustworthy guide—the year 1934 saw 15,436 new volumes thrown into this weltering confusion of assertion, argument and denunciation, in Great Britain alone.

What can be done about it? If there is one thing more certain than another, it is that some appreciation of the magnitude and mode of action of these forces of disintegration, of these rapidly changing aspects of political, moral and religious thought, of the social repercussions of the advances of scientific knowledge, must be the possession, not merely of an oligarchical or aristocratic governing class, but also of every man who by his vote or otherwise may influence the policy and outlook of the community of which he forms a unit.

Government to-day is much more of an art than a science, and grave questions of national policy are settled as the result of waves of mass-emotion—emotion which may or may not have its origin in a wise, altruistic and rational attitude to the problems of life. It will always be so—great movements of humanity will ever be determined by the forces directed by the emotions and passions of mankind; and it is the business of all who can help, to do so by assisting each one of us to form, so far as his limitations of capacity and opportunity will permit, that background of ordered knowledge which so much enlarges his outlook and thereby his ability to think clearly and wisely, and to direct his emotions to a worthy end. Moreover, the need presses; in more than one community where shallow draughts of psychology and philosophy have intoxicated the brain, we see a growing habit of depreciation of the actions of the intellect and of undue exaltation of emotional and intuitive processes.

We can at least provide the means towards supplying this need—we can, granted goodwill and energy, put at the disposal of every man,

learned and unlearned, ordered statements of present-day knowledge in all branches of life and learning that the mind of man has traversed, and concerning which he has recorded his thoughts, his difficulties and conclusions in the pages of a book. Such a statement is an encyclopædia.

The notion of an encyclopædia is old enough, as old as the appreciation of the organic unity of knowledge—of the fact that the totality of knowledge is something more than the sum of its parts. The name is no older than 1541, the date of publication of Ringelberg's "Cyclopædia" at Basel; the notion is possibly as old as Aristotle, whose mind was essentially encyclopædic—as Pliny's was not. But the great incentive to encyclopædia-building came from the labours of Francis Bacon, whose attempt at a systematic classification of knowledge fired the imagination of Diderot and inspired the labours of D'Alembert.

Our countryman, Ephraim Chambers, had the root of the matter in him when he remarked that, in his view of an encyclopædia, one should "consider the several matters not only in themselves, but relatively, or as they respect each other; both to treat them as many wholes, and as so many parts of some greater whole". A truly admirable ideal; whether the "Cyclopædia or Universal Dictionary of the Arts and Sciences" (two volumes, folio; London, 1727) fulfilled these generous aspirations is another matter.

It cannot be too strongly emphasized that a true encyclopædia is something more than a bare summary of the knowledge of its day. Its articles may or may not be dashed off hastily—in the age of intellectual ferment that produced the great French Encyclopædia, articles were written at a white heat of enthusiasm, and it was just *because* that enthusiasm was linked with the forces of reason and of knowledge the French Encyclopædia became such a mighty weapon for the cause of progress. For that very reason it rallied, in the words of one of its great historians, "all that was then best in France round the standard of light and social hope".

So, too, the age that saw the passing of the Reform Bill saw the birth of a desire for the spread of positive knowledge that resulted in the publication of those remarkable volumes (twenty-seven of them, and two or three appendix-volumes) known as the "Penny Cyclopædia". He who has these volumes on his shelves will more willingly part with more pretentious cyclopædias. The wealth of articles contributed by Augustus de Morgan will never lose their value; and the whole encyclopædia is a noteworthy record of the aspirations and limitations of a phase in our history marked by a special enthusiasm for "the particular go" of material things.

It was also, we note in parentheses, the England of the Oxford Movement. But it was also the England of the Society for the Diffusion of Useful Knowledge—a Society the activities of which produced an inimitable passage in "Crotchet Castle"—and the "Penny Cyclopædia" faithfully reflects that aspect of its age. Calculus and chronology are there in full measure; the artistic and mystical side of life find but scanty record.

What type of encyclopædia will most fittingly serve the needs of our own age? Mr. Wells's vision sees a World Encyclopædia where all that is best of everything that need be said is gathered together in one great series of volumes—the best thoughts of the best writers—"selections, extracts, quotations, very carefully assembled with the approval of outstanding authorities in each subject, carefully collated and edited and critically presented".

It may well be so; this represents a high, though not an unattainable ideal. But though the difficulties are great and will have to be considered, we need not assume that the gain in authority of a collection and collation as nearly perfect as this imperfect world of ours will permit, will involve a loss of unity if control is entrusted to a band of learned workers informed with an enthusiasm for their task, and having a clear perception of the social needs of their age. It is, however, vitally necessary to realize such difficulties before embarking on the task of preparing an encyclopædia the influence of which may be so far-reaching.

Yet a further possibility should be considered. *Entia non multiplicanda sunt praeter necessitatem*, a dictum which is specially true of encyclopædias. But, broadly speaking, there is room and need for three types: the encyclopædia wherein the articles are written in terms of specialized knowledge; the more popular encyclopædia written with an eye to the needs of the layman; and a really critical bibliography of existing knowledge which shall discriminate between the needs of the specialist and those of the layman.

Such a critical bibliography—an almost indispensable preliminary to the greater task—would place at man's disposal a weapon of immense social value.

Topics of the Age for Everyman

The Columbia Encyclopedia

Compiled and edited at Columbia University. Clarke F. Ansley, Editor in Chief. Pp. v+1949. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1936.) 63*s*. net.

THIS massive volume, twelve inches by nine inches in its superficial dimensions, nine and a half pounds in weight and containing, within the compass of its nineteen hundred and fifty pages, not less than four and a half million words, represents a heroic attempt on the part of editor and publisher to give to Everyman such information on the topics of the age as Everyman is likely to seek—and, moreover, to give him pointers which shall tell him where further detailed and authoritative information may be found.

This is a principal function of a modern *compact* encyclopædia. Tendencious disquisitions are not wanted here ; detail should be cut down to the minimum ; fine writing is anathema—"no flowers by request," said Leslie Stephen to contributors to the "Dictionary of National Biography" ; the information conveyed should be both judicious and judicial ; and the pointers should direct the way to the latest and fullest sources of information. Though, it must be confessed, the pointers are occasionally missing where they might well have been supplied, these necessary qualities are well shown in the "Columbia Encyclopedia", and the crucial questions now arise : What is the *content* of the volume ? Over what regions of thought and of fact does it range ?

These questions can be answered only by a process of sampling, and sampling processes are peculiarly liable to error. Everyman interested in theology may seek aid in the matter of the distinction between homoousian and homoiousian, or the thinkings and doings of sublapsarians, supralapsarians and semi-Pelagians, while remaining completely indifferent to the discovery of the neutron or the meaning of the Œdipus-complex ; and contrariwise. (May it be said at once, and in parenthesis, that Œdipus, his complex and the neutron receive due notice, and that the Pelagian heresies and the views of the semi-Pelagians are handled in clear and scholarly fashion, but that the only entry made under the term 'supra' deals with the supra-renal gland—a pleasant, and not inapposite illustration of the trend of modern thought as interpreted in this encyclopædia.)

Still, if Everyman has a fairly inquisitive and ranging disposition the sampling process may not be devoid of significance. So far as the process has gone, it indicates, as was to be expected, that the outlook of the work is American. This is not an adverse criticism ; it is a mere statement of fact, and does not imply that English interests do not receive adequate treatment. On the gazetteer side, for example, we find small American townships entered with a degree of particularity which it would be quite impossible to observe universally. But the English entries are adequate, and thoroughly up to date, as may be tested by reference to very recently formed boroughs.

The historical and political articles are remarkable for their clarity and for the completeness with which they supply essential and no more than essential information. In the articles which deal with theological topics, the omission of one or two subjects of special English interest is noteworthy. The accounts of the various Christian churches are admirably executed, the tenets of quite obscure sects being duly and briefly elucidated ; but while Bishop (pop. 1159) and Bishopville (pop. 2249) are entered and described, the English Church dignitary is passed unmentioned ; and he who would seek to know something of the duties of an archdeacon must remain content to think of him as one who exercises archidiaconal functions.

The scientific articles are definitely qualitative in character, in the sense that they abjure any attempt at symbolic exposition. Thus there is no entry to be found under the headings 'Differential Calculus' or 'Integral Calculus' and, under the general heading 'Calculus' a short entry of some two hundred words disposes of the whole matter. Similarly, the terms 'exponent' and 'logarithm' are simply and briefly explained, but there is no entry of the corresponding series, and these articles, again, contain no references to texts in which further information may be found. One or two references to mathematical literature are entered *s.v.* 'Mathematics'. Indeed, it is not only mathematical symbolism that is abjured, for the compilers are at pains to avoid any specialized jargon. Thus, to take a simple random example, 'Wallflower' is defined as an "ornamental perennial shrub of the mustard family" and the salient facts are given concerning its origin and cultivation, further descriptive notes on the family being found under the heading "mustard".

Although finer details are occasionally missing, the physical, chemical and astronomical articles are, in general, admirable examples of lucid compression. The articles under the headings 'variables', 'nebulæ', 'planetesimal hypothesis', 'hydrogen', 'X-rays' and 'photometry' may be cited as typical. A few of the more modern terms have been overlooked or treated very briefly in comparison with the space allotted to classical work. The policy of qualitative, or rather, of non-symbolic exposition—for there is no lack of numerical detail, where numbers are necessary—is one that has obviously been pursued of set purpose. It has everything to commend it, and the editor is to be congratulated on breaking away from the older tradition of exposition. He who can understand a symbolic expression of the binomial theorem or of a matrix is not likely to seek further information in a popular encyclopædia; and, in the great majority of such cases, he knows where to seek his information, and is scarcely likely to need those pointers which are so useful to the reader interested in historical or literary matters.

What of the articles which are concerned with matters literary? The lives and work of the great ones of the earth are expounded well and clearly, and most of the lesser lights find adequate mention, though Alfred Austin achieves a five-line immortality, whereas his fellow-laureate Pye ("Better to err with Pope, than shine with Pye") is left to languish in an unnamed obscurity.

It is when one comes to those very minor stars concerning whose merits and interest opinions may differ so widely that lacunæ begin to manifest themselves. Is Everyman entitled, as of right, to know something of the life of that odd figure, John Buncle, and of his equally odd creator, Thomas Amory? Or of the author of "Valentine Vox, Ventriloquist", and his illustrator, Onwhyn? The English reader may seek, but he will not find. On the other hand, the American, Gilbert Imlay, whose main interest to English readers lies in his relations with Mary Wollstonecraft, receives a notice of some twenty lines, and this may be taken as a fair example of the American leanings of an encyclopædia, which after all is called the "Columbia Encyclopedia".

Again, the claims of taste may be heard in the matter of the inclusion or omission of certain topics. The personal side of crime and criminology does not bulk largely in the pages of the encyclopædia, and Everyman interested in these matters may look up the story of Prof. Webster (one of our few academic murderers) only to be fobbed off with the life-history of the blameless and dull Noah Webster of dictionary fame. And why should the poisoner Thomas Griffiths Wainewright ('Janus Weathercock' and friend of Charles Lamb) be chosen, and Henry Wainwright, of the Whitechapel Road, left? These be snobbish distinctions.

Seriously, this must not be interpreted as adverse criticism. From every point of view, the work is crammed with matter of very deep interest to the English reader. In the end, the test of such a volume, the compilers of which must necessarily pick and choose, decide to insert this and omit that, is: How often does it let one down? The result of a fairly severe test shows that the occasions are relatively small.

Editor and publishers are to be congratulated on the completion of an arduous undertaking which fully deserves the success that doubtless awaits it.

A. F.

International Co-operation in Astronomy

Transactions of the International Astronomical Union

Vol. 5: Fifth General Assembly held at Paris, July 10 to July 17, 1935. Edited by F. J. M. Stratton. Pp. viii+429. (Cambridge: At the University Press, 1936.) 15*s*. net.

IT is difficult to speak without admiration of this volume and of the indefatigable editorship of Prof. F. J. M. Stratton, formerly secretary of the Union, to whose almost unaided efforts we owe it. Following a brief report and financial statement from the Executive Committee, there appear the reports of the presidents of the thirty-one Commissions which form the Union. These deal with topics so diverse as notations, meridian astronomy, chromospheric phenomena, wave-lengths, nebulæ, radial velocities and stellar statistics. Amongst so much that is good, each reader, depending upon his ignorance or his knowledge, will select some reports as outstanding; for his part, the reviewer would choose Fowler on wave-lengths and Jackson on meridian astronomy.

The remaining two fifths of the volume is concerned with accounts of the meeting of the Union as a whole, and of the meetings of the separate Commissions. While some of the Commissions, notably those on Ephemerides, Minor Planets, Wave-Lengths and Nebulæ appear to have taken advantage of the meeting in Paris to hold useful

discussions, others appear to have indulged in little more than formal business.

It is in this respect that the present Astronomical Union differs so markedly from its predecessor, the International Union for Co-operation in Solar Research. In that body, if one may safely infer something of its proceedings from the published *Transactions*, informal discussion at the meetings took precedence over previously prepared formal reports, and even after an interval of twenty years, one can still recover something of the stimulation to research which those meetings must have provoked. Unquestionably there were giants in those days, and it would be difficult to imagine meetings attended by Schwarzschild, Schuster, Rydberg and Kayser which were not exciting. It is not to this, however, that the difference between the two Unions is to be ascribed ; indeed, a meeting which has its Eddington, its Russell, its Shapley and its Milne can scarcely be said to be lacking in colour. Rather it would appear that, while by its own statutes the present Union puts first the facilitation of "the relations between astronomers of different countries where international co-operation is necessary or useful", the International Solar Union, in the words of its founder, put research first. Speaking at Mt. Wilson in 1910, Hale said :

"It seems to me obvious that the most important work of the Union has been, and must continue to be, the stimulating of research. That is, it seems to me to be more important for us to come together, and talk together, than to carry on formal co-operative investigations. That has been our idea, I think, from the very beginning, and I believe that the Solar Union has accomplished it by stimulating research."

International co-operation is good, but individual research is better, and in the opinion of the reviewer the International Astronomical Union can only hope to reach the standard set by its predecessor when discussions on research problems take precedence over co-operative schemes and formal business. H. H. P.

Mr. Fisher's History of Europe

A History of Europe
By the Rt. Hon. H. A. L. Fisher. Complete edition in one volume. Pp. xv+1301. (London : Edward Arnold and Co., 1936.) 10*s*. 6*d*. net.

THE recent issue in one cheap volume of Mr. Fisher's already popular work is an event of considerable educational importance. There can be no doubt of the great vogue of this attractive reprint. It will become the most widely read book of general history for this generation of Englishmen, as Gibbon was for our forefathers of a century and a half ago, and there is a touch of Gibbon—a Liberal Gibbon—in its learning, spirit and style. It deserves, therefore, careful scrutiny and judgment, as much for its own great merits as for the sake of those whom it will influence. Moreover, the chief side on which it is open to criticism is that which comes most naturally within the scope of this journal. To that alone we must confine our attention here.

Mr. Fisher's book does not purport to be merely a political history of Europe, and it contains many suggestive passages—notably those on Dante and Luther—dealing with other aspects of the life of Europe beside statecraft. On the aspect of intellectual life which specially interests us here, handsome homage is accorded in the introductory chapter. The passage deserves quotation.

"It is, moreover, to Europe-man that the world owes the incomparable gifts of modern science. To the conquest of nature through knowledge the contributions made by Asiatics have been negligible [this, of course, is far too sweeping] and by Africans (Egyptians excluded) non-existent. The printing press and the telescope, etc., etc., together with all the leading discoveries in physiology . . . are the result of researches carried out by white men of European stock. It is hardly excessive to say that the material fabric of modern civilized life is the result of the intellectual daring and tenacity of the European people."

This is a magnificent exordium, and later on at the beginning of the second volume, there is an excellent chapter on the various aspects of the Renaissance with due reference to Copernicus and Vesalius, and again, in the third volume a few pages on Darwin and Spencer. But sound in tone as these passages are, they form but a small digression in the 1,300 packed and brilliant pages which narrate the characters and actions of the heroic Vikings, the founders of dynasties and the leading statesmen and warriors who make up the traditional historical pageant of Europe. It has never been better mustered and presented in English than in these pages ; but is it the most important part of the truth ? One asks the question, not with any wish to disparage the value of the actual matter of which Mr. Fisher treats, or

with the absurd idea that a historical work should be an encyclopædia and mention everything, but quite seriously and with a sincere desire to have his considered judgment, if he would give it. Two contrasted cases, nearly contemporary, will make the point clear. L. Cornelius Sulla, "an aristocrat of fine culture and licentious manners", whose calculated butcheries came to nothing, receives three pages. Archimedes, one of the greatest and most constructive minds who ever lived, is not mentioned at all. Nor indeed are most of the men of similar type throughout the story.

Our object here, however, is not to set up a series of such unprofitable, almost inconceivable, comparisons. There is a much more substantial question involved to which Mr. Fisher himself alludes in his preface. He there says, with modest pathos, that he is not one of those "wiser and more learned" than himself who can discern in history "a plot or rhythm", and that for him there is "only one emergency following another, and that the ground gained by one generation may be lost by the next". Surely it is just here that the growth of organized knowledge comes in to supplement, correct and give a background to the political story with its inevitable breaks and contretemps. For knowledge grows and works, no doubt with temporary lapses, but never with any permanent loss of what has been secured. Nor is organized knowledge a separate thing which can be left alone by the political historian to be treated by others. It enters intimately, continuously and with increasing dominance into the ordering of the life of the people, which we all agree is the main subject of history.

One consideration alone is sufficient to prove this in relation to the subject of Mr. Fisher's book. At the best period of the Roman Empire in Europe there was, it has been estimated, a population of some 70 million persons in the area, largely enslaved. There are now more than 400 millions, leading on the whole a peaceful and industrious life and all free—at least from legal slavery. It is the greatest and the most beneficent revolution which the world has seen and must be regarded as the goal of any history of Europe. Many causes have led the way. Better political organization is no doubt a large factor, and moral advance assisted by the Christian church and doctrine. But some of us hold that the organized knowledge of Nature, applied to industry, should have a leading place among the causes, and we look anxiously in any account offered to us for some recognition and analysis of this factor. It is not only essential to the understanding of the past, but it also gives to those disturbed by present events (among whom Mr. Fisher includes himself) a better standing towards the future. Here is the plot and the rhythm, and it is sadly to seek in this otherwise magnificent achievement.

F. S. MARVIN.

Anthropology as it is

The Economics of Primitive Peoples

By Dr. Stephan Viljoen. Pp. 282. (London: P. S. King and Son, Ltd., 1936.) 12*s*. 6*d*. net.

WHEN first we set eyes on Negroes or Chinamen, their faces seem all alike. So do the minds of all non-Europeans. To the anthropologist, all men outside the trousered world are of one mental hue, called primitive. Since they are all one kind, what is true of one tribe can unhesitatingly be applied to all the rest from the North Cape to Cape Horn. If one is crassly conservative, all are (p. 30); if marriage is an extremely loose bond, say in Tahiti, it must be so in the Solomons; a place has been found where a woman's ambition is satisfied with presenting a son to her husband, so this is characteristic of all 'primitive' women.

Those who have had first-hand experience will demur at such generalizations and challenge the statements that lack of food leads to war (p. 75), that the arts and crafts are held in contempt by the men (p. 84), that primitives like to carry their most precious possessions on their person (p. 233). He is sure to know at least one tribe that does not conform, and perhaps a great number. But it would not be fair to hold the author responsible for the initial fallacy and its inevitable consequences. He has not undertaken to speak from experience, but only to mirror faithfully the views generally accepted, or at least discussed, in anthropological departments, not on economics alone, but also on a large number of subjects slenderly connected, such as couvade, human sacrifice, birth rites, metal working, etc. This is a work that is needed, especially by students.

For this task, the author is well fitted. Free from sectarian prejudice, or even from very decided opinions of his own, he can be content to record impartially the views of the recognized authorities. Sensible when critical, widely tolerant and eclectic, he has selected his materials well, put them together lucidly, and produced a very readable manual of anthropology as it is in 1936.

A. M. HOCART.

Schlacke und Vitamine:
die Schlackenkost als Behandlungsweg bei Krankheitszuständen. Von Prof. Dr. Hugo Salomon. Pp. vii+263. (Leipzig und Wien: Franz Deuticke, 1936.) 12 gold marks.

THAT anyone should be able to write some 250 pages on vitamins and roughage, in relation to the treatment of disease, is in itself surprising. When, however, we consider the author's name along with the facts that his book is published in Leipzig and Vienna and that he describes himself as of Buenos Ayres, we turn with some curiosity to see what it is all about, noting in passing that the dedication (to the author's wife) appears on a page headed by a text from Houston Stewart Chamberlain.

After all, there turns out to be nothing very exciting or subversive in the book. The author is an enthusiast for diets with a high roughage content, which also frequently means a high content of water-soluble vitamins and possibly of carotene. He seems to advocate wholemeal bread ("Schrotbrot", "Grahambrot") as an essential dietary constituent in the treatment of conditions as pathologically diverse as catarrhal icterus, hypertension, eczema, tuberculosis, diabetes (*sic*) and migraine.

Actually vitamins come in for very little mention at all; it is almost as if they had just been put into the title "to make it harder". The author's belief would seem, therefore, to be that if you take care of the roughage, the vitamins will take care of themselves. We know of little evidence for this faith, if fat-soluble vitamins are included in the creed.

This book may be of some assistance to those who have to ring changes on laxative diets with the view of achieving palatability and variety. As a contribution to nutritional or biochemical science it does not, however, seem likely to make an epoch, but its extreme colon-consciousness may give it an interest for psychologists. A. L. B.

Jabo Proverbs from Liberia:
Maxims in the Life of a Native Tribe. By George Herzog, with the assistance of Charles G. Blooah. (Published for the International Institute of African Languages and Cultures.) Pp. xiv+272. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

PROVERBS are mere pin-points of a mass of communal wisdom and experience. A collection of proverbs is therefore meaningless unless to each saying there is added an account of the traditions and situations that give rise to it.

However well this may be done—and our authors have done it well and thoroughly—it is beginning at the wrong end. God and eternity, for example, do not appear as concepts that permeate life and inspire many things of which proverbs are the least; they are introduced merely as footnotes to pithy sayings. Those sayings are recorded with a phonetic minuteness which is entirely laudable, but the subject of titles is scattered in allusions that are sufficient only to convince us that they play an important part in Liberian society (pp. 28, 31, 196, etc.). On the other hand, many topics often go to one proverb. Thus, No. 192 is a multiple peg for the care of teeth, matrimonial troubles, sacrifices, etc.

The reader feels as would a student of zoology who, instead of being given the whole animal to dissect, is faced with 416 carefully arranged heaps of miscellaneous tissues, which, if it were possible to piece them together, would represent only a small part of the whole.

The greater the care lavished on the preparation, the more one regrets that the labour should have been invested at so small a yield. The authors are thorough, painstaking, accurate, minute; in fact, they have the virtues one expects in research, except a sense of purpose. A. M. H.

The Rational Quartic Curve in Space of Three and Four Dimensions:
being an Introduction to Rational Curves. By H. G. Telling. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 34.) Pp. viii+78. (Cambridge: At the University Press, 1936.) 5*s*. net.

IN this tract Miss Telling has presented in compact form a great deal of information, gathered from various sources, which is not available as a whole elsewhere. The tract is divided into two chapters and a short appendix. The first chapter deals with the four-dimensional curve and its projective generation, invariants and the symbolical notation for them, fundamental polarity, trisecant planes, chords, quadratic involutions, director lines and planes, g-lines and the manifold G, the chordal J, the quartic surface K and its nodes, Segre cubic primals, and linear complexes containing the curve, or apolar to it. In the second chapter we descend to three-dimensional space, and consider quartic curves of the first and second kind, principal, quadratic, and cubic involutions; flexes, trisecants and Hessian points, the surfaces of Steiner and Veronese, and several special kinds of quartic curves. The appendix consists of a note on involutions on the four-dimensional quartic.

The style of the tract is clear and readable. The text is confined to the main line of argument without minor details, and the smaller points are summarized in the form of examples for solution by the reader. H. T. H. P.

Mesure des températures
Par Prof. G. Ribaud. (Collection Armand Colin: Section de physique, No. 190.) Pp. 224. (Paris: Armand Colin, 1936.) 10.50 francs.

THIS handy volume on the measurement of temperature maintains the high standard we have been led to expect in the Collection Armand Colin. Prof. Ribaud has had wide experience of the subject both in Strasbourg and in Paris, and his larger volume "Traité de Pyrométrie Optique" is an authoritative account of one single branch. The amount of information contained in this smaller book is remarkable, and the presentation is admirable. The international temperature scale is adopted as standard, and the various methods of measuring high temperatures receive special attention. At the moderate price charged, the volume ought to be in the possession of all concerned in this important practical problem.

The McCoy Society's Expedition to Lady Julia Percy Island

By Prof. Frederic Wood Jones, F.R.S.

THE complete ecological survey of Lady Julia Percy Island was the first enterprise undertaken (in January 1936) by the McCoy Society for Field Investigation and Research. The McCoy Society was founded and organized by students of the University of Melbourne during 1935; and Lady Julia Percy Island lies off the coast of western Victoria (38° 24′ S., 142° E.). The island is separated from the mainland by a channel some five miles wide, and with as much as twenty fathoms of water intervening between it and the coast of Victoria to the west of Port Fairy (Fig. 1). The island is uninhabited, though various unsuccessful enterprises have at one time or another attempted to exploit it for grazing, for pig raising, or as a source of guano. It is more than 100 feet high, sheer on all sides, save for a precarious landing to the north, and is flat and exposed to all winds on its elevated plateau.

