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Science and Industrial Reconstruction

The North-East Coast

THE report on the industrial position of the 'North-East Coast', prepared in 1931 for the Board of Trade by Armstrong College, Newcastle-upon-Tyne, has now been supplemented by a new survey conducted by the staff of the Economics Department of Armstrong College under the direction of Mr. E. D. McCallum*. The report on this survey, which covers the years of the depression, has been published, opportunely enough, at a time when the question of remedial measures in the distressed areas is being widely discussed, and when the necessity for research into the suitability of various areas for different manufactures has been emphatically urged by such authorities as Sir Harry McGowan.

In 1931 it was estimated that the volume of labour surplus to the requirements of local industries even in a year of good trade would be 64,000 males. It now appears that this estimate was too low, chiefly because improved methods of production allow of a greater output for an equivalent amount of labour. The report faces the problems which such more or less permanent unemployment and depression create for the community, and points out that it is now generally recognised that the depressed areas cannot themselves solve their problem, and that positive action on the part of the central Government is necessary.

The present investigation indicates that unemployment on the north-east coast of England has been twice as heavy in the years of depression as it was in the pre-depression years, and has continued to be about twice as severe as in the rest of the country outside the depressed areas. Further, it has continued to be concentrated mainly on male workers. A second feature has been the maintenance and often considerable increase of employment in the lighter industries and services. There has also been a remarkable shift in the distribution of labour from the basic, and in the main, exporting industries, to the lighter industries and services mainly concerned with house consumption.

Finally, the survey shows that the economic depression which began towards the end of 1929 reached its depth in the north-east in 1932. Although there has been some recovery from the worst of the depression, the volume of unemployment, amounting to about 200,000 persons, or 29 per cent of the industrial population of the area, is still twice as great as in 1929. Economic recovery in the area has thus been less marked than in Great Britain as a whole, and much less marked than in the non-depressed areas of the country.

The main problem of the north-east coast of England is the continued depression in the heavy industries, and the survey holds out no hope of the volume of employment in these industries regaining the level of the years before the Great War. The capacity of the heavy industries of the area appears to be in excess of normal post-War requirements. Prospects of it reaching the level of the years preceding the depression are brighter, but are somewhat clouded by restrictions on international trade which have been imposed in many countries through the intensification of economic

* The Industrial Position of the North-East Coast of England. By the Staff of the Economics Department of Armstrong College, Newcastle-upon-Tyne. Pp. vii+54. (London: P. S. King, Ltd.) 2*s*. 6*d*. net.

nationalism during the depression. So long as these restrictive measures are followed, there can be little hope of widespread economic recovery in the export industries of the world and therefore in the heavy industries of the north-east coast. The report in this respect gives a timely warning against undue optimism as a result of the partial improvement in the economic position of the country as a whole. Under such conditions recovery is likely to be superficial rather than real, and the danger of further collapse not very remote.

The growth of the lighter industries, however, provides a basis for optimism on the north-east coast, as elsewhere in the country. These industries now employ about half the workpeople of the area, but although they show signs of further growth, in view of their own surplus of labour it would be rash to assume that in the next few years they will be able to absorb the unemployed workers of the heavy industries. Moreover, the fact that they are engaged primarily on the supply of local needs sets limits to their expansion.

Hopes of the establishment of new industries in the area have hitherto been disappointed. The Surveys of Industrial Development published by the Board of Trade show that the north-east coast has failed to attract relatively as many of the new factories as other parts of the country. A memorandum on science and industry submitted last year (1935) to the District Commissioner for Depressed Areas at Newcastle-upon-Tyne laid a good deal of the responsibility for this position upon the absence of foresight and neglect of science by the industrial leadership of the area (see NATURE, Aug. 31, 1935). In the survey of the area conducted by Armstrong College in 1935, evidence was cited of failure to grasp the opportunities afforded by new developments which have since reached commercial production outside the area.

It would, nevertheless, be unjust to lay all the responsibility for the present position upon the industrial leaders of the area. With full knowledge of these facts, the present report concludes that without special aid the north-east coast is unable to attract even its proportionate share of the new factories which are being established in the country, and that in the absence of vigorous action on the part of the central Government, large-scale unemployment on the north-east coast is likely to persist.

The lines of Government action have been indicated in a series of recent reports, but the Tyneside Industrial Development Board has recently directed the attention of the president of the Board of Trade to the way in which the establishment of a new light industry on Tyneside that would have provided work for more than two hundred persons has been prevented by the importation of the glass linings required from Germany at a quotation which undercut the Tyneside quotation by some £3,000. Had the linings been obtained locally, the manufacture of the vacuum flasks for which they were required would have been established in Tyneside.

This lost opportunity is worthy of note in connexion with the proposals recently advanced by Sir Harry McGowan in commenting at the annual dinner of the British Electrical and Allied Manufacturers Research Association on the failure of virtually all efforts to develop new industries in the distressed areas. Sir Harry suggested that the resources and personnel of the existing development councils are inadequate and that the grants at the disposal of the Commissioner for the Special Areas in England and Wales should be largely increased. Various ways of finding the money might be considered, but Government contributions towards capital expenditure on plant, machinery and other fixed assets of new industries established in the distressed areas deserve careful attention. We should not be afraid of applying novel expedients to such desperate situations.

The question of personnel is, however, equally important, and without the knowledge and experience of an adequate personnel there can be no assurance of the wise expenditure of public or private grants, or sound decision as to the wisdom of subsidies or other measures in such cases as that recently noted by the Tyneside Industrial Development Board. Effective action depends primarily upon accurate knowledge, and the requisite knowledge of the suitability of the special areas for different manufactures and for the development of their potentialities may well require, as Sir Harry McGowan suggested, research extending over several years.

For this research the right type of personnel is required, and not all of this is likely to be found in the area itself, in spite of the greater use that might well be made of the *alumni* of Armstrong College. The seconding to each area from the Civil Service of one or two workers experienced in the knowledge of proposals likely to prove acceptable to the Government, or skilled in the knowledge of difficulties to be avoided, might well prove an

invaluable form of Government assistance. Equally the leadership in such survey work might be drawn from industry itself, by industrial firms and associations lending qualified men to explore possibilities of manufacture in the distressed areas.

The sombre picture of the industrial area known as the 'North-East Coast' disclosed by this report is thus not without some rays of hope. While no early solution of the unemployment problem is in sight without effective State intervention, it is clear that with leadership of the right type and effective mobilisation of the natural resources to the task, much can be done. Scientific workers have their own part to play in the necessary exploratory and development work, and they should require no other stimulus than their own sense of citizenship. The heavy burden which lies upon these distressed areas is due only partly to purely economic factors. It is due also to the lopsided development and application of advances in mechanical and physical science, and indirect though his responsibility may be, the scientific worker must take his share in the work of reconstructing the community and enabling it to reap more fully and equably the advantages with which these sciences could endow it.

Babylonian Mathematics

Mathematische Keilschrift-Texte
Herausgegeben und bearbeitet von O. Neugebauer. (Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik, Abteilung A: Quellen, Band 3.) Teil 1: Texte. Pp. xii+516. Teil 2: Register, Glossar, Nachtrage, Tafeln. Pp. iii+64+69 plates. (Berlin: Julius Springer, 1935.) 128 gold marks.

IN the past six years our knowledge of the ancient Babylonian mathematics has been vastly increased, thanks mainly to the labours of Dr. Neugebauer. The impulse to his researches seems to have come from his attention having been directed to the fact that certain Sumerian and Babylonian texts from the National and University Library of Strassburg, published by C. Frank in 1928, contained six passages of mathematical content. These formed the subject of an article "Zur Geschichte der babylonischen Mathematik" in Part 1 (1929) of Division B (Studien) of the first volume of the series of "Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik", of which the two volumes before us make up volume 3. Further articles followed, and in 1934 the author's results took definite shape in an admirable volume on "Vorgriechische Mathematik", a notice of which appeared in NATURE of February 23, 1935, p. 283. The greater part of it deals with Babylonian, and the rest mainly with Egyptian, mathematics. The preface to it announced the author's intention to publish separately a collection of all the original texts known and accessible to him (most of them so far unpublished) with the view of giving chapter and verse for the conclusions arrived at. The present large volumes are the result.

Most of the texts belong to the period, say, from 2000 B.C. until 1800 B.C., and only a few to the Hellenistic period. The first chapter (of 92 pages) deals exhaustively with texts of tables (tables of reciprocals, multiplication tables, tables of squares and cubes, square roots and cube roots, and more general tables, including one of nth powers of numbers where n ranges from 2 to 10); lengthy extracts from all the classes of tables are given. The remaining chapters give the original cuneiform texts from the Louvre and the British Museum, from Berlin and Strassburg, and from the Yale Babylonian Collection. Each text is first given in a transliteration; this is followed by a German translation, and then by a commentary dealing with all questions of language and content.

The second volume contains elaborate indexes and a glossary, a classification of the texts, references to the whole of the relevant literature, 29 pages dealing in full with texts left over from Part 1, and 61 fine plates at the end, 34 of which are photographs of the original tablets, while the rest are "Autographien", that is, texts copied in the cuneiform script. The labour involved must have been stupendous, and we can only express our unstinted admiration of the imposing result.

All points of difficulty in the original text, where it is mutilated or defaced, and where there are errors or doubts as to the proper interpretation, are exhaustively discussed; as to these, experts on cuneiform texts will no doubt have much to say; here we are concerned only with the mathematical content, which is sufficiently remarkable. The strong point of Babylonian mathematics was arithmetic and algebra rather than geometry, though in geometry they did the usual mensuration of triangles, rectangles, trapezia and parallelepipedal

solids; they used the Pythagorean theorem of the square on the hypotenuse; they approximated to the length of the diagonal of a rectangle, the volume of a frustum of a cone and a pyramid, the area of a segment of a circle, etc.; they seem, however, to have been content with 3 as an approximation to the value of π.

The most remarkable feature of the arithmetic of the Babylonians is their universal use, so far back as 2000–1800 B.C., of the sexagesimal system of numeration, in which the successive denominations containing the descending powers of 60 are set down as simple numbers (from 0 to 59) like our digits, and after the units come the succession of sexagesimal fractions, the successive powers of 1/60, represented in the same way by simple numbers. There is no explanation as to which term represents which power of 60, positive or negative—this is left to be inferred from the context. In the beginning, the Babylonians used no sign, corresponding to our zero, to denote the absence of a particular denomination (the earliest use of a sign for zero that Neugebauer has noticed seems to date from the "Persian era"); for example, we find 2, 25 written where 2, 0, 25 is meant, so that we have always to be on our guard. The Babylonians circumvented the trouble of *ad hoc* calculations by using elaborate tables of reciprocals, multiplication tables, etc., each number in the tables containing few or many denominations. Thus a reciprocal table gives the reciprocal of 1, 46, 17, 17, 31, 12 as 33, 52, 12, 37, 55, 59, 40, 14, 48, 53, 20! Here, of course, the 1 in the first expression is the unit, while the 33 in the second expression means 33/60. Let anyone verify the calculation who will! To divide one number by another, as a/b, the Babylonians first expressed the reciprocal of b, $1/b$, in sexagesimal fractions and then multiplied it by a.

Coming to the Babylonian algebra, we find no sort of algebraical symbols. When two unknown quantities have to be found, they are commonly called "length" and "breadth"; when three, "length", "breadth" and "height". As a rule, the given relations connecting two or three unknowns reduce to a quadratic equation, and this is solved, without any statement of, or reference to, any rule, by substituting the particular numbers given in the question for the algebraical symbols in precisely our formula for the two roots. Certain cases are reduced to cubic equations, and correct solutions are stated. One of these cases reduces to an equation in which two terms containing the second and third powers of the variable have the same coefficient and their sum is equated to a constant. The solution here seems to have been obtained from a table containing, for different values of n, the sum of its square and its cube. But this method cannot be used in two other cases of cubic equations which occur; and, though the proper result is stated and verified, it is not clear from what table (if any) it may have been obtained; perhaps the problems were framed in such a way that they would produce results known beforehand. Another case would give an equation of the fifth degree in x, and its solution would be beyond the powers of the Babylonian.

The texts contain some arithmetical and geometrical progressions; another sums the squares on the first ten natural numbers, obtaining the result in the form $(\frac{1}{3}\cdot 1 + \frac{2}{3}\cdot 10)55$. Finally, some problems involving interest, simple and compound, are found in the Berlin and Yale texts. "If interest be at the rate of 20 per cent, and I get back after three years, in principal and interest combined, 1 'gin', what was the original capital? Answer 0; 34, 43, 20 'gin'". When the period had to be calculated after which a given capital would accumulate to a given sum, obviously some kind of table must have been used. T. L. H.

Hooke and his Editors

Early Science in Oxford

By R. T. Gunther. Vol. 10: The Life and Work of Robert Hooke (Part 4); Tract on Capillary Attraction, 1661; Diary, 1688 to 1693. Pp. xliv+294. (Oxford: Dr. R. T. Gunther, Museum of the History of Science, 1935.) 21*s*.

DR. GUNTHER's latest publication is distinguished by a preface containing so many questionable statements that a full consideration of it, desirable as it may be, is not possible here. I gather from it that he considers himself aggrieved that Mr. Robinson was allowed by the Guildhall Library, owners of the manuscript, to publish, with the collaboration of Mr. Adams, the Hooke Diary recently noticed in these columns. Some of the sentences are so obscure that they cannot be refuted, as when he says of the Guildhall manuscript: "This had lain sterile and unused for some forty years, and I was naturally desirous of adding a transcript to this edition of Hooke's Collected Works. The requisite permission, however, was refused by Mr. Owthwaite" (the misspelling of Mr. Douthwaite's name is an unfortunate, but no doubt

unintentional, inaccuracy) "although he has given permission to Dr. P. Pelseneer of Brussels, to Mr. MacPike, of Chicago, and to Mr. Robinson". Permission to do what; add a transcript to this edition of Hooke's works? He then proceeds, in a manner that coming from anybody but a scholar of Dr. Gunther's repute would be offensive, to take the Royal Society to task for making a grant in aid of publication of the Guildhall diary. "The Council of the Royal Society has, however, made a charitable grant of £100 to the worthy firm of Messrs. Taylor and Francis, printers, towards *their* expense in printing a work, the copyright of which is claimed by the Guildhall Librarian." Why "claimed": is there any doubt as to the ownership of the manuscript, which is what is in question? Finally, he adds that, had he, Dr. Gunther, been entrusted with the editorship, many advantages would have accrued to the public, not the least being that "the text now printed would have been more correct".