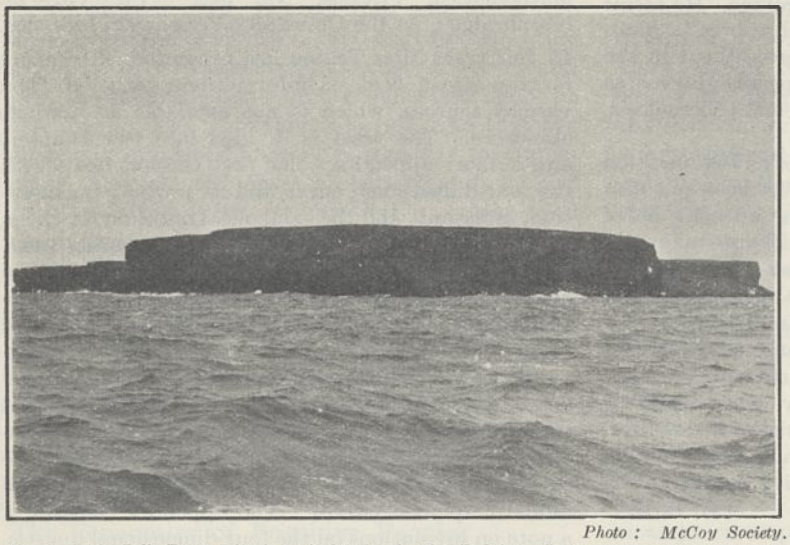

Photo: McCoy Society.

FIG. 1. Lady Julia Percy Island, an isolated volcanic pile lying off the south coast of Victoria.

The island plateau is a mile and a quarter long and three quarters of a mile wide. It was completely surveyed and mapped by the members of the expedition, and floral and faunal areas were precisely determined. A century ago it was covered with a dense, almost impenetrable, growth of the mixed bushy scrub that characterizes certain parts of the coast of the adjacent mainland. Some sixty years ago this dense scrub was still standing over the major portion of the island; but to-day the whole of the plateau is devoid of any growth more majestic than bracken fern and thistles. The whole plateau is, at present, a wind-swept area, clothed only by vegetation knee-high at the best, and at the worst, by loose volcanic soil or bare rock. This denudation of forest cover is due to human interference, for pigs were at one time turned down on the island, rabbits were liberated and are still living in their thousands, and sealers, fishermen and guano workers have cut down and burned the stunted and wind-blown trees that formerly covered the island.

Barren, inhospitable and forbidding though the island now appears, it proved to be a place of the most absorbing interest. The Bass Straits, St. Vincent's and Spencer's Gulfs, and the Great Australian Bight—the whole of the southern shores of Victoria and South Australia are dotted with islands, and I have visited more than thirty of them. But Lady Julia Percy Island, off Port Fairy, in Victoria, is different from all these. It is a pure volcanic island uprisen in the sea, and it has never formed a part of the continental mass of Australia, as have all the other offshore islands.

The whole of the flora and fauna of the island tell the same story as that which was unravelled by the geologists of the party. No land molluscs live on the island, though even the most inconsiderable of the islands of the Bight, and of Bass Straits, support a flourishing land-shell fauna. No slugs were present, and no amphibia. The only earthworm was not an Australian species, but was one introduced from Europe—an eloquent testimony to the reality of human interference in the dispersal of animal forms. There were no snakes, and the only reptile was a lizard which has an aptitude for being dispersed on every tiny fragment of land that lies off the Australian coast. No mammals live on the island plateau save the swarm of introduced rabbits, and the history of their advent is well attested. The only other mammals are the sea lions that resort to the island to breed, to raise their pups, to play, squabble and indulge in aquatic sports, and generally to

have a wonderful time of fooling about that renders them the most engaging of animals for the casual observer—and the most lovable to the real student of Nature. It is a noteworthy fact that the sea lion of Lady Julia Percy Island differs profoundly, both in behaviour and in anatomical characters, from the species that inhabits the islands of the Great Australian Bight. This sea lion is a resident and local species, just as is the sea lion of the islands to the west, and it is much to be desired that local and uninformed legislation will never be directed towards the slaughter of these animals, the distribution of which is so restricted and the economy of which is, at present, so little understood.

The birds inhabiting the island are of two kinds, the land birds resident and breeding in the island, and the truly marine species that breed upon the plateau or among the rock boulders. In addition to these breeding species there are the visitors, both land and marine.

The resident and breeding species of land birds are of no especial interest. Native swallows, pipits, chats and red-capped dottrel breed in their accustomed sites upon the island, but only the pipits and the chats are numerous. The fine native swamp harrier is the dominant bird, and it breeds among the bracken ferns upon the open island plateau. On our arrival, these birds were so tame that it was possible to pick up the fully fledged young birds from their nests among the bracken ; but, although they were not molested, they very soon learned all the wariness of their kind. They are the most conspicuous birds of the island and, at almost any time of the day, half a dozen or so could be seen floating above the plateau on the watch for young rabbits, penguins and mutton birds. Even the kestrels and the peregrines, which had apparently nested on the rock ledges of the cliffs, took a very minor part in policing the plateau. Introduced starlings and sparrows have reached the island, but they are inconspicuous and timid, and, for the most part, have their home in the volcanic cliffs and find their food upon the seal beaches.

Of the true sea birds, the Bass Straits mutton birds or short-tailed (or slender-billed) shearwaters (*Puffinus tenuirostris*) breed in large numbers in burrows tunnelled into the soft volcanic earth of the island plateau. The whale bird, ice bird or prion (*Prion turtur*) visits the island to lay its egg in the cavities beneath the vast basaltic boulders that strew the shore line, and the talus slopes of those parts of the island where the cliffs do not rise sheer from the water's edge. The shearwater and probably the prion are seasonal breeding visitors, but almost certainly the little diving petrel (*Pelecanoides urinatrix*) is a resident bird, breeding on the island and returning to it at dusk all the year round. The diving petrel is one of the most attractive of sea birds, a sturdy, manly, independent little fellow, with the most beautiful turquoise blue legs and feet and shining black and white plumage. He comes to the island only when the evening dusk has settled down, and as he comes he makes a little noise like a new-born puppy seeking its mother. From beneath some great boulder there comes the same little sound in answer, and soon, after flitting around like a bat in the dusk, he creeps into some chink, and a duet of little puppy-like love notes comes forth.

Photo : McCoy Society.

FIG. 2. The evening arrival of the penguins. The start of the long climb from the sea to the top of the island, taken by flashlight.

The prion is a ghost. A fluttering thing of pale grey-blue and white, a delicate wraith of a bird that comes moth-like into the beam of an electric torch and falls confused among the boulders—as it does at every lighthouse on the islands around the coasts of Victoria and Tasmania.

The Bass Straits shearwaters are birds of mystery. Anyone who has watched their evening arrival at a breeding island, seen their wheeling, watched them, as myriads of boomerangs, hurtling in the air, and followed their flutterings as they quarter the ground seeking their breeding burrows, has witnessed one of the most remarkable perfections of avian flight.

Then everywhere on the island are the penguins (*Eudyptula minor*). These little blue and white birds are among the most engaging of all the penguins, despite the fact that all their island activities are nocturnal. In solemn thousands they come ashore from the surf, and always at the same place, and in a sudden rush, every evening.

Every evening the whole company marches and hops up the same well-marked pathway to the island plateau and, at the plateau, disperses along numerous tracks to the breeding burrows. Every step of the way, every jump, every turn, is performed by every individual in the whole great army in exactly the same manner, and with the utmost solemnity. Every bird that, after the whole long journey, arrives at its home, finds two fluffy chicks awaiting it at the mouth of the burrow and regarding it with solemn expectancy. The little blue penguin is attractive beyond all birds in its serious and ordered ways of life, and in its queer sturdy independence that is combined with a most remarkable communal spirit. It is a strange thing that all these birds coming to the island at nightfall should forgather in the surf until their numbers are complete, and then, making a concerted rush through the breakers to the landing rock, start their long climb together (Fig. 2). For this coming and going is their time of peril, and a visit to any island upon which penguins breed tells its own tale. Penguin carcases, killed by harriers, peregrines and seals, strew the pathway from the surf to the breeding places; and around the rock holes or the burrows in which they breed are downy chicks ripped open by hawks or gulls. On Lady Julia Percy Island they did not have to run the gauntlet of gulls, for, strangely enough, these birds were not present on the island; but despite this, their mortality was very high.

During the hours of daylight, the island was a comparatively quiet place. Always there were the farmyard noises of the sea lions, for every sound, from the bleating of the lamb to the snarling of dogs and the lowing of oxen, came perpetually from the seal beaches. But when dusk came on there were added the indescribable groaning, mewing and caterwauling tumult from the mutton birds; the noise, rising from human snoring almost to donkey braying, of the penguins, and the newborn puppy sounds from the diving petrels and the prions. But despite all this, and the scarcity of fresh water, the members of the McCoy Society spent six happy weeks camped upon this volcanic island. They examined and collected everything, from soil bacteria to sea lions, and endeavoured to link the whole together in one complete ecological survey.

Terminology in Physics

By Prof. C. G. Darwin, F.R.S.

THERE has for some time existed an international committee, the 'S.U.N.', charged with the duty among other subjects of standardizing the nomenclature of physical quantities. So far as concerns such things as the names of units and their symbols it has proved effective. There has perhaps been a tendency for some of the members to point out that the majority were marching out of step; but in view of the very different approaches of different schools of thought, a certain latitude is perhaps permissible in the meaning and symbol of such a thing as *free energy*. This side of the question of nomenclature is adequately cared for, and is not the subject of the present article. Here it is proposed to consider certain obvious deficiencies and nonconformities in descriptive technical terms as they have arisen during the last decade or so in both English and American writings on atomic physics. It is not to be expected, perhaps not even to be desired, that any exact uniformity should be reached, but there are a number of cases where there is complete anarchy, and it is the aim of the present review to examine what principles should guide us in giving names to things, and possibly in a few examples to suggest appropriate solutions which may appeal to some of those who have not a conscientious preference for anarchy.

One of the greatest difficulties in the naming of physical ideas lies in the difficulty of translating a name out of one language into another. Consider, for example, the energy that remains in a body at the absolute zero of temperature. This idea was chiefly developed in German writings, and the quantity, following the polysynthetic spirit of the language, was called *Nullpunktsenergie* —name and definition in a single mouthful. Unfortunately, those who are charged with the literary side of education in England seem to hold that the best way to teach the writing of English is by

drill in the very different rules of Latin grammar, and that nothing further is needed. The consequence of this curious opinion is that those, who will later have to invent new English terms, have been given no literary principles whatever to guide them in doing so, and therefore, since the idea was acquired in German, they can do no better than a literal translation, *zero-point-energy*, or even *zeropointenergy*. Now this is quite a different kind of name from any given when the original idea was invented by an English-speaking physicist; for example, if the α-particle had first been studied in Germany, we should, on this principle, be now calling its *range* its *reach-width*. Moreover, the translation of *Nullpunktsenergie* is a poor one, because we do not translate *Nullpunkt* as *zero-point*, but simply use the English term *zero*. It must rest with individuals to judge whether the expressions *zero-point energy*, *zero-point displacement* and so on (anyhow with only one hyphen) are so well established that their ugliness must be accepted, but it does seem a pity not to create an English technical term and speak of *residual energy*, etc., which could be done without ambiguity.

The expression *zero-point energy* is merely clumsy and ugly; but our next example is rank bad grammar. One of the great advantages of English is the latitude allowed in grammatical construction, but even this has its limits. Contrary to the rules of most European languages, it is admissible to use a noun as an adjective qualifying another noun, and this makes it unnecessary to coin many adjectival forms that would otherwise be needed, but it is not allowable to use a noun to qualify an adjective. One may not infrequently see in learned journals such a phrase as "This may be proved by *quantum theoretical* methods". What part of speech is *quantum* here? Some writers, perhaps conscious of offence, run the two words into one—a pure Germanism. Others hyphenate them, and if the expression must be used at all this is the least intolerable form. The proper English form would be *quantum theory methods*, though even that is very clumsy, and *quantum methods* is quite good enough. However, for such a fundamentally important idea there is need for a real adjective, if only to make the contrast with *classical*. Moreover, there is absolutely no need to have the word *theory* (or the word *mechanics*) in the name, and so the right procedure is to coin the adjective *quantal*. To justify its adequacy it is only necessary to notice the impossibility of finding anything that would be *quantally* right, but *quantum-mechanically* wrong.

The general difficulty about the translation of technical terms is that when an idea is first invented one is not sure if it will be worth translating at all, and later, when its utility is established, one is so accustomed to the awkward literal translation that one is like the cricketer who was asked the origin of the 'yorker' and replied, "I don't see what else you could call it". In the choice of a name for a new idea there are several alternative methods. First it is easy to overrate the danger of taking an ordinary word and giving it a technical meaning: witness such words as *force*, *strain*, *susceptibility*. In spite of the double meanings, these are good names, but not all such words have been so well chosen; the word must be recognizably a technical term, which means that there must be no likelihood of its ordinary use being needed in the same context as its technical use. The difficulty of this method of choosing a name is that the word will always have a whole set of mental associations different from the new intention, so that the inventor is conscious of objections against any choice; for this reason it is inadvisable to stretch the meaning of a common word very far.

Another method of nomenclature gives up the problem altogether by simply taking the name of the inventor. This is often a good method, but it must not be carried too far or the reader will have to construct a special dictionary in order to remember the meanings of the various names. Another confusion arises when two things, cognate but different, are named after the same author. For example, there are a *function* and *equations* and a *principle*, all named after *Hamilton*. The first two belong together and are habitually called after him, but the *Hamiltonian principle* is something rather different, and is better called, by a slight misdescription, the *principle of least action*. Another thing to avoid with this method is what appears to be a growing fashion, the stringing together of a sequence of the names of all those who have worked at a subject. There is a most useful process in quantum theory often called the *Wentzel-Kramers-Brillouin method*, and it is no disparagement of the brilliant work of these writers to say that this is a very inconvenient name. If no better technical name can be found, then physics should borrow a rule established in taxonomic biology and take the name of the author who had the strict priority of publication; in the present case it happens that it would be none of the three names above, for the method has been discovered no less than four times independently, and *Jeffreys* has the priority.

Another way of making a name is to construct it from parts out of the classical languages, and this method has the great advantage that the word, being a new one, is immediately recognized as being a technical term. A thing like *entropy* has to be given some sort of name, though the idea is really incapable of any short description,

and we feel that this is a better kind of name than the artificial *gas*, even though Aristotle would have been equally unable to make anything of either. There are, however, many words which do aim at explaining themselves, so that the classical scholar, perhaps repressing a shudder at faults of synthesis, would have some idea what they meant, and the guiding principle for these ought to be that their composing parts should be fairly well-known words in the original language; for this reason, Latin is perhaps more suitable than Greek. Following this line, and without suggesting that established practice should be changed, it seems a pity that one must use the word *hæmatopoietic*, instead of *sanguinific*, always supposing that there are objections to the honest and simple *blood-making*.

Yet another method is to take a word straight out of some foreign language and use that. This is a method that needs much caution; for the borrowed word must be such as will fit into a spoken English sentence. Consider Gibbs's *ensemble*. It is a most embarrassing word to have to speak in a lecture, since all the letters have different values from those in the accompanying words. Even the skilled bilinguist has to 'change gear' in the middle of his sentence, and the less accomplished can scarcely fail to exhibit the deficiencies of his international culture. When such a word has been adopted, the proper course is boldly to give every letter its English value*. This word also exhibits the general difficulty of nomenclature. In French it does not really describe the idea at all well, since a *together* does not convey the idea of the simultaneous consideration of a set of quite separate motions of an assembly of atoms. Indeed, one would naïvely suppose that it meant the assembly itself, and such a word as *collection* seems to describe the idea better in English than does *ensemble* in French. As it turns out, the French word, used in English and anglicized, is best of all, but this may be partly because the inventor had the field entirely to himself for many years, so that his word has been accepted without having to prove its superiority over possible rivals. German words on the whole fit the English mouth better than French, but their uncongenial length gives them an alien character much more marked than that of an anglicized French word; we may accept *eigen*-functions, etc. (though the more usual prefix would have been *auto*-) but most others are unsuitable.

There is quite a different matter in which our present terminology is bad; unfortunately, sometimes in well-established practice. This is when two words which express opposite ideas sound nearly the same. To make a contrast between *intra-molecular* forces and *inter-molecular* forces confuses listener, reader, printer and sometimes even speaker as well. Here the right course is undoubtedly to make names which, even if less exactly suitable, sound quite different; the proper contrast to *intra* is *extra*. A worse example is *microscopic* and *macroscopic* when used in physics. To the inventor, this contrast may have had a pleasing epigrammatic flavour, but when the freshness has gone it becomes fantastic. We have two diametrically opposite ideas described by eleven letters with only one of them different, and they are such that the pronunciation of either in some of the English dialects would give the impression that the other was meant*. Both words are objectionable. *Microscopic* in this contrast habitually refers to things far too small to be seen in any microscope; it might just do in the popular sense of 'awfully small', but if a change is to be made we might as well get it right. *Macroscopic* is worse, because μάκρος is not one of the words otherwise used for derivatives, so that it will not convey its meaning to any but a scholar, and to be understood by others the word ought to have been *megascopic*. We want a word which the dictionary would describe as 'of, or pertaining to, bulk', and the best seems to be *molar*. It is true that this word has other meanings both in physical chemistry and in dentistry, but there is little danger of confusion. The contrasted word would be *atomic* (better than *molecular* because so much less like *molar*), since this describes the actual scale of magnitude which has hitherto been misdescribed as *microscopic*.

Finally we may refer to a less important matter, but one which makes an inconvenient gap in our language; this is the non-existence of an ordinal number corresponding to the cardinal number *zero*. In the literature one can find the expressions, "Bessel function of *zero* order", "*null* approximation", "*zeroth* law of thermodynamics", where in each case the next of the sequence would be called *first*, not *one*. The word *zeroth* is a terrible hybrid, but the mere fact that it has been tried shows that the need of a distinction between ordinal and cardinal is really felt. On the whole, this seems to be a case for the technical use of an ordinary word, and the word *null* might be adopted. It may be objected that it does not quite mean what is wanted; of course, it has not meant it hitherto, for if it had the question would not arise, and this paragraph would not have been written. But it is a true adjectival form connected with the number *zero*, and so seems to fill the bill with less strain than any other word.

* In the same way *spin* has recently been adopted abroad, and it is to be hoped that it is called *shpin* in Germany, and nasalized in France.

* There is less danger in other languages when spoken, but a careless printer might give just as much trouble.

There are no doubt other examples where improvements are needed, but the above are among the most glaring. The present article does not aim at inducing any exact conformity to its suggestions, but rather at directing attention to the real difficulty in the invention of suitable names for new things, and to the importance of doing it carefully. It may also be hoped that the actual suggestions may be of service, so that those future writers who have not yet firmly established their own usages may be induced to accept at least some of them.

Control of the Prickly-pear in Australia

THE control of the prickly-pears, *Opuntia inermis* and *O. stricta*, in Australia affords one of the most outstanding examples of the application of biological knowledge to economic purpose. It needs to be recollected that in 1925, about sixty million acres of grazing and farming land were known to be under infestation by prickly-pear in Queensland and New South Wales: the rate of spread of this scourge was stated to be reliably figured at almost one million acres a year. About fifty per cent of the infested territory was under dense prickly-pear, 3–5 ft. high, while the remaining area was affected by scattered infestations of varying intensity. To-day, the enormous rate of increase has been arrested, and less than ten per cent of the former great body of infestation survives: the whole of the primary pear in Queensland and much in New South Wales has broken down and collapsed. Approximately, twenty-five million acres of good land are now cleared and are being developed and brought under production.

The history of the campaign of control and eradication of prickly-pear has recently been briefly discussed by Mr. Allan P. Dodd, officer-in-charge of prickly-pear investigations, Brisbane. All interested in the subject should read his important paper in the September issue of the *Bulletin of Entomological Research* (27; 1936); a comprehensive history of the whole subject is promised in book form within two years time.

At the outset, the problem was how to eradicate a plant pest which had overrun, and rendered valueless, vast areas of territory. A pest, in fact, which could not be controlled by cultural, mechanical or chemical means, since the cost of widespread treatment by any of these methods rendered their application out of the question. The first steps towards applying biological methods of control were taken in 1912, and in 1920 the Commonwealth Prickly-pear Board came into being. This Board was charged with the study of prickly-pear in its natural home in America and the introduction, if possible, of insect or other enemies into Australia.

Since 1921, officers of the Board have visited most of the known prickly-pear regions of North and South America. Their investigations resulted in the discovery of about 145 species of insects which appear to be confined, in feeding habits, to prickly-pears and other Cactaceæ. Fungal and bacterial diseases also came in for investigation, but it was revealed that they did not afford much promise of direct utility, since many of these diseases were already established in Australia.

The Board's policy was based upon the conception that biological control offered best chance of success if a carefully selected group of species, working more or less in association, was established. A variety of promising species readily became adapted to Australian conditions and it was anticipated that their combined activities would, in course of time, result in gradual thinning out of the prickly-pear, in reduction of fruiting and consequently restriction of the spread of the pest.

It was quite unforeseen that the outstanding success evident to-day would have been effected by the agency of a single species of insect in the space of a few years. Nevertheless, this is what actually has happened, and the insect in question is the phycitid moth, *Cactoblastis cactorum* Berg. The fact is all the more remarkable for the reason that only 2,750 eggs (from the Argentine) of the insect were introduced into Australia, yet between 1926–30, about three thousand million eggs, laid by descendants of insects issuing from the original batch, have been distributed in the great prickly-pear areas. The eggs are laid by the moth in 'sticks', averaging seventy-five eggs in each: these 'sticks' are readily collected and artificially attached to the cladodes of the host plant. The resulting larvæ are gregarious, internal feeders which tunnel in companies through the tissues of the plant, thus also providing for the ingress of disease organisms. In this way the prickly-pear ultimately becomes so completely destroyed that it is reduced to a rotting mass of pulp. The various insects, established prior to the *Cactoblastis*, have

either been largely suppressed or their activities nullified owing to competition with its larvæ. It is only locally, and in relation to a few species of *Opuntia* of lesser importance, that the *Cactoblastis* has proved more or less ineffective. Such problems, however, are being dealt with effectively through the operations of other phytophagous insects including cochineal (*Dactylopius*) and cerambycid beetles.

In any campaign involving the repression of pest plants through the medium of introduced species of insects, the potential danger that such insects, in a new environment, may transfer their activities to other host plants cannot be neglected. In the case of prickly-pear control, elaborate biological tests as to the host plant range and preferences of such insects have been a feature of inestimable value. Doubtful species have been excluded and none so far introduced has betrayed any tendency, other than of a sporadic nature, to resort to hosts outside the species of *Opuntia*.

We hope to refer to prickly-pear control again at a later date when the promised book, recounting full details, becomes available.

A. D. IMMS.

Obituary

Prof. T. M. Lowry, C.B.E., F.R.S.

THOMAS MARTIN LOWRY, who died at Cambridge on November 2, came of an old Cornish family which had been long connected with the Methodist Church; he was born at Low Moor, Bradford, Yorks, on October 26, 1874, the second son of the Rev. E. P. Lowry, senior Wesleyan chaplain and staff officer at Aldershot. He was educated at Kingswood School, Bath, and thence passed to the Central Technical College, South Kensington, in 1893, with a Clothworkers' scholarship, and was ultimately awarded the fellowship of the City and Guilds of London Institute. From 1896 until 1913 he was an assistant to Prof. H. E. Armstrong; in 1904–13, was lecturer in chemistry, Westminster Training College, and from 1913 until 1920 head of the chemical department in Guy's Hospital Medical School; in 1920 he was appointed to the newly created chair of physical chemistry in the University of Cambridge, a position which he held at his death. He married a daughter of the late Rev. C. Wood in 1904 and leaves two sons and a daughter.

During his long service with Prof. Armstrong, Lowry gained recognition for his delicate work in organic chemistry. The proficiency which he then acquired as a crystallographer expressed itself later in the aptitude which he displayed in applying exact physical methods of measurement to the solution of chemical problems; he developed a rare instinct for grasping the essentials of any subject which he attacked and for ensuring that the quantitative methods used were devoted to the measurement of something which was clearly defined. The vast mass of quantitative physical data collected by Lowry is thus not of merely ephemeral interest but will also provide useful working material for future generations of physical chemists.

During Lowry's first research work, he noted that the optical rotatory power of nitro-*d*-camphor solutions changes with lapse of time, and he early realized that this effect, which he termed mutarotation, arises from the tautomeric change of substances such as derivatives of camphor and of sugars. Mutarotation is dependent on the nature of the solvent, and the mutarotation of *d*-glucose can be arrested in such a hydroxylic solvent as cresol, or a basic one like pyridine, but proceeds almost too rapidly for measurement in a mixture of these solvents. Lowry thus showed that an amphoteric solvent is necessary as a catalyst for the mutarotation process, and built up his now well-known theory of prototropic change; it is largely on this work that the conception of dynamic isomerism advanced by van Laar became generally accepted.

Concurrently with his purely chemical work on mutarotation, Lowry studied the variation of rotatory power with wave-length, a subject which had been much neglected since the death of Biot in 1862. He demonstrated the validity of Drude's equation for simple substances and expanded the equation so that it covered the anomalous rotatory dispersion of *d*-tartaric acid and the tartrates; this formed the subject of the Bakerian Lecture before the Royal Society by Lowry and Austin in 1921. Lowry's later determinations of the rotatory power of quartz, made on a column nearly half a metre in length, both in the visible and ultra-violet, furnished data of the highest precision by which again the validity of the Drude equation was established. He turned next from the optical rotatory power of transparent media to that of absorbent media and studied the Cotton effect; here he was able to develop equations which adequately express the dispersion throughout the absorption band. Whilst Lowry's main work in this field bore on optical rotatory power, he also studied other optical phenomena, and during recent years had initiated a series of investigations concerned with the refractive dispersion of organic compounds.

During the Great War, Lowry devoted himself to problems connected with high explosives and acted as director of shell-filling from 1917 until 1919; he did valuable service on the Trench Warfare Committee and the Chemical Warfare Committee and was an associate member of the Ordnance Committee at the time of his death. His war services gained him the C.B.E. and the Order of St. Maurice and St. Lazarus. He took the D.Sc. (London) in 1899 and held the honorary degree of M.A. (Cambridge) and doctorates of science of Dublin and Brussels; he became a fellow of the Royal Society in 1914.

In addition to some hundreds of important papers published with numerous collaborators, Lowry wrote several useful books; the last of these, on "Optical Rotatory Power", was issued last year and will long remain a standard work on the subject. The immense amount of accurate experimental work which Lowry has left on record secures him a permanent place in the history of the science to which he was devoted. His old colleagues and students in the laboratory of physical chemistry which he built up at Cambridge will remember him as a staunch friend, an inspiring teacher and an indefatigable worker who has passed too soon from their ranks. WM. J. POPE.

Prof. H. R. Briton-Jones

PROF. HARRY RICHARD BRITON-JONES whose untimely death occurred in Trinidad on November 3, following an operation for appendicitis, will be mourned by a wide circle of friends, scientific colleagues and past and present students of the Imperial College of Tropical Agriculture. He was born in 1893 and educated at Llandovery College, of which he was a scholar. He entered King's College, London, in 1912, proceeding to the Royal College of Science in 1913, where he took the associateship and, later, the diploma of the Imperial College. In 1915 he was commissioned in the R.G.A. and he gained the M.C. on active service, being eventually invalided from shell-shock, with the rank of captain. Attracted to the study of plant diseases, he re-entered the Royal College of Science to equip himself for phytopathological research; a short period was also spent at the Royal Botanic Gardens, Kew, in systematic study of the fungi parasitic on plants.

At the end of 1919, Briton-Jones was appointed mycologist in the Egyptian Department of Agriculture, but he left in 1923 to become mycologist at the Horticultural Research Station of the University of Bristol at Long Ashton. He was appointed professor of mycology and bacteriology at the Imperial College of Tropical Agriculture, Trinidad, in 1926 and dean of the College in the following year; he acted as principal on several occasions.

In Egypt, Briton-Jones devoted himself largely to the study of cotton and cereal diseases, publishing in 1925 the main results in a memoir entitled "Mycological Work in Egypt during the Period 1920–1922". At Long Ashton he was led to consider the influence of the nutrition and cultural management of the host plant on its susceptibility to parasitic disease, a subject which afterwards became increasingly predominant in his mind. While there, he published work on the cause of die-back of fruit trees, a problem not yet fully elucidated but in which the factors of nutritional and soil-moisture unbalance which he emphasized probably play a considerable part. On proceeding to Trinidad, he applied the same considerations to the diseases of permanent tropical crops, especially cacao and coco-nuts. His book on "The Diseases and Curing of Cacao" (Macmillan and Co., Ltd., London, 1934) was followed by a similar work on coco-nut diseases, but he did not live to see it published.

Briton-Jones's outstanding virtue as a mycologist was his very practical outlook. His opposition to academic views was sometimes carried to extremes, but he was intensely in earnest, and his enthusiasm in combating theory by practical experience often supplied a useful corrective. He helped to place plant pathology on a wider basis than that of parasitology, and in this his influence has been spread by his students to many parts of the Empire. As a teacher, he was the right man in the right place; to his students he was a friend, and he shared in their college life—he was a keen Rugger player—and gained their affection to an unusual degree.

E. J. B.

Lieut.-Colonel R. H. Elliot

LIEUT.-COLONEL ROBERT HENRY ELLIOT, whose death on November 9 we regret to record, had a distinguished career in ophthalmology as well as in other walks of life. The son of a colonel in the Army, he was educated at Bedford School and St. Bartholomew's Hospital, where he was a prizeman of the medical school. He had a brilliant career as a student and qualified M.B., B.S. (London) with honours in three subjects. He took his fellowship of the Royal College of Surgeons of England in 1892 and in the same year took the D.P.H. Cambridge and entered the Indian Medical Service. At Netley he was Montefiore scholar and medallist and Maclean prizeman in military surgery.

Soon after arrival in India, Elliot joined the Southern Presidency. His work there naturally led to an extended experience in ophthalmology, and he was superintendent of the Government Ophthalmic Hospital, Madras, and professor of ophthalmology in the Medical College from 1904 until 1914. While on leave in 1904, he completed his qualifications by obtaining the Sc.D. (Edin.) and the M.D. (Lond.).

Elliot's name will always be remembered for the work he did on sclero-corneal trephining in cases of glaucoma. The operation is known by his name all over the world, and was a notable advance in the surgical treatment of a disease the origin of which is in many cases obscure, and which has in the past led to a great deal of blindness.

Elliot's literary output was considerable. His chief works were handbooks on glaucoma and an account of sclero-corneal trephining, each of which went to a second edition. Besides this, he wrote an excellent text-book on tropical ophthalmology, which has been translated into a number of foreign languages, as well as smaller works. His work brought him many distinctions at home and abroad. Returning home in 1915, Elliot settled in London and quickly acquired a very large practice. For a number of years he was ophthalmic surgeon to the Prince of Wales General Hospital, Tottenham; and he was Consulting Ophthalmic Surgeon to the Hospital for Tropical Diseases.

Apart from his work as an ophthalmic surgeon, Elliot was an authority on snakes and a first-class amateur conjurer. His last book was published

two years ago with the title "The Myth of the Mystic East". In it he discussed Indian magic and miraculous cures. He insisted that there was little if anything in Indian medicine that was unknown to European medicine; and he was equally sceptical as to the Indian rope trick, as may be seen from an article on "Indian Conjuring" contributed by him to NATURE of September 12 last.

Of late years, Col. Elliot had taken a prominent part in the management of the British Health Resorts Association, and until his health broke down he made his driving force felt in whatever he undertook. His wife died some years ago; much sympathy will be extended to his three sons.

We regret to announce the following deaths:

Captain H. J. Coningham, an authority on the geography of Asia Minor and the Caucasus, aged sixty-nine years.

Prof. Edwin O. Jordan, professor of bacteriology in the University of Chicago, known for his work on public health, on September 2, aged seventy years.

Prof. Oskar Klotz, professor of pathology and bacteriology in the University of Toronto, an authority on diseases of the arteries and the liver, on November 3, aged fifty-eight years.

Dr. Alfred Nippold, director of the Magnetic Observatory, Berlin, on October 4, aged sixty-two years.

News and Views

Rev. Wm. Tuckwell: a Pioneer of School Science

IN the first number of NATURE appeared an article by one of Huxley's friends, the Rev. Wm. Tuckwell, on "Science Teaching in Schools". Tuckwell was a pioneer in this work, and it was he who really first introduced a regular course of instruction amounting to no less than three hours per week per boy. The story of his career as headmaster of Taunton College School, now King's College, Taunton, is a long and interesting one. At first he met with extraordinary success, numbers of scholarships were won, and with the help of Henry Labouchere, Lord Taunton, and other influential friends the ancient school was moved to new quarters outside the town at a cost of £25,000. Then trouble arose owing to local clerical and conservative suspicion as to Tuckwell's orthodoxy; and after a furious controversy resignation was forced on him in 1877.

TUCKWELL was a man of wide culture, a good classical scholar, with a deep knowledge of English literature, and, although his work was apparently a failure, his methods were copied in schools all over the country. The school almost broke up when he left, but was later acquired by the Woodard Corporation and has since gradually risen in numbers to two hundred boarders. The pendulum has swung back again, and in 1934, Dr. R. D. Reid, a science graduate and the first layman for three hundred years, was appointed headmaster. He, wishing to recognize the work of his pioneering predecessor, sought out Mr. Tuckwell's surviving daughters, Lady Welsh, and Miss Gertrude Tuckwell, C.H. They have presented many of their father's books and MSS. to the school library, including a much treasured first copy of NATURE. They also have erected a memorial to him in the school chapel, and this will be dedicated by the Chaplain, Bishop O'Rorke, on November 29, at 6 p.m., at which service any friends would be welcomed. King's College possesses what is believed the first school laboratory, erected by Tuckwell in 1868. It is still in use, but is shortly to be demolished.

Wilhelm Ebstein

NOVEMBER 27 marks the hundredth anniversary of the birth of the eminent German physician Prof. Wilhelm Ebstein. He was born at Jauer, in Silesia, and studied medicine in Breslau and Berlin, where he was the pupil of Frerichs, Virchow and Romberg. After qualifying in 1859, he became physician to the All Saints Hospital at Breslau, where he did valuable work on gastric secretion and dermatology, a subject in which he always took a keen interest. He served as a medical officer in the Franco-Prussian War of 1870–71, and in 1874 was appointed professor of medicine and director of the Polyclinic at Göttingen, where he proved himself to be an indefatigable teacher, investigator and organizer, and created a model clinic well equipped with laboratories for scientific research. He was a remarkably prolific writer, as will be seen by the list of his works compiled by his son, the late medical historian Dr. Erich Ebstein (*Deut. Arch. Klin. Med.*, **89**, 367; 1907), but he is best known for his studies on obesity, gout and diabetes. His book on diabetes and its treatment was translated into French, Danish, Swedish and Russian, and one on the nature and treatment of gout into English and French. His historical contributions included articles on the Plague of Thucydides, the English Sweat, medicine in the Bible, Linnæus as physician, and the history of chicken-pox. He retired from his chair in 1906 at the age of seventy years, but remained in active consulting practice until a few days before his death from apoplexy on October 12, 1912.

Relation of Science to War and Defence

AT a public meeting organized by the Association of Scientific Workers, held at the Royal College of Science, London, on November 19, questions relating to "Defence and the Responsibilities of the Scientist" were discussed by a representative gathering of scientific workers. Prof. J. B. S. Haldane presided, and Prof. S. Chapman and Air Commodore L. E. O. Charlton opened the discussion. Prof. Chapman

denied the accusation that science is responsible for the horrors of war; dismissed the proposal that scientific workers should refuse to do war work as impracticable; urged them to join with the general public in order to take the necessary political action to stop the use of science for purposes of destruction, and suggested finally that the most suitable form of action would be the setting up of an international police force under the auspices of the League of Nations. Air Commodore Charlton showed how one of the principal technical achievements of our age, the aeroplane, has brought war to our doorstep, and has made the world population centres, such as London, the principal military objective in a future war. He presented quantitative evidence of the inadequacy of all known methods of defence, and urged scientific workers to devise something that would render the use of bombers impossible. In the subsequent discussion, attention was directed to the alternative policies advocated for avoiding war. The general consensus of opinion seemed to be in favour of some system of genuine collective security, and rejected both the isolationist and the pacifist solutions. J. D. Bernal reported the principal recommendations of the Science Section of the International Peace Conference held in Brussels last September. These included the proposal that scientific workers should apply scientific method to the study of war in all its aspects, to investigate the causes of war from the point of view of social and biological science, and to expose pseudo-scientific theories justifying war and racial superiority. It was finally proposed that a national commission representing all branches of science be set up to co-ordinate this work. These recommendations met with the warm support of the meeting.

Social Mission of Science

THE "Social Mission of Science", which formed the subject of a leading article in NATURE of October 24, has no more important objective, according to Prof. John Dewey, the veteran philosopher of Columbia University, than to elucidate the relation between authority and freedom. In his address at the Harvard Tercentenary Conference of Arts and Sciences on September 4 on "Authority and Resistance to Social Change" (*School and Society*, October 10), he exposed two fallacies underlying much of the philosophy that has gone by the name of liberalism, namely, that authority and freedom have separate and independent spheres of activity and no form of authority is justifiable that is not the product of, and sanctioned by, the conscious wants, efforts and satisfactions of individuals in their private capacity. While decrying the principle of authority, this philosophy, in fact, erected the wants and endeavours of private individuals seeking personal gain to the place of supreme authority in social life. Its failure to produce the conditions of a generally shared individual freedom is largely responsible for the recrudescence of the principle of authority in its most extreme and primitive form—the rise of dictatorships.

No collective planned economy, Prof. Dewey said, will succeed without some hitherto untried means for bringing into life an organic co-ordination of authority and freedom. It is here that science may help. It is suggested that the working of co-operative intelligence as displayed in science may serve as a working model of the union of freedom and authority. Here is seen individual freedom that is both supported by collective organized authority and, in turn, changes and is encouraged to change and develop by its own operation the authority upon which it depends. The extension to the wider field of human relations of the method of control by organized intelligence operating through the release of individual powers and capabilities presents enormous difficulties, but it is, Dewey holds, the only means whereby humanity can be rescued from "that futile and destructive oscillation between authoritative power and unregulated individual freedom to which we may justly attribute most of the sorrows and defeats of the past".

The Permanent International Studies Conference

THE report on the work of the Intellectual Co-operation Organisation, submitted by the Sixth Committee to the Assembly of the League of Nations, refers to the expansion of the Permanent International Studies Conference, which is now engaged in an objective and scientific study of foreign policy. This is an autonomous body which is able to pursue its work in the complete independence proper to scientific research. The most recent subjects dealt with by the Conference are State intervention in economic life, the possibility and conditions of an organization of collective security, and peaceful methods of change as applied to particular problems. For 1936 and 1937, the subjects chosen include the procedures for the peaceful settlement of disputes which have been applied in particular cases, over-population, colonies, migration and distribution of raw materials. In the field of education, an important result of the year's work of the Committee has been the publication by the Paris Institute of a first volume dealing with the organization of higher education and research in several European and American countries, while the Committee's efforts in the teaching of history are bearing fruit in the revision of text-books.

SPECIAL interest is attached to the attention which the International Committee is now giving to the question of unemployment among intellectual workers. While this question cannot be separated from the problem of unemployment as a whole, and the remedies to be recommended are chiefly national in character, international action may be of great value, particularly in the nature of co-operation between university information bureaux. Closer relations are being established between the Intellectual Co-operation Organisation and the International Council of Scientific Unions, and a permanent scientific committee is being set up as a result of the meeting of an expert committee to develop the Organisation's work in this field, and conversations on scientific

subjects contemplated include the future of scientific research and of science in modern societies. In this field also the Institute of Intellectual Co-operation and the International Labour Office have undertaken an inquiry into the social consequences of progress in mechanization, and its effects on man and the circumstances in which he lives. Discussions on the main international systems governing authors' rights have led the Committee to conclude that amalgamation of the Berne Convention and the Pan-American Convention of Havana is not possible, and a new convention is being prepared with the object of reconciling the principles common to these Conventions and capable of forming the basis of a universal system of authors' rights.

Indian Science Abstracts

THE immense volume of original work now published necessitates a very complete system of abstracts, and the requirements of the individual sciences are now well served in this respect. Rarely, however, is an attempt made to abstract separately the scientific publications of any country, so that it is not possible to estimate its direct contributions to knowledge. Prior to the Great War, the now defunct Board of Scientific Advice published annually a résumé of the principal Indian scientific memoirs, and now, after the lapse of many years, the National Institute of Sciences in India has undertaken the much more difficult task of compiling an annual bibliography of science in India. This comprises not only the titles of all papers published by authors resident in India and of Indians working abroad, but also of papers dealing with problems specifically related to India. In the majority of cases, not only is the title of the paper given, but it is also followed by a brief, but adequate, abstract. To those who look upon India as a backward country this publication will come as a revelation, not merely from the volume of the work produced but also by the high standard to which much of it attains. In a country so predominantly agricultural it is gratifying to find that so much attention is being paid to biological subjects ; nearly one half of the abstracts come under the heads of botany, zoology and physiology, the latter including veterinary and medical subjects. As the general editor points out in his introduction, the present division of subjects, which is under nine main heads, is purely tentative and may require revision in the light of experience.

FUTURE historians of science are sure to find this publication invaluable, but we would suggest that the addition of an author index would facilitate reference. To the general editor, Dr. Baini Prashad, and to his associate editors, we would offer our congratulations, and we trust that the favourable reception which is sure to be accorded to these abstracts will encourage them to continue the issue of the bibliography. Further evidence of the great attention now being devoted to research in India is found also in the publication by the Inter-University Board, India, of a bibliography of the theses accepted for higher degrees in arts and science by the universities during the years 1930–35. By their system of external examiners, the Indian universities ensure that their higher degrees shall equal those of the Western universities, and this bibliography shows how active these young universities are as centres for the advancement of knowledge. It will go far to dispel the idea that they are merely examining bodies.

Post Office Tests of Inoculation against Colds

THE common catarrhal cold is responsible for much sickness disability, and preventive vaccines containing a mixture of the predominant microbes present in the secretions have been employed, the microbes being bacteria such as *M. catarrhalis*, *B. hofmanni*, Friedlander's bacillus, *Pneumococcus*, *Staphylococcus* and *Streptococcus*. Trials of such a vaccine in the past, some of them on a large scale, have been disappointing, occasionally seeming to be useful in individual cases, but not significantly so in any large groups. A further test by the Chief Medical Officer of the Post Office during the last three years upon a large scale has, it is announced, similarly been disappointing. Volunteers were invited from large towns, and some hundreds of them were inoculated in the autumn of the three years 1933–35, and their sickness rates over periods antedating the inoculations and during the treatment were compared. Comparisons were also made with large control groups in each place of uninoculated workers. About ten per cent of the volunteers—less than half the original number—who persisted throughout the three years of the experiment showed some improvement, but taken as a whole the results were not encouraging, for there was little reduction of sickness among the whole group compared with the control groups or with their previous record. The use of anti-catarrhal vaccine as a large-scale routine measure in the future is, therefore, not considered justifiable. The negative character of the results of this experiment is not unexpected, as the common cold is now regarded as being a virus disease, the bacterial organisms associated with it being of the nature of secondary invaders.

Civilization since James Watt

AT a dinner given by the Franklin Institute on January 21, 1936, to celebrate the two hundredth anniversary of the birth of James Watt, J. P. Boyd gave a thoughtful address, a résumé of which appears in the *Journal of the Franklin Institute* for September. He pointed out that while James Watt was still an infant, Saint-Pièrre had suggested that the attainment of knowledge and the subjugation of the material world to the requirements of human welfare would lead to a continual improvement in the lot of mankind. But the logic of academicians and the pamphleteering of philosophers could not compare in effectiveness with the work initiated by James Watt. The steam engine meant freedom from the limitations of time and space. England in 1750 contained seven million inhabitants, and was over-

(*Continued on p.* 925.)

NATURE

SUPPLEMENT

No. 3500 SATURDAY, NOVEMBER 28, 1936 Vol. 138

The Idea of a World Encyclopædia*

By H. G. Wells

MOST of the lectures that are given in this place to this audience are delivered by men of very special knowledge. They come here to tell you something you did not know before. But to-night I doubt if I shall tell you anything that is not already quite familiar to you. I am here not to impart facts but to make certain suggestions; and there is no other audience in the world to which I would make these suggestions more willingly and more hopefully than I do to you.

My particular line of country has always been generalization and synthesis. I dislike isolated events and disconnected details. I really hate statements, views, prejudices and beliefs that jump at you suddenly out of mid-air. I like my world as coherent and consistent as possible. So far at any rate my temperament is that of a scientific man. That is why I have spent a few score thousand hours of my particular allotment of vitality in making outlines of history, short histories of the world, general accounts of the science of life, attempts to bring economic, financial and social life into one conspectus and even, still more desperate, struggles to estimate the possible consequences of this or that set of operating causes upon the future of mankind.

All these attempts had profound and conspicuous faults and weaknesses; even my friends are apt to mention them with an apologetic smile. Presumptuous and preposterous they were, I admit, but I look back upon them, completely unabashed. Somebody had to break the ice. Somebody had to try out such summaries on the general mind. My reply to the superior critic has always been—forgive me—"Damn you, do it better".

* Friday Evening Discourse delivered at the Royal Institution on November 20.

The least satisfactory thing about these experiments of mine, so far as I am concerned, is that they did not at once provoke the learned and competent to produce superior substitutes. And in view of the number of able and distinguished people we have in the world professing and teaching economic, sociological, financial science, and the admittedly unsatisfactory nature of the world's financial, economic and political affairs, it is to me an immensely disconcerting fact that the "Work, Wealth and Happiness of Mankind" which was first published in 1932 remains—practically uncriticized, unstudied and largely unread—the only attempt to bring human ecology into one correlated survey.

Well; I mention this experimental work now in order that you should not think I am just throwing casually formed ideas before you to-night. I am bringing you my very best. The thoughts I am setting out here have troubled my mind, for years, and my ideas have been slowly gathering definition throughout these experiments and experiences. They have interwoven more and more intimately with other solicitudes of a more general nature in which I feel fairly certain of meeting your understanding and sympathy.

I doubt if there is anybody here to-night who has not given a certain amount of anxious thought to the conspicuous ineffectiveness of modern knowledge and—how shall I call it?—trained and studied thought in contemporary affairs. I think that it is mainly in the troubled years since 1914 that the world of cultivated, learned and scientific people, of which you are so representative, has become conscious of this ineffectiveness. Before that time, or to be more precise before 1909 or 1910, the world, our world as we older ones recall it, was living in a state of

confidence, of established values, of assured security, which is already becoming now almost incredible. We had no suspicion then how much that apparent security had been undermined by science, invention and sceptical inquiry. Most of us carried on into the War and even right through the War under the inertia of the accepted beliefs to which we had been born. We felt that the sort of history we were used to was still going on, and we did not realize at all that the War was a new sort of thing, not like the old wars, that the old traditions of strategy were disastrously out of date and that the old pattern of settling up after a war could only lead to such a thickening tangle of evil consequences as we contemplate to-day.

We know better now. Wiser after the events as we all are, few of us now fail to appreciate the stupendous ignorance, the almost total lack of grasp of social and economic realities, the short views, the shallowness of mind, that characterized the treaty-making of 1919 and 1920. I suppose Mr. Maynard Keynes was one of the first to open our eyes to this world-wide intellectual insufficiency. What his book, "The Economic Consequences of the Peace", practically said to the world was this: These people, these politicians, these statesmen, these directive people who are in authority over us, know scarcely anything about the business they have in hand. Nobody knows very much, but the important thing to realize is that they do not even know what is to be known. They arrange so and so, and so and so must ensue and they cannot or will not see that so and so must ensue. They are so unaccustomed to competent thought, so ignorant that there is knowledge and of what knowledge is, that they do not understand that it matters.

The same terrifying sense of insufficient mental equipment was dawning upon some of us who watched the birth of the League of Nations. Reluctantly and with something like horror, we realized that these people who were, they imagined, turning over a new page and beginning a fresh chapter in human history, knew collectively scarcely anything about the formative forces of history. Collectively, I say. Altogether they had a very considerable amount of knowledge, uncoordinated bits of quite good knowledge, some about this period and some about that, but they had no common understanding whatever of the processes in which they were obliged to mingle and interfere. Possibly all the knowledge and all the directive ideas needed to establish a wise and stable settlement of the world's affairs in 1919 existed in bits and fragments, here and there, but practically nothing had been assembled, practically nothing had been thought out, nothing practically had been done to draw that knowledge and these ideas together into a comprehensive conception of the world. I put it to you that the Peace Conference at Versailles did not use anything but a very small fraction of the political and economic wisdom that already existed in human brains at that time; and I put it to you as rational creatures that if usage had not dulled our apprehension to this state of affairs, we should regard this as fantastically absurd.

If I might attempt a sweeping generalization about the general course of human history in the eighteen years that have followed the War, I believe I should have you with me if I described it as a series of flounderings, violent ill-directed mass-movements, slack drifting here and convulsive action there. We talk about the dignity of history. It is a bookish phrase for which I have the extremist disrespect. There is no dignity yet in human history. It would be pure comedy, if it were not so often tragic, so frequently dismal, generally dishonourable and occasionally quite horrible; and it is so largely tragic because the human animal really is intelligent, can feel finely and acutely, expresses itself poignantly in art, music and literature, and—this is what I am driving at—impotently knows better.

Consider only the case of America during this recent period. America, when all is said and done, is one of the most intelligently *aware* communities in the world. Quite a number of people over there seem almost to know what is happening to them. Remember first the phase of fatuous self-sufficiency, the period of unprecedented prosperity, the boom, the crisis, the slump and the dismay. And then appeared the new President, Franklin Roosevelt, and from the point of view of the present discussion he is one of the most interesting figures in all history. Because he really did make an appeal for such knowledge and understanding as existed to come to his aid. America in an astounding state of meekness was ready to be told and shown. There were the universities, great schools, galaxies of authorities, learned men, experts, teachers, doctors, professors, gowned, adorned and splendid. Out of this knowledge mass there has since come many very trenchant criticisms of the President's mistakes. But at the time this—what shall I call it—this higher brain, this cerebrum, this grey matter of America was so entirely unco-ordinated that it had nothing really comprehensive, searching, thought-out and trustworthy for him to go upon. The President had to experiment and attempt this and that, he turned from one promising adviser to another, because there was nothing ready for him. He did not pretend to be a divinity. He was a politician—of exceptional good-will. He was none of your dictator gods. He showed himself extremely open and receptive for the organized information and guidance . . . *that wasn't there*. And it isn't there now.

Some years ago there was a considerable fuss in the world about preparedness and unpreparedness. Most of that clamour concerned the possibility of war. But here was a case of most fantastic unpreparedness on the part of hundreds of eminent men, who were supposed to have studied them, for the normal development of a community in times of peace. There had been no attempt to assemble that mechanism of knowledge of which America stood in need.

I repeat that if usage had not dulled us into a habit of acquiescence with this sort of thing we should think our species collectively insane to go about its business in this haphazard, planless, negligent fashion.

I think I have said enough to recall to anyone here who may have lapsed from the keen apprehension of his first realization, of this wide gap between what I may call the at present unassembled and unexploited best thought and knowledge in the world and the ideas and acts not simply of the masses of common people, but of those who direct public affairs, the dictators, the leaders, the politicians, the newspaper directors, and our spiritual guides and teachers. We live in a world of unused and misapplied knowledge and skill. That is my case. Knowledge and thought are ineffective. The human species regarded as a whole is extraordinarily like a man of the highest order of brain, who through some lesions or defects or insufficiencies of his lower centres, suffers from the wildest uncoordinations, St. Vitus's dance, agraphia, aphonia, and suffers dreadfully (knowing better all the time) from the silly and disastrous gestures he makes and the foolish things he says and does.