In face of this kind of thing it behoves us to examine a little Dr. Gunther's claim to have a right to be the editor of anything pertaining to Hooke. Dr. Gunther's series of volumes is entitled "Early Science in Oxford", of which the present work is vol. 10. It is true that Hooke as a young man spent some years at Oxford, but by far the greater part of his work was carried out in London, where he was, from 1662 until his death in 1702, inseparably connected with the Royal Society. This body may, therefore, be allowed some say in the handling of his manuscript. The diary of 1688–93 might with equal justice appear under the heading "Early Science in the Isle of Wight". But, it may be said, Dr. Gunther's profound learning and skill as an editor gives him a moral right to take charge of manuscripts that other men discover in libraries. Let us see.

First of all, what have previous reviewers in NATURE had to say of his recent productions? In the issue of April 12, 1930 (125, 556), "R. S." says that the title page of his "Chaucer and Messahalla on the Astrolabe" is a "monumental piece of vandalism", deprecates Dr. Gunther's claims and regrets that he has not made the subject clear to the scientific reader. Of his edition of the "Cutlerian Lectures", "R. A. S." says on May 30, 1931 (127, 810) "that there is almost as wide a difference in flavour between this book and the original of it as there would be between the original Robert Hooke and a modern waxwork image of him". In NATURE of June 10, 1933 (131 819), "J. K. F." says, of his "The Astrolabes of the World": "Where I have been able to check the author, I have found him careless both in his statements and in the correction of the press." "The errors in the history and literature of the astrolabe are more astonishing." "Dr. Gunther's information about the Renaissance literature is equally unreliable", and much more to the same purpose, with especial reference to his habit of "mixing nominatives and genitives in his own way".

As regards the present book, lest the casual reader should suppose him capable of transcribing a manuscript, let alone annotating it, Dr. Gunther has considerately provided us with a reproduction of two pages of the diary, each of about 200 words, one being, according to him, "careful script", and the other "hurried script". Comparison with his text records a major error in each case. In the first page the word "scouring", a word in common use by Hooke, is transcribed "suffuring"! On the same page there are over thirty differences between the punctuation of the original and the transcription, twenty odd differences in the use of capital letters, two words in italics that are not italicised or otherwise distinguished in the original, and the word "some" omitted. This is not bad for one page. The other page (as a further example of our editor's care it is referred to as page 225 in the transcription, whereas it should be page 255) contains an even less creditable blunder, the strange word "Dumparded". What Dr. Gunther supposes this to mean we are not told. What Hooke wrote was "*diem perdidi*"—"I have wasted my day"—a common expression with him. It appears, for example, on page 153 of the present work, in the Guntherian form "*diem perditi*". Further examples of Dr. Gunther's, not Hooke's, Latin, from other pages, are "*fallere fallentens*" (for *fallentem*), "*Deo Omnipotenta*", "*Deo Gracias*" (several times), "*Timens Locrus*" (for *Tim(a)eus Locrus*—Timaeus the Locrian, who was Plato's Timaeus, of whom Dr. Gunther can read in any encyclopædia). On the present page there are the usual errors in transcribing punctuation and capital letters, and at least one more word is wrongly transcribed.

In the absence of any notes or critical apparatus it is impossible to say why the punctuation is freely altered, and why capital letters are put for small, small letters for capital. The use of italics is another puzzle. Passages are sometimes underlined in the manuscript diary, but this is not indicated in any way in Dr. Gunther's text, while the words which he gives in italics are in no way singled out in the original. In general the editor puts book titles in italics, while authors are sometimes distinguished in this way, and sometimes not; in addition, occasional phrases are italicised in an apparently completely arbitrary way. Sometimes words are completed in square brackets, at other times not. The same casual methods hold sway throughout the book. Hooke's *q* for query

is sometimes transcribed as "query", or "query ?"; sometimes as "Qu"; once as ♀, the sign for copper (or, according to Dr. Gunther, a pewter mark, so that we are confronted with the entry "[pewter mark] paling" !). Hooke's "tb" is printed as "to bed", but "DH" (dined home) is left as such. We find "G[old] ⊙", but the G stands for guinea, and the symbol ⊙ for gold, as is abundantly clear from other passages. ⊖, the symbol for "earth", is printed as θ, again and again. The arbitrarily added punctuation is bad enough, as when we have "Rev. Williams shew"—there is no fullstop in the original, and it looks to me like "Reev Williams Shaw" which makes sense; added letters are worse, as when, having apparently made up his mind that "West." means "Westminster", Dr. Gunther prints it as "Westm:", without any warning. These are merely examples. The letters "u" and "v" receive queer treatment—we have, for example, "vp till 4", "pulu", but "Loue dead", although, to even things, he appears in the index as "Love". The index, by the way, is unprejudiced by the text, as when, for example, "No Hall" of the text is indexed as "Nottall". Dr. Gunther does, it is true, seem a little doubtful himself as to whether Hooke put money into his "pn", for he follows it by a query. What about his "pix" ? These few examples may give the impression that the book has been combed for errors, but the fact is that they occur in such quantities that no search is necessary. The few examples given are to put the student on his guard against accepting this production as a transcript. He might wonder, for example, why on May 6, 1693, Hooke received one guinea for a "view", instead of the usual half-guinea; the reason is that Dr. Gunther has dropped a 2.

Occasionally Dr. Gunther gives himself great trouble to be wrong. On May 12, 1693, Hooke records "S. R. Southw. had Recd Lamps but not paid for them" (N.B. "them"), which following directly an entry referring to Marshall, the microscope maker, suggests that Sir Robert Southwell had received from Marshall some special lamps, probably for microscopic work. This appears as "Sr R. Southw. had read *Lamps*, but not paid for them", with a note that *Lamps* means Hooke's "Lampas" (published sixteen years earlier !) To take another example of the length to which Dr. Gunther will go in his devotion to error, on page 184 we have a footnote on nuts as a cure for scurvy. To get the material for this footnote Dr. Gunther has to run together the titles of two books, mentioned by Hooke as two books, namely Scheffer's "*De Varietate Navium*" (a well-known book) and a treatise "*Scorbuti Cura*"; and then change "*Navium*" (of ships) as written by Hooke, to "*Nucium*" (of nuts, the Guntherian genitive), getting "*Scheffer de Varietate Nucium Scorbut. cur.*", of which he says the author is unidentifiable ! Again, it requires some determination to produce, from an obvious "Hoskins belyed me, as he does every time", Dr. Gunther's "Hoskins belged me". On the other hand to print, instead of "Lister a proud huff" the Guntherian "Lister . . . half" merely argues unfamiliarity with Hooke's phraseology, just as "Slupy" for "Shapy" does with his environment. We do not attach any significance to the fact that Dr. Gunther repeatedly prints the well-known builder Fitch, whose name appears in all popular accounts of London, as "Filch".

Having made this small selection—and it is a small selection—from among the pages of noted blemishes of this production we turn once more with admiration to Dr. Gunther's boast that, if he had had the handling of the other diary, the text now printed would have been more correct. Monumental ! If Dr. Gunther is to bring out any more diaries let us have a good reproduction of the actual pages, and supply our own notes. For while the attributions of the books are in most cases correct, some of the notes are as astonishing as the text. The misspellings of names are not worth remark, but what are we to make of the footnote to "Comission of Leiftenancy", which runs simply and solely "Commission of Leiftenancy" ? What of the footnote that suggests that "M m D" means "M. Mores Dream", which entry occurs, it is true, at the end of a day on which "M Mores Dream" is recorded, but also occurs in exactly the same form three days earlier ? Later, in a note to March 11, 1688–9, Dr. Gunther suggests that Mr. Moor is Henry More—possibly his ghost, as the Platonist died in 1687. We are told that the Royal Society always met on a Wednesday, which is not correct. And so wearisomely on. But we are not told a meaning, even a wrong meaning, of "essedum", "sandover" (more usually "sandever") and other words which might have occasioned a little trouble. In fact, even if it were free from errors this editing would be a deplorable performance, on account of its omissions.

We turn from this dismal record to brighter aspects of the book. The mangled diary, although of less interest than the earlier one, is nevertheless informative, and contains at least one strangely modern entry, for St. Andrew's Day, 1689, when, after recording the election of officers of the Society, the diarist adds, "The gang tryd utmost effort, but faild". The book also contains a facsimile reproduction, page by page, of the exceedingly rare "Attempt for the Explication of the Phenomena", which many will be glad to consult,

although the type would have looked more like the original on a paper less porous. In addition, we have Dr. Gunther's "Preface", containing a reprint of a letter by Miss Batten, which relates to the Guildhall Diary, and some pages of good reproduction of manuscript, including Sir Isaac Newton's celebrated letter of November 28, 1679, on the path of bodies descending to the earth, and Hooke's "Survey of Wharves" from the B. M. drawings (already reproduced recently by Mr. Perks). The matter in this volume is thus selected from the period 1661–93, and brought together rather by Dr. Gunther's whim than by any considered scheme. Still, Heaven forbid that we should cavil at matter reproduced in facsimile and without comment, however little it may have to do with the diary. But from Dr. Gunther's scholarship we crave a respite. Surely his shining temple to the Goddess of Inaccuracy should by now be complete. E. N. da C. A.

Bird Behaviour

The Nature of a Bird's World

By Eliot Howard. Pp. vii+102. (Cambridge : At the University Press, 1935.) 7*s*. 6*d*. net.

MR. ELIOT HOWARD has devoted more time to the study of bird behaviour than any other ornithologist of his time. But this 'behaviour' has always been in relation to that manifested during the sexual cycle, from the onset of the emotions relating thereto, up to the care of the young ; and always his interpretation of that behaviour is in terms of psychology, with which the average ornithologist does not greatly, if at all, concern himself. But that is all the more reason why he should explore this new field of observation. The psychologists will certainly find in these pages a very helpful source of inspiration.

During the rising tide of the sex emotions, Mr. Howard shows us, birds display no more than a blurred sense of awareness, a sort of premonition that something has to be done. But, it is to be noted, these 'premonitions' always have a frame of reference to the sexual cycle, and display an orderly sequence. The gradual development of the hormones formed in the reproductive glands is accompanied, at first, by an apparent confusion of impulses. Leaves or twigs will be seized, only to be dropped again, or, in the case of the male, displayed before the female during his more amorous moments, as if to arouse in her the desire for mating and nest-building ; and these dumb signs he will presently fortify by the posturings characteristic of his species at such times. Even the first attempts at 'mating' are, so to speak, half-hearted and unaccomplished. Their final consummation is quickly followed by nest-building, incubation and the care of the young wherein ; there is less hesitancy and confusion of impulses than in the earlier stages.

The apparent capriciousness of birds' behaviour, especially conspicuous at the onset of the sexual cycle, is, as Mr. Howard shows us, not the outcome of mere contrariness of moods, but has always a frame of reference to the appropriate phase of the cycle, and, he suggests, to the amount of the flow of hormones from the sex glands into the blood. This much seems to be attested by the fact that the manifestations of sexual activity are quickened by a few days of warm weather, and as easily quenched, or suspended, by a sudden spell of cold.

Mr. Howard completely abandons the conception, which, even now, is commonly held, that birds behave 'instinctively', and in this we agree with him. In many parts of his book, indeed, he seems to prefer to speak of their behaviour as being governed by 'impulses' traceable to the sex hormones, which is surely a most reasonable and probable interpretation. He describes experiments he has made to test the responses made by a bird to unexpected situations, such as moving a nest containing young to a new site, though no more than a few inches away ; or placing another nest containing blown eggs on the site of the nest it has just left to hunt for more food, and shifting the nest with young to a short distance away. Its behaviour in response to this last experiment has some surprising results.

But are such experiments of any real value, since the bird is confronted with a situation entirely outside its experience, and outside the possibility of occurring in Nature ? The relatively small, smooth brain of a bird is sufficient for its needs, but quite unequal to cope with such artificially created situations. As a test of mental capacity, it is interesting, and perhaps no more than this was intended.

Here is a book which will yield up its good things only to those who read it with concentrated attention. But it is a book which *must* be read, both by ornithologists and psychologists, and with profit to both. W. P. P.

A First Course in Differential Equations

By Prof. Norman Miller. Pp. v+148. (London: Oxford University Press, 1935.) 7*s*. 6*d*. net.

THE course developed in this interesting volume is intended for students who have taken a first course in calculus and, therefore, it assumes some familiarity with the relevant processes of algebra and analytical geometry. The subject-matter embraces the methods of solving equations of the first order, both of the first and higher degrees; linear equations with constant and variable coefficients; ordinary equations in more than two variables; partial equations of the first and higher orders.

As a first course, no attempt has been made to deal with the purely theoretical side which would demand a greater knowledge of the theory of functions than is expected from a student who has only taken a first course in calculus. Indeed, the author has dealt with the subject in so skilful a manner that interest for further study is almost unconsciously stimulated. This is especially true in the treatment of partial equations.

The methods of solution are well illustrated both geometrically and by their application to practical problems. As a professor in a Canadian university, the author has followed the usual custom on the other side of the Atlantic by using the word *slope* in the same sense as the term *gradient* is used in Great Britain.

The book is well printed and may be thoroughly recommended as a reliable text-book for students beginning the very important study of differential equations.

Problems in Soil Microbiology

By D. Ward Cutler and Lettice M. Crump. (Rothamsted Monographs on Agricultural Science.) Pp. vii+104. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 9*s*. net.

ONE of the most characteristic features of the soil is the presence of a complex micro-flora and micro-fauna. The activities of this complex population are of the highest importance both for the philosophical and practical study of the soil, for there is scarcely a reaction or property of the soil which is unaffected by micro-biological processes. In the investigation of these processes, the Rothamsted workers have played a leading and distinguished part.

The present book is a series of studies in soil micro-biology. Whilst it appeals to the specialist rather than to the elementary student, the general reader may gain from it an idea of the complexity of the processes in which the micro-organisms of the soil are concerned. The authors liken the problems of soil micro-biology to a tangled skein which can only be unravelled thread by thread. The realisation of this precludes any hope of a speedy solution. Yet here, as in other branches of pedology, patient and imaginative study is winning order from chaos.

As may be expected in one of the Rothamsted monographs, the subject matter is presented in a lucid and interesting manner. G. W. R.

Descriptive Mathematics

By John Maclean. Pp. xvi+143. (Bombay, Calcutta, Madras and London: Macmillan and Co., Ltd., 1935.) 2.8 rupees.

IN this interesting book, the author, as a result of a search through many recent scientific papers, has collected the varied applications of the methods of elementary mathematics, which are employed in the description of quantitative phenomena. The form in which these are presented is based upon experience gained in teaching such methods. Whilst, however, the applications are drawn from a wide field, emphasis is laid rather on the method than upon its practical use.