I don't think this has ever been so evident as it is now. I doubt if in the past the gap was so wide as it is now between the occasions that confront us, and the knowledge we have assembled to meet them. But because of a certain run of luck in the late nineteenth century, the existence of that widening gap and the menace of that widening gap were not thrust upon our attention as they have been since the War.

At first that realization of the ineffectiveness of our best thought and knowledge struck only a few people, Mr. Maynard Keynes for example, who were in what I may call salient positions, but gradually I have noted the realization spreading and growing. It takes various forms. Prominent men of science speak more and more frequently of the responsibility of science for the disorder of the world. And if you are familiar with that most admirable of all newspapers, NATURE, and if you care to turn over the files of that very representative weekly for the past quarter of a century or so and sample the articles, you will observe a very remarkable change of note and scope in what it has to say to its readers. Time was when NATURE was almost pedantically special and scientific. Its detachment from politics and general affairs was complete. But latterly the concussions of the social earthquake and the vibration of the guns have become increasingly perceptible in the laboratories. NATURE from being specialist has become world-conscious, so that now it is almost haunted week by week by the question: "What are we to do before it is too late, to make what we know and our way of thinking effective in world affairs?"

In that I think it is expressing a change which is happening in the minds of—if I may presume to class myself with you—nearly all people of the sort which fills this theatre to-night.

And consider again the topics that have been dealt with at the latest gathering of the British Association. The very title of the presidential address: "The Impact of Science upon Society"! Sir Josiah Stamp, as you will remember, stressed the need of extending endowment and multiplying workers in the social sciences. Professor Philip dealt with "The Training of the Chemist for the Service of the Community". Professor Cramp talked of "The Engineer and the Nation", and there was an important discussion of "The Cultural and Social Values of Science" in which Sir Richard Gregory, Professor Hogben and Sir Daniel Hall said some memorable things. There can be no doubt of the reality of this awakening of the scientific worker to the necessity of his becoming a definitely *organized* factor in the social scheme of the years before us.

Well, so far I have been merely opening up my subject and stating the problem for consideration. We want the intellectual worker to become a more definitely organized factor in the human scheme. How is that factor to be organized? Is there any way of implementing knowledge for ready and universal effect? I ask you to examine the question whether this great and growing gap between special knowledge and thought and the common ideas and motives of mankind can be bridged, and if so how it can be bridged.

Can scientific knowledge and specialized thought be brought into more effective relation to general affairs? Let us consider first what is actually going on. I find among my scientific and specialist friends a certain disposition—and I think it is a mistaken disposition—for direct political action and special political representation. The scientific and literary workers of the days when I was a young man were either indifferent or conservative in politics; nowadays quite a large proportion of them are inclined to active participation in extremist movements; many are leftish and revolutionary, some accept the strange pseudo-scientific dogmas of the communist party though that does no credit to their critical training, and even those who are not out on the left are restless for some way of intervening, definitely as a class, in the general happenings of the community. Their ideas of possible action vary from important-looking signed pronouncements and protests to a sort of strike against war, the withholding of services and the refusal to assist in technical developments that may be misapplied. Some favour the idea of a gradual supersession of the political forms and methods of mass democracy by government through some sort of *élite* in which the man of science and the technician will play a dominating part. There are very large vague patches upon this idea but the general projection is in the form of a sort of modern priesthood, an oligarchy of professors and exceptionally competent people. Like Plato they would make the philosopher king. This project involves certain assumptions about the general quality and superiority of the intellectual worker that I am afraid will not stand scrutiny.

I submit that sort of thing—political activities, party intervention and dreams of an authoritative *élite*—is not the way in which specialists, artists and specialized thinkers and workers who constitute the vital feeling and understanding of the body politic can be brought into a conscious, effective, guiding and directive relationship to the control of human affairs. Because—I hope you will acquit me of any disrespect for science and philosophy when I say this—we have to face the fact that from the point of view of general living, men of science, artists, philosophers, specialized intelligences of any sort, do not constitute an *élite* that can be mobilized for collective action. They are an extraordinarily miscellaneous assembly, and their most remarkable common quality is the quality of concentration in comparative retirement—each along his own line. They have none of the solidarity, the customary *savoir faire*, the habits arising out of practices, activities and interests in common, that lawyers, doctors or any of the really socially organized professions for example display. A professor-ridden world might prove as unsatisfactory under the stress of modern life and fluctuating conditions as a theologian-ridden world.

A distinguished specialist is precious because of his cultivated gift. It does not follow at all that by the standards of all-round necessity he is a superior person. Indeed by the very fact of his specialization he may be less practised and competent than the average man. He probably does not read his newspaper so earnestly, he finds much of the common round a bother and a distraction and he puts it out of his mind. I think we should get the very gist of this problem if we could compare twelve miscellaneous men of science and special skill, with twelve unspecialized men taken—let us say—from the head clerk's morning train to the city. We should probably find that for commonplace teamwork and the ordinary demands and sudden urgencies of life, the second dozen was individually quite as good as if not better than the first dozen. In a burning hotel or cast away on a desert island they would probably do quite as well. Yet collectively they would be ill-informed and limited men ; the whole dozen of them would have nothing much more to tell you than any one of them. On the other hand, our dozen specialists would each have something distinctive to tell you. The former group would be almost as uniform in their knowledge and ability as tiles on a roof, the latter would be like pieces from a complicated jig-saw puzzle. The more you got them together the more they would signify. Twelve clerks or a hundred clerks ; it wouldn't matter ; you would get nothing but dull repetitions, and a flat acquiescent suggestible outlook upon life. But every specialized man we added would be adding something to the directive pattern of life. I think that consideration takes us a step further in defining our problem to-night.

It is *science* and not *men of science* that we want to enlighten and animate our politics and rule the world.

Now I will take rather a stride forward in my argument. I will introduce a phrase, *New Encyclopædism*, which I shall spend most of the rest of my time defining. I want to suggest that something—a new social organ, a new institution, which for a time I shall call *World Encyclopædia* is the means whereby we can solve the problem of that jig-saw puzzle and bring all the scattered and ineffective mental wealth of our world into something like a common understanding and into effective reaction upon our vulgar everyday political, social and economic life. I warn you that I am flinging moderation to the winds in the suggestions I am about to put before you. They are immense suggestions. I am sketching what is really a scheme for the reorganization and reorientation of education and information throughout the world. No less. We are so accustomed to the existing schools, colleges, universities, research organizations of the world ; they have so moulded and made us and trained us from our earliest years to respect and believe in them ; that it is with a real feeling of temerity, of alma-matricidal impiety, so to speak, that I have allowed my mind to explore their merits and question whether they were not now altogether an extraordinarily loose, weak and out-of-date miscellany. Yet I do not see how we can admit, and I am disposed to think you have admitted with me, the existence of this terrifying gap between available knowledge and current social and political events, and not go on to something like an indictment of this whole great world of academic erudition, training and instruction from China to Peru—an indictment for, at least, inadequacy and inco-ordination if not for actual negligence. It may be only a temporary inadequacy, a pause in development before renascence, but inadequate altogether they are. Universities have multiplied greatly, yes, but they have failed to participate in the general advance in power, scope and efficiency that has occurred in the past century. In transport we have progressed from coaches and horses by way of trains to electric traction, motor-cars and aeroplanes. In mental organization we have, so to speak, simply multiplied our coaches and horses and livery stables.

Let me now try to picture for you this missing element in the modern human social mechanism, this needed connexion between the percipient and informative parts and the power organization for which I am using this phrase, World Encyclopædia. And I will take it first from the point of view of the ordinary educated citizen—for in a completely modernized state every ordinary citizen will be an educated citizen. I will ask you to imagine how this World Encyclopædic organization would enter into his life and how it would affect him. From his point of view the World Encyclopædia would be a row of volumes in his own home or in some neighbouring house or in a convenient public library or in any school or college, and in this row of volumes he would, without any great

toil or difficulty, find in clear understandable language, and kept up to date, the ruling concepts of our social order, the outlines and main particulars in all fields of knowledge, an exact and reasonably detailed picture of our universe, a general history of the world, and if by any chance he wanted to pursue a question into its ultimate detail, a trustworthy and complete system of reference to primary sources of knowledge. In fields where wide varieties of method and opinion existed, he would find, not casual summaries of opinions, but very carefully chosen and correlated statements and arguments. I do not image the major subjects as being dealt with in special articles rather hastily written, such as has been the tradition of encyclopædias since the days of Diderot's heroic effort. Our present circumstances are altogether different from his. Nowadays there is an immense literature of statement and explanation scattered through tens of thousands of books, pamphlets and papers, and it is not necessary, it is undesirable, to trust to such hurried summaries as the old tradition was obliged to make for its use. The day when an energetic journalist could gather together a few star contributors and a miscellany of compilers of very uneven quality to scribble special articles for him, articles often tainted with propaganda and advertisement, and call it an encyclopædia, is past. The modern World Encyclopædia should consist of selections, extracts, quotations, very carefully assembled with the approval of outstanding authorities in each subject, carefully collated and edited and critically presented. It would be not a miscellany, but a concentration, a clarification and a synthesis.

This World Encyclopædia should be the mental background of every intelligent man in the world. It should be alive and growing and changing continually under revision, extension and replacement from the original thinkers in the world everywhere. Every university and research institution should be feeding it. Every fresh mind should be brought into contact with its standing editorial organization. On the other hand its contents would be the standard source of material for the instructional side of school and college work, for the verification of facts and the testing of statements—everywhere in the world. Even journalists would deign to use it; even newspaper proprietors might be made to respect it. Such an encyclopædia would play the role of an undogmatic Bible to a world culture. It would do just what our scattered and disoriented intellectual organizations of to-day fall short of doing. It would hold the world together mentally.

It may be objected that this is a Utopian dream. This is something too great to achieve, too good to be true. I won't deal with that for a few minutes. Flying was a Utopian dream, a third of a century ago. What I am putting before you is a perfectly sane, sound and practical proposal. But first I will notice briefly two objections—obstructions rather than objections—that one will certainly encounter at this point.

One of these is not likely to appear in any great force in this gathering. You have all heard and you have all probably been irritated or bored by the assertion that no two people think alike "*quot homines, tot sententiæ*", that science is always contradicting itself, that economists like theologians can never agree. It is largely mental laziness on the defensive that makes people say this kind of thing. They don't want their intimate convictions turned over and examined, and it is unfortunate that the emphasis put upon minor differences by men of science, and belief in their strenuous search for the completest truth and the exactest expression sometimes give colour to this sort of misunderstanding. But I am inclined to think that most people overrate the apparent differences in the world of opinion to-day. Even in theology a psychological analysis reduces many flat contradictions to differences in terminology. My impression is that human brains are very much of a pattern, that under the same conditions they react in the same way, and that were it not for tradition, upbringing, accidents of circumstance and particularly of accidental individual obsessions, we should find ourselves—since we all face the same universe—much more in agreement than is superficially apparent. We speak different languages and dialects of thought and can even at times catch ourselves flatly contradicting each other in words while we are doing our utmost to express the same idea. And self love and personal vanity are not excluded from the intellectual life. How often do we see men misrepresenting each other in order to exaggerate a difference and secure the gratification of an argumentive victory! A World Encyclopædia as I conceive it would bring together into close juxtaposition and under critical scrutiny many apparently conflicting systems of statement. It might act not merely as an assembly of fact and statement, but as an organ of adjustment and adjudication, a clearing house of misunderstandings; it would be deliberately a synthesis, and so act as a flux and a filter for a very great quantity of human misapprehension. It would *compel* men to come to terms with one another. I think it would relegate "*quot homines, tot sententiæ*" back to the Latin comedy from which it emerged.

The second type of obstruction that this idea of a World Encyclopædia will encounter is even less likely to find many representatives in the present gathering and I will give it only the briefest of attention. (You know that kind of neuralgic expression, the high protesting voice, the fluttering gesture of the hands.) "But you want to *stereotype* people. What a dreadful, dreadful world it will be when everybody thinks alike"—and so they go on. Most of these elegant people who want the world picturesquely at sixes and sevens are hopeless cases, but for the milder instances it may be worth while remarking that it really does not enhance the natural variety and beauty of life to have all the clocks in a town keeping individual times of their own, no charts of the sea, no time-tables, but

trains starting secretly to unspecified destinations, infectious diseases without notification and postmen calling occasionally when they can get by the picturesque footpads at the corner. I like order in the place of vermin, I prefer a garden to a swamp and the whole various world to a hole-and-corner life in some obscure community, and to-night I like to imagine I am making my appeal to hearers of a kindred disposition to my own.

Next let us take this World Encyclopædia from the point of view of the specialist and the super-intellectual. To him even more than to the common intelligent man World Encyclopædia is going to be of value because it is going to afford him an intelligible statement of what is being done by workers parallel with himself. Further, it will be giving him the general statement of his own subject that is being made to the world at large. He can watch that closely. On the assumption that the World Encyclopædia is based on a world-wide organization he will be—if he is a worker of any standing—a corresponding associate of the Encyclopædia organization. He will be able to criticize the presentation of his subject, to suggest amendments and restatements. For a World Encyclopædia that was kept alive and up to date by the frequent re-issue of its volumes, could be made the basis of much fundamental discussion and controversy. It might breed swarms of pamphlets, and very wholesome swarms. It would give the specialist just that contact with the world at large which at present is merely caricatured by his more or less elementary class-teaching, amateurish examination work and college administration. In my dream of a World Encyclopædia I have a feeling that part of the scheme would be the replacement of the latter group of professorial activities, the college business, tutoring, normal lecturing work and so on, by a new set of activities, the encyclopædic work, the watching brief to prevent the corruption of the popular mind. In enlightening the general mind the specialist will broaden himself. He will be redeemed from oddity, from shy preciousness and practical futility.

Well, you begin to see the shape of this project; and you will realize that, except in so far as the nature of its reaction upon the world's affairs is concerned, it is far away from anything like the valiant enterprise of Denis Diderot and his associates a century and a half ago. That extraordinary adventure in intellectual synthesis makes this dream credible. That is our chief connexion with it.

And here I have to make an incidental disavowal. I want to make it clear how little I have to do with what I am discussing. In order to get some talk going upon this idea of an Encyclopædia, I have been circulating a short memorandum upon the subject among a number of friends. I did not think to mark it *Private*, and unhappily one copy seems to have fallen into the hands of one of those minor pests of our time, a personal journalist, who at once rushed into print with the announcement that I was proposing to *write* a brand new Encyclopædia, all with my own little hand out of my own little head. At the age of seventy! Once a thing of this sort is started there is no stopping it—and I admit that announcement enables you to put me in my place in a pleasantly ridiculous light. But I think after what I have put before you now that you will acquit me of any such colossal ambition. I implore you not to let that touch of personal absurdity so difficult to avoid altogether belittle the greatness and urgency of the cause I am pleading. This Encyclopædia I am thinking of is something in which manifestly I have neither the equipment nor the quality to play any but an infinitesimal part. I am asking for it in the role of a common intelligent man who needs it and understands the need for it, both for himself and his world. After that you can leave me out of it. It is just because in the past I *have* had some experience in the assembling of outlines of knowledge for popular use, that I realize, perhaps better than most people, the ineffectiveness of this sort of effort on the part of individuals or small groups. It is something that must be taken up—and taken up very widely and seriously—by the universities, the learned societies, the responsible educational organizations if it is to be brought into effective being. It is a super university I am thinking of, a world brain; no less. It is nothing in the nature of a supplementary enterprise. It is a completion necessary to modernize the university idea.

That brings me to the last part of this speculation. Can such an Encyclopædia as I have been suggesting to you, be a possible thing? How can it be set going? How can it be organized and paid for? I agree I have now to show it as a possible thing. For I am going to make the large assumption that you think that *if it is a possible thing* it is a desirable thing. How are we to set about it?

I think something in this way: To begin with we want a promotion organization. We want, shall I call it, an Encyclopædia Society to ask for an Encyclopædia and to get as many people as possible asking for an Encyclopædia. Directly that society asks for an Encyclopædia it will probably have to resort to precautionary measures against any enterprising publisher who may see in that demand a chance for selling some sort of vamped-up miscellany as the thing required, and who may even trust to the unworldliness of conspicuous learned men for some sort of countenance for his raid.

Next this society of promoters will have to survey the available material. For most of the material for a modern Encyclopædia exists already—though in a state of impotent diffusion. In all the various departments with which an Encyclopædia should deal, groups of authoritative men might be induced to prepare a comprehensive list of primary and leading books, articles, statements which taken together would give the best, clearest and most quintessential renderings of what is known and thought within their departments. This would make a sort of key bibliography to the

thought and knowledge of the world. My friend Sir Richard Gregory has suggested that such a key bibliography for a World Encyclopædia would in itself be a very worthwhile thing to evoke. I agree with him. I haven't an idea what we should get. I imagine something on the scale of ten or twenty thousand items. I don't know.

Possibly our Encyclopædia Society would find that such a key bibliography was in itself a not unprofitable undertaking, but that is a comment by the way.

The next step on from this key bibliography would be the organization of a general editorial board and of departmental boards dealing with separate fields of interest. These boards would be permanent bodies—for a World Encyclopædia must have a perennial life. We should have to secure premises, engage a literary staff and, with the constant co-operation of the departmental groups, set about the task of making our great synthesis and abstract. I must repeat that for the purposes of a World Encyclopædia probably we would not want much original writing. If a thing has been stated clearly and compactly once for all, why paraphrase it or ask some inferior hand to restate it? Our job may be rather to secure the use of copyrights and induce leading exponents of this or that field of science or criticism to co-operate in the selection, condensation, expansion or simplification of what they have already said so well.

Now I will ask you to take another step forward and imagine our World Encyclopædia has been assembled and digested and that the first edition is through the press. So far we shall have been spending money upon this great enterprise and receiving nothing; we shall have been spending capital, for which I have at present not accounted. I will merely say that I see no reason why the capital needed for these promotion activities should not be forthcoming. This is no gainful enterprise, but you have to remember that the values we should create would be far more stable than the ephemeral encyclopædias representing sums round about a million pounds or so which have hitherto been the high-water mark of encyclopædic enterprise. These were essentially book-selling enterprises made to exploit a demand. But this World Encyclopædia as I conceive it, if only because it will have roped in the larger part of the original sources of exposition, discussion and information, will be in effect a world monopoly, and it will be able to levy and distribute direct and indirect revenue, on a scale quite beyond the resources of any private publishing enterprise. I do not see that the financial aspects of this huge enterprise, big though the sums involved may be, present any insurmountable difficulties in the way of its realization. The major difficulty will be to persuade the extremely various preoccupied, impatient and individualistic scholars, thinkers, scientific workers and merely distinguished but unavoidable men on whose participation its success depends, of its practicability, convenience and desirability.

So far as the promotion of it goes I am reasonably hopeful. Quite a few convinced, energetic and resourceful people could set this ball rolling towards realization. To begin with, it is not necessary to convert the whole world of learning, research and teaching. I see no reason why at any stage it should encounter much positive opposition. Negative opposition—the refusal to have anything to do with it and so forth—can be worn down by persistence and the gathering promise of success. A World Encyclopædia has not to fight adversaries or win majorities before it gets going; and once this ball is fairly set rolling it will be very hard to stop. A great danger, as I have already suggested, will come from attempts at the private mercenary exploitation of this world-wide need—the raids of popular publishers and heavily financed salesmen, and in particular attempts to create copyright difficulties and so to corner the services and prestige of this or that unwary eminent person by anticipatory agreements. *Vis-à-vis* with salesmanship the man of science, the man of the intellectual *élite*, is apt to show himself a very Simple Simon indeed. And of course from the very start, various opinionated cults and propagandas will be doing their best to capture or buy the movement. Well, it mustn't be captured or bought, and in particular its silence must not be bought or captured. That danger may in the end prove to be a stimulus. It may be possible in some cases to digest and assimilate special cults to their own and the general advantage.

There will also be a constant danger that some of the early promoters may feel and attempt to realize a sort of proprietorship in the organization, to make a group or a gang of it. But to recognize that danger is half way to averting it.

I have said nothing so far about the language in which the Encyclopædia should appear. It is a question I have not worked out. But I think that the main text should be in one single language, from which translations in whole or part could be made. Catholic Christianity during the years of its greatest influence was held together by Latin, and I do not think that I am giving way to any patriotic bias when I suggest that unless we contemplate a polyglot publication—and never yet have I heard of a successful polyglot publication—*English*, because it has a wider range than German, a greater abundance and greater subtlety of expression than French and more precision than Russian, is the language in which the original text of a World Encyclopædia ought to stand. Moreover, it is in the English-speaking communities that such an enterprise as this is likely to find the broadest basis for operations, the frankest criticism and the greatest freedom from official interference and government propaganda. But that must not hinder us from drawing help and contributions from and contemplating a use in every community in the world.

So far I have laid no stress upon the immense advantage this enterprise would have in its

detachment from immediate politics. Ultimately if our dream is realized it must exert a very great influence upon everyone who controls administrations, makes wars, directs mass behaviour, feeds, moves, starves and kills populations. But it does not immediately challenge these active people. It is not the sort of thing to which they would be directly antagonist. It is not ostensibly anti-*them*. They would not easily realize its significance for all that they do and are. The prowling beast will fight savagely if it is pursued and challenged upon the jungle path in the darkness, but it goes home automatically as the day breaks.

You see how such an Encyclopædic organization could spread like a nervous network, a system of mental control about the globe, knitting all the intellectual workers of the world through a common interest and a common medium of expression into a more and more conscious co-operating unity with a growing sense of their own dignity and responsibility, informing without pressure or propaganda, directing without tyranny. It could be developed wherever conditions were favourable ; it could make inessential concessions and bide its time in regions of exceptional violence, grow vigorously again with every return to liberalism and reason.

So I sketch my suggestion for a rehabitation of thought and learning that ultimately may release a new form of power in the world, recalling indeed the power and influence of the Churches and religions of the past but with a progressive, adaptable and recuperative quality that none of these possessed. I believe that in some such way as I have sketched, the mental forces now largely and regrettably scattered and immobilized in the universities, the learned societies, research institutions and technical workers of the world, could be drawn together into a real directive world intelligence, and by the mere linking and implementing of what is known, human life as a whole could be made much surer, stronger, bolder and happier than it has ever been up to the present time. Until something of this sort is done, I do not see how the common life can ever be raised except occasionally, locally and by a conspiracy of happy chances, above its present level of impulsiveness, insincerity, insecurity, general under-vitality, under-nourishment and aimlessness. For that reason I think the promotion of an organization for a World Encyclopædia may prove in the long run to be a better investment for the time and energy of intelligent men and women than any definite revolutionary movement, Socialism, Communism, Fascism, Imperialism, Pacificism or any other of the current *isms* into which we pour ourselves and our resources so freely. None of these movements has anything like the intellectual comprehensiveness needed to construct the world anew.

Let me be very clear upon one point. I am not saying that a World Encyclopædia will in itself solve any single one of the vast problems that must be solved if man is to escape from his present dangers and distresses and enter upon a more hopeful phase of history ; what I am saying—and saying with the utmost conviction—is this, that without a World Encyclopædia to hold men's minds together in something like a common interpretation of reality, there is no hope whatever of anything but an accidental and transitory alleviation to any of our world troubles. As mankind is, so it will remain, until it pulls its mind together. And if it does not pull its mind together then I do not see how it can help but decline. Never was a living species more perilously poised than ours at the present time. If it does not take thought to end its present mental indecisiveness catastrophe lies ahead. Our species may yet end its strange eventful history as just the last, the cleverest, of the great apes. The great ape that was clever—but not clever enough. It could escape from most things but not from its own mental confusion and the destruction that is the inevitable consequence of incurable mental confusion.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

crowded. Now great masses of people can concentrate in towns secure in the promise of food, shelter and clothing. In 1936 the population of London is as great as that of all England a hundred years ago. The materials required for human life in crowded centres are obtained by the steam engine. Science and engineering accelerated the growth of the 'empire of the machine'. Men everywhere, although freed from the soil, feel themselves enslaved to the machine. To-day, four of the largest modern turbines have an energy capacity greater than that of the entire adult working population of the United States.

MANKIND now appears to be on the eve of a third industrial revolution. We have machines watched and directed by other machines. As an example, consider the photo-electric cell, which never makes a mistake and never knows fatigue. It is used for many and varied purposes. It sorts vegetables, fruit and eggs, it measures illumination, appraises colours, classifies minerals, counts bills and throws out counterfeits. It times races, counts people and vehicles, records smoke in tunnels, directs traffic automatically and substitutes a new process for photo-engraving. Automatically controlled machinery for making lamp bulbs at Corning, New York, produces 650 thousand bulbs per machine per day, which is ten thousand times more than that produced by the methods previously employed. Remarkable progress in material culture has been witnessed during the last hundred years; but institutions, social customs and thought patterns have, as always, lagged behind. Saint Pièrre's idea of progress is beginning to be challenged; some social pessimists are substituting the notion of change for that of progress. To establish control over the gigantic material gains and to cope with the resultant problems are the challenges facing mankind to-day. Many years may be required to solve them, but surely that intelligence which has performed such marvellous feats in material matters will find an avenue for social progress.

The Newcomen Society

AT a meeting of the Newcomen Society held at the Iron and Steel Institute on November 18, the report of the Council for the session 1935–36 was presented. This showed that the activities of the Society have been well maintained and that the total membership is now 424 as compared with 343 a year ago. There has been a considerable increase in the membership in America. Fourteen papers were read during the session and the Society has published as an extra publication the "Collected Papers" of Mr. Rhys Jenkins, one of the founders of the Society. Mr. W. J. Tennant was elected president for the ensuing year. After the passing of the report and accounts, a paper was read by Dr. J. Thomas on "Josiah Wedgwood as a Pioneer of Steam Power in the Pottery Industry". By searching the Boulton and Watt papers at the Public Library and the Assay Office at Birmingham, Dr. Thomas has brought to light new material relating to the introduction of the Watt rotative steam engine into industry in the Midlands, and he has come to the conclusion that the earliest of such engines installed in a factory was that supplied to Wedgwood and erected at Etruria in 1782. Wedgwood's faith in the steam engine was shown by the financial assistance he gave to Boulton at a critical time. Like Priestley, Erasmus Darwin, Keir, Boulton, Watt and others, Wedgwood was a member of the famous Lunar Society, and his scientific leanings were shown in many ways. Towards the close of his paper, Dr. Thomas was able to show by a series of lantern slides how Watt used the medallions and casts of Wedgwood when in his retirement he devoted his time to the construction of the two statuary reproducing machines now preserved in Watt's garret workshop at the Science Museum. There can be little doubt that Watt's work in this direction was largely due to his friendship with Wedgwood.

New Tube Trains in London

EXPERIMENTS have recently been made on the first of four six-car tube trains manufactured by the Metropolitan–Cammell Carriage and Wagon Co., Ltd. for the London Passenger Transport Board. The train is composed of three two-car units, each car having the whole of the electric equipment under the floor. This avoids the necessity of a switch compartment, and so the new six-car train has approximately the same sitting accommodation as the existing seven-car train. The acceleration has been increased to two miles per hour per second and the braking rate (deceleration) to three miles per hour per second. The increased power has been gained partly by driving directly fifty per cent of the axles and by arranging so that more of the weight of the train is available for cohesion. The total horse-power of the new trains will be 1,650, as compared with 960 for the existing six-car trains. Several firms have suggested various schemes for operating the trains, but the following features are common to them all. All the control is operated at 50 volts and each car is separate and complete. Resistance switches are never called upon to brake under load. Each of the bogies is of all-welded construction and each carries one traction motor on the inside axle. This arrangement provides 58 per cent of the available weight of the car for adhesion. Three of the trains are streamlined at the driving end. The driver's seat is in the centre of the cab, with the master controller and braking controller on either side. The air-operated sliding doors are electrically controlled. Particulars with photographs are given in the *Electrical Review* of November 20.

Steamship Communication between Europe and America

In the *Metropolitan Vickers Gazette* of October, Mr. Leivesley continues his papers on notable ships and their equipment. He points out that it is now ninety-six years since a regular steamship communication was inaugurated between Europe and America. This was first established by the Cunard S.S. *Britannia* in July 1840, which crossed from Liverpool to Boston

via Halifax in 14⅓ days. She was equipped with steam engines driving paddle wheels, and her average speed was 8½ knots. Since then, the speed of the steamers has increased uniformly up to the present when it is 30 knots. The tonnage of the *Britannia* was 1,154 and her length was 207 ft. The tonnage of the *Queen Mary* is 80,773 and her length 1,020 ft. When it is realized that the former ship was equipped with engines barely equal to the power equipment of a modern trawler, our respect for the pioneers in sea transport is greatly increased. The horse-power of the *Queen Mary* is nearly 200,000 whilst that of the *Britannia* was 740. The author deals with the auxiliary plant which the Metropolitan-Vickers Co. supplied to the *Queen Mary*. These have chiefly to do with the winches and the ventilating system. There are six cargo winches, the same number of gangway winches and three baggage winches. These three types are all self-contained water-tight units. The ventilating system is naturally very extensive. There are no less than 40 miles of duct through which 118 million cubic feet of air are driven per hour.

Mediterranean Unity and Diversity

THE unity of the Mediterranean world in all geographical aspects, physical, climatic and vegetational, is a familiar conception to all geographers, and nowhere has the theme been more ably expounded than in a lecture by Dr. G. Sarton on "The Unity and Diversity of the Mediterranean World" (*Osiris*, 2, Part 9). While he dwells on this unity, enhanced by relative enclosure, he points out also the effective channels by which the area is linked with the outer world, especially with the civilizations of the East in ancient times, and the diversity within the larger unity owing to enclosed seas and restricted area of high fertility. These ideas he expounds as a background for a study of Mediterranean civilization. Among many links between geographical conditions and human development, Dr. Sarton takes the myth of St. George. Everywhere in the Near East, Al-Khidr, the young or ever-living one, is venerated by Muslims as well as by Jews and Christians. The festivals of Al-Khidr, Elijah and St. George occur on the same day, April 23, which, irrespective of religion, is one of the important holidays. St. George or Al-Khidr is not simply an ever-living one but a giver of life, for he is the most powerful rain-bringer, and in the Mediterranean rain has a vital significance. His name is connected with the struggle against darkness, winter and drought. He is the recrudescence of spring and he symbolizes the struggle against evil and ignorance. Dr. Sarton suggests that if ever the historian of science should need a patron saint, he could not find a better one than Al-Khidr or St. George, the ever-living symbol of Mediterranean unity and diversity, of our culture and ideals, and of the everlasting struggle between truth and superstition.

Forests of Trinidad and Tobago

THE forests of Trinidad are not one of the least of its beauties, and a recent informative statement on them ("Forests and Forestry in Trinidad and Tobago". Govt. Printer, Trinidad, 1935) was drawn up by Mr. R. L. Brooks, the conservator of forests, for the British Empire Forestry Conference held in South Africa last year. The statement covers the whole field of forestry administration tracing the past history, geographical position, geology, climate and distribution of the forests in the Islands; and the botanical types of the forest growth. There is a small amount of private planting undertaken, but forestry activities are chiefly confined to the Department of Forestry. Co-operation exists between the Agricultural Society of Trinidad and Tobago and the Department. This Society publishes a quarterly record of its work in its *Proceedings*, but the chief scientific journal of Trinidad is *Tropical Agriculture*, the monthly journal of the Imperial College of Tropical Agriculture, in which forestry articles occasionally appear. The problems connected with forestry in its professional aspects are discussed in some detail by the conservator, Mr. Brooks, whose statement may be confidently recommended to those visiting Trinidad wishing for information on the Islands not available in the ordinary popular guide books. It suffers, as is the case with others submitted to the Empire Forestry Conference, in having been drawn up on a common prescribed schedule. A "Progress Report on Exotics" and a statement on "Timber Consumption and Marketing" were also drawn up for Trinidad and Tobago for the Empire Conference.

The Lyre-bird in Victoria

CONCERN has been expressed at the possibility of the extinction of the lyre-bird in Victoria, but F. Lewis, chief inspector of fisheries and game, points to the improvement which has taken place in public opinion, the more rigorous protection by law, and the fact that a great deal of the land inhabited by lyre-birds is rough and inaccessible (*Victoria Naturalist*, **53**, 12; May 1936). He is of opinion that the future of the lyre-bird is assured, granted that public opinion in favour of protection continues to be educated in country districts as well as in the cities, and that a stop should be put to the clearing of lyre-bird gullies and the destruction wrought by bush-fires and the activities of egg-collectors. In another paper in the same journal (p. 3), R. T. Littlejohns states that no other Australian bird adheres so strongly to a definite area. In this case, the territory is two or three acres in extent, and for week after week, especially during the singing season, the place of any particular individual may be known exactly. It is seldom indeed that a bird is to be found outside its own area.

Allotments as an Amenity Asset

ALTHOUGH few will question the value of allotments, their frequent unsightliness is one of the chief reasons why there is so little public support for including them in town-planning schemes or otherwise making their tenure secure. Useful work has already been done by the National Allotments

Society and the Society of Friends, but expenditure on outlay is necessarily restricted when the land may (after three months notice) be sold to a speculative builder. Lady Allen of Hurtwood discusses this problem in a booklet entitled "How Allotments could be made an Amenity Asset to the Community". Constructive suggestions for the development of the allotment garden as an outdoor social centre are made, stress being laid on the necessity for well-considered planning of the land from the start, if possible in conjunction with other forms of social activity. An illustration is given of a suitable lay-out designed by the author herself, and sketches for a community centre building and hut units by William Tatton Brown are also included. The booklet (price 4*d*. post paid) may be obtained from The Housing Centre, 13 Suffolk Street, London, S.W.1.

Professional Workers in the Ukraine

FIGURES have recently been issued by the Soviet Union Year Book Press Service relating to the increase in the number of Soviet professional workers in the Ukraine. In 1914, the territory now constituting Soviet Ukraine had 44,083 teachers ; at the beginning of the school year 1936–37 the number had risen to 150,000. The number of medical men in 1913 was 5,192, in 1936 it was 19,266. The number of secondary medical staff in 1913 was 8,357 and in 1936 40,243. In 1934 there were 83,390 engineers and technical experts employed in the Ukraine ; in 1936 the number had increased to 116,600. The number of agronomists employed by the Commissariat of Agriculture in the Ukraine three years ago was 8,200 ; in January 1936 it was 12,346.

The Public Health Act, 1936

THE Ministry of Health has issued a circular to local authorities reminding them that the above Act, which passed into law in July last, comes into operation on October 1, 1937 (Circular No. 1576. H.M. Stationery Office). Attention is directed to some of the more important changes introduced in the new Act and to matters which call for early consideration. This Act consolidates in some 350 sections the provisions of more than six hundred sections contained in some sixty existing Acts.

Gift to the Royal Aeronautical Society

MR. C. R. FAIREY, past president of the Royal Aeronautical Society, and Mr. F. Handley Page, vice-president, have jointly agreed to give £750 a year for seven years to the Society. The object of this gift is to enable the Society to carry out as fully as possible its main object, "the general advancement of aeronautical science and engineering", and to enable it to be placed on a self-supporting basis. The intention is that the Society should become completely independent of donations from outside bodies, so that it may be free to express opinions upon aeronautical research and engineering when necessary, and can encourage the dissemination of papers, etc., on all matters pertaining to aeronautical research and engineering.

Announcements

THE Right Hon. the Viscount Falmouth has been appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Prof. A. C. G. Egerton has retired from the Council on completion of his term of office.

SIR JOHN PARSONS, the new president of the Royal Society of Medicine, has recently returned from the United States, where he was awarded the Lucien Howe Medal of the American Ophthalmological Society.

PROF. NOCHT, the founder and former director of the Institute of Marine and Tropical Medicine at Hamburg, has been awarded the Gold Medal of the University in recognition of his great services to the University in the domain of scientific work overseas.

ERRATUM. In NATURE of November 21, p. 875, paragraph entitled "Grassland of Great Britain", line 16, for "150 ft. contour" read "1500 ft. contour".

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

Two male pharmacists in the Royal Naval Hospitals—The Medical Director-General of the Navy, Admiralty, S.W.1 (November 28).

A mechanical and automobile engineer in the Yorkshire Traffic Area office at Leeds—The Establishment Secretary, Ministry of Transport, 6 Whitehall Gardens, S.W.1 (November 30).

A chief agricultural officer to the Salop County Council—The Clerk of the County Council, Shirehall, Shrewsbury (December 5).

An assistant physicist in the Radiotherapy Department, Royal Infirmary, Bradford—The Secretary-Superintendent (December 7).

Assistants (Grades II and III) in metallurgy in Admiralty Dockyard Establishments—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (quote *C.E.* 7180/36) (December 12).

A lecturer in mining surveying and economics in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, London, W.C.2 (December 12).

An assistant director, with a knowledge of textiles, of the Testing House and Laboratory of the Manchester Chamber of Commerce—The Director, Testing House, Royal Exchange, Manchester (December 15).

A taxidermist and an articulator in the National Museum, Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (January 4).

A professor of mechanical engineering in the Benares Hindu University—The Pro-Vice-Chancellor, Benares Hindu University, Benares, India (January 15).

A county agricultural organizer in Leicestershire—The Director of Education, Gray Friars, Leicester.

A lecturer in mathematics (woman) in the Avery Hill Training College, Eltham, S.E.9—The Principal.

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. 934.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Atrophy, Burial, Suppression or Total Loss in Evolution

AN examination of a series of sheep embryos has indicated that the ungulates are not removed from the general mammalian plan to the extent usually indicated by the specialization of their fore- and hind-limbs in the earliest Tertiary period. In 1890[1] Wincza described a transient rudiment of a bony clavicle in the embryo of a sheep at the site of the fibrous raphe of Leisering in the muscle sheet spreading from the head to the trunk and forelimb. The study of a group of fossil forms by Cuvier, Darwin, Owen, Cope, Matthew and others has brought to light a number of extinct suborders, of which the Typotheria, alone amongst the adult ungulates, possess definite bony clavicles.

The clavicle is visible by strong trans-illumination in the sheep embryo of 39–42 days and in a radiograph taken with a 'soft' tube; it is still more easily seen on staining the skeleton with alizarin or on histological section. In a transverse section of the neck of a sheep embryo of 36 days the clavicle appears (Fig. 1) as a condensation of mesenchyme cells. At 39 days the cells enlarge and become osteogenic in character; bone is laid down (Fig. 2) and appears as a system of trabeculæ in the intracellular matrix. Ten days later, the bony clavicle disappears leaving only a fibrous raphe in the occipito-humeralis muscle.

This transient waxing and waning of the bony clavicle in the sheep embryo suggested that the bony

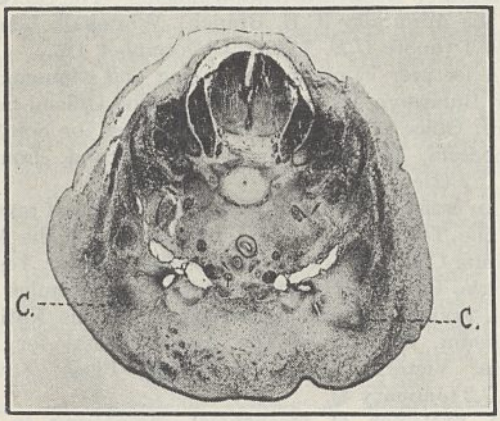

FIG. 1. Transverse section of the neck of a sheep embryo of 36 days. The condensation of mesenchyme cells to form a clavicle (*C*) is marked. (× 12·5.)

elements of the limb should be examined. The cannon bone of the adult sheep consists of the fused third and fourth metacarpals or metatarsals. The first, second and fifth bones are absent. In the fore-limb of a sheep embryo of 65 days, the fifth metacarpal is visible as a thin long bone of about 0·4 mm. in diameter in the radiograph, in the specimen stained with alizarin (Fig. 3) and in histological

FIG. 2. Ossification centre with osteoblasts and bone trabeculæ in the clavicle of a sheep embryo of 39 days. (× 160.)

section. A week earlier the fifth metacarpal is entirely cartilaginous (Fig. 4). At 90 days there is no trace of this fifth metacarpal.

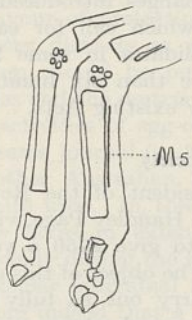

FIG. 3. Tracing of the fore-foot of a sheep embryo of 65 days indicating the cannon bone (fused metacarpals three and four) and the transient fifth metacarpal (*M*.5).

Transverse sections of the metatarsus of the sheep embryo of 36–42 days have been examined. Four metatarsals are present at an early stage. Two of these (the third and fourth) become centres of rapid growth, whereas the second and fifth grow slowly. The subsequent growth in diameter of the third and fourth becomes so great that they soon touch the second and fifth respectively, and eventually bury them, so that the shafts of the two latter are in process of being enclosed within the shafts of the actively growing bones (Fig. 5, *a* and *b*). The reduction of the metatarsals is thus not accomplished by suppression but by incorporation. At a later stage no trace of the buried elements is seen. Thus it is possible to see in a few days in the life of the sheep embryo a process of evolutionary reduction

which has taken aeons of geological time—a story worked out in the study of ungulate fossil forms by Cuvier, Owen, Darwin, Cope and Matthew.

Edgeworth[2] has recently indicated that the important problem in morphology is to ascertain

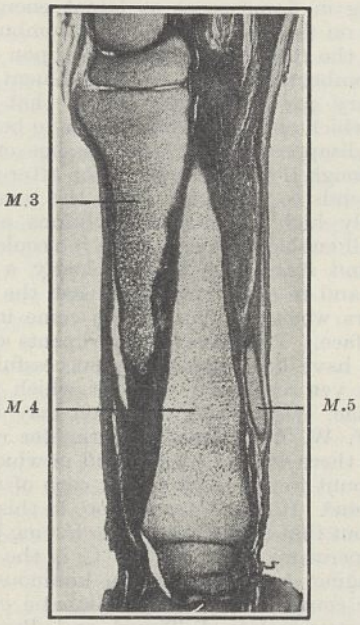

FIG. 4. Longitudinal section of the fore-foot of a sheep embryo of 56 days, showing metacarpals three and four and the transient small fifth metacarpal (*M*.5) in the cartilaginous state.

whether a given structure undergoes atrophy during life or whether it has ceased to exist. It is well known that a separate bony costal element near the transverse process of the seventh cervical vetebra is present in almost all human fœtuses. After birth this fuses with the transverse process. Occasionally it continues to grow and gives rise to the condition known as 'cervical rib'. The cervical rib sometimes gives rise to a palsy of the small muscles of the hand as a result of pressure on the brachial plexus. The patient is not to be regarded as a freak who has grown a new cervical rib, but as an unfortunate who has failed to keep the embryonic rib within normal bounds by fusion and suppression. Similarly, many of the abnormalities of the hands and feet in the quadrupeds are a failure to absorb and suppress various elements in the normal embryological sequence, rather than the acquirement of additional bony elements in the limbs.

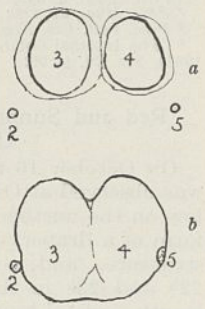

FIG. 5. Tracings of the transverse sections of the metatarsus in a sheep embryo of 39 days to indicate the gradual incorporation of the second and fifth metatarsals in the rapidly growing third and fourth metatarsals which fuse to form the cannon bone.

The process of burial and absorption of the bony elements of ungulates may be significant in the study of the distribution of tumours and cysts in this area, for the sites of embryological happenings may often be the sites of pathological changes. Finally, it is not without interest that the date of ossification in the clavicle of the sheep, the 39th day, is identical with that in the human embryo, as is the ossification in the transverse fifth metacarpal in the 8th–9th week of fœtal life. The divergence in the pattern of ossification in the sheep and human forms is negligible in the first 6–8 weeks and becomes of rapidly increasing significance, inasmuch as the sheep at birth has reached a measure of skeletal ossification which is not reached by man until seven years after birth.

H. A. HARRIS.

Anatomy School,
Cambridge.
Oct. 17.

[1] H. Wincza, *Morph. Jahrb.*, **16**, 647 (1890).
[2] F. H. Edgeworth, "The Cranial Muscles of Vertebrates" (Cambridge, 1935).

Physiological Potency of Dilute Traces

THE attention of readers must have been arrested by the brief reports contributed to NATURE[1] at various times by Mr. Hugh Ramage, an eminent spectroscopic chemist, on the concentration of certain metals in special tissues of plants and animals, up to amounts spectroscopically measurable. The explanation would be that the ultra-infinitesimal amounts of these metallic substances that are present in the food that passes through the organism must be arrested in the organs concerned until the accumulation becomes sensible. An opening seems here to arise into the chemistry of minute traces, which is the aspect of that science that promises most for mathematical development.

But my present motive is a different one. In a recent report of the Medical Research Council astonishment is expressed at the potency, continued for as long as a month, of a minute injection of a substance refined from liver extract, in staving off pernicious anæmia—a result with which the writer has unfortunately some practical acquaintance. On the analogy of the metallic accumulations above, this substance may be arrested, but now more rapidly, in the lumbar bone marrow which is the seat of the production of the red blood corpuscles, so as to restore its function to a degree that may last a month before decay has again set in. At any rate this analogy, perhaps not novel, renders its efficacy in one respect less wonderful.

The relations of a virus and its counteracting serum may perhaps provide an illustration. For example, the virus of hydrophobia is distributed through the system by the circulation of its fluids, so that it soon becomes very dilute : where this flow passes through the nervous structures the virus is arrested chemically by some type of affinity, and gradually accumulates until its destructive action on the nervous framework acquires full play. This process may take a long time. The antidotal serum spreads also dilute throughout the system ; but at *every* place in it the two dilute constituents virus and antidote come together by intimate diffusion, which is a rapid process, with destructive result by their mutual combination.

The principle underlying the production of a blocking or destructive serum as an *excretum* limiting or destroying the activity of the agent that emits it need not be involved here. The antidotal serum introduced quite late has thus time to overtake the virus. This is only an amateur analogy, effective just by reason of its limitation of range, as this indeed

may be all that is open to us in such organic structural problems : there may be nothing essentially novel in its present explicit statement. Yet even Pasteur was an amateur.

The phenomena which used to be grouped under the name chemotaxy, and also the mode of transfer of hormones, might arise from cognate activities.

JOSEPH LARMOR.

Holywood,
Co. Down.
Oct. 31.

[1] H. Ramage, NATURE, **138**, 762 (Oct. 31, 1936).

Gaseous Combustion

IT was shown by Mallard and Le Chatelier more than fifty years ago that, during the passage of flame through an inflammable gaseous mixture, two types of flame movement were clearly distinguishable, namely, the initial uniform slow movement and the very rapid movement known as detonation which is set up—if the mixture is strong enough—after the flame has travelled some distance.

Prof. W. A. Bone states that there is now much evidence for the view that, during the initial slow movement, combustion is far from being complete in the flame front, but that as the detonation stage is reached, combustion in the flame front becomes practically complete[1]. With this view I am in agreement, provided that incomplete combustion is not identified with incomplete combination but is to be accounted for by a stable form of latent energy formed in the flame front and left behind in the flame gases. The nature of the latent energy must for the present be left vague, but it seems probable that it will be found to be located in metastable molecules of some kind or other which result from the reactions in the flame front.

The reason why incomplete combination would appear to be ruled out is that it must remain constant in amount for a very long time after the flame front has passed if it is to explain flame temperature[2] and explosion and heat-loss[3] measurements, and this, of course, is most unlikely. Furthermore, had the photographic studies by H. B. Dixon, Bone and others of flame-travel in tubes been made with tubes of very large diameter, so that the cooling of the inflamed gases did not take place rapidly, it would have been found that the duration of the after-glow of the inflamed gases was so long as to be inconsistent with an explanation in terms of incomplete combination. Indeed, in some explosion experiments made in a very large vessel, the after-glow continued for at least 14 seconds[4], and it is a fair inference that had the explosion vessel been still larger so that the cooling would have taken place much more slowly, the luminosity would have lasted for a longer time than this.

It has been shown that the latent energy left behind in the flame gases decreases markedly with the pressure at which the gases are burnt[5] and, since the pressure in the flame front during detonation is very high, it is to be expected that the latent energy in the detonation phase would be much less than in the initial slow movement phase. Assuming also, as would appear to be legitimate, that the latent energy decreases with distance of travel of the flame front, a completely satisfactory explanation is obtained as to why there is a smaller proportion of latent energy in large vessel explosions than in flames[3].

Our experiments, so far as they have gone, have shown latent energies varying between 1 per cent and 10 per cent of the heat of combustion in explosions[3], and between 6 per cent and 28 per cent of the heat of combustion in flames[5]. Doubtless further experiments will show that these limits may be extended in either direction. There seems little doubt that the amount of the heat of combustion remaining in flame gases as latent energy depends not only on the pressure at which combustion takes place in the flame front, but also upon the nature of the combustible gases and the diluent gases[3,5].

Ordinary gas calorimetry shows that the latent energy, which our experiments show to be long-lived, entirely disappears during the passage of the flame gases through the calorimeter. The after-glow shows that it tends to disappear when the temperature is sufficiently high to produce collisions of the kind which will enable the metastable molecules to attain the ground state, but this is clearly a very slow process, and it seems probable that the bulk of it disappears when the flame gases come into contact with surface. Preliminary experiments designed to test this have been apparently successful, but they have not yet reached a stage at which publication is desirable. Meanwhile, attention may be directed to Dr. F. W. Lanchester's calorimeter experiment, in which there was no surface and in which he could only account for at most 85 per cent of the heat of combustion[6]. It is of interest, too, in this connexion to point out that flame gases, after having been cooled to a temperature so low as 200° C. in the cylinder of a gas engine, have been made luminous again by adiabatic compression[4]. The adiabatic compression ignition experiment of Tizard and Pye in which explosion took place on the second compression[7] would also appear to be relevant.

W. T. DAVID.

Engineering Department,
University,
Leeds.
Nov. 9.

[1] *Phil. Trans. Roy. Soc.*, **230**, 364.
[2] *Phil. Mag.*, **17**, 172, **18**, 228 and *Proc. South Wales Inst. Eng.*, **51**, 375.
[3] *Phil. Mag.*, **22**, 513.
[4] *Phil. Mag.*, **9**, 399.
[5] *Phil. Mag.*, **21**, 280.
[6] *Proc. Inst. Civ. Eng.*, **237**, 200.
[7] "The Internal Combustion Engine", D. R. Pye (Clarendon Press 1931), Fig. 20, p. 98.

Red and Sunlit Auroras and the State of the Upper Atmosphere

ON October 16 this year, a strong auroral display was observed at Oslo. It commenced as an arc fairly low on the northern sky, but at intervals it took the form of a drapery-shaped band with pronounced ray structure, and sometimes—for example, between 22^h and 23^h in the evening—rays of quite unusual length (several hundred kilometres) were observed.

These observations show that extremely long rays may appear also on the night side of the earth, and that they are not restricted to regions exposed directly to sunlight.

Our direct measurements from auroral band spectra gave a night temperature of $-30°$ to $-47°$ C. in the auroral region. Thus the slow rate of decrease of density from 100 km. and upwards as shown by the long auroral rays cannot be accounted for by a high temperature, but as I have stated in previous papers, it must be due to an electrical state of the atmosphere, resulting from the action of ultra-violet light or corpuscular rays entering the atmosphere during auroral displays and magnetic disturbances.