The subjects dealt with include: the slide rule, Cartesian graphs, the angle as an independent variable, nomography, statistics, probability and finite differences. There are some valuable notes on calculation and upon the misuse of scales and contours. The text is amply illustrated by diagrams and charts dealing with such remote subjects as properties of blood, basal metabolic rate determinations, periods of art, etc., whilst a good glossary, index and bibliography are provided. Mathematical rigour is well-tempered by interesting descriptive matter, and the whole course aims at giving the student an insight into the methods of simple mathematical research.

Higher School Geometry

By L. Crosland. Pp. xiv+322+xx. (London: Macmillan and Co., Ltd., 1935.) 6*s*.

THE book is to be welcomed as meeting the need for a single text-book dealing with all branches of geometry required in a two-years' course for a Higher School Certificate. The first seven chapters contain an analytical treatment of straight lines, circles and conics. Then follow three chapters on the geometrical properties of parabolas, ellipses and hyperbolas, treated sometimes analytically and sometimes by pure geometry, including orthogonal projection. The remaining chapters deal with the pure geometry of triangles and circles, solid geometry of straight lines, planes and polyhedra, and with the mensuration of prisms, pyramids, cones and spheres.

Thermionic Emission

By T. J. Jones. (Methuen's Monographs on Physical Subjects.) Pp. viii+108. (London: Methuen and Co., Ltd., 1936.) 3*s*. net.

THIS elementary account of thermionic emission, after a short historical introduction, gives a brief, but well-documented, discussion of the theory of electron emission, and proceeds to a description of atomic film emitters, oxide-coated emitters and the thermal emission of positive ions. The companion monograph by Prof. E. V. Appleton on "Thermionic Vacuum Tubes" deals with applications of thermionics, and the two volumes are, in a measure, complementary. A bibliography of about one hundred and fifty references rounds off a very useful monograph. A. F.

Estimation of Vitamin A

A VITAMIN or accessory food factor is discovered from the effects produced in living animals by its removal from the diet. Progress in this field has been dependent upon the invention of methods of preparing many of the different constituents of a diet in a pure state, without loss of their own essential qualities, so that characteristic symptoms may be produced by the removal from the diet of hitherto unknown factors which are frequently associated with the better-known constituents. Following their discovery, interest was aroused in their distribution in Nature.

The work, at first qualitative, rapidly assumed a quantitative aspect, necessitating the devising of quantitative biological methods. At the same time, search for quantitative chemical or physical methods of assay was unremitting, since the biological method at its best is usually relatively inaccurate. Thus for vitamin A, two methods have been much used recently to supplement or even replace the biological 'growth' test, namely, the depth of the blue colour given by the antimony trichloride reagent in the 'Carr-Price' test and the intensity of absorption at 3280 A. as measured by the spectrophotometer. Before either of these methods can replace the biological, however, it must be proved that it estimates the same thing and with greater accuracy. Owing to the inherent errors of the biological test, this proof is not easy to obtain; the first need is to improve the biological method, and for this the provision of a stable standard of reference with which all samples may be compared is an absolute essential.

The International Conferences for the Standardisation of Vitamins held in London in 1931 and 1934 under the auspices of the Permanent Standards Commission of the Health Organisation of the League of Nations adopted first carotene and then β-carotene as standard for vitamin A. A considerable amount of the preparatory work for the second Conference was carried out by a special sub-committee of the Accessory Food Factors Committee, some of which has now been brought together and edited by Miss Hume and Dr. Chick*.

With the choice of carotene as standard for vitamin A, it became of the greatest importance to select a suitable solvent in which to administer it to the animals, since it had been previously shown to be inactive when given in an unsuitable solvent such as ethyloleate, in which it is unstable. Apart from instability in the solvent, there was also to be considered the question of absorption from the alimentary tract, since Lathbury and Greenwood[1] had found different biological values for carotene when dissolved in different samples of arachis and coco-nut oil, although colorimetric tests had shown that carotene was stable in certain samples of these solvents. Preliminary investigations indicated that, of a number of oils examined, coco-nut was the most satisfactory. Three samples of different origin were therefore obtained and submitted to extensive examination. All observers found that the carotene (1931 standard) had the highest potency in one of these oils; but there was less agreement about the suitability or otherwise of the other two. Colorimetric tests indicated that the carotene was most stable in the most satisfactory oil as determined biologically and least stable in the oil which one observer found to be the least suitable by the biological test. Addition of hydroquinone to 0·01 per cent obliterated the difference between these two oils in the colorimetric test. It was concluded that a selected coconut oil was the most suitable solvent for the standard, and the 1934 International Conference decided to issue the standard in solution in coconut oil with addition of hydroquinone.

The next step was to select and obtain in the pure state one of the carotene isomers to replace the 1931 standard carotene, which appears to have consisted of a mixture of β-carotene and inert material with little or no α-carotene. β-carotene is the form most widely distributed in Nature and most easily prepared, and seemed therefore the most suitable isomer to select. The results of the biological tests, carried out to determine its growth-promoting activity in terms of the 1931 standard, showed quite good agreement. The dose of β-carotene equivalent to 1γ (one unit) of the 1931 standard was found to be 0·57γ by Coward, 0·66γ by Hume and 0·50γ by Lathbury. The average of these values taken as 0·6γ was accepted by the International Conference 1934 as the figure which should be adopted as equivalent to one unit. Colorimetric and spectroscopic tests confirmed this figure.

The report then describes the spectrophotometric tests which were carried out by a number of different observers, to determine the suitability of this method as a means of estimating vitamin A. The results obtained in seven different laboratories in estimating $E\ \frac{1\ \text{per cent}}{1\ \text{cm.}}$ 3280 A. for six cod liver oils and one concentrate showed that

* Medical Research Council—Special Report Series, No. 202. Reports of Biological Standards, 4: The Standardisation and Estimation of Vitamin A. Edited by E. Margaret Hume and Harriette Chick. Pp. 61. (London: H.M. Stationery Office, 1935.) 1*s*. net.

estimations on cod liver oils should be made on the unsaponifiable fraction, and that cyclohexane or ethyl alcohol should be used as the solvent and not chloroform. From the results of the biological tests on a number of oils for which the extinction coefficient was also determined, it was concluded that the most likely factor for converting $E\,^{1\text{ per cent}}_{1\text{ cm.}}$ 3280 A. into international units of vitamin A per gram is 1600. This figure is to be considered provisional and subject to revision with the accumulation of further data. Other conversion factors have in fact been published: for example, Lathbury[2] found a factor of 1400 in her examination of an extensive series of oils and concentrates; and even lower figures have been suggested.

The report does not refer to work which has been carried out on the relationship between the blue value of an oil and its biological potency. Lathbury (ibid.), for example, found that the blue value, determined on the unsaponifiable fraction, should be multiplied by 40 to obtain the biological activity in units per gram in the case of crude oils, whilst for concentrates the blue value should be multiplied by 20. Assuming the conversion factor of 1600 for converting the extinction coefficient to biological units, the potency of the purest preparation of vitamin A hitherto made[3], which had a coefficient of 1600, is $2\frac{1}{2}$ million units per gram. This concentrate had a blue value of 80,000, from which the conversion factor for blue value to biological units becomes 30. The determination of blue value is subject to greater errors than the spectrophotometric test but may be a very useful indication of the potency of an oil or concentrate when carried out under well-defined conditions.

The report of the vitamin A sub-committee concludes with a section upon the possible use of cod liver oil as a subsidiary standard. Provided its potency is maintained, a standard oil would be a convenience owing to the fact that the quantities of β-carotene available as international standard are somewhat limited. The report of the 1934 International Conference is also reprinted in an appendix.

Only further experience can decide whether the different methods of estimating vitamin A will always give the same results. A recent letter in our columns[4] suggests that more work is required before the relationship between the extinction coefficient and the biological activity can be considered to be quantitatively established.

[1] *Biochem. J.*, **28**, 1665 (1934).
[2] *Biochem. J.*, **28**, 2254 (1934).
[3] Carr and Jewell, NATURE, **131**, 92 (1933).
[4] Bacharach, Drummond, and Morton, NATURE, **137**, 148 (1936).

Sign Language as a Form of Speech*

By Sir Richard Paget, Bt.

THE relationship between mouth gestures (which produce speech) and bodily gesture was indicated by Darwin ("Expression of the Emotions", 1872): it had been noticed thirty years earlier by Charles Dickens in the "Pickwick Papers", where he shows Sam Weller, junior, forming with his tongue "imaginary characters to correspond" with the letters of his valentine to Mary. This hand and mouth association deserves to be systematically studied. It lies at the very root of human speech: its rudiments are found in the behaviour of chimpanzees.

The present object is to give an account of gesture as an alternative to speech, for the communication of ideas between people of different races. I will deal first with the natural sign language of deaf mutes. As to this, I have had the fact questioned—by a responsible authority—whether the sign language of deaf mutes *was* 'natural' at all. The fact is that in all countries, deaf mutes develop a natural and mutually understandable pantomime. On August 18, 1935, a deaf mute service was held in St. Paul's Cathedral; it was attended by deaf mutes of fourteen different countries. The service was conducted in pure sign language (though *The Times* unfortunately described it as "international signs alphabet"), and all present could understand. Of course, separate communities develop their distinctive slang; thus, the present English deaf mute sign for 'Prime Minister' might be 'pipe-in-mouth'!

The Red Indians of North America also had a universal sign language by which all the different tribes, speaking more than a hundred different languages, could communicate.

Literature on sign language is very scarce: the British Museum Library appears to have no book on the deaf mute sign language, and only one on Red Indian signs—that of Garrick Mallery—"Sign Language among the North American Indians"

* Substance of a Friday evening discourse delivered at the Royal Institution on December 13, 1935.

(1881). Recently (1929), William Tomkins, of San Diego, California, published his "Universal Indian Sign Language" (London : Boy Scouts Headquarters, Buckingham Palace Road) which describes 700–800 separate signs.

The main differences between the deaf mute and Red Indian systems are : (1) Deaf mutes make free use of facial expression, while Red Indians suppress all facial expression, and their gestures are very restrained. (2) Deaf mute signs are less poetical and imaginative than those of Red Indians. Thus, *annoy* in R.I. is 'fluttering heart' (compressed R. hand held pointing downward over heart, all fingers then spread and fluttered). In D.M., it is 'forearm tapped', that is, the man who keeps tapping your arm to attract your attention. (3) There are differences of outlook : thus, *dig* in R.I. is to scratch like a badger ; in D.M. it is to make the action of digging with a spade. *Think* in R.I. is to draw from the heart ; in D.M. it is to touch, or describe small circle on, forehead with the first finger. The R.I. mistakenly considered the heart as the seat of thought—but so do we, and the French, when we say to 'learn by heart', or 'apprendre par coeur'.

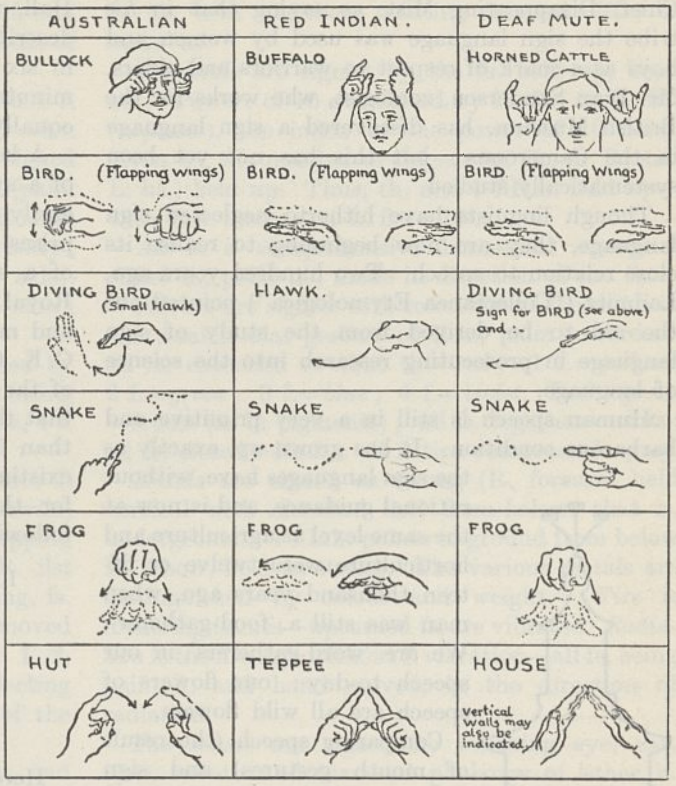


FIG. 2.

In 1897, Walter E. Roth's "Ethnological Studies among the North-West-Central Queensland Aborigines" described the sign language used, over an area about twice that of England, by some ten different tribes ; Roth describes and illustrates 213 different signs.

Figs. 1 and 2 show a comparison between the Australian, Red Indian and deaf mute signs ; the deaf mute signs were supplied by the Rev. Albert Smith, chaplain to the Royal Association in Aid of the Deaf and Dumb. The similarities are obvious.

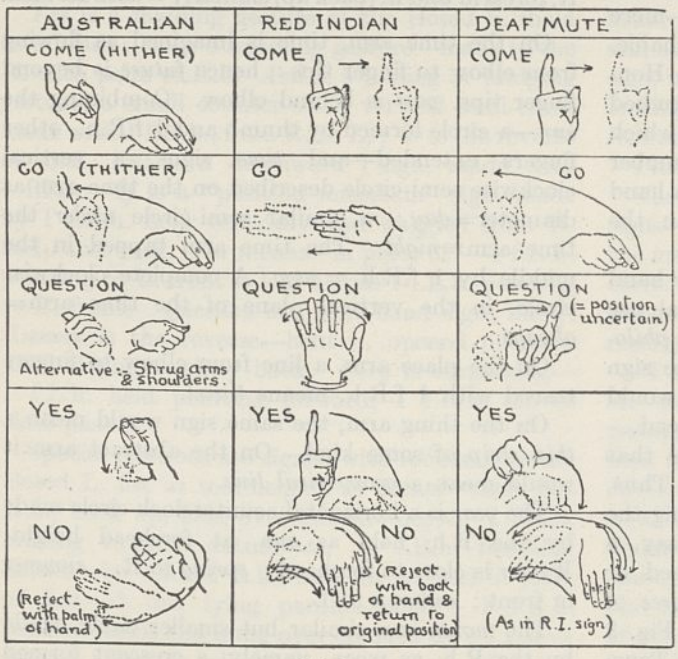


FIG. 1.