On account of these influences, a large proportion of the matter in the auroral region consists of electrons and free atoms, and *this dissociated state will have an effect on the distribution of matter similar to that of a large reduction of average molecular weight or increase of temperature.*

In the morning (of October 17) a spectrogram of sunlit auroras was obtained on panchromatic plates[1]. In this case, the red line (6300) appeared with a photographic density even considerably greater than that of the green line. If the line 6300, which is enhanced from sunlit auroras and for red auroras of type *A*, is due to the transition $(^1D_2 - ^3P_2)$ of oxygen, then the two other weaker components ought also to be enhanced. In previous spectrograms of red and sunlit auroras, only the strongest component has been observed. On the spectrogram obtained on the morning of October 17 the second weaker line $(^1D_2 - ^3P_1)$ was also observed. *This result shows that it is the oxygen triplet* $(^1D - ^3P_{012})$ *which is enhanced in the sunlit and red auroras (of type A).*

Red auroras of type *A* were observed for long intervals during the night; *but they were restricted to certain fairly limited regions of the sky* (mostly the north-east), while at the same time auroral bands, streamers and long rays appeared with the ordinary greenish-white colour.

As a rule, the red auroras of type *A* are red throughout the whole length of the streamer from top to bottom. In this case, however, we found that the red colour was restricted to the upper region, while the lower part had the ordinary greenish colour. This was verified by spectroscopic observations. In the upper red part of fairly small intensity, the red line 6300 was clearly visible, while the lower more intense part, where the green line appeared very much stronger, the red line could not be seen.

In this way we have proved that, at any rate under certain conditions, *the intensity of the red line* 6300 *relative to that of the green one* (5577) *increases upwards.*

If the life-time of the metastable $(^1D_2)$-state is of the same order of magnitude as the average time between molecular collisions in the auroral region, the intensity of the red triplet O I $(^1D_2 - ^3P_{012})$ must increase with diminution of density and increasing height.

In this way we might account for the observed altitude effect. The fact that most auroras—even very long rays—do not appear red at the top, shows that the enhancement of the O I $(^1D_2 - ^3P_{012})$ triplet of the sunlit and red auroras cannot be entirely due to a change of density, but, as I have previously mentioned, there must be some excitation process which brings the oxygen atom to the $(^1D_2)$-state and not the $^1S_0$ state, and this process must be attached to some *variable* component of the atmosphere.

Some years ago I suggested that the enhancement of the red line was due to the action of activated nitrogen on ozone molecules, resulting in the expulsion of an oxygen atom in the $(^1D_2)$-state. This explanation is supported by the fact that the red colour is, for long intervals of time, restricted to certain regions of the sky. This gives indications of a very variable ozone concentration—perhaps due to violent or eruptive motions or local precipitations of corpuscular rays—occurring in the upper regions.

L. VEGARD.

Physical Institute, Oslo.
Oct. 28.

[1] Cf. L. Vegard and E. Tönsberg, NATURE, **137**, 778 (1936).

Clocks showing Mean and Sidereal Time Simultaneously

IN the Paris Observatory a number of clocks provided with two dials showing sidereal and mean time were installed last year as part of the permanent equipment of the Observatory. This suggested to me an investigation of the many ingenious attempts to achieve it, and to seek a simpler and better method.

The problem involves the precise expression of the ratio between the sidereal and mean time in the form of a train of gear wheels. Since one mean solar day is $24^h\ 03^m\ 56{\cdot}555\ 36^s$ in sidereal time, the ratio of sidereal to mean is 1·002 737 909 3. . . . This ratio must be expressed by a fraction; for our purpose the numerator and denominator of this fraction must both be factorizable into factors not exceeding a few hundreds, as the number of teeth on any wheel cannot reasonably exceed this. Moreover, the number of factors (or suitable combinations of them) in the numerator and denominator must be the same, as wheels must work in pairs.

The first to accomplish it was George Margetts, a member of the Clockmakers' Company *circa* 1800. It is in the form of a large watch and is to be seen in the Company's collection in the Guildhall. It has separate dials for hours, minutes and seconds, each having a smaller dial mounted concentrically with the larger ones. These inner dials were gradually revolved backwards by gearing, so that the same three hands indicated simultaneously mean time on the outer dial and sidereal time on the inner dial. His train includes a wheel of 487 teeth so fine that they are invisible to the naked eye. The ratio is $\frac{1465}{1461} = \frac{5 \times 293}{3 \times 487} = 1{\cdot}002\ 737\ 85$, which is correct to the sixth decimal. The sidereal component would lose at the rate of $1{\cdot}8^s$ in a year.

In the Science Museum there is a clock designed by Joseph Vines a hundred years ago (1836), with two dials coupled by the ratio $\frac{43 \times 247}{32 \times 331}$. This is 1·002 737 915 4, which is correct to the seventh decimal. It will take 5·2 years for the sidereal dial to be in error relatively to the solar dial by one second.

Paris adopted a train by Ungerer, of Strasbourg, $\frac{119 \times 317}{114 \times 330}$, which is 1·002 737 905 4, and correct to the eighth decimal; it will be 8·2 years before it is a second wrong.

Sir George Airy contributed to the *Monthly Notices of the Royal Astronomical Society* in 1850 a train by Dr. Henderson, $\frac{50 \times 182 \times 196}{30 \times 211 \times 281}$, a ratio of 1·002 737 908 5. This is very close, being correct to the ninth decimal, and requiring forty years to accumulate an error of 1 sec.

At this stage of the investigation, I was fortunate in interesting Dr. L. J. Comrie who, as a result of "a pleasant week-end's arithmetical recreation", summed up the whole matter and contributed a solution which we may accept as final. He gives the true ratio as 1·002 737 909 265, plus the centennial term, and a wheel train of $\frac{45 \times 71 \times 257}{29 \times 151 \times 187}$ which is the value of the precise ratio required in the year 1955, namely, 1·002 737 909 297. The error would amount to one second in about 100,000 years.

The Paris installation mentioned above suffers from a shortcoming common to every combined mean solar and sidereal clock yet made. They have invariably derived their time from a pendulum driven by an escapement in steps; hence it is necessary to decide whether to rate it for mean solar time and gear it up to sidereal or vice versa. Whichever is chosen, the progression of the wheelwork, and therefore the hand of *both* dials, will advance in seconds of the same length. If it is dead-beat on the divisions on the mean time dial, the pointer will creep forward progressively on the sidereal dial, gaining a second in about six minutes; conversely, if the clock is rated to be dead-beat on the sidereal dial it will creep backwards on the mean dial. Thus a dead-beat reading on both dials is never attained.

By means of a simple device, however, the problem of giving dead-beat seconds hands on both dials has been solved. A synchronous motor of 50 cycles per second is applied to the mean time end of the train and is driven by the alternating current on the Grid. Since the *average* frequency of 50 cycles is rigidly maintained, there is no cumulative error. The automatic time control of the speed of our turbo-alternators is an ambition that has already been realized in individual stations. The conditions laid down by the Central Electricity Board for the technical management of the Grid are such that the disturbances inevitably caused by load sharing will be progressively diminished. Astronomers can help the campaign to improve the timing of the Grid by making their requirements known.

In the meantime, either end of the wheel train of these clocks can be synchronized from the Royal Observatory's standard slave clock. For those who fear breakdowns, in spite of the steady progress of our generating stations towards the high standard of continuity of service that they have set themselves, a simple little instrument is available to take up the duty automatically if the alternating current is cut off.

Synchronous motor clocks are destined to prove extraordinarily useful for purposes that were not visualized at the time of their introduction in the United States in 1919, although forty years ago I forecast that they would be the electric clocks of the future. This combination of mean time and sidereal time clocks is just another instance of the utility of the synchronous motor method.

F. HOPE-JONES.

The Synchronome Company, Ltd.,
32 and 34 Clerkenwell Road,
London, E.C.1.
Nov. 3.

Stability of Rotating Threads

STUDIES of rotating threads have disclosed some curious features with regard to the spiral sinusoidal forms which they assume. Two simple cases were first examined experimentally in order to explain anomalies in the third. The three cases are (1) a long freely hanging thread, attached to a horizontal rotating arm, supporting a spherical weight (M), (2) a thread similarly rotated about a horizontal axis, the thread passing over a light pulley at the loaded end, and (3) a thread withdrawn vertically at high speeds from its rest position closely coiled on a vertical cylindrical surface (that is, a full parallel-wound yarn bobbin) through an eyelet situated at an axial distance (L) above the surface.

Case (1) is illustrated in Fig. 1, *a* and *b*, and Case (3) in Fig. 1*c*. Fig. 1*b* shows two spiral stroboscopic images and the general form of the thread. The images were obtained by using a beam of light interrupted by an inverted metal bowl (containing two diametrically opposite slots) attached to the rotating head.

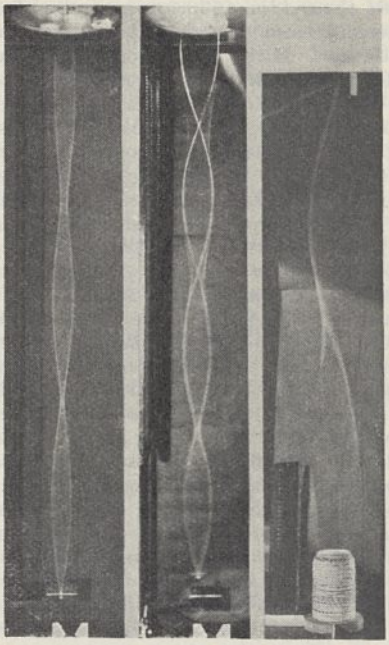

FIG. 1.

In the first two cases, measurements of the average loop lengths (l) agree closely with the well-known formula for plane vibrations in a thread

$$l = \frac{1}{2n}\sqrt{\frac{Mg}{m}}$$

even for an arm radius as high as 5 cm., n being the revolutions per second of the rotating arm and m the mass per centimetre of the thread.

In the third case a tension recorder was placed in the path of the thread above the eyelet, and records were obtained showing the tension varying from a maximum to a minimum as the thread uncoils from the base to the top of the bobbin. With uniform close coiling on the bobbin, L being fixed, the tension traces rise and fall in a series of sharp steps and are symmetrical about the peak value. These 'jumps' and 'drops' to new tension levels (T) occur when instability of the thread causes it to change to a new form containing a greater or smaller number of loops. The tension peak values vary discontinuously with the value of L, other things being constant. On plotting the tension levels, T, against L, the points tend to lie on a series of approximately co-axial parabolas represented by

$$L = \frac{s}{2n}\sqrt{\frac{T}{m}}$$

where s is somewhat less than 1, 2, 3, etc. The smaller the bobbin radius, however, other things being equal, the more closely s approaches 1, 2, 3 . . . etc.

If the thread in Case 1 be progressively shortened, alternating ranges of stable and unstable length are traversed. Further, if cathetometric measurements are made of the rise h of the weight M due to rotation, it is found that (*a*) h rises regularly to approximately the same maximum for lengths of thread accommodating a complete number of stable loops; (*b*) h falls to a minimum for lengths accommodating approximately $(p+\frac{1}{2})$ stable loops, p being integral; (*c*) in the range of thread length which accommodates $(p+\frac{1}{2})$ to $(p+1)$ loops the loop form is stable: for lengths accommodating p to $(p+\frac{1}{2})$ instability occurs, but transition points from stable to unstable lengths are not experimentally very sharp; (*d*) the loop length is not measurably dependent on the total thread length.

Since h is indirectly a measure of loop amplitude (the arm radius, etc., being constant), the amplitude must depend on the total length of the thread, the number of complete loops and the fraction of a loop which it accommodates.

Examination with stroboscopic illumination showed that in air and under all conditions imposed, the thread spirals through an angle π for each complete loop.

It is hoped to publish further details and a mathematical treatment of the first two cases elsewhere.

H. W. HALL.

Experimental Department,
Fine Cotton Spinners' and
Doublers' Association, Ltd.,
Rock Bank, Bollington,
Cheshire.
Oct. 23.

State of Ascorbic Acid in Plant Tissues

THE cause of the apparent gain in the ascorbic acid content of vegetables brought about by cooking has given rise to much correspondence in these columns. An attempt has been made in this laboratory to explain this phenomenon along the lines of either the 'combined ascorbic acid' or 'oxidase' theories, experiments being conducted along the following lines:

25 ml. aqueous extracts of cauliflower (C) or potato (P).

Expt. No.	Treatment	Ascorbic acid found before H_2S reduction (mgm.)	Ascorbic acid found after H_2S reduction (mgm.)
1	C (*a*) 6·25 ml. water added	0·20	2·42
	(*b*) 6·25 ml. 10 per cent metaphosphoric acid added. Precipitate filtered off		1·60
	(*c*) As in 1(*b*) using 13·3 per cent trichloracetic acid		1·04
2	P (*a*) 6·25 ml. water added	<0·06	2·36
	(*b*) As in 1(*b*)		2·26
	(*c*) As in 1(*c*)		
3	P (*a*) 6·25 ml. water added	<0·06	2·31; 2·20
	(*b*) As in 1(*b*)		1·76; 1·76
4	C (*a*) 6·25 ml. water added	<0·06	2·48
	(*b*) Boiled 20 min. (reflux). Cooled. 6·25 ml. 10 per cent $(HPO_3)_x$ added		0·28
5	P (*a*) 6·25 ml. water added	<0·06	2·36
	(*b*) As in 4(*b*)		0·28
6	C (*a*) 6·25 ml. water added	<0·06	1·24
	(*b*) Boiled 20 min. (reflux)		0·11
	(*c*) As in 1(*b*)		0·74
	(*d*) As in 6(*c*). Boiled 20 min.		0·30

The first three experiments confirm the presence of combined ascorbic acid in potato and cauliflower as demonstrated by McHenry and Graham[1]. 2 per cent metaphosphoric acid gives the true value of free ascorbic acid in the extracts, bearing out the findings of Fujita and Iwataka[2] that this acid is preferable to trichloracetic acid.

Experiments 4 and 5 show the tremendous losses in 'total ascorbic acid' experienced on boiling. Van Eekelen[3] has obtained similar results. This indicates that the oxidases are still active during the heating, and must be only slowly destroyed. If the oxidases were completely inactivated, then the length of time of heating should not affect the ascorbic acid content at all.

Experiment 6 demonstrates that the oxidase activity of acidified extracts is somewhat decreased, indicating the important part played by the acid in the destruction of the enzymes. Also aqueous extracts with the vitamin present in the reversibly oxidized form are more liable to loss in activity during boiling. The statement of McHenry and Graham[4] that reduced aqueous extracts of cauliflower give the same titration values as an equivalent amount of the vegetable after heating and subsequent reduction can only be explained by the fact that cold aqueous extraction is far from complete.

The failure of Mack[5] to observe any increase in the ascorbic acid content of cabbage on heating while repeating the experiments of Guha and Pal[6] is probably due to the very small content of the combined acid in cabbage. In fact this vegetable always shows a decrease of between 40 and 50 per cent in ascorbic acid on boiling.

In view of the above, it is evident that the combined ascorbic acid hypothesis for the apparent increase must be accepted, but at the same time it must be taken into account that oxidases are active during the boiling process which brings about the hydrolysis of this compound. Indeed, this increase in titration is not even as high as it would be, if the oxidases were rapidly and completely destroyed on heating.

L. F. LEVY.

South African Institute for Medical Research,
Hospital Street,
Johannesburg.
Oct. 27.

[1] McHenry and Graham, NATURE, **135**, 871 (1935).
[2] Fujita and Iwataka, *Biochem. Z.*, **277**, 293 (1935).
[3] Van Eekelen, NATURE, **136**, 144 (1935).
[4] McHenry and Graham, *Biochem. J.*, **29**, 2013 (1935).
[5] Mack, NATURE, **138**, 506 (1936).
[6] Guha and Pal, NATURE, **137**, 946 (1936).

Luminosity of Meteoric Trains

IT is well known that the portion constituting *nearly, but not quite*, the end part of a meteoric train is generally brighter and more persistently visible than the rest of it. Charles P. Olivier also refers to it in his book on meteors. The phenomenon may be explained as due to:

(1) The peculiar effect of density, composition and condition of the atmosphere between altitudes which mark the limiting points of persistent visibility of meteoric trains.

(2) The effect of velocity: only certain velocities that obtain along particular portions of a meteor track giving rise to persistent visibility.

As the velocity would obviously be smaller near the end part of meteoric trains, and it is more appropriate to associate better visibility with greater velocity as giving rise to more vigorous ionization

of the surrounding air, it appears that the phenomenon is due only to the effect of atmospheric condition and composition.

It would be worth while, therefore, to collect data concerning the height and velocity of meteors along their tracks of *maximum* visibility, as distinct from their entire visible courses.

Meteors seen with very long streaks are doubtless those that move more or less horizontally, the major part of their journey being accomplished in the region of right density and composition.

It is common knowledge that only the brighter meteors have more or less persistent trains. This may be due to the 'gas-mantle' surrounding them, which gives them a higher luminosity and the air left in their tracks greater facility of ionization.

Meteors of low luminosity that appear as reddish (or reddish-white) specks, moving generally with small apparent velocity, rarely, if ever, develop persistent trains. Their tracks probably lie above the region of appropriate density and composition.

MOHD. A. R. KHAN.

Begumpet, Deccan,
N.S.R., India.
Oct. 22.

Curve Fitting

IN *Biometrika*, 28, 34–59, the late Prof. Karl Pearson published a severe criticism of some work on curve fitting by the Indian statistician, R. S. Koshal. Since the criticism, if taken at its face value, is likely to injure the reputation and prospects of Mr. Koshal, I take this opportunity to point out that in the table (p. 44) in which Pearson contrasts his results with those of Koshal, much to the latter's disadvantage, Pearson's theoretical frequencies, said to be derived from his equation (v), are seriously in error. In consequence, his equation is made to appear to be a closer fit than that obtained by Koshal, although in reality it does not fit the data so well.

In this letter I cannot deal with the numerous points of Pearson's criticism. It is only fair, however, to recognize that it was evidently written under a misapprehension of the numerical values he was discussing.

R. A. FISHER.

Galton Laboratory,
University College,
London, W.C.1.
Nov. 14.

Points from Foregoing Letters

PROF. H. A. HARRIS puts forward the view that the even-toed ungulates are not so highly specialized as would appear to be the case in view of the reduction of the digits to two and the absence of a clavicle. In the sheep embryo, a clavicle appears and various additional digits in the fore and hind foot. These are rapidly lost, either by absorption as in the case of the clavicle, or by incorporation in the neighbouring bony elements. The second and fifth metatarsals are buried in the substance of the rapidly growing third and fourth, which fuse to form the cannon bone.

Sir Joseph Larmor suggests that the potency of a minute amount of active principle from liver extract in staving off pernicious anæmia, may be accounted for on the supposition that the active principle is arrested in the affected lumbar bone marrow which, under normal conditions, is the seat of production of red blood corpuscles, and that it restores to it for a while its function.

Prof. W. T. David agrees with Prof. W. A. Bone that during the passage of a flame through an inflammable gaseous mixture the initial slow movement is accompanied by 'incomplete combustion'. He stipulates, however, that this incomplete combustion does not imply incomplete combination, but indicates that a certain amount of 'latent energy' formed in the flame front is left behind in the flame gases. This assumption he considers to be necessary in order to account for the duration of the afterglow of the inflamed gases, seen in wide tubes.

Recent observations of the spectra of northern lights (both 'red' and 'sunlit' auroras) indicate, according to Prof. L. Vegard, that the night temperature in the auroral region is $-30°$ to $-47°$ C. Therefore, he concludes, any inferred decrease in the density of the atmosphere from 100 km. upward cannot be accounted for by an increase in temperature; it may, however, be due to the presence of electrons and of free atoms, which would be equivalent to a decrease in the average molecular weight. Prof. Vegard finds, further, that under certain conditions the intensity of the red line (6300 A.) relative to the green line (5577 A.), increases upwards, and recalls his previous suggestion that the enhancement of the red line is due to the action of 'activated nitrogen' upon ozone molecules.

F. Hope-Jones describes a new clock showing simultaneously mean and sidereal time. With the help of a more accurate value for the ratio between the solar and the secular day, calculated by Dr. L. J. Comrie, and with a corresponding train of gears in the ratio $\frac{45 \times 71 \times 257}{29 \times 151 \times 187}$, the clock error has been reduced to one second in about 100,000 years and, by means of a simple device, the problem of giving dead-beat seconds hands on both dials has been solved.

Features concerning the stability of the spiral sinusoidal forms assumed by threads under rotation are described by H. W. Hall. Conditions of rotation for three cases have been examined; in the first two, fixed lengths loaded by weights were used, and, in the third, the thread was withdrawn vertically at high speeds from a stationary bobbin. Examination with stroboscopic illumination showed that in air and under all conditions imposed, the thread spirals through an angle π for each complete loop.

New determinations of the ascorbic acid (vitamin C) in cauliflower and potato, carried out by Dr. L. F. Levy, employing several methods of extraction, lend support to the hypothesis that the ascorbic acid exists partly in a combined state and is freed during boiling. On the other hand, oxidases which are active during the boiling process reduce the amount of ascorbic acid.

Research Items

Indian Temple Architecture

A VAST amount of fresh information necessitates a revision and simplification of Fergusson's treatment of styles in Indian architecture, towards which an interpretation of the facts and suggestions as to terminology are offered as a basis by Dr. F. H. Gravely, of the Madras Government Museum ("An Outline of Indian Temple Architecture." Bull. Madras Government Museum. N.S. General Section, 3, pt. 2). The separation of Buddhist, Jain and Hindu is unsound; Buddhism and Jainism sprang from Hinduism, and there is every reason for believing that their temples have a similar history. No essential architectural difference seems to exist. Pending the working out of the evolution of the decorative detail, form is the only available criterion of a system of classification. The *vimāna*, or shrine, has long been found the most helpful in distinguishing styles. In the northern form, the so-called 'Indo-Aryan', the vertical lines predominate over the horizontal, and the 'crown' resembles the *amalaka* (myrobalan) fruit. In the south, of various forms the most characteristic and widely distributed has a *vimāna* which consists of a series of successively smaller and smaller tiers of miniature pavilions, in which horizontal lines predominate over vertical, capped by a cupola-like 'crown'. Two styles are distinguishable in the southern temple, that of the Kanarese country, Early Chalukyan, and that of the Tamil country, which differs from the Kanarese in details of both decoration and form. In the west are two styles, that of the ancient Kadamba kingdom, in which the *vimāna* is square in plan with a pyramidal tower composed of a series of horizontal stages, and the Malabar, in which the walls resemble a wooden railing with a simple or multiple pitched roof suggesting similarities to those of Nepal and China. Multiple roofs are also found in the temples of Kashmir. Lastly, in Bengal, is a form of temple with a tendency to the multiple roof, which is evidently a copy from the leaf huts common in the area.

Effect of Noise

RECENT experiments by Dr. Foster Kennedy on trephined patients at the Bellevue Hospital, New York, have demonstrated that the noise resulting from the explosion of a paper bag raised the brain pressure to four times normal for seven seconds, and that thirty seconds elapsed before the pressure returned completely to normal. According to Dr. Kennedy (*N.Y. State J. Med.*, Oct. 5), the undoubted effect of constant noise is disturbance of the circulatory system and an increase in the degenerative processes in the heart and arteries.

Metabolism at High Altitudes

ACCORDING to the Soviet Union Year Book Press Service, a Soviet expedition sent out under the joint auspices of the Academy of Sciences of the U.S.S.R. and the All-Union Institute of Experimental Medicine to Elbrus, the highest mountain in the Caucasus and in Europe, has recently been making a study of metabolism at high altitudes. Analysis of the blood of donors revealed that the blood becomes thicker, the potassium content increases and the quantity of nitrogen falls. Studies were made of the relative change in the organs of persons who ascend to high altitudes directly and those who break the ascent by remaining at different altitudes for a period of time. The expedition also studied changes in the function of the organs of smell, circulation and respiration with the view of ascertaining the cause and course of mountain sickness. It is reported that the skin became hypersensitive to the sun's rays at high altitudes.

Pacific Dinoflagellates

DR. ANTON BÖHM has described the dinoflagellates, excluding *Ceratia*, from a collection of plankton made in the western Pacific by Dr. Victor Pietschmann in 1927–28 (Dinoflagellates of the Coastal Waters of the Western Pacific. Bernice P. Bishop Museum, Bulletin 137, January 1936). The material was collected with the ship's pump from depths of 1–6 metres during one or more hour's run and was filtered through nets. The author has already published a paper on the *Ceratia* (1931), from the collection in this same publication. This is the most comprehensive account of the group in these regions so far published, 111 species in all being described, 46 being new records for the district, 5 of which are new species. The distribution of these dinoflagellates in the east Asiatic waters shows the same arrangement that was found for the *Ceratia* population. The coastal waters from Singapore to Shanghai (in summer at the time of the south-west monsoon stream) show two strongly marked distribution areas which are connected by a transition zone. Area I, Singapore to Hong Kong, besides eurythermal and euryhaline forms, harbours the typical population which is neither purely oceanic nor purely neritic; Area II, the transition zone, shows warm water forms, and Area III, approximately the population of the East China Sea, the Yellow Sea and its boundary (Korea Strait), chiefly warm water forms. Certain widely distributed species, such as *Ceratium furca*, *Peridinium conicum*, *P. depressum* and others were observed in all the samples. The diagrammatic drawings of the variation, and measurements of the different species are interesting; some of the species vary enormously.

Coral-infesting Crabs

THE *Hong Kong Naturalist* (Supplement) for June 1936 (No. 5) contains Part 5 of a description with illustrations of the Hong Kong seaweeds, Sargassaceæ, by W. A. Setchell. Besides this very useful memoir, there is a paper by Dr. Chia-Jui Shen entitled "Notes on the Family Hapalocarcinidæ (Coral-Infesting Crabs) with Descriptions of Two New Species". These crabs usually inhabit the cavities or pits in living coral and "owing to their peculiar habitat their size is small and the anterior portion usually depressed and narrower than the posterior, so that the former can come out of the pit and the latter remain within". The author shows that there are only two valid genera in the *Hapalocarcinidæ* Stimpson, namely, *Hapalocarcinus* and *Cryptochirus*. The two new species described are *Cryptochirus hongkongensis* from Hong Kong and *C. granulatus* from Christmas Island [specimens from the British Museum (Natural History)]. Good figures are given of both species.

Northern Spy Apple Stock

A RECOGNIZED means of combating the attacks of woolly aphis (*Eriosoma lanigerum*) is to use an immune root system and main stem on which desired varieties can be budded or grafted. The 'Northern Spy' stock has been widely used in this way, particularly in Australia, New Zealand and South Africa. Unfortunately, it cannot be regarded as a desirable rootstock from other points of view, and this view is confirmed by the work of Miss J. Hearman (*J. Pom. and Hort. Sci.*, **14**, 3, 246; 1936). The characteristics of the stock were compared with those of several well-known Malling types by detailed examination of a number of root systems at the East Malling Research Station. Besides being difficult to propagate vegetatively, it appears that Northern Spy recovers very badly after transplanting. It is generally very shallow rooted, rarely sending down deeper roots from the periphery of the root system. On the whole, the growth habit can be described as weak and uneven, and compares unfavourably with such stocks as Malling Types I, II and IV.

Rejuvenating Old Rubber Trees

ALTHOUGH for some time past inorganic fertilizers have been successfully used for young *Hevea* trees, of late they have scarcely been used at all for old or deteriorated stands, partly owing to the economic depression in the rubber world, and partly because many planters were not convinced that it 'paid to fertilize'. During these last five or six lean years, however, Dr. W. B. Haines, of Dunlop Plantations, Ltd., and E. Guest have been conducting a series of large-scale experiments on the manuring of *Hevea* in Malaya, and have arrived at some important conclusions (*Empire J. Exp. Agric.*, Oct. 1936). These authors give 'chapter and verse' for their conclusion that the primary need of old or deteriorated rubber trees is nitrogen; young trees, however, mostly need 'minerals' as well. Response to manuring with nitrogen (4 lb. of sulphate of ammonia per tree) usually occurs in two stages. In the first, which is associated with improved foliage, the yield of latex increases by about 10 per cent; in the second, associated with improved bark renewal, the increase in yield averages about 35 per cent but does not begin until the second or third year after the initial application. As a rule, it does not pay to apply nitrogen unless the latex-yield has fallen below 400 lb. per acre; and it is suggested that the best criterion of the need of nitrogen is given by the growth-rate of the tree: when the annual girth-increment has fallen to, or below, ½ inch per annum, quick response to nitrogen may be confidently expected. The authors also review past experimental work, and discuss problems related to manuring, such as the use of cover crops and *Oidium* leaf-disease.

Recent Earthquakes in California

THE latest quarterly number (for July 1936) of the *Bulletin of the Seismological Society of America* contains several papers on recent earthquakes in California. Messrs. P. Byerly and J. T. Wilson (pp. 207–213) continue their valuable list of Northern California earthquakes from April 1, 1934, until December 31, 1935, the number of earthquakes recorded being 170, and the number of centres in action 106. Only one of these earthquakes, that of Parkfield on June 7, 1934, was of destructive intensity. From the map and tables, it follows that, though there was an increase of activity in the Pacific region off the coast of Humboldt County, the coastal region between that county and San Francisco Bay was comparatively free from epicentres. The region lying to the east of Monterey Bay was remarkably active, and activity on the San Andreas fault crept northward to San Francisco. Mr. J. T. Wilson (pp. 189–194) also considers the distribution of the fore-shocks and after-shocks of the Parkfield earthquake. The epicentres of the principal earthquake and of all the minor shocks lay on the San Andreas fault, those of the three fore-shocks on the north-west side of the main epicentre and within 3 km. of it, while those of the eight after-shocks all lay on the other side at distances between 3 km. and 17 km. Thus, the total length of fault in action was about 20 km.

Tropical Storms

THE mechanism of tropical revolving storms is not yet understood, for although theories about them abound, these do little more than show that certain factors not inimical to their development are present in the tropics, and there is still no way of foretelling where and when the storms must appear. Meanwhile, the volume of statistics relating to their incidence and life-history grows apace. The latest contribution to the statistics of the tropical storm is in the form of a memoir by V. Doraiswamy Iyer, entitled "Typhoons and Indian Weather" (*Mem. Indian Meteorol. Dept.*, **26**, Part 6; 1936). Typhoons of 1884–1930 which came from the China Sea or the Pacific Ocean and had moved westwards to strike the coast of Indo-China or South China were studied, and it was found that 135 out of 370 re-developed into storms or depressions over India after having died out or become indistinguishable on entering the mainland lying in their path. This is contrary to the generalization of Sir John Eliot made many years ago in the infancy of synoptic meteorology, to the effect that "All cyclonic storms in the Bay of Bengal originate or are produced in the Bay itself"—a generalization that Eliot began to modify at the end of last century. The effect of these reconstituted storms on Indian weather is discussed, although not in great detail. The author follows the custom of to-day, according to which few students of storms of any kind fail to make a great effort to connect the storm with some kind of 'front'—in this case what is described as "the climatic front between the humid monsoon current and the comparatively drier winds from the north". The success of this effort can in this instance only be gauged by those who make a special study of synoptic meteorology, and are familiar with Indian weather.

Order – Disorder Transition in Alloys

C. SYKES and F. W. Jones (*Proc. Roy. Soc.*, A, **157**, 213; 1936) have studied experimentally the order – disorder transitions in the alloy Cu_3Au. They examined the variation of specific heat with temperature, and also devised a method for finding directly the variation of energy content with temperature. This was valuable, since the alloy could first be brought to any condition, not necessarily that of equilibrium, and the energy change measured on heating to a standard temperature at which equilibrium was always attained. The specific heat

method is only applicable to conditions in which the substance is always in equilibrium. The X-ray examination of heat-treated specimens was also used. The theories of Bragg and Williams and of Bethe and Peierls differ mainly in that the latter takes account of a 'local order' persisting above the transition point and due to nearly neighbouring atoms not being strictly random, although the superlattice structure has disappeared. Neither theory gives quite correctly the energy changes just below the critical temperature, but the Bethe-Peierls view explains correctly the existence of an abnormal specific heat above the critical temperature and fits well with evidence that nuclei of local order exist in the metastable structure obtained by quenching.

Molecular Weight of a Virus Protein

THE isolation by W. M. Stanley in 1935 of a crystalline protein showing the properties of the tobacco-mosaic virus was the first example of a chemically well-defined virus, previous preparations having been defined by means of biological tests only. Preliminary measurements gave molecular weights of the order of millions. I. B. Eriksson-Quensel and The Svedberg (*J. Amer. Chem. Soc.*, **58**, 1863; 1936) have now examined the protein by sedimentation (ultra-centrifuge) and electrophoresis methods. The results show considerable inhomogeneity of molecular weight. At $p\mathrm{H} = 6{\cdot}8$, about 65 per cent of the material has a molecular weight between 15 and 20 millions, provided the dissymmetry constant is the same as for other high molecular proteins. It is not improbable that the virus protein might be homogeneous with regard to molecular weight in its native state. Electrophoretic determinations showed the virus protein to be chemically well defined and practically homogeneous.

Electrolytic Oxidation

IN a series of recent papers by S. Glasstone and A. Hickling, the view has been put forward that hydrogen peroxide may be formed at the anode in aqueous solutions by the combination of discharged hydroxyl radicals, and some examples of electrolytic oxidation have been explained in this way. If this is the case, it might be expected that an anode would exhibit some of the apparent reducing properties of hydrogen peroxide, notably in reducing acidified solutions of permanganate and dichromate. Large effects are not to be anticipated, since the rate of spontaneous decomposition of the peroxide at an anode is high, and there is the possibility that any reduction which occurs may be masked by re-oxidation. The point has been investigated (A. Hickling, *J. Chem. Soc.*, 1453; 1936) and the predicted effects, although small, have been observed, so that the interesting result of apparent reducing properties of an anode has been established. The general method was to collect the oxygen evolved at the anode under consideration along with hydrogen from the cathode in a separate voltameter in series, and to show that the oxygen–hydrogen ratio is greater than that, 0·500, expected for the electrolysis of water. In the case of permanganate, the ratio was above 0·65 for favourable current densities, whilst in the case of dichromate a smaller but definite increase was observed. Other possible explanations are discussed, but the author considers them less probable than the one given above.

Impulse Voltages for Transformer Testing

THE apparatus required to get the high voltages necessary in order to test the devices used on the Grid is very expensive. An alternator which can produce a million volts for breakdown tests is not only expensive but also requires a large laboratory in which to operate. A simpler way of getting a million volts is to charge a hundred high-tension condensers in parallel to 10,000 volts, then connect them in series and so get a million volts between the electrodes. The apparatus necessary is much cheaper and the cost of operating much less. It has, however, the drawback that, as Kelvin pointed out many years ago, the discharge in certain cases is oscillatory, and so the maximum electric stress on which the breakdown depends is difficult to compute. A paper was read on this subject by Dr. T. E. Allibone, D. B. McKenzie and F. R. Perry before the Institution of Electrical Engineers on November 5. They have analysed theoretically and experimentally impulse voltages of varied wave-shapes applied to transformers having different winding characteristics, and obtained good agreement between theory and experiment. Hence tests of this nature should be of use in testing apparatus for use with the Grid so as to find out the effect of surge voltages and probably improve the continuity of the service. Tests of this nature have been employed for some years both in Switzerland and Germany which have enabled the engineers to improve their transformers. Further tests are in progress both in the United States and Great Britain, and the method of the authors in checking the theoretical results by means of oscillographic records promises to be of great value.

Air Locks in Aeroplane Fuel Systems

As a possible explanation of one type of failure of aircraft engines, the presence of an air or vapour lock in the fuel system and its prevention have been studied at the Royal Aircraft Establishment, and a discussion of the subject, the nature of the investigation, and the conclusions reached are now published (Air Ministry: Aeronautical Research Committee. Reports and Memoranda, No. 1693 (2237): Air and Vapour Locks in Fuel Systems. By M. A. A. Allfrey. Pp. 14+9 plates. London: H.M. Stationery Office, 1936. 1*s.* 3*d.* net). Several unavoidable causes operate to enable air to collect in the petrol pipe line, and in order to ensure the release of such bubbles as might, from any such cause, be entrapped, experiments were made by introducing air into glass pipes down which petrol was flowing under conditions comparable with those in practice. These showed that perfection of venting can be attained either by so building the pipe system that the air vents upwards at all flows, in which case the critical flow at every point is greater than the maximum demand of the engine, or by arranging that the critical flow never increases downwards. The first alternative being impracticable in that it requires pipes and cocks of excessive size, the second, which leads to an ideal system, was investigated, and the report sets out in detail the results and recommendations essential to its successful incorporation in petrol pipe lines, distinguishing between those applicable to air locks and those found to be successful in preventing locks caused by evaporation of the fuel itself, which is liable to give trouble at great heights.

Chemical and Physical Basis of Pharmacological Action

A JOINT discussion in which pharmacologists and chemists took part was organized by the Royal Society at Burlington House on November 12.

Prof. A. J. Clark opened the discussion with a general review of the difficulty of obtaining quantitative pharmacological data and of interpreting these data when obtained. The observations are subject to large errors, and the results are affected by so many factors that it is usually possible to explain them in several different ways. It is never possible to obtain formal proof of any one explanation, but in many cases the analogy between the action of drugs on living organisms and their actions under simpler conditions is close enough to establish a strong presumption as to the mechanisms involved. The most hopeful line of approach lies in the study of the form of the curve connecting the concentration of a drug with the magnitude of its effect after dynamic equilibrium is obtained. Such concentration-action curves can be divided into three distinct classes :

(1) It has been shown, in many cases, that the relation between the concentration of adrenaline, or acetylcholine, and its action on an isolated piece of muscle is accurately expressed by a hyperbola. This relationship can be interpreted in terms of mass action. If the drug, present in large excess, combines reversibly with a limited number of receptors in the muscle, simple calculations suggest that the curve connecting concentration and uptake would be a hyperbola. It is only necessary to assume that the effect on the muscle is directly proportional to the number of receptors acted on by the drug. Similar calculations have been used to explain quantitatively the uptake of gases by adsorbents, of oxygen by hæmoglobin, and of poisons by enzymes.

(2) Concentration-action curves for narcotics are usually nearly linear for small concentrations, and resemble closely the curves connecting the concentration of these substances with their effect on surface tension. Since the active narcotics are those which have most effect on surface tension, it is probable that this relationship is not fortuitous. Similar curves are obtained for the action of certain drugs on enzymes.

(3) In certain cases the concentration-action curve for effects, both on living tissues and on enzymes, is *S*-shaped. This can be interpreted as an irreversible all-or-none action on a collection of cells or other elements, the accessibility, or sensitivity, of which varies.

These three types of curve are found not only in the study of the action of drugs on isolated tissues and on enzymes, but also among the 'characteristic curves' which show the relationship between the dose of a drug and the percentage mortality which it causes in a large group of animals.

These curves were also discussed by Prof. J. H. Gaddum. It is true that, when characteristic curves are plotted on an arithmetic scale of doses, the curves may be either symmetrical or asymmetrical. When they are plotted on a logarithmic scale of doses, they are always approximately symmetrical. This fact is an example of the general law, which is justified both by theory and in practice, that the logarithm of any biological measurement is more likely to be normally distributed than the measurement itself (Galton, 1879). These facts are exemplified by the work of Hemmingsen (*Vidensk. Medd. fra Dansk naturh. Foren.*, **98**, 125 ; 1934) who showed that the logarithms of the measurements of different species of animal in one phylogenetic group are normally distributed. Curves were shown in which the effect of drugs on isolated tissues, and on enzymes, and the effect of oxygen on hæmoglobin, were plotted both on arithmetic, and on logarithmic, scales of concentration. Plotted in these ways, all these curves looked similar to the characteristic curves, and it was suggested that the shape of the curves might be explained in terms of variations among the cells in the isolated tissue, or the protein molecules in the enzyme or the hæmoglobin.

Prof. W. Straub, of Munich, said that it is premature to speculate on the mechanisms behind the action of drugs until more is known of the actual effects produced. The central problem lies in the fact that atropine will act only on cells of a certain kind, and has no apparent action on all the other cells in the body. Some of the facts are illustrated by the inhibitory action of muscarine on the frog's heart. The action takes only a fraction of a second to develop, and when the solution is changed the heart recovers in a few seconds. If the muscarine is left in contact with the heart it diffuses into the heart. When diffusion ceases, the heart recovers from the inhibition. At this stage, the heart contains large quantities of muscarine. Inhibition only occurs while there is a potential gradient, or concentration gradient of muscarine, and the drug is diffusing into the heart. Drugs which act like this are called *potentialgifte*. Acetylcholine and adrenaline act as *potentialgifte*, but these two drugs, being natural constituents of the body, are destroyed in the cells, so that they can go on diffusing for long periods without the gradient disappearing. This is the reason why these substances can cause prolonged effects if the external concentration is maintained.

According to Prof. R. A. Peters, the time has come to replace the old biochemical concept of the cell as an unorganized colloidal solution by one of the cells as a co-ordinated structure. In 1929 he postulated what J. Needham has since called a cyto-skeleton for cells : by this he means a three-dimensional mosaic throughout the cell, composed of a network of protein molecules, the surface proteins being connected with the nuclear proteins by threads of cytoplasmic proteins. The amino and carboxyl groups of protein must play an important part in this pattern. The organization envisaged is submicroscopic ; it provides the cell with means for independent and localized reactions, and is the cellular counterpart of a nervous system. Since these ideas were put forward, a clearer picture of the sort of organization which might exist has been obtained by the work on the X-ray structure of proteins, on surface films and by such protein models as those suggested by Drs. D. Wrinch and Jordan Lloyd. The cell contents appear to correspond more closely to a thixotropic gel than to a simple solution. Some enzymic systems appear to be structurally related, for example, the lactate and pyruvate system in

brain. The cellular organization proposed might allow drug action to be explained in chemical terms, drugs reacting with specialized features of the cell structure.

Dr. J. F. Danielli discussed the structure of cell surfaces. The simplest possible concept of the cell plasma-membrane which is compatible with permeability data, surface tension data, and wetting properties, consists of a lipoid layer at least two molecules thick, with an adsorbed protein layer at each oil-water interface. The external oil-water interface must have an excess of acidic groups. Points of interest in this conception from the aspect of drug action are : (*a*) the excess acidity of the surface, which may be modified by surface active acids or bases ; this change will in turn affect the adsorbed protein layer, enzyme activity at the surface, and the permeability of the lipoid layer ; (*b*) the potential gradient at the interfaces, which will be of the order of 10^7–10^9 volts/cm. ; (*c*) the kinetics of penetration of such a membrane provide for high temperature coefficients for the simple process of penetration of the membrane by a drug, which may mask the temperature coefficient of drug action ; (*d*) it is of interest to know whether the enzyme centres on the cell surface are arranged in an organized fashion. This can be done by using poisons of the type A'–$(R)_n$–B' where A' and B' are specific poisons for the centres of type A and B. If there is any typical distance between A and B, there will be a sudden increase in efficiency of the poison for a particular value of n.

Dr. J. H. Quastel described the experiments with isolated pieces of tissue which have led him to the conclusion that the action of narcotics on the brain is due to their action on carbohydrate metabolism. Luminal reduces the oxygen consumption of slices of brain. It is particularly effective when glucose, lactic acid, or pyruvic acid is used as a substrate. It has no action on the oxidation of glutamic acid or succinic acid. Other narcotics have a similar action, and among narcotics of one type those which are powerful narcotics are also powerful reducers of oxygen consumption. The effect is reversible. The concentrations present in the blood during narcosis would be sufficient to have an action on the oxygen consumption of slices. Slices of tissues other than brain are less sensitive to narcotics. The action of narcotics on slices of brain is antagonized by potassium, but is not affected by calcium. The temperature coefficient of the effects on isolated slices is large ($Q_{10}=6{\cdot}6$) as is also the temperature coefficient of narcosis in the whole animal.

It was pointed out by Dr. H. R. Ing that the pharmacological properties of many drugs have been shown to depend on definite functional groups or combinations of groups. The recognition of such pharmacologically active groups is exploited in chemotherapy. Some hormones and vitamins have also been shown to contain such groups. Aliphatic narcotics do not appear to contain active groups, and consequently the drug action must depend primarily on their physical properties. Drugs with active groups of quite different structure may also show similar pharmacological properties. When gross physiological changes, for example, the death of bacteria, are involved, several mechanisms may achieve the same gross effect ; but it is difficult to account for drugs so unrelated chemically as muscarine and pilocarpine acting selectively at the same sites and producing similar results. Again, drugs of the same structural type may have different actions, for example, butyl trimethyl ammonium augments, but octyl trimethyl ammonium antagonizes the action of acetylcholine on the frog's auricle.

Pharmacologically active groups seem to imply a chemical mechanism for drug action. The difference in the activity of stereo-isomeric drugs also suggests chemical combination of the drug with receptor molecules in tissues. Homologous series of drugs frequently show maximum activity for one member of the series, for example, alkylcresols, alkylamines, etc. In these cases, the activity may represent the summation of two opposite effects, depending on at least two physical properties. Other factors may be involved, such as the length of chain between two active groups, but in some series, for example, choline esters, the relatively high activity of one member is difficult to account for on these simple lines.

The factors affecting the action of chemotherapeutic drugs on Protozoa were discussed by Prof. Warrington Yorke. *Trypanosoma rhodesiense* is normally resistant to organic arsenicals, but when it is passaged through mice, there is a change in its morphology, and it becomes not only more pathogenic for mice, but also more sensitive to arsenicals. Similar changes occur more slowly when it is passaged through guinea pigs. *T. gambiense*, on the other hand, is comparatively easily killed by drugs, but if infected mice are treated with ineffective doses of organic arsenicals or antimonials or with acridine dyes, the Protozoa become resistant to all drugs of these classes. They remain sensitive to arsenious acid, tartar emetic and Bayer 205. It has been found impossible to develop resistance to tartar emetic, and difficult to develop resistance to Bayer 205. This artificially produced resistance differs from the natural resistance of *T. rhodesiense*, since it survives prolonged passage through mice and tsetse flies.

These facts represent a real danger in Africa, where these drugs are being injected into whole populations of people without proper precautions to ensure that the treatment is always continued until it is effective. It is probable that a strain of trypanosomes is being developed which will resist treatment. Later in the discussion, however, Dr. C. M. Wenyon gave reasons for believing that this development of immunity is due to the selection of resistant trypanosomes.

Sir Henry Dale, in opening the general discussion, expressed the belief that quantitative studies can only give superficial information. He agreed with Prof. Straub that the most important problem is the explanation of the fact that certain drugs affect certain tissues in very low concentrations and have no action on other tissues.

Among those who made impromptu contributions was Dr. F. Hawking, who discussed the effect of chemical structure on the action of organic arsenicals consisting of a benzene ring, a side chain containing arsenic, and a second side chain. The absorption of such substances by trypanosomes can be demonstrated. Trypanosomes which are resistant to treatment *in vivo*, fail to absorb substances containing the second side chain. Similar substances containing no second side chain are taken up, even by undamaged resistant trypanosomes.

Sir Rickard Christophers, discussing the chemical structure of antimalarial drugs, pointed out that it is difficult to predict the action of new substances. This is perhaps because insufficient attention is given to the physicochemical properties of these substances.

Preliminary measurements of solubilities and of *p*K's might discriminate between substances worth testing and those which would be useless.

Prof. R. Robinson asked why it is that plants so often contain alkaloids with marked actions on animal tissues. This may be explained by some theory of the biological history of the animals and plants which have developed together, or it may be due to the fact that the alkaloids are probably degradation products of proteins, since their structure can usually be derived formally from the naturally occurring amino acids.

Magnetic Properties of the Nickel-Iron Alloys

IN a pamphlet issued by the Bureau of Information on Nickel of the Mond Nickel Co., Ltd., Millbank, S.W.1, an account is given of nickel-iron alloys and their characteristics which will be of special value to electrical engineers and manufacturers.

The magnetic properties present very striking contrasts. The permeability of pure iron, for example, is gradually reduced by additions of nickel exceeding ten per cent, until in the region of 30 per cent the alloys are completely non-magnetic. Further additions of nickel give a range of alloys containing 35–85 per cent of nickel, which have a very high magnetic permeability and are in fact the softest materials magnetically that are commercially available. New alloys have now been developed by adding substantial proportions of nickel and aluminium, which are very hard and form permanent magnets of great strength. The 25 per cent nickel steel is characterized by an extremely high ductility and is corrosion resisting. It is practically non-magnetic and is used extensively in electrical engineering.

The group of iron alloys having 35–80 per cent of nickel, on account of their high permeability, are of great commercial importance. In 1921 the Western Electric Co. of America took out a patent for an alloy consisting of 78·5 per cent nickel and 21·5 per cent iron, all impurities being kept as low as possible. The heat treatment necessary consisted in heating the alloy to 900° C. and then cooling at a definite rate. The alloys patented by this company are given the general name of 'permalloy'. Since then, patents have been taken out for other nickel-iron alloys, containing small proportions of other elements. 'Mumetal', patented by the Telegraph Construction and Maintenance Co., Ltd., London, is one of these. It contains 6 per cent of copper, which facilitates heat treatment and stabilizes the alloy.

The first use to which the high permeability alloys were put was for the 'loading' of submarine cables. In accordance with Heaviside's theory, this would prevent distortion of the signals and also their attenuation. Simultaneously with the development of the loaded submarine cable, continuous attention was given to long-distance land line cables, and nickel-iron devices were found very helpful. Afterwards, in order to save space, it was found advantageous to employ the magnetic alloy in the form of dust or powder. Various chemical and physical methods are used to produce the alloy in this form. A drawback is that the powder has very low permeability, but the energy losses in it are much smaller.

In the year 1930, news first came from Japan of the discovery of a new series of permanent magnet alloys in which the principal alloying elements were nickel and aluminium. Since their introduction, these new magnet steels have been intensively studied, and they are now superseding the cobalt and other steels previously used for these applications. These alloys offer the maximum magnetic energy per unit volume yet available to manufacturers. One of the most important applications of the new magnets is for radio loud speakers. In the manufacture of small motors, magnetos and other small-sized dynamo electric equipment, the nickel alloy magnets are found very efficient and adaptable. They are used in the magnetic detectors used in 'automatic' traffic signalling.

On the theoretical side, our knowledge of magnetic alloys is far from complete. When we have a better knowledge of how heat treatment affects them, still more useful alloys may become available.

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor has received a letter from Sir Harry McGowan, chairman of Imperial Chemical Industries, Ltd., stating that it is not proposed to continue to support financially the work on molecular rays carried out since 1929 by Mr. R. G. J. Fraser, who has now been appointed to the research staff of I.C.I. (Alkali) Ltd. The apparatus and equipment installed, at a cost of about £2,500, is being offered to the University for the use of the Departments of Chemistry and Physics, and Sir Harry hopes that it will continue to be used for research on molecular rays.

The Managers of the Benn W. Levy Fund have appointed K. P. Harrison, of King's College, to the studentship in biochemistry.

J. H. Gaddum (Trinity College), W. B. R. King (Magdalene College) and Dr. O. M. B. Bulman (Sidney Sussex College) have been approved for the degree of Sc.D.

The Governing Body of Emmanuel College invites applications for a research studentship which will be awarded in July 1937. Preference will be given to candidates who have already completed one but not more than two years of research. The studentship, which must be held at Emmanuel College, and has a maximum annual value of £150, is awarded and normally held for two years, but may be renewed for a third. Further information can be obtained from the Master of the College.

LONDON.—The title of professor of pathology of mental disease in the University has been conferred on F. L. Golla, in respect of the post held by him at the Maudsley Hospital; that of professor of psychiatry in the University on Dr. Edward Mapother, in respect of the post held by him at the Maudsley Hospital, and that of reader in mathematics in the University on Dr. L. S. Bosanquet, in respect of the post held by him at University College.

The following doctorates have been conferred: D.Sc. in botany on H. Chaudhuri (Imperial College—Royal College of Science); D.Sc. in horticulture on R. G. Hatton (East Malling Research Station); D.Sc. in physics on F. C. Chalklin (King's College).

Prof. F. A. Cavenagh has been appointed, as from September 1, 1937, to the University chair of education tenable at King's College. Since 1934, he has been professor of education in the University of Reading.