Garrick Mallery (loc. cit.) describes yet another sign language—that of the Neapolitans. Summarising, he says (p. 323) : "the result of the studies so far as prosecuted is that what is called *the* Sign Language of Indians is not, properly speaking, one language, but that it, and the gesture systems of Deaf Mutes and of all peoples constitute together one language—the Gesture Speech of mankind—of which each system is a dialect". With this definition I would personally entirely agree.

Quite recently, the U.S.S.R. Academy of Sciences, Leningrad, has discovered a sign language in Russian Armenia, south of the Caucasus, which is in use by women (only), over an area of about 60,000 square miles. Women are not allowed to speak to any man except their own husbands ; so they use signs ! Mallery (loc. cit.) quotes the Iroquois

Chief, Disappearing Mist, as saying that in *his* tribe the sign language was used by women and boys as a mark of respect to warriors and elders. Mr. Ivan Sanderson, zoologist, who works for the British Museum, has discovered a sign language in the Cameroons; but this has not yet been systematically studied.

Though linguists have hitherto neglected sign language, they are now beginning to realise its close relation to speech. Two hundred years ago, Leibnitz ("Collectanea Etymologica") pointed out the aid to be derived from the study of sign language in prosecuting research into the science of language.

Human speech is still in a very primitive and barbarous condition. It has grown up, exactly as the sign languages have, without rational guidance, and is now at the same level as agriculture and horticulture were twelve or fifteen thousand years ago, when man was still a 'food-gatherer'. We are 'word-gatherers' in our speech to-day: our flowers of speech are all wild flowers.

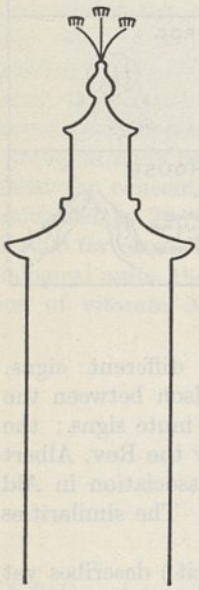


FIG. 3.

Comparing speech (the result of mouth gestures) and sign language (the result of hand gestures), the hand has a great advantage. Prof. Lundall's Universal Phonetic Alphabet contains 144 signs, representing all the different vowels and consonants of all languages; but any *one* language only contains 30–50 separate gestures—more would not be distinguishable. With the help of the Hon. Gerard Vanneck, I have studied the number of possible distinctive gestures which can be made with *one* hand and arm. The number is more than 700,000! Evidently the human hand is about 20,000 times more versatile than the human mouth.

Abstract ideas are just as easily signed by hand as by mouth, namely, by the metaphorical use of signs for simple concrete ideas. Thus, *philosophy* = love wisdom. In sign language the sign for love would be hand over heart: wisdom would be first finger right hand drawn across forehead.

Sign language has the further advantage that it can be quantitative as well as qualitative. Thus, the word *big* cannot by itself indicate *how* big the object is; in signs, the gesture for *big* (say, a piling or heaping-up sign) may be enlarged or diminished to any extent to show the *degree* of bigness intended. Similarly as to shapes. Fig. 3 shows the outline of the tower of Stockholm Town Hall, with its three crowns on top. This can be described in signs (by outlining with both hands) in six to seven seconds. It would take several minutes to describe the shape and proportions equally exactly in words.

A beginning has been made in the development of a systematic sign language intended as a very easily learnt universal language. The team comprises Mr. Bertrand Davis (himself the inventor of a sign language), Mr. Tafler (student of the Royal Academy of Dramatic Art), Mr. Rothfield and myself. We have made sign equivalents for C. K. Ogden's 850 Basic English words, but many of the basic words are themselves compounds, so that the basic *signs* will not need to number more than 500–600. The signs are selected from the existing sign languages, or modified, or invented for the purpose. In describing the signs, the following abbreviations will be used:

1, 2, 3, 4, *th* = 1st, 2nd, 3rd, 4th and thumb.
f = finger
h = hand
S = sign
R = right
L = left.

Here are some of the principal conventions:

L. forearm and h. (back up) held horizontal—pointing forward—is the sign for *time* (it can be remembered as a wrist-watch sign—but is actually used in a R.I. time sign).

L. forearm and h. (palm up) held as before = *place*
R. forearm and h. (palm up) similarly = *thing*.
R. forearm and h. (back up) similarly = *abstract* idea.

On the time arm, time is imagined as flowing from elbow to finger tips: hence *future* is beyond finger tips, *past* is behind elbow. Combining the *sun*—a circle formed by thumb and 1 f.R.h., other fingers extended—and *time* signs, a vertical clockwise semi-circle described on the time arm as diameter = *day*; a similar semi-circle *under* the time arm = *night*. The time arm tapped in the middle by 1 f.R.h. = *now*. A complete clockwise circle, in the vertical plane of the time arm = *always*.

On the place arm, a line from elbow to fingers traced with 1 f.R.h. means *travel*.

On the thing arm, the same sign would mean a *thin strip* of some kind. On the abstract arm it would mean a *geometrical line*.

The *year* is a horizontal counterclock circle made by the R.h. held as *sun*, at forehead height. *Winter* is close to forehead; *spring* to R.; *summer* in front; *autumn* to L.

The *month* is a similar but smaller circle, made by the R.h. as *moon*, namely, a crescent formed

by curved 1, 2, 3, 4 fs. forming the upper half, and the upward curved th. forming the lower half of the crescent.

I, *you*, and *he* are signed by pointing with 1 f. to signer's chest=I; forward=you; to R.=he. The possessive forms: *my*, *yours*, *his*, are signed by pointing, as before, with the hand *closed* (palm forward). *Good* is th. up; *bad* is th. down (Roman signs). *Male* is the R. side (strong side) of the body; *female* is the L. side (weaker and heart side). Hence, 1 f. touching near R. shoulder=*man*; touching near L. shoulder=*woman*.

Literal constructions of a sign are indicated by holding up the 4 f.L.h. (the little finger) or pointing with it—instead of with the 1 f.; for example, 1 f. to temple=*thought*; 4 f. to temple=*temple*.

Operative verbs:—*Do* is R. fist struck into L palm; *make* is R. fist screwed, half-turn, clockwise, in L. palm. *Try* is begin to do—R. fist stopping short of contact with L. palm. *Fail* is R. fist passing under L. palm. *Use* is both hs. facing, fs. pointing forward a few inches apart, moved forward a few inches, then withdrawn—the 1, 2, 3, 4 fs. of both hs. being incurved, as if collecting material for use. (Cf. the mouth gesture of the root, *us*, Latin *usus*.)

Be is 1 f. lightly touching below R. breast, and moving upward by wrist action. A similar sign made with both hs., with 1, 2, 3, 4 fs. touching body and moved up more vigorously, means *live*. A still more ample sign, with outspread fs. and hs. raised above head, means *soul*.

Have is a holding sign; R.h. closed forcibly near R. side. *Of* is a smaller edition of this sign, made with th. against median phalange of 1 f.

Yes is a nodding gesture of the closed h. (held as a head); *no* is a rejecting gesture—made to the R. with palm of R.h. *And* is a joining or bridging gesture, a small counter-clock vertical semi-circle made with 1 f.R.h., from R. to L.; *or* is the reverse of *and*. *But* is a downward) sign, made with 1 f.R.h. *If* is a "position uncertain" sign, made by 1 f.R.h. held vertically and waggled from R. to L. and back. *For* means "in place of"—1 f.R.h. pointing to L. front is laid across 1 f.L.h. pointing to R. front. *Question* is a bent hand sign, like ?. *Answer* is the reverse—bent h. opened outward until sloping slightly back. *Very* is surpassing—1 f.L.h. held pointing forward, 1 f.R.h. moves close past it.

Spacial relations are signed with reference to the closed L. fist at mid-height, as *datum*—thus, flat R.h., back up, held over datum=*above*. 1 f.R.h. moving towards datum=*to*. 1 f.R.h. touching datum=*at*. Closed R.h., back to R., laid in palm of L.h.—2 ths. lying parallel=*with*. 1 f.R.h. crooked down and hung over crooked up 1 f.L.h.=*because*, that is, depending on. 1 fs. R. and L. hs. held together, pointing forward=*like*, or same as.

Numerals are signed by the fs. held up, back out. Powers of 10 are signed by R. fist on L. fist (=*power*), the index of the power of 10 being given by the number of fingers (of R., or R. and L. hs.) held up. Thus, th. and 1 f.R.h. held up—with R.h. resting on L. fist=10^1.

All is a comprehensive horizontal sweep of either h., palm up, made in direction of the th.

Colours are signed with reference to the rainbow—a semicircular gesture of R.h., palm inwards—all fs. extended so that th.=*red*; 1 f.=*yellow*; 2 f.=*green*; 3 f.=*blue*; 4 f.=*violet*. Red+green =*brown* (as in pigments); all fs. together=*white*; all fs. closed=*black*; all f. tips compressed=*grey*.

Metals are signed as strong (R. forearm held vertical with clenched fist) from-below, that is, underground; 1 f.L.h. points to ground from below R. elbow, held as strong. The various metals are distinguished by colour and weight. *Fire* is flickering flames—upturned fs. are vibrated. *Radiation* is the fire sign without f. vibration—all fs. being pointed, and hand moved, in the direction of radiation.

The *senses* are signed by touching eye, ear, nose, mouth and terminal phalange of other h. with 1 f.

Grass is a similar sign to fire, but the h. is held low, and the upturned fingers are held still. *Tree* is a similar sign, with forearm held vertical and all fs. extended as branches. *Flower* is R.h. bent *down*, fs. pointing down. *Fruit* is the same sign made with L.h. (that is, female side). *Animal* is similar to flower sign, but the 2 f. is extended as head. 1 and 3 fs. as forelegs, 4 and th. as hindlegs, and h. is moved slightly forward. *Bird* is a flapping sign, made with both hs. *Insect* is signed by interlocking the two ths., and pointing the two 1 fs. forward (cf. antennæ).

Plurals are formed by repeating the sign.

The following address was then given in signs—the audience being invited to call out the meaning of each sign as made. All signs were correctly called, except *chemistry* (gesture of pouring into test tube, heating it from below, and examining result) which was translated as "experiment":

"I try now if you mind-grasp my talk to you all—not make with mouth but with hands. Surpassing 100 years ago, many level-mind and good men make this House for use like centre for discovery and for show new thought and new things to all same want mind-grasp. Here you all can see about chemistry, lightning-power (electricity), stars, radiation, colours, metals, plants, insects, and abstract thoughts about all-things (Nature). If you come to all meetings (coming-together) and mind-hold all same you see and hear, then you

future be surpassing highbrow and surpassing happy!"

The following sign poem was then delivered by Mr. Tafler, with musical accompaniment by the lecturer:

"Were I in future blind, yet would I always have
A rainbow in my life, since you love me.
My red would be your lips, yellow your golden hair—
Your fragrance violet, and green scented leaves.
My blue would be your eyes, your arms would light my heart.
Your absence be my gloom, your soul—my sun!"

(At the conclusion of the discourse, a short extract was exhibited of a film under preparation by the Smithsonian Institution, Washington, on the Red Indian sign language. The extract showed the late General Scott performing the signs for the names of a number of Red Indian tribes.)

Obituary

Mr. T. H. Pope

THOMAS HENRY POPE, who passed away on January 12, was born in London on February 1, 1875. He received his early scientific education at the Finsbury Technical College and in 1893 entered the Central Technical College, South Kensington, as a student of chemistry under Prof. H. E. Armstrong. After gaining the diploma of associate of the City and Guilds Institute in 1896, he became research assistant, first to Prof. W. C. Unwin and afterwards to Mr. (now Sir) Robert Mond until 1898, when he joined Julian L. Baker, then chief chemist to the Beetroot Sugar Association. In 1900 he became himself chief chemist to that Association, and shortly afterwards, in 1901, was appointed lecturer and demonstrator in the British School of Malting and Brewing under the late Prof. Adrian Brown. Pope stayed at the Birmingham School of Brewing until October 1917, when he joined Messrs. Calder's, Ltd., working at the distilleries at Bo'ness and Gartloch on problems arising in alcohol and yeast manufacture. This firm became an associated company of the Distillers Company, Ltd., in 1922, when T. H. Pope was transferred, first to the Vauxhall Distillery, Liverpool, and later, 1925, to Bankhall Distillery, in the same city. In 1927 he went as one of the senior chemists to the Research Department of the Distillers Company, then newly established at Great Burgh, Epsom, where he remained until the time of his death.

T. H. Pope was essentially a student, and devoted most of his spare time to the study of languages and to scientific literary work. He was an abstractor to the *Journals* of the Chemical Society and of the Society of Chemical Industry for more than thirty-five years, and also did valuable work for the Society of Public Analysts, first as an abstractor, later, in 1933, as assistant editor of the *Analyst*. Up to the time of his death, he had for a number of years contributed abstracts of Italian scientific papers to NATURE. He had a wide knowledge of foreign languages, including Spanish, Italian and Russian, and his translations of standard works such as Euler's "Chemie der Enzyme", Molinari's "Trattato di Chimica Generale ed Applicata all'Industria" and Villavecchia's "Trattato di Chimica Analitica Applicata", are well known.

Pope will be greatly mourned by all who knew him. He had an essentially critical mind, combined with a courtly dignity and quiet humour, which made him a most agreeable colleague. His wide reading and appreciation of detail were of very great service in the study of large-scale operations, with which he was occupied in his later years.

J. VARGAS EYRE.

Mr. F. A. Bellamy

FRANK ARTHUR BELLAMY, who died suddenly on February 15 at the age of seventy-four years, started his astronomical career in 1881 as an assistant at the Radcliffe Observatory at Oxford, where his two elder brothers had been before him. Eleven years later he was selected by Prof. Pritchard to be his assistant at the University Observatory at Oxford. When H. H. Turner succeeded to the Savilian chair two years later, the share of the Astrographic Catalogue which Pritchard had accepted was in its inception; a suitable telescope had been presented to the Observatory by Warren de la Rue; and to Bellamy fell a large share of the taking of the plates, the measurement of some 400,000 star images, the reduction of the measures, and the preparation of the results for publication. That a piece of work of this magnitude could be carried out in a reasonable time at an observatory with such a meagre staff was mainly due to the ingenious methods of measurement and reduction introduced by Turner, but its completion within the short period of ten years owes much to the enthusiasm and assiduity which Bellamy devoted to it.

The passing through the press under Bellamy's supervision of the seven volumes of measures was not completed until 1911, but no sooner was this done than Prof. Turner offered a helping hand to the Vatican Observatory, which had undertaken a section of the Catalogue and was finding it more than it could manage. The plates were taken in

Rome and measured there by members of a sisterhood, and the reductions were carried out by Bellamy, now assisted by his niece. In recognition of this work Prof. Turner and his two assistants each received a medal from the Pope. Just before his death, Turner undertook a part of the Potsdam zone relinquished by that Observatory after the War. Bellamy was not so young as he had been, but he managed nearly to finish this piece of work before he died. He was a good example of the accurate and painstaking assistant to which British astronomy has owed so much in the past. He received the degree of M.A. *honoris causa* from the University of Oxford.

Mr. George A. Macmillan

We regret to record the death of Mr. George A. Macmillan, which took place at Botton Hall, Danby, on March 3 at the age of eighty years. George Augustus Macmillan was born at Cambridge on August 1, 1855, and was educated at Eton. On leaving school in 1873 he joined the publishing house founded by his father and uncle, becoming a partner in 1879 and later a director, when the business was converted into a company.

Outside the claims of his business career, George Macmillan was deeply interested in farming and music ; but the chief devotion of his life was to the literature, history and archæology of Greece and Rome. Not only was he a close personal friend of the most eminent classical scholars of his day, such as J. P. Mahaffy, Sir Richard Jebb, Sir Arthur Evans and Sir James Frazer, but also he freely gave the full force of his business ability and organising powers to the promotion of the studies in which lay their common interests. British scholarship, more especially the study of the archæology of classic lands, is deeply indebted to him for his ceaseless efforts on behalf of the Society for the Promotion of Hellenic Studies, which celebrated its fiftieth anniversary in 1929. Not only was he one of the most active of its original promoters, but he also served as its honorary secretary for forty years, retiring in 1919 to become its treasurer until 1934. He also served as president.

The foundation of the British School of Archæology at Athens was largely due to Mr. Macmillan's activities, and he also took a part in the founding of the Society for the Promotion of Roman Studies. He was a member of the Managing Committee of the British School and afterwards chairman ; and it was largely due to his energy and ability in the conduct of its affairs that the great achievement of the School was made possible. His intimate knowledge of the Hellenic Society and the School gives the history of each which he wrote an unquestionable authority. His services are commemorated in the Macmillan Hostel at Athens and the Macmillan Studentship, which he himself founded. His numerous benefactions and services to scholarship were recognised by the honorary degree of D.Litt. conferred on him by the university of Oxford, and an honorary fellowship of Lincoln College, Oxford.

WE regret to announce the following deaths :

Dr. F. B. Allan, professor of organic chemistry in the University of Toronto, on January 9, aged sixty-eight years.

Dr. R. G. Harris, director of the Biological Laboratory, Cold Spring Harbor, an authority on the physiology of reproduction, on January 7, aged thirty-seven years.

Dr. Heinrich Lumpe, known for his work on the protection of birds, and the establishment of bird sanctuaries, especially in Bohemia, aged seventy-six years.

Prof. I. P. Pavlov, For.Mem.R.S., Copley medallist of the Royal Society in 1915, on February 27, aged eighty-six years.

News and Views

The King's Message

"IT has been an ancient tradition of the British monarchy that the new Sovereign should send a message to his peoples. Science has made it possible for me to make that written message more personal, and to speak to you all over the radio." Thus H.M. King Edward VIII on March 1, in words eloquent in their simplicity, marked an occasion which he himself, no less than the countless millions of his subjects and peoples of other nations who 'listened in', cannot but have felt will live as ever memorable in history. Never has ancient ceremonial been wedded more impressively to the progress of science. It is surely a good omen for the advancement of science that the potentialities of its application to ends which may seem remote from the laboratory of the research worker, should be emphasised on such an occasion by one who not only has availed himself freely of its aid in many ways in the performance of his official functions in the past, but also will be able in the future to do much to guide and influence public opinion towards a scientific approach to the problems of the State and the needs of daily life. It is perhaps permissible to feel in the King's affectionate and reverent reference to the acts and qualities by which his father won the deep-rooted loyalty of his people, as well as in the message of thanks for the people's sympathy from himself, his mother and the members of his family, an undercurrent of dedication of himself to a like personal service and sympathetic under-

standing of the common lot among the peoples of his Empire. It needed no more than his simple reminder that as Prince of Wales he had come to know the people of nearly every country of the world and that, though he spoke as the King, he was the same man "whose constant effort it will be to continue to promote the well-being of his fellow-men" to win the most loyal accord of each and every one of his vast audience in his aspiration, "may we be worthy of the heritage which is ours".

FOR the purpose of King Edward's broadcast, all the stations of the British Broadcasting Corporation were linked together so that his message, delivered from a studio in Broadcasting House, was radiated to all parts of the Empire at home and overseas. According to the various reports, the reception conditions were very good in all parts of the world, and the location of those listening on this occasion was by no means confined to the British Empire. Although this is the first occasion since his accession on which listeners have been able to hear King Edward, he has appeared before the microphone on many previous occasions as the Prince of Wales. He was the first member of the Royal Family to broadcast, in October 1922, from the first British transmitting station installed at Marconi House. At that time there were less than 18,000 holders of wireless licences in Great Britain, whereas the number of British listeners to the recent broadcast can be safely placed as of the order of tens of millions.

Flying Boats for Empire Air-Routes

THE first six of the twenty-nine big flying boats for Imperial Airways Ltd. are now nearing completion at Messrs. Short Bros.' works at Rochester. The first should be ready during April, and it is hoped to deliver them at regular intervals, completing the order by the end of 1937. Their estimated cruising speed of more than 150 miles per hour will make practicable the promised seven day schedule from England to Australia, allowing the necessary halts for refuelling, with a reasonable time in hand for contingent delays. These new boats will also run on the Bermuda–New York service, in co-operation with the U.S.A. Pan-American Airways, and it is understood that one will be specially fitted for the long-range direct Atlantic flights. They are to be fitted with four Bristol 'Pegasus' engines each of 900 horse-power, using Hamilton controllable-pitch airscrews. The standard form carries 650 gallons of fuel, which gives a range of 540 miles against a head wind of 40 miles per hour. This is considered to be sufficient for most of the Australian journey; but for longer stretches, such as the 1,200 mile crossing of the Tasman Sea to New Zealand, special fuel loads will be necessary, and a consequent adjustment in pay load made. In construction the boats are high-wing monoplanes of exceptionally clean lines. The engines are buried in the wings, and there are practically no excrescences creating drag or interference except the wing tip floats. The hull contains two decks with accommodation for the crew, twenty-four passengers with sixteen sleeping berths, and the usual freight space.

Germany's New Zeppelin Airship

THE one hundred and twenty-ninth Zeppelin designed in Germany, the *L.Z. 129*, will be making its trial flights shortly, and will be officially 'launched' later this month. It is expected to be put into regular service between Frankfort-on-Main and Rio de Janeiro by the end of March. Later in the summer, Dr. Eckener hopes to make some experimental journeys to Lakehurst, New Jersey, U.S.A., but there is no suggestion of the ship being used at present for the North Atlantic services permanently. It is hoped to reduce the time of the normal run to Rio to three and a half days, twenty-four hours less than the present *Graf Zeppelin's* time. This is due partly to the higher speed of 80 miles per hour—10 miles per hour faster than at present—and to the extra air endurance of 8,000 miles, which will save the necessity for refuelling at Pernambuco. The ship is powered by four compression ignition engines of about 1,100 horse-power each, housed in separate gondolas, hung from the flanks of the hull. Each gondola is a self-contained unit, except for its fuel oil, and is connected to the main body by a ladder hatchway. The 130,000 lb. of fuel is contained in a series of tanks in the keel of the main hull, interconnected at will, as required. The gas capacity is 7,070,000 cub. ft., twice that of the *Graf Zeppelin*, contained in sixteen balloonets, each with an inner and outer gas cell. The outer cells may contain helium if desired, as a safeguard against fire, and special arrangements are made to allow the hydrogen to escape from the inner bags if necessary. The ship carries fifty passengers, a crew of forty and about ten tons of paying freight load.

Commercialism and Industrial Research

NOT many years ago, the British nation was rudely brought to a realisation of its scientific unpreparedness to meet a major world crisis; a crisis which happened to be of a military nature. The Great War came and its passing left us with a vivid appreciation of the national, if not of the international, value of scientific research; so that science became news, and there was ample public support for the view that in peace, as in war, our future must depend to a very great extent on our progress in scientific research. Industry has made wonderful strides by its aid, and we have substantially earned the right to regard ourselves as a progressive nation as well as a nation of reasonably successful shopkeepers. But we would do well to review our position afresh, and to ask ourselves whether indeed all is as well as it seems. Prof. J. F. Thorpe, the retiring president of the Institute of Chemistry, spoke, in his presidential address, delivered on March 2, words of some gravity on this subject.

PROF. THORPE referred, for example, to the danger to which our home industries and our research organisations are exposed when not only finished materials, but also processes, are purchased abroad. Such purchase, unless proved to be in the public interest, means that so much less chance is afforded our research schools to foster national industry, and

so much less chance is given them of placing their men in suitable employment. The oil industry, he declared, may learn too late its need of research. Oil is now so readily available that restriction, in the interests of commercialism, has to be placed on its production. The processes are wasteful and uneconomic, but "no one seems to mind so long as dividends are maintained". Yet petroleum can be made the source of a vast number of chemical products of service to man. Finally, Prof. Thorpe characterised as a "disastrous tendency" the results which accrue from the neglect, or even refusal, of directors of companies dealing with industries based on scientific methods to place on their boards men of scientific experience and capacity. We have seen the light; but do we not now seem to be reverting to type?

Public Television in Germany

THE Minister of Posts, Herr Eltz von Rubenach, opened on March 1 the German Post Office's two-way telephone-television service connecting Berlin and Leipzig, a distance of about 100 miles, by cable. According to *The Times* of March 2, the Minister afterwards saw and spoke to the Chief Burgomaster of Leipzig. This is the first service of the kind in the world and it will remain open during the Leipzig Spring Fair, which ends on March 7; it will then be closed until March 30 for testing purposes. At present, seeing by telephone in Germany is limited to persons who go to public offices, two of which have been opened in each town. A three minute communication costs 3 marks 50 pfennigs. This includes the notification of a specified person in the town at the other end of the line. Great public interest has been aroused, the bookings for last Monday being all taken up by 6 p.m. on Sunday. The quality of the pictures produced appears to be good, 180-line definition and 25 frames a second being used. The head and shoulder image of a person is clearly produced. The effect is comparable to a small size projection of a substandard cinema film. The cabins are fitted with comfortable armchairs; the user rests his head on a cushion and the attendant lowers or raises the chair until it is exactly in focus with the scanning apparatus. The image of the correspondent appears above the bright light of the scanner, but is not disturbed by it. Details like the hands of a wrist-watch or a ring on the hand holding the telephone are said to be clearly visible. The apparatus used in Berlin was constructed by the German P.O. laboratory and that used in Leipzig by the Fernseh-Aktiengesellschaft, of which Baird Television Ltd. holds a quarter of the shares.

X-Ray Studies of Molecular Structure

THE thirty-third Bedson Lecture was delivered on February 21 at Armstrong College, Newcastle-on-Tyne, by J. D. Bernal, assistant director of research in the Crystallographic Laboratory, Cambridge, who took as his subject "Modern Crystallography and Organic Chemistry". Mr. Bernal gave practical details of the method of X-ray examination of organic substances, which he explained constitutes an indirect method of seeing molecular structures. A pencil of X-rays is diffracted by all possible internal planes of regularity of a crystal to a series of points which can be photographed; the intensities and angles of deviation of these diffracted rays constitute the observed data which will unequivocally characterise a substance. It is also relatively easy to determine the symmetry of the molecule, which in some cases identifies an isomeride as *cis* or *trans*, and to determine the size of the unit cell of the crystal from which, knowing the density, the molecular weight can be found, and also the shape of the molecule, which has been of value in sterol chemistry. The complete interpretation of X-ray diagrams to yield the position of each atom in the unit cell and the electron density in each part of the molecule is much more laborious and has only recently been achieved. Besides confirming the classical organic structures, this method gives direct information of the distortion of valency angles in such cases as durene, and of the semi-aromatic nature of the bonds in benzoquinone and dinitrobenzene.

Maori Culture and Modern Civilisation

Lord Bledisloe's eloquent appeal on behalf of the Maoris in his address to the Royal Society of Arts on February 27 came with added force from one who both by his official and his personal acts during the five years of his tenure of the Governor-Generalship of New Zealand had shown that not only had he a sympathetic appreciation of the history of the race and its achievement in the past, but also that he believed in the potentialities of this people as an element in the future cultural development of the Dominion. In characterising them as the most interesting, the most attractive and the most civilisable of the 'native' peoples of the world, he did not go beyond the warrant of the results of scientific study of the Maori during the last generation or more. When he reviewed the relations of white administration and the natives from the days of early colonisation down to recent times, Lord Bledisloe displayed sound judgement in attributing the decadence of the race, which at one time seemed in danger of extinction, to the harsh and inequitable land policy of the Government, which confiscated and alienated native holdings after the Maori wars. Experience elsewhere, notably in South Africa and North America, has shown that the well-being of an indigenous people is closely bound up with an understanding on the part of the administration of the place of land-tenure in its cultural economy. The remarkable recovery of the Maoris during the last generation, to which Lord Bledisloe referred, is in itself a sufficient guarantee that if the present moment is, as he describes it, a crisis in their history, they will repay the confidence which he trusts will be reposed in them, should their future be assured them and their equality of status under British sovereignty be unchallenged in four years time, when New Zealand will celebrate her centenary as a British possession.

Maiden Castle, Dorchester

EACH succeeding season of Dr. R. E. Mortimer Wheeler's excavation of Maiden Castle adds to the impressive character of the picture of this corner of Britain in prehistoric times which he is reconstructing from the evidence revealed by the spade. The masterly survey of the history of the site from neolithic times, dated approximately at 4,000 B.C., down to the close of Roman domination in the late fourth century of our era, which he gave in his report on the excavations of 1935 to the Society of Antiquaries on February 27, concurs with the evidence of recent excavation elsewhere in showing that life in early Britain, at least in later prehistoric times, was an affair of much more highly organised and settled conditions than has been conceived, even when the story of 'painted' savages is sufficiently discounted. It may be that Dr. Wheeler is right when he sees in the improved and strengthened fortifications, with their elaborated stone-walling reinforcements, which appear at the beginning of the first century B.C., evidence of the driving force of the individual megalomaniac; but the existence even before this of a town of some five to six thousand inhabitants argues no mean standard of culture and considerable ability in ordering and administering the daily details of communal life. In describing the objects which accompanied the remarkable extension of urban fortification and show traces of what is here at Maiden Castle a new culture, Iron Age "B", Dr. Wheeler suggests that the use of masonry may have come from the west; but it is significant that he does not find that the new culture arrived in any bulk. The population of Maiden Castle appears to him to remain unchanged, but dominated by an administration of an ambitious kind. A further season is to be devoted to the exploration of the site, when one of the principal tasks will be the exploration of the Roman eastern gate and the elaborate prehistoric structures which lie beneath.

Egypt and Asia under the Twelfth Dynasty

A DISCOVERY of no little importance in its bearing on the relations of Ancient Egypt and Asia under the Middle Kingdom is reported from Toud, the ancient Tuphium, twenty-five miles south of Luxor, where an expedition of the Institut Français d'Archéologie Orientale is now at work. According to a dispatch from the Cairo correspondent of *The Times* in the issue of March 2, four small bronze caskets have been found which contain a tribute from Asia to Amenemhet II, one of the Pharaohs of the Twelfth Dynasty who reigned from 2000 to 1790 B.C. They were excavated from sand among the foundations of a temple of Mont, the god of war. The contents of the caskets are lapis lazuli beads and amulets, and ingots of gold, silver and lead. The amulets are said to be of a type hitherto unknown in Egypt. In addition to figures of Asiatic divinities, a human-headed eagle and a winged lion, each of the boxes contained a cylinder with a cuneiform inscription, which has not yet been deciphered.

Imperial Standards

THE periodical comparison of the Standards of Length and Mass with the Parliamentary copies was due in 1932, and the Board of Trade has just issued a report of 56 pages on the results obtained. The work has been carried out in the Metrology Department of the National Physical Laboratory. As compared with the measurements made in 1922, the four parliamentary copies of the Standard Yard have decreased in length as compared with the Standard itself by 28 millionths of an inch, a change which must be attributed in part at least to an increase in length of the Standard Yard. The British copy of the metre has been compared with the Sèvres copies of the Prototype Metre and has been found 0·66 parts in a million short, as compared with 0·60 parts in 1922. Two other copies have retained the lengths they had in 1922. Four Parliamentary copies of the Standard Pound weigh 3·6 and 1·1 thousandths of a grain more, and 0·7 and 3·0 thousandths less than the Standard respectively, the changes since 1922 being slight. The British National copy of the kilogram has been compared with the International Prototype and found to be 58 millionths of a gram too heavy, in good agreement with the 1922 value. The pound has been remeasured as 453·592338 grams. It is highly desirable that a new series of pound weights should be constructed of more stable materials than the present standards.

Diesel Engines for Road Transport

A COMPREHENSIVE statement of the present position of the Diesel engine in its application to road vehicles was given by Major Goddard in a paper presented at a joint meeting of the East Midland Section of the Institute of Fuel and the Institution of Mechanical Engineers at University College, Nottingham, on February 20. It is almost eight years since the first Diesel-engined vehicles, two demonstration lorries imported by the Daimler Benz Co., from Germany, were seen in Great Britain and, in the interval, this class of vehicle has been adopted by many transport companies. It is estimated that the number in operation in Great Britain is approximately 12,000; more than 900 London buses have already been fitted with Diesel engines, and the rest are being converted as quickly as circumstances permit; the magnitude of the change that is taking place so unobtrusively is probably little realised by the general public. This rapid adoption of the engine in commercial vehicles and, still more, the appearance of a Diesel-engined car—a Bentley with Gardner engine—in the Monte Carlo Rally in 1933, when it gained one of the awards, give a general interest to the information Major Goddard brought together in his paper. After setting out in detail the advantages of this type over the petrol engine, he discussed the conditions under which combustion is controlled and gave figures relative to fuel consumption and economy, speeds and maintenance costs. From these, a clear idea as to current practice and performance can be obtained. In dealing with the advantages of conversion of petrol-engined vehicles to the newer system, given a

thoroughly reliable make of engine, the saving on fuel alone over a period of five years was stated to be rather more than twice the initial cost of conversion.

Suggested Museum for Croydon

CROYDON now has an excellent opportunity of building a museum worthy of the town. A large area of ground of several acres has lately been acquired from the Southern Railway Company, but at present the proposed lay-out of the area does not foreshadow a museum. There will be a technical college, art school, with other public buildings, and the Corporation could now very appropriately consider the establishment of a museum. The large bequest of Dr. Franklin Parsons of a good many years ago is still unexhibited, and the small museum at Grangewood Mansion has been from time to time curtailed, in order to provide schoolrooms. There is a wealth of material waiting to find a place in a public museum, and the educational facilities of the town are not complete until it possesses a well-stocked museum. The population of the borough approaches a total of a quarter of a million, and it must be difficult to find a borough of the same dimensions that has so far not seen fit to equip itself with a suitable museum. Now a site offers itself, and it is to be hoped that the Corporation will rise to the occasion.

B.M.A. Fund for Research in Australia

A CORRESPONDENT in Melbourne writes: "Readers of NATURE may be interested to know that the British Medical Association meeting in Melbourne in September last wound up with a surplus of about £1,500. This has been offered to, and gratefully accepted by, the University of Melbourne as the nucleus of a special fund for medical research. We have in Melbourne two excellent medical research organisations, namely, the Walter and Eliza Hall Institute at the Royal Melbourne Hospital and the Baker Institute at the Alfred Hospital. But some of us feel that we want a fund which can be devoted to the aid of someone recommended for a particular piece of work terminable when the work is finished. The members of the permanent staff of these institutes have a good deal of routine work to do—essential and valuable—but here and there someone is found who wants to extend the boundaries of knowledge and wants help and guidance. Hence this fund, of which we are somewhat proud, as Congresses do not generally end with a credit balance. The senior medical men worked hard and organised excellently."

Nationalism and Soil Erosion

A STRIKING connexion between physical geography and economic policy is outlined by Prof. C. F. Shaw in the *Geographical Review* for January. He points out that the upland soils of much of Great Britain are shallow. In England and Wales they average twenty-five inches in depth and in Scotland, where glacial deposits are more general, forty inches. Chalk soils of southern England are the thinnest, averaging only ten inches. On all these upland soils erosion, though not conspicuous, is active. Evidence is obtainable from remains of Roman occupation and other sources as shown at the recent International Congress of Soil Science held at Oxford. Prof. Shaw's contention is that economic pressure, exerting itself in increased grain production in the home country, will entail the ploughing of sloping uplands, which will loosen the soil cover and so promote more active erosion. This will in turn impoverish the uplands and cause further deposition of soil on the lowlands. A sounder economic policy is in his opinion the preservation of the thin upland soils by maintaining them under grass, which would at least ensure their continued usefulness as grazing grounds for food animals.

Insurance Against Price Fluctuations

DISCUSSING some statistical aspects of future trading on a community exchange, Mr. G. R. White, in a paper read recently before the Royal Statistical Society, remarked that, during the past ten years, 'future' trading has spread rapidly and now covers commodities such as coffee, cocoa, sugar, butter, eggs, pepper, vegetable oils, shellac, wool tops, hides, rubber, silk, jute, tin, copper and zinc, in addition to grain and cotton, in which future trading has been an established practice for upwards of seventy years. Supporters of the system claim that, among other things, future trading reduces major fluctuations in prices, and provides a method of price insurance through 'hedging'. Mr. White, selecting for the purpose of his investigation future trading in hides, controverted this assumption; he concludes that there is no evidence that fluctuations in the price of hides have been reduced since a future exchange was established for this commodity in New York in 1929. In fact, he says the evidence trends in the opposite direction. 'Hedging' on the Hide Exchange has only provided imperfect price insurance. He suggests that more attention should be paid to evolving a method of insurance more akin to that evolved for other insurable risks, and taking data of the past fourteen years, he calculates that the premiums necessary to insure over a period of twenty weeks against either a fall or rise in price would not be prohibitive.

Malvern College Natural History Society

THE twelfth report of this Society (1935) contains an article by J. W. B. Waring on minute pond organisms, well illustrated by original drawings from the living material, both plant and animal. The author has collected samples of ooze from a number of ponds including an artificial gold fish pond in his garden, and records his own observations on the life in these ponds. Such work is valuable, and should be encouraged in every way. An article on the history of the Malvern College Natural History Society shows that it dates from 1868, when the Malvern Naturalists' Field Club was transferred to the College. The present membership is thirty-six, and it is to be hoped that the number will increase considerably.

Botanical Acquisitions at the British Museum

THE Department of Botany of the British Museum (Natural History) has received 430 plants collected by Miss Nancy Lindsay and Mrs. A. Fullerton in Iran, principally from the Elburz Mountains, an area which has been little worked. The collection is accompanied by useful notes and by a number of excellent water-colour paintings of the more attractive plants by Miss Lindsay. The Biological Department of the Medical College, St. Bartholomew's Hospital, has presented its botanical herbarium. It is in twelve volumes and contains about eight hundred well-mounted sheets. The collection was apparently got together between 1823 and 1844; the majority were collected by T. R. Tuck, although a large number bear the names of the Rev. Prof. J. S. Henslow and C. C. Babington. The Hon. Mrs. de Beaumont has presented the botanical press of A. L. de Jussieu. This interesting historical relic is strongly constructed of mahogany, and resembles a copying press. It takes only a small sheet, such as those of the herbarium of de Jussieu in Paris.

Research in Tropical Medicine

A TROPICAL Medical Research Committee has been appointed by the Medical Research Council in consultation with the Colonial Office. The new committee will advise and assist in the direction of such investigations as the Council may be able to promote, whether at home or abroad, into problems of health and disease in tropical climates, and make suggestions generally as to research in this field. The Committee is to be a purely scientific body. It will include representatives of the Colonial Office and of the Liverpool and London Schools of Tropical Medicine, with other members appointed as individual experts in tropical medicine or in different branches of medical science. The following will serve in the first instance: Prof. J. C. G. Ledingham (*Chairman*), Prof. A. J. Clark, Dr. N. Hamilton Fairley, Prof. W. W. Jameson, Dr. Edward Mellanby, Dr. Muriel Robertson, Sir Leonard Rogers, Dr. H. Harold Scott, Sir Thomas Stanton, Dr. C. M. Wenyon, Prof. Warrington Yorke, and Dr. A. Landsborough Thomson (*Secretary*).

University of Heidelberg

WRITING with reference to the letter "Heidelberg, Spinoza and Academic Freedom" in NATURE of February 29, p. 364, a correspondent states that the solemn presentation of the charter to the Elector Palatine took place on June 24, 1386, and suggests that this date is an appropriate one to have in mind in connexion with the celebrations to be held in the University of Heidelberg in June next. October 19, 1936, would appear to be the opening of the 551st academic year, not the 550th, as stated in Miss Gardiner's letter. It is now stated (*The Times*, March 3) that the Rector of the University of Heidelberg has sent a letter to universities and academies in Great Britain (with the exception of Cambridge) which have received invitations to participate in the celebrations, withdrawing the invitations. In the course of his letter, the Rector says: "a number of English personalities have to our great regret confused before the public at large their own political opinions with the academic character of the invitation of the University of Heidelberg to its 550th anniversary celebrations and thus deprived the latter of its true meaning. By such action it appears to me that public opinion has been influenced in such a manner as to make it difficult for an Englishman to accept an invitation which has been sent in a friendly spirit".

New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 2, the following ordinary fellows were elected: Prof. Thomas Alty, Applied Physics Department, University of Glasgow; Dr. L. E. Bayliss, lecturer in biophysics, University of Edinburgh; Dr. John Berry, research officer, Avon Biological Research, University College, Southampton; Prof. Duncan McC. Blair, Department of Anatomy, University of Glasgow; Mr. A. J. Brown, lecturer in metallurgy and demonstrator in radiology, Edinburgh Dental Hospital and School; Sir Robert Bruce, editor of the *Glasgow Herald*; Dr. William Bryden, lecturer in biology, Technical College, Christchurch, New Zealand; Dr. A. M. Cockburn, assistant, Geological Department, University of Edinburgh; the Right Hon. Thomas Mackay Cooper, His Majesty's Advocate for Scotland; Mr. R. C. Cowan, paper manufacturer, Penicuik; Mr. C. J. T. Cronshaw, managing director, Dyestuffs Group, Imperial Chemical Industries, Ltd., Manchester; Mr. J. F. Fairweather, fiscal of the Society of Writers to the Signet, Edinburgh; Dr. S. G. Gibbons, naturalist, Fishery Board, Aberdeen; Dr. W. J. Hamilton, lecturer in anatomy and deputy-director, Anatomy Department, St. Thomas's Hospital Medical School, London; Prof. D. K. Henderson, Department of Psychiatry, University of Edinburgh; Mr. Thomas Henderson, secretary to the Educational Institute of Scotland, Edinburgh; Dr. A. Fergus Hewat, secretary, Royal College of Physicians, Edinburgh; Mr. Donald E. Innes, reader in geology, University of St. Andrews; Dr. John McQ. Johnston, pharmacologist, Department of Health for Scotland, Glasgow; Mr. C. H. Kemball, dental surgeon, lecturer on orthodontics, Edinburgh Dental Hospital and School; Dr. P. L. M'Kinlay, medical officer (statistics), Department of Health for Scotland, Clydebank; Dr. John M'Michael, lecturer in physiology, University of Edinburgh; Dr. William McRae, (lately agricultural adviser to the Government of India and director, Agricultural Research Institute, Pusa, India), Edinburgh; the Very Rev. J. Harry Miller, principal, St. Mary's College, University of St. Andrews; Mr. Francis More, chartered accountant, Edinburgh; Dr. D. Owen Morgan, lecturer in helminthology, Department of Zoology, University of Edinburgh; Principal W. G. R. Paterson, West of Scotland College of Agriculture, Glasgow; Dr. D. S. Raitt, naturalist, Fishery Board for Scotland, Aberdeen; Prof. L. P. W. Renouf, Department of Zoology,

University College, Cork, and director of the Biological Station; Dr. James Robb, secretary to the Carnegie Trust for the Universities of Scotland, Edinburgh; Lieut.-Colonel A. D. Stewart, superintendent, Royal Infirmary, Edinburgh; the Very Rev. C. L. Warr, Dean of the Thistle and of the Chapel Royal in Scotland, Chaplain to H.M. The King; Andrew Whyte, chartered accountant, Darlington.

Announcements

THE following have been elected members of the Athenæum Club under the provisions of Rule II, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service: Prof. N. H. Baynes, professor of Byzantine history, University of London; Sir Patrick Laidlaw, member of the scientific staff of the National Institute for Medical Research; Sir Stephen George Tallents, controller of the Public Relations and Publications Departments, British Broadcasting Corporation.

MR. FREDERICK CHAPMAN, of the National Museum, Melbourne, has recently retired from the post of Commonwealth palæontologist. Mr. Chapman, who is an associate of the Linnean Society of London, is an authority on the Foraminifera and also on Australian fossils. He has recently been searching for oil in Australia, and hopes to carry on this work in a private capacity. He is being succeeded in the office of Commonwealth palæontologist by Miss I. Crespin.

PROF. PETER H. BUCK, Bishop Museum professor of anthropology in Yale University, has been appointed director of the Bernice P. Bishop Museum at Honolulu and professor of anthropology in Yale. He will thus succeed Prof. Herbert E. Gregory, professor of geology in Yale University, as director of the Museum. The Museum is affiliated to the University for the study of the anthropology and natural history of the Pacific islands.

MR. F. Le Gros Clark, secretary of the Committee against Malnutrition, will deliver a lecture on "Men, Medicine and Food in the U.S.S.R." (under the auspices of the Society for Cultural Relations) in the rooms of the Royal Society of Arts, 18 John Street, Adelphi, Strand, W.C.2, on March 12 at 8 p.m. The chair will be taken by Prof. Julian Huxley. This meeting follows the discussion in recent League of Nation's publications of the public food service in the Soviet Union, and the subsequent visit to that country of associates of the Committee against Malnutrition. A special bulletin will be on sale, price 1*d*. Tickets at 1*s*. and 6*d*. can be obtained from the Hon. Secretary, Committee against Malnutrition, 19c Eagle Street, Holborn, W.C.1.

THE new laboratories of the Research Department of the Institution of Automobile Engineers, which is one of the co-operative research organisations supported by the Department of Scientific and Industrial Research, will be opened on March 18 by Lord Rutherford.

FOLLOWING a meeting on December 13 of interested bodies, the Society of Engineers has decided to form an Agricultural Engineering Section. This Section has been formed for the reading and discussion of papers, the publication of transactions and the formation of a library. Its work, therefore, will not overlap that of the Agricultural Engineers' Association, which deals with the commercial side of agricultural engineering. Further information can be obtained from the Secretary, Society of Engineers, 17 Victoria Street, Westminster, S.W.1.

THE Albert Brachet prize of 15,000 francs for the triennium January 1, 1935–December 31, 1937, is offered for the best work on embryology published during this period in French, Dutch, English, German or Italian. Further information can be obtained from the Perpetual Secretary of the Royal Academy of Sciences, Literature and Fine Arts, Palais des Académies, Brussels.

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

A junior research assistant for investigations on blast furnace reactions at Imperial College, London—The Secretary, Iron and Steel Industrial Research Council, Caxton House, Tothill Street, S.W.1 (March 7).

A research assistant and advisory officer in plant husbandry, a research assistant in chemistry and a research assistant in zoology in the West of Scotland Agricultural College—The Secretary, 6 Blythswood Square, Glasgow (March 11).

A district forest officer (male) in H.M. Forestry Commission—The Secretary, Forestry Commission, 9 Savile Row, London, W.1 (March 12).

Heads of the Departments of Engineering and Science in the South-East Essex Technical College, Dagenham—The Director of Education, County Offices, Chelmsford (March 14).

A lecturer in civil engineering in the Portsmouth Municipal College—The Registrar (March 21).

Ten temporary civilian engineers for the Military Engineer Services, India—The Under-Secretary of State, Military Department, India Office (March 28).

An assistant in ethnology in the Colombo Museum, Ceylon—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (March 31).

A University professor of biochemistry in St. Bartholomew's Hospital Medical College (March 31) and a University reader in anatomy in the London Hospital Medical College (April 15)—The Academic Registrar, University of London, S.W.7.

A lecturer in anthropology, with experience of India and a knowledge of Indian peoples, in the University of Cambridge—Prof. E. H. Minns, Pembroke College, Cambridge (May 31).

Architectural and civil engineering assistants in the drawing offices at the Admiralty and H.M. Dockyards—The Civil Engineer-in-Chief, Whitehall, S.W.1.

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. 407.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Masses of Light Atoms

THE redetermination of the masses of several of the light nuclei announced recently by Aston[1] has led to mass-spectroscopic values which are in good agreement with those deduced from atomic transformation data[2]. The accuracy of these new masses is probably very high, and it is of interest to recalculate the masses of the other light atoms from the very accurate transformation data now available. The accompanying table gives the masses obtained in this way.

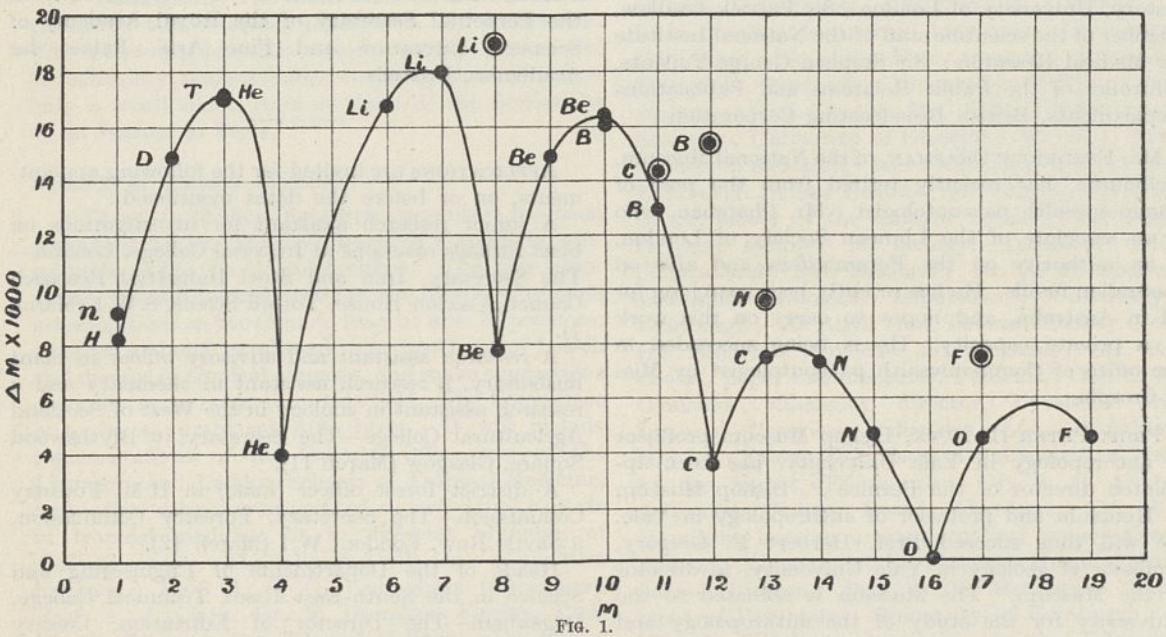


FIG. 1.

Atomic species	Mass	Atomic species	Mass
n	1·0091	^{11}B	11·0128
^{1}H	1·0081*	(^{12}B)	(12·0153)
^{2}D	2·0147*	(^{11}C)	(11·0143)
^{3}T	3·0171	^{12}C	12·0036*
^{3}He	3·0171	^{13}C	13·0073
^{4}He	4·0039*	(^{13}N)	(13·0096)
^{6}Li	6·0167	^{14}N	14·0073*
^{7}Li	7·0180	^{15}N	15·0048
(^{8}Li)	(8·0190)	^{16}O	16·0000
^{8}Be	8·0078	^{17}O	17·0046
^{9}Be	9·0149	(^{17}F)	(17·0073)
^{10}Be	10·0164	^{19}F	19·0045
^{10}B	10·0161		

Elements given in brackets are radioactive, and the masses are known only very approximately. Values marked with an asterisk are those given by Aston, the mass of ^{14}N being privately communicated and not yet published. The other masses have been calculated through appropriate transformation data. No estimate of the accuracy is given, but it is improbable that the error can exceed 0·0003 units in any case.

The mass found for the neutron is much greater than has generally been assumed, as it is heavier than the hydrogen atom by approximately the mass of two electrons, or heavier than the proton by almost three times the mass of the electron. The value given is the mean of the masses obtained from three different transformations which give very concordant results, and it agrees almost exactly with that deduced from the photo-electric disintegration of deuterium, using the mass given by Aston and the energy released as given by Chadwick and Goldhaber[3], and by Feather and Bretscher[4]. It is not in agreement with a recent determination of this energy release by Ising and Helde[5]. The apparent high mass of the neutron at once raises the question of its stability, though no observations so far reported suggest that it can change spontaneously into a proton with the emission of an electron.

We have plotted the departure of the mass from a whole number in terms of ^{16}O = 16·0000, against the mass-number (Fig. 1), and it is seen that we obtain a smooth curve showing repeated oscillations. This curve indicates that if we imagine the stable atomic species to be built up from hydrogen by successive additions of single particles, proton or neutron, the most strongly bound atoms are ^{4}He, ^{8}Be, ^{12}C, ^{16}O, ^{20}Ne, etc. It is difficult to avoid the

conclusion that this greater stability of these atoms implies the existence of units of mass 4—α-particles—in the nucleus itself, or at any rate that some peculiarly stable configuration is reached with the addition of the components of an α-particle, at least for the light elements. The unstable radioactive nuclei are seen to lie above the curve, but the masses of these particles are not known well enough to be able to say whether they form any simple sequence, or show any simple relations with the stable nuclei.

It is worth noting that the mass of ^{3}T is almost exactly the same as that of ^{3}He, and the same holds approximately for the other pair of isobars, ^{10}Be and ^{10}B. It will be of interest to see whether the same equality of mass is preserved among isobars of heavier atoms. The mass of ^{8}Be appears to be almost exactly equal to the sum of the masses of two α-particles. The evidence is that this isotope is quite stable, as it appears in several reactions as a recoil nucleus with a kinetic energy which is high compared with the extremely small apparent binding energy. This may perhaps be regarded as evidence against the assumption that α-particles exist as separate entities inside the nucleus.

The only mass-number missing appears to be 5. If a nucleus of this mass can exist, it must be either ^{5}He or ^{5}Li, and the first of these is the more probable. The general form of the curve suggests that the mass of ^{5}He will be close to 5·0125. This mass would make ^{5}He a normal stable isotope of helium, while ^{9}Be would be stable against spontaneous disintegration into ^{5}He and ^{4}He. We have so far been unable to detect ^{5}He as a product of atomic transformations, but it seems probable that this mass-number will be found to exist.

M. L. OLIPHANT.

Cavendish Laboratory,
Cambridge.
Feb. 24.

[1] NATURE, **137**, 357 (1936).
[2] *Proc. Roy. Soc.*, A, **150**, 241 (1935); Bethe, *Phys. Rev.*, **47**, 633 (1935); Cockcroft and Lewis, *Proc. Roy. Soc.*, A (in press).
[3] NATURE, **134**, 237 (1935); *Proc. Roy. Soc.*, A, **151**, 479 (1935).
[4] NATURE, **136**, 468 (1935).
[5] NATURE, **137**, 273 (1936).

Theoretical and Experimental Laue Patterns from Bent Sodium Chloride Crystals

IN this note a method of quantitative calculation and construction of Laue patterns from bent sodium chloride crystals is proposed, which is in good agreement with experiment. It is known[1] that when a crystal rod is subjected to tension or pressure, the angle between the direction of the force and the direction of slipping tends respectively to decrease or to increase.

If μ_0 is the angle between the direction of the force and direction of slipping before the deformation; μ, the same angle after the deformation; l_0, the length of the rod before the deformation; l, its length after the deformation, then

$$\sin\mu = \frac{\sin\mu_0\, l_0}{l} = \sin(\mu_0 \pm \Delta\mu).$$

If $\Delta\mu$, the angle through which the direction of slipping or of the orientation of the crystal is rotated with respect to the initial orientation, is small, then

$$\Delta\mu = \frac{l_0 - l}{l}\tan\mu_0 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Consider the case of a circular bending of a sodium chloride crystal rod with a rectangular cross-section about the direction [100]. Such bending is usually characterised by the predominance of one plane of slipping, for example, of the plane $(0\bar{1}1)$. Polar co-ordinates ρ and u for the determination of any point in the crystal are introduced (see Fig. 1). The origin of co-ordinates is placed in the neutral layer and the Z axis is directed along the radius of bending of the rod; the angle u being reckoned from the Z axis.

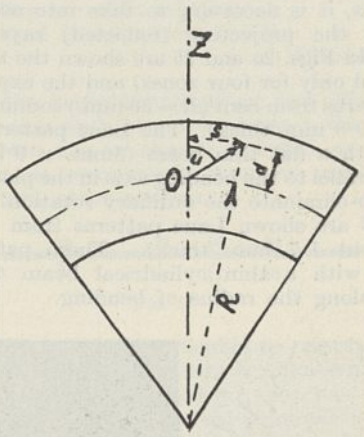


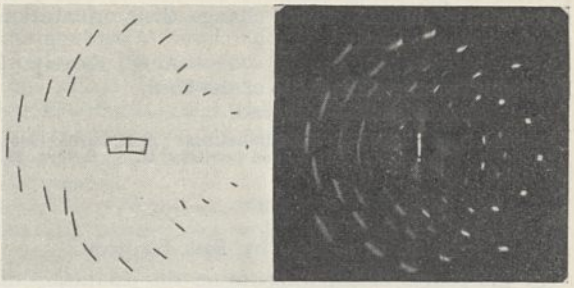
FIG. 1.

Any portion of the crystal at the point (ρ, u) rotates owing to the bending with respect to the origin O about the axis [100]. The total rotation $\Delta\psi$ consists in the ordinary rotation $\Delta\varphi$ about [100] and the crystal rotation $\Delta\mu$ also about [100].

The ordinary rotation is

$$\Delta\varphi = \frac{S}{R + d} \quad . \quad . \quad . \quad . \quad (2)$$

where R is the radius of the neutral layer, d is the distance between the point under consideration and the neutral layer, S the arc of the circle with radius $R + d$ enclosed between the Z axis and the point under consideration.



a b

FIG. 2.

The crystal rotation can be calculated using equation (1). Instead of l we put l_d, the length of the layer at the distance d from the neutral layer.

$$l_d = l_0\left(1 + \frac{d}{R}\right).$$

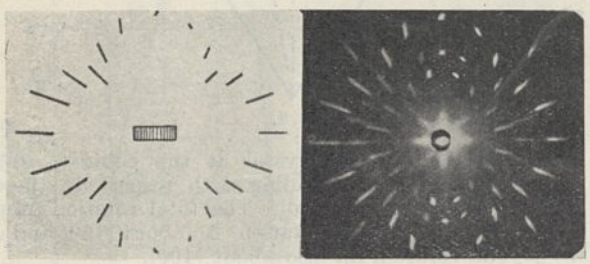
As in this case the angle $\mu_0 = 45°$, then

$$\Delta\mu = \frac{\pm\, d/R}{1 \pm d/R}.$$

Introducing polar co-ordinates, we obtain the total rotation $\Delta\psi$ with respect to the origin of co-ordinates as follows:

$$\Delta\psi = \Delta\mu + \Delta\varphi = \frac{\frac{\rho}{R}\cos u}{1+\frac{\rho}{R}\cos u} + \frac{\frac{\rho}{R}\sin u}{1+\frac{\rho}{R}\cos u} \quad . (3)$$

The construction of Laue patterns is reduced to the construction of reflection projections of the irradiated volume on the plane normal to the direction of the X-ray beam. In the construction of these projections, it is necessary to take into account the fact that the projecting (reflected) rays are not parallel. In Figs. 2*a* and 2*b* are shown the theoretical (calculated only for four zones) and the experimental Laue patterns from bent ($R = 26$ mm.) sodium chloride crystals (0·8 mm. thick). The Laue patterns are obtained with a flat thin beam (3mm. × 0·2 mm.) of X-rays parallel to the bending axis in the plane of axial section, to eliminate the ordinary rotation. In Figs. 3*a* and 3*b* are shown Laue patterns from the same crystal (but 1·7 mm. thick). These patterns are obtained with a thin cylindrical beam of X-rays directed along the radius of bending.



a *b*

FIG. 3.

It is evident that experimental and theoretical Laue patterns are identical. The very small difference in the length of the theoretical and experimental Laue spots is explained by the divergence of the beam and the transverse deformation.

The coincidence of the theoretical and experimental Laue patterns shows that the crystal in the process of plastic deformation behaves as a mosaic aggregate of blocks, which change their orientation nearly independently[2].

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Sosnovka 2, Leningrad.

[1] Schmid, E. und Boas, W., "Kristallplastizität", p. 62, Berlin (1935).
[2] Joffe, A., Kirpitschewa, M. W. und Lewitzky, M. A., *Z.Phys.*, 22, 286 (1924).

Excitation of γ-Rays by Fast Neutrons

IN the course of experiments on the excitation of γ-rays by slow neutrons already reported, we have noticed that in some cases an appreciable amount of observed γ-rays was due to fast neutrons. Recently, we have investigated the emission of γ-rays by the bombardment of fast neutrons, and have obtained an interesting result as to the correlation of the cross-section for the exciting γ-rays with the atomic number. The experimental arrangements were essentially the same as those already described. The substance to be examined was surrounded by B_2O_3, and we believe that most of the neutrons reaching the substance retained their initial energy, which was about 2×10^6 e.v., in our case of D–D neutrons. The result is tabulated in an accompanying table. The figures given in the second column are the relative cross-section per atom in an arbitrary scale. The γ-ray activity did not remain after the bombardment was ceased.

TABLE 1.

3	Li	− 0·04 ± 0·4	26	Fe	2·2 ± 0·2
6	C	− 0·1 ± 0·3	27	Co	2·1 ± 0·34
7	N	− 0·05 ± 0·3	28	Ni	1·3 ± 0·2
8	O	− 0·01 ± 0·1	29	Cu	2·6 ± 0·2
9	F	0·68 ± 0·15	30	Zn	2·6 ± 0·4
11	Na	0·60 ± 0·23	35	Br	2·5 ± 0·3
12	Mg	0·05 ± 0·23	47	Ag	5·5 ± 0·3
13	Al	0·42 ± 0·1	48	Cd	11·8 ± 1·0
15	P	0·43 ± 0·1	50	Sn	5·1 ± 1·1
16	S	0·39 ± 0·1	51	Sb	8·1 ± 1·0
17	Cl	0·05 ± 0·2	53	I	6·1 ± 1·2
19	K	0·05 ± 0·3	56	Ba	− 0·6 ± 1·5
20	Ca	− 0·16 ± 0·20	79	Au	6·1 ± 1·2
22	Ti	1·2 ± 0·3	80	Hg	5·4 ± 2·4
24	Cr	3·0 ± 1·1	82	Pb	0·2 ± 0·3
25	Mn	1·7 ± 0·4	83	Bi	1·0 ± 1·1

We shall first consider the elements with atomic number Z lower than 30. For $Z \leqslant 8$ the cross-section is so small that we could detect no γ-rays. At $Z = 9$ the emission becomes suddenly noticeable, and the cross-section decreases then with the increasing atomic number up to $Z = 16$ (with the exception of Mg). At $Z = 17$ it falls suddenly down to zero and remains so up to $Z = 20$. An intense emission of γ-rays begins again at $Z = 22$. (The element $Z = 21$ was not investigated.)

Thus we notice discontinuities at 8–9, 16–17 and 20–22; that at 16–17 is not so prominent, and it needs further precise measurement before we can decide as to its reality. The position of these discontinuities coincides with the positions where the regularity in the scheme of the stable isotopes changes discontinuously. This coincidence may not be merely an accidental one, or it may be deeply connected with the internal structure of the atomic nuclei of light elements.

On account of the small number of elements investigated, we cannot draw further conclusions as to the elements of high atomic number, except to say that the cross-section does not seem to be a smooth function of the atomic number. The absolute value of the cross-section is roughly estimated to be of the order of 10^{-24} cm.^{2} for copper. Our results are not directly comparable with those of Lea on account of the difference in energy of the neutrons.

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Jan. 10.

A Provisional Map of a Human Chromosome

BY studying the simultaneous segregation of several genes in multiple heterozygotes, chromosome maps have been constructed for *Drosophila*, *Zea* and a few other organisms, and it has been shown that the order of the genes so deduced corresponds to a physical reality. It seemed likely that such maps could only be constructed very slowly for man, since very few pedigrees record the segregation of more than one gene at a time. In spite of this, indications of linkage between pairs of autosomal genes have been secured by Penrose[1] and Bell[2].

Sex segregates in all pedigrees, and complete sex linkage was therefore early detected. A number of genes, such as those for colour-blindness and hæmophilia, are known to be located in that part of the X chromosome which is specific to it and does not form chiasmata with the Y. But Koller and Darlington[3] showed that another segment of the X chromosome in the rat is homologous with a corresponding segment of the Y, and forms chiasmata with it. The human sex chromosomes are probably similar. Thus if any genes are located in this segment, they will exhibit incomplete sex-linkage. If a man inherits such a gene from his father, it will be in his Y chromosome. In the majority of spermatogonial meioses it will remain associated with the Y, in a minority it will cross over to the X. Thus it will be handed down by such men to a majority of their sons and a minority of their daughters. On the other hand, men inheriting such a gene from the mother will transmit it to a majority of their daughters and a minority of their sons. On a cursory examination of human pedigrees, such genes have hitherto passed as autosomal. Incompletely sex-linked genes are known in three Cyprinodont fishes, in *Drosophila melanogaster*, and in the liverwort *Sphærocarpus Donnellii*.

In man, most supposedly autosomal genes investigated by me show no signs of incomplete sex-linkage. Among them are those for blood-group membership, the M and N agglutinogens, and albinism. But six genes appear to be incompletely sex-linked. The probability that the deviations from the numbers expected in the absence of partial sex-linkage could be due to chance ranges between 7×10^{-7} in the case of xeroderma pigmentosum to a little less than 0·01 in that of dominant retinitis pigmentosa.

Three methods of detection are available. In the case of a dominant, a simple enumeration of the children of affected males is sufficient. In the pedigrees of retinitis pigmentosa exhibiting dominance, we have the following distribution of such children :

Of like sex with affected grandparent	Affected	81
	Normal	60
Of unlike sex with affected grandparent	Affected	64
	Normal	83

However, it is clear that the linkage is restricted to certain pedigrees, and in them there appears to be about 33 per cent crossing-over.

In the case of a rare recessive, the parents will clearly be relatives in many cases. If the father is related to the mother through his own father, the recessive gene must be in his Y chromosome. If the parents are related through the father's mother, it must be in his X chromosome. Hence if p be the frequency of crossing-over, we have the following expectations :

	Male		Female	
	Normal	Affected	Normal	Affected
Relationship through father's father	$1+p$	$1-p$	$2-p$	p
Relationship through father's mother	$2-p$	p	$1+p$	$1-p$

Of course, however, the frequency of affected persons will be greater than this because families including no recessives are not detected. Applying this test to the progeny of consanguineous unions including one or more sufferers from achromatopsia (total colour-blindness with photophobia) we find :

Of like sex with relating paternal grandparent	Normal	4
	Affected	8
Of unlike sex with relating paternal grandparent	Normal	6
	Affected	1 ?

Even if the doubtful individual was affected, the probability that such large deviations in the expected direction were due to chance is 0·008, and in this case there is somewhat stronger confirmatory evidence from other sources.

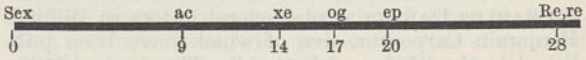

FIG. 1.

The third method is applicable to recessives when the relationship of the parents is unknown. It was originally devised by Bernstein[4], but has been improved by Fisher[5]. Its general principle is obvious from the fact that in cases of partial sex-linkage, the mean product of the numbers of affected males and females will be less than in the absence of linkage. Thus two typical families segregating for xeroderma pigmentosum are :

Males		Females	
Normal	Affected	Normal	Affected
1	3	4	0
4	0	1	3

In every case the cross-over frequency can be approximately calculated, and is given in Fig. 1, where no allowance is made for double crossing-over, and it is assumed that the genes for dominant and recessive retinitis pigmentosa are allelomorphic. The characters determined by these genes are :

Achromatopsia (total colour-blindness). Recessive.
Xeroderma pigmentosum (severe light sensitivity of the skin). Recessive.
Oguchi's disease (night blindness with golden retinal pigmentation). Recessive.
Epidermolysis bullosa dystrophica (skin disease). Recessive.
Retinitis pigmentosa without deafness. Recessive.
Retinitis pigmentosa without deafness. Dominant (some pedigrees only).

The data have mainly been obtained from the pedigrees collected by Bell[6], Komai[7], Cockayne[8] and Siemens and Kohn[9]. The locations of Oguchi's disease and epidermolysis are very uncertain. The above map only applies to spermatogenesis. For oogenesis it would be extended to the left.

It is obvious that much further work, and rigorous criticism of various assumptions, will be needed before the above map, or even the existence of incomplete sex-linkage, can be regarded as proved. Nevertheless, I think the data on xeroderma and achromatopsia would have been accepted without question had they

indicated linkage with autosomal genes such as those for blood-group membership.

A full account of the research will be published in the *Annals of Eugenics*, and further investigations are being undertaken.

J. B. S. HALDANE.

Department of Genetics,
University College,
London, W.C.1.

[1] Penrose, *Ann. Eugen.*, **6** (1935).
[2] Bell, *Treas. Human Inher.*, **4** (1936).
[3] Koller and Darlington, *J. Gen.*, **29**, 159.
[4] Bernstein, *Z. Abst. Vererb.*, **5** (1931).
[5] Fisher, *Ann. Eugen.* (in the press).
[6] Bell, *Treas. Human Inher.*, **2** (1933).
[7] Komai, "Pedigrees of Hered. Dis. and Abnormals, found in the Japanese Race". Kyoto (1934).
[8] Cockayne, "Inherited Abnormalities of the Skin and its Appendages". Oxford (1933).
[9] Siemens and Kohn, *Z. Abst. Vererb.*, **38** (1925).

Three Unpublished Letters of Charles Darwin

CHARLES DARWIN wrote several letters to William Benjamin Carpenter, five of which have been published in the "Life and Letters". The original MSS., eight in number, came to me on the death of my uncle, Joseph Estlin Carpenter, the last surviving son of William Benjamin, and I have presented them to Down House for preservation by the British Association.

A small misprint in the "Life and Letters", volume 2, page 262, may now be corrected. The bottom line of that page gives the word "limbs", instead of "lambs" which obviously makes better sense.

The three unpublished letters are of some interest. The first is headed "Down, Bromley, Kent. June 17th", but the year is not given, though it may be surmised from the subject. The first two-thirds concern the recovery from illness of his daughter, and Darwin then continues:

"I have been of late sufficiently well pitched into to please anybody, about my Book. But I care very little, which I entirely and absolutely owe to the generous and kind support of a very few men. When I reflect, as I often do, that such men as Lyell, yourself, Hooker, and Huxley go a certain way with me nothing will persuade me that I am so wholly and egregiously in error as many of my reviewers think. *Pray* do not trouble yourself to answer this—my dear Carpenter."

The second letter, dated April 21, is as follows:

"I read two days ago your article in the last Contemporary, and I must take the pleasure of expressing my extreme interest and admiration of it. This will cause you no trouble, as this most obviously requires no answer. The case of the 3 species of Protozoon (I forget the names) which apparently select differently sized grains of sand, &c. is almost the (most ?) wonderful fact I ever heard of. One cannot believe that they have mental power enough to do so, and how any structure or kind of viscidity can lead to this result passes all understanding.

"Your views on the functions of the brain are also profoundly interesting, but I know not enough for my opinion to be worth a fraction of a farthing. I was, however, speculating on this subject, when writing on Expression, and came to the conclusion that when we actually tasted and thought of a sour taste, the same or some closely related part of the brain must be affected. Had I then known of your views I should have omitted the first alternative. I thank you heartily for the pleasure derived from your article and remain . . ."

The article in the *Contemporary Review* is one entitled "On the hereditary transmission of acquired psychical habits" and will be found in the issue for April 1873 (volume 21, pages 779–795). This is the second of three articles; the first was published in January, the third in May.

"The case of the 3 species of Protozoon" is discussed on p. 784. Carpenter wrote, "Here, then, is most distinct evidence of *selective* power; and the question forces itself upon us,—by what instrumentality is it exercised? . . . It seems . . . difficult to conceive that so artificial an operation can be performed by a mechanism so simple".

The views on the functions of the brain to which Darwin also referred are given as follows on p. 791. ". . . there seems equal reason for believing that when Ideational changes in the Cerebrum give rise to Sensations, they do so by transmitting back to the Sensory Tract, through the *descending* fibres, some 'nervous modification' which those changes involve; thus producing in the Sensorium *the same physical* condition, whatever may be its nature, *as that through which the Sensation was originally excited*".

Darwin's third letter has a pathetic interest as it was written so shortly before his death. Dated February 13, 1882, from Down, it solicited Carpenter's vote on behalf of Mr. Albert Dicey's candidature for the Athenæum Club, and ends "I hope that you are fairly