OXFORD.—In Congregation on November 21 the honorary degree of D.C.L. was conferred upon the American Ambassador, Mr. R. W. Bingham, and on J. L. A. Avenol, secretary-general to the League of Nations.

Dr. W. Stephenson, assistant director of the new Institute of Psychology, has been given the degree of M.A. by decree.

Convocation and Congregation, with Lord Halifax, the Chancellor, as president, assembled in the Divinity School on November 24 to assist at the promulgation of the decree respecting Lord Nuffield's benefaction to the Medical School. Speeches were made conveying the thanks of the University for his magnificent gift. The most dramatic speech, however, was made by Lord Nuffield himself in which he announced that he proposed to raise the original sum of £1,250,000 to £2,000,000. This sudden and quite unexpected announcement was received with a curious mixture of astonishment and gratitude. The trustees of the new trust will consist of a chairman and three others nominated by Lord Nuffield, the vice-chancellor and another member of Hebdomadal Council, the professor of medicine, and three representatives of the two hospitals in Oxford concerned in the scheme. There will also be a committee for carrying out the scheme in detail—the vice-chancellor, the professor of medicine, the director of the Nuffield Institute, three members of the faculty of medicine, three representatives of the hospitals, and the four new Nuffield professors of surgery, clinical medicine, anæsthetics, and obstetrics. The new professors are to be appointed as soon as practicable and already their chairs have been allotted to four colleges. The mode of their appointment, and the regulations governing them, will be very similar to those affecting other professors. The salary attached to each chair, however, will be £2,000 a year. The new professors may not engage in private practice but they will be allowed to receive fees from some of the patients they attend in the hospitals associated with the scheme.

THE University of Leyden has been awarded a sum of 20,000 dollars by the Rockefeller Foundation for researches to be made in the course of five years on infantile psychology.

ON the proposal of the Minister of Public Health, the Belgian Government is to create a second Superior School of Physical Education at Liège similar to that attached to the medical faculty of Ghent.

AT the reopening ceremony of the University of Paris held in the great amphitheatre of the Sorbonne on November 7, in the presence of M. Albert Lebrun, President of the French Republic, the Minister of Education and the Rector of the University, the degree of doctor *honoris causa* was conferred on Dr. Israel Holmgren, professor of physiology at the Caroline Institute of Stockholm, and on Prof. George David Birkhoff, professor of mathematics at Harvard University.

Science News a Century Ago

Schönbein and Faraday

ON November 26, 1836, Schönbein wrote from Basle to Faraday: "The Philosophical Society of Bale in one of their last meetings elected you their honorary member and I am charged by our President to forward the diploma and ask you the favour to accept of the latter as a weak expression of the high esteem which our Society entertain for you, on account of the eminent services you have rendered natural Science". Schönbein then went on to refer at length to his own observations of the behaviour of iron wires in acids, and concluded his letter by remarking: "Before closing this letter, I take the liberty to ask you a favour. Our Establishment wants to get a good magnetic-electrical Machine, by means of which the principal experiments on Magneto-Electricity may easily be made in classes. Now if it be not too much asked, the Committee of our Museum should feel themselves laid under great obligations to you, would you be so kind as to order such an apparatus to be sent to us by a London instrument-maker."

Berzelius awarded the Copley Medal

AT the anniversary meeting of the Royal Society held on November 30, 1836, the president, H.R.H. the Duke of Sussex, returned to the chair, after an absence of two years owing to severe eye trouble. The report of the proceedings of the Council, read by the secretary, said "The Council have awarded a Copley Medal to Baron Berzelius for his application of the Doctrine of Definite Proportions in Determining the Constitution of Minerals. To the labours of this distinguished chemist, science is indebted for many of the facts by which the Laws of Definite Union were established. As early as 1807, soon after Dalton and Gay-Lussac had made known their views on this vital branch of chemistry, Berzelius commenced an elaborate examination on the proportions in which the elements of compound bodies are united, beginning with the salts, and subsequently extending his researches to all other departments of his science, as well to the produces of organised existences as to those of the mineral world. . . . His numerous analyses of minerals enabled him at once to elucidate their nature through the light derived from the laws of definite combination, and at the same time to supply in the composition of minerals a splendid confirmation of those laws. . . ."

As had been the case in 1821, 1825, 1827, 1832, a second Copley Medal was awarded, Edward Kiernan receiving the medal for his discoveries relative to the structure of the liver. "Before the researches of Mr. Kiernan," the report said, "the liver was supposed to consist of two dissimilar substances. . . . The relation of the vessels and excretory ducts to those supposed dissimilar substances was not known. . . . Mr. Kiernan's discoveries show that in place of two textures there exists but one, but that the difference in colour results from the accidental congestion of one or other of the system of vessels which are found in the liver. He has demonstrated the size and limits of the internal glandules of which the liver consists; has traced the relation to these glandules of the different orders of vessels, which are distributed through the organ and has explained the mechanism of biliary secretion."

Pierre-Simon Girard (1765–1836)

ON December 1, 1836, the eminent French civil engineer Pierre-Simon Girard died in Paris at the age of seventy-one years. Born in Caen on November 4, 1765, he was trained as an engineer and in 1792 attracted attention by his essay on "Locks for Navigation", for which he was awarded a prize by the Paris Academy of Sciences. Thus brought into notice, he was chosen with Monge, Berthollet, Fourier and other scientific men to accompany Napoleon to Egypt, and became one of the members of the short-lived Institute founded in Cairo. On his return to France, he was appointed engineer-in-chief of the Canal de l'Ourcq and entrusted with the water supply of Paris. His "Recherches sur les Eaux Publiques de Paris" published in 1812 contains a historical account of the water supply of the city. Girard was elected a member of the Academy of Sciences in 1813 and six years later superintended the installation of a gas supply for the streets and theatres of Paris.

Opium Eating and Health

IN a lecture on opium eating published in the *Lancet* of December 3, 1836, Dr. George G. Sigmond remarked that a very interesting question had arisen as to the effect of the habit on health and on longevity. He instanced the case of the late Earl of Mar, who had insured his life in an Edinburgh office to a large amount. Although he consumed two to three ounces of laudanum daily, he did not state the fact when he obtained the policy of insurance, and on his death from jaundice and dropsy two years later, the company declined payment of the policy on the grounds that his lordship had concealed from them a habit which tended to shorten life. The bank that held the policy as security for money lent entered on an action, with the result that the insurance office had to pay the amount, not, however, on the ground that the habit was fatal to life, but because the office had not shown the proper degree of caution when the insurance was effected.

St. James's Ornithological Society

IN the last part for 1836 of the quarterly journal the *Analyst* (5, 314), under the heading "St. James's Ornithological Society", it is stated that "this Society is instituted for the purpose of forming a collection of water birds in the garden of St. James's Park; and its operations will subsequently be extended to the waters in the other parks, if the funds of the Society be found sufficient. The first object will be to exhibit a complete collection of British Anatidae, both resident and migratory. . . . It is intended to keep the whole, as far as practical, in a state of nature, and the collection, being formed in the public parks, will, of course, be open to the view of every one. As there is in London no other exclusively Ornithological Society, it is unnecessary to point out to the ornithologist the advantages which may result from an institution possessed of a locality so admirably calculated for a collection of aquatic birds, and for affording facilities for observations on the changes of plumage from sex, age, or season, which are so interesting to Naturalists, and so difficult to be observed elsewhere."

The Earl of Liverpool was president of the Society, and its proceedings were sanctioned by the Commissioner for Woods and Forests.

Societies and Academies

London

Royal Society, November 19.

W. A. BONE and L. E. OUTRIDGE: Some influences of dilution on the explosive combustion of hydrocarbons. Certain effects are dealt with of dilution with inert gases (Ar, He and N_2) upon explosions of equimolecular mixtures of ethylene, or acetylene and oxygen, such as $C_2H_4 + O_2$ and $C_2H_2 + O_2$ which normally give rise to carbonic oxide and hydrogen, without any separation of carbon or steam-formation in accordance with the equations:

$$C_2H_4 + O_2 = 2CO + 2H_2,$$

and

$$C_2H_2 + O_2 = 2CO + H_2,$$

respectively. Chemical, photographic and spectrographic tests show that sufficient dilution of such media, while not much affecting the main result, may induce some secondary carbon deposition and steam-formation on explosion, when the mean flame temperature is thereby reduced to a point well below 2,000° C., such result being probably due to the fall in flame temperature induced by dilution.

W. PAYMAN and W. C. F. SHEPHERD: Explosive waves and shock waves. (4) Quasi-detonation in mixtures of methane and air. Experiments on a small and on a large scale have been carried out to investigate the possibility of detonation in mixtures of methane and air. In small-scale experiments the resulting explosion is in some respects similar to detonation; but it is unlike detonation in that the speed is not uniform and in that the wave or flame front is partly sustained first by the flame and then by hot particles from the detonator. The explosion is described as 'quasi detonation', since the energy maintaining the wave is not wholly derived from the combustion of the methane. An explosion which is similar to detonation was also established in large-scale experiments in which a 9·1 per cent methane-air mixture was contained in a gallery 30·5 cm. in diameter and ignited by means of a charge of high explosive. This quasi-detonation is propagated through quiescent mixture at a uniform rate of 1,900 metres per second, and the flame is intensely luminous and accompanied by high pressure.

Paris

Academy of Sciences, November 3 (*C.R.*, 203, 833–900).

EDOUARD CHATTON and FÉLIX VILLENEUVE: The evolutive cycle of *Eleutheroschizon Duboscqui*. Experimental proof of the absence of schizogony in this form and in *Siedleckia Caulleryi*.

PAUL DELENS: The anallagmatic geometry of the tetrahedron.

P. BONÉT-MAURY: A manometer for high vacua. A modified manometer of the Knudsen type.

PIERRE CHEVENARD: A very small testing machine with photographic recording, and its application to the study of textile fibres. The machine is constructed to test single fibres, with a maximum load of 50 gm. The record shows the relation between elongation and load.

JEAN CHAZY: The almost circular movements due to a nearby force of Newtonian attraction.

EMILE SEVIN : The influence of a magnetic field on the atom of hydrogen.

ROGER MÉRIGOUX : The movement of contaminated liquid surfaces.

FÉLIX EHRENHAFT : The experimental determination of the mobility of small spheres in a gas.

ARCADIUS PIEKARA and BRUNO PIEKARA : Electrical saturation in pure liquids and their mixtures. Study of the influence of the electric field on the dielectric constant of mixtures of benzene and nitrobenzene at varying concentration. The effect of traces of moisture.

OUANG TE-TCHAO : Counting particles in suspension in air.

GABRIEL FOEX and CHARLES FEHRENBACH : The calculation of the magnetic moment of the ions.

NY TSI-ZÉ and WENG WEN-PO : The absorption spectrum of cæsium.

GEORGES BRUHAT and PIERRE GUÉNARD : Study of the circular dichroism of solutions of camphor in water and in acids.

THÉODORE V. IONESCU : The structure of the photon.

LOUIS CARTAN : The application of the methods of electronic optics to mass spectrography.

ROBERT TRÉHIN : The application of certain physical methods to the search for complex compounds in solution. The variation of a physical property of a liquid mixture with the composition is frequently used for detecting the formation of a complex compound. The method fails when more than one complex compound is present, and generally it is not possible to prove or deny the existence of such compounds on such evidence alone.

GUILLAUME RUMEAU : Optical antipodes and velocities of crystallization.

MORDECHAÏ BOBTELSKY and MME. LJUBA BOBTELSKY-CHAJKIN : Mixed catalytic effects in the decomposition of hydrogen peroxide in the presence of sodium tungstate and other catalysts.

MARC ANTOINE FOEX : The action of hydrogen on alkaline glasses at a high temperature. Alkaline glasses suffer marked loss of weight when heated in hydrogen at 850°–1,150° C., and this is due to loss of alkali.

MLLE. MARIE FALINSKI : Study of the system ZrO_2–SO_3–H_2O. The conditions for the existence of a new acid zirconium sulphate, $Zr(SO_4)_2,H_2SO_4,2H_2O$.

MME. LÉONE WALTER-LÉVY : Contribution to the study of the double decomposition between solutions of magnesium sulphate and potassium carbonate at the boiling point.

HENRI LEFEBVRE and R. FAIVRE : Contribution to the study of the oxidation of coal. At temperatures between 150° and 300° C., oxygen rapidly penetrates coal, especially the vitrain. The coal becomes poorer in hydrogen and more resistant to oxidation.

JEAN FELDMANN and ROBERT LAMI : The growth of the mangrove at Guadeloupe.

JEAN CHAZE : Intoxicating rye-grass (*Lolium temulentum*) and the pure culture of its endophyte.

JOSEPH MAGROU : The culture and inoculation of the symbiotic fungus of *Arum maculatum*, the cuckoo-pint.

YVES LE GRAND : Binocular vision through crossed polarizers.

ALBERT VANDEL : The appearance of colourless mutations in *Trichoniscus* (*Spiloniscus*) *elisabethæ* and their hereditary behaviour.

PAUL MEUNIER : The presence and distribution of aluminium in animal tissues. Aluminium is always present in animal tissue, but in much smaller proportions than in plants.

ALBERT PEYRON and HENRI LIMOUSIN : Intravascular polyembryony and the metastases with multiple tissues in the embryomes of the testicle.

ANDRÉ LWOFF and MME. MARGUERITE LWOFF : The physiological role of the co-dehydrogenases for *Hæmophilus parainfluenzæ*.

CONSTANTIN LEVADITI, CARL KLING, MLADEN PAÏC and PEREZ HABER : The approximate size of the poliomyelitic virus.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 525–566, Sept. 15).

ERNST ÖPIK : Meteor heights from the Arizona Expedition. About 22,000 meteors were observed between October 1931 and July 1933 ; of these, 3,540 were observed simultaneously from two stations and their heights could therefore be calculated. 80 per cent of the objects observed were sporadic meteors and only 7 per cent belonged to the major showers. It is deduced that meteors meeting the earth are vaporized 23 km. higher than those overtaking the earth, due to greater relative velocity. Seasonal variation of height suggests an annual fluctuation of height of the atmosphere of amplitude $3{\cdot}7 \pm 0{\cdot}7$ km. There is no evidence of a hydrogen atmosphere, at least to a height of 130 km.

A. W. BELLAMY : Inter-specific hybrids in *Platypœcilus* : one species *ZZ–WZ* ; the other *XY–XX*. The results are discussed from the point of view that there is a single sex differential which prejudices development in the direction of maleness or femaleness.

G. W. BEADLE and BORIS EPHRUSSI : Development of eye colours in *Drosophila* : transplantation experiments with suppressor of vermilion.

G. A. MILLER : Groups containing a relatively large number of operators of the same order.

JOHN H. LAWRENCE, PAUL C. AEBERSOLD and ERNEST O. LAWRENCE : Comparative effects of X-rays and neutrons on normal and tumour tissue. Normal healthy albino mice and pieces of an easily transplantable mouse tumour (Sarcoma 180) were submitted to filtered 200 kv. X-rays and to neutrons from the cyclotron, the doses of the two types of radiation being measured in r units by a Victoreen condenser type r meter. After irradiation, the tumour tissue was implanted into susceptible mice and its development watched. It is concluded that, per unit of ionization, neutrons are much more effective than X-rays in destroying normal mice *in vitro* and Sarcoma 180 *in vitro*.

F. ZWICKY : Characteristic temperatures in supernovæ. A theoretical discussion.

CARROLL C. PRATT : Interaction across modalities : simultaneous stimulation. A lowering of the apparent pitch of musical instruments in a concert hall on dimming the illumination has not been generally remarked. Conversely, an experimental test in which observers compared an illuminated source with a previously illuminated standard source while listening by ear-phones to a high- or a low-pitch tone, showed no significant influence of the sound stimulus on the estimates made of the illumination of the light source. It seems unlikely that two psychological events from different modalities, operating at a sensory level, will influence each other.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 30

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Lincoln Ellsworth: "A Recent Flight across Antarctica".

Tuesday, December 1

ROYAL SOCIETY OF ARTS, at 4.30.—Brigadier J. G. Browne: "The Assyrians".

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—(in the Great Hall, University College, London, W.C.1).—J. Davidson Pratt: "The Defence of the Civil Population against Gas".

Wednesday, December 2

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, at 7.—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Dr. M. C. Marsh: "Humidity in Industry".

Friday, December 4

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section).—Prof. I. M. Heilbron: "Modern Technique in Biochemistry" (Hurter Memorial Lecture).

KING'S COLLEGE, LONDON, at 5.30.—Dr. J. Johnson: "Methods of Excavations for Greek Papyri in Egypt".*

ROYAL INSTITUTION, at 9.—Sir Stephen Gaselee: "Natural Science in England at the End of the Twelfth Century".

BRITISH INSTITUTE OF RADIOLOGY, December 2–4.—Annual Congress and Exhibition to be held in the Central Hall, Westminster, S.W.1.

Official Publications Received

Great Britain and Ireland

Education in 1935: being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (Cmd. 5290.) Pp. xiii+231. (London: H.M. Stationery Office.) 3*s.* 6*d.* net. [911

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1935–36. Pp. 17. (Durham: University of Durham.) [911

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 17, 1935. Pp. 128. (London: Chemical Engineering Group.) 21*s.* [1111

A Chapter in the Chemistry of Essential Oils. By Prof. John Read. (Nineteenth Streatfeild Memorial Lecture, 1936.) Pp. 34. (London: Institute of Chemistry.) [1211

Technical Publications of the International Tin Research and Development Council. Series A, No. 46: The Spectrographic Analysis of Tin. By D. M. Smith. Pp. 26. (London: International Tin Research and Development Council.) Free. [1211

The British Science Guild. Science in Development. By the Rt. Hon. Lord Rutherford. (The Norman Lockyer Lecture, 1936.) Pp. 20. (London: British Association.) 1*s.* [1211

A Survey of the Present Organization of Standardization—National and International. Pp. viii+55. (London: World Power Conference.) 3*s.* 6*d.* net. [1211

Third Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 5303.) Pp. xii+210. (London: H.M. Stationery Office.) 3*s.* 6*d.* net. [1211

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1935. Pp. 66. (Shinfield: National Institute for Research in Dairying.) [1311

University College of North Wales. Calendar for Session 1936–37. Pp. 441. (Bangor: University College of North Wales.) [1311

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 3, No. 14: Genetical and Cytological Studies of the Intergeneric Hybrid of *Cairina moschata* and *Anas platyrhyncha platyrhyncha*. By Prof. F. A. E. Crew and Dr. P. C. Koller. Pp. 210–241+4 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 3*s.* 6*d.* [1311

Air Raid Precautions. Handbook No. 6: Air Raid Precautions in Factories and Business Premises. (Issued by the Home Office: Air Raid Precautions Department.) Pp. 69. (London: H.M. Stationery Office.) 6*d.* net. [1611

Conference on Atmospheric Ozone held at Oxford, September 9th to 11th, 1936. Papers read at the Conference. Pp. iv+76. (London: Royal Meteorological Society.) 5*s.* 1711

Other Countries

Regenwaarnemingen in Nederlandsch-Indië. Vijf en vijftigste Jaargang, 1933. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [911

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 21, Memoir No. 4: Fossil Algæ from the Uppermost Cretaceous Beds (The Hiniyur Group) of the Trichinopoly District, S. India. By L. Rama Rao and Dr. Julius Pia. Pp. v+49+6 plates. (Calcutta: Geological Survey of India.) 4.10 rupees; 7*s.* 9*d.* [911

League of Nations: Eastern Bureau, Singapore. The Soil in relation to Malaria. By K. B. Williamson. Pp. ii+7. (Singapore: Government Printing Office.) [1011

Imperial Agricultural Research Institute, New Delhi. Report of the Director for the Year ending June 30, 1936. Pp. 18+2 plates. (New Delhi: Government of India Press.) [1011

Sveriges Geologiska Undersökning. Ser. C., No. 401: Berggrunden inom Kantorps malmtrakt. Av Nils H. Magnusson. Pp. 88+1 plate. 2.50 kr. Ser. C, No. 404: Auftreten und Paragenese der Antimomminerale in zwei Sulfidvorkommen im Skelleftefelde, Nordschweden. Von Sven Gavelin. Pp. 20. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.) [1211

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1936. Pp. 19. (Wellington: Government Printer.) [1311

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 11, No. 11: The Water Transport of Gradient Currents. By Anton Jakhelln. Pp. 14. (Oslo: A. W. Brøggers Boktrykkeri A/S.) 2.50 kr. [1311

Cornell University Agricultural Experiment Station. Bulletin 643: Prices of Farm Products in New York State, 1841 to 1935. By S. E. Ronk. Pp. 76. Bulletin 646: Growth Experiments with Pin Oaks which are growing under Lawn Conditions. By Donald Wyman. Pp. 23. Bulletin 647: An Economic Study of Part-Time Farming in the Elmira and Albany Areas of New York, 1932 and 1933. By Kenneth Hood. Pp. 139. Bulletin 648: An Economic Study of Land Utilization in Tioga County, New York. By Paul B. Jones. Pp. 40. Memoir 189: Effect of Packing Materials on the Flavor of Storage Eggs. By Paul F. Sharp, George F. Stewart and J. C. Huttar. Pp. 26. (Ithaca, N.Y.: Cornell University.) [1311

Meddelelser om Grønland. Bind 78, Nr. 4: Die Godthaabexpedition 1928—Bericht über die chemischen Arbeiten, 2. Von S. Kühnel Hagen. Verteilung von Phosphat und Nitrat im Gewässer zwischen Grønland und Kanada. Pp. 36. 1.75 kr. Bind 80, Nr. 3: The Godthaab Expedition 1928—Tomopteridæ and Typhloscolecidæ. By Elise Wesenberg-Lund. Pp. 17. 0.75 kr. Bind 88, Nr. 2: Researches into Norse Culture in Greenland—Sandnes and the neighbouring Farms. By Aage Roussell. Appendix: Greenland Runic Inscriptions, 4, by Erik Moltke. Pp. 232+6 plates. 11.00 kr. Bind 88, Nr. 3: Researches into Norse Culture in Greenland—Animal Remains from the West Settlement in Greenland, with Special Reference to Livestock. By Magnus Degerbøl. Pp. 55. 2.50 kr. Bind 88, Nr. 4: Researches into Norse Culture in Greenland—Evidence of Iron Extraction at Sandnes, in Greenland's West Settlement. By Niels Nielsen. Pp. 14. 0.75 kr. Bind 95, Nr. 7: Treaarsexpeditionen til Christian den X's Land, 1931–34—On the Crystalline Complex of Liverpool Land. By E. H. Kranck. Pp. 122+4 plates. 6.00 kr. Bind 97, Nr. 2: Treaarsexpeditionen til Christian den X's Land, 1931–34—On the Placodermi of the Upper Devonian of East Greenland; Supplement to Part 1. By Erik A:son Stensiö. Pp. 52+30 plates. 5.00 kr. Bind 100, Nr. 6: Treaarsexpeditionen til Christian den X's Land, 1931–34—The Larval Development, Growth and Metabolism of Arctic Marine Bottom Invertebrates compared with those of other Seas. By Gunnar Thorson. Pp. 155. 7.00 kr. Bind 104, Nr. 10: The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land—The Former Eskimo Habitation in the Kangerdlugssuak District, East Greenland. By Magnus Degerbøl. Pp. 48. 2.50 kr. Bind 109, Nr. 2: 6 og 7 Thule-Expedition til Sydøstgrønland, 1931–33—The Former Eskimo Settlements on Frederik VI's Coast. By Therkel Mathiassen. Pp. 58. 2.50 kr. Bind 112, Nr. 3: Treaarsexpeditionen til Christian den X's Land, 1931–34—Some Few Preliminary Remarks on Triassic Fishes from East Greenland. By Eigil Nielsen. Pp. 55. 2.50 kr. Bind 118, Nr. 1: The Eskimo Archæology of Julianehaab District, with a Brief Summary of the Prehistory of the Greenlanders. By Therkel Mathiassen, in collaboration with Erik Holtved. Pp. 141+4 plates. 7.00 kr. Bind 118, Nr. 2: Revision of the Greenland Rock Ptarmigans. By Finn Salomonsen. (Miscellaneous Notes on Greenland Ornithology, 3.) Pp. 36. 1.75 kr. Bind 118, Nr. 3: On *Metopa Groenlandica* H. J. Hansen (Crust. Amphip.). By K. Stephensen. Pp. 8. 0.50 kr. Bind 118, Nr. 4: On the Amphipod *Metopa Groenlandica* H. J. Hansen found in the Mantle Cavity of the Lamellibranchiate *Pandora glacialis* Leach in East Greenland. By K. Stephensen and G. Thorson. Pp. 7. 0.50 kr. Bind 118, Nr. 5: Om Grønlands Areal. 1: Arealmaaling af Kommunerne i de Vestgrønlandske Kolonidistrikter Ritenbenk, Godhavn, Jakobshavn og Christianshaab. Af J. M. Danbo. Pp. 12. 0.50 kr. (København: G. A. Reitzels Forlag.) [1611

Catalogues

List of Publications. Pp. ii+14. (The Hague: Dr. W. Junk.)

Apparatus for the Measurement of Dielectric Constants. (Dipol 36.) Pp. 8. Colorimeter of Hymans van den Bergh—Grotepass. (Col 36.) Pp. 2. (Delft: P. J. Kipp and Zonen; London: W. Edwards and Co.)

The Use of Marmite Yeast Extract in the Prevention and Treatment of Nutritional Disorders: its Vitamin B Content and Anti-anæmic Potency. Pp. 32. (London: The Marmite Food Extract Co., Ltd.)

Biological and General Apparatus: Laboratory Equipment and Apparatus for Bacteriology, Pathology, Public Health, Chemistry and Cognate Sciences. (Catalogue No. 30K.) Pp. iv+537. (London: Griffin and Tatlock, Ltd.)

Zeiss Nachrichten. Folge 2, Heft 1, Mai 1936. Pp. 40. (Jena and London: Carl Zeiss.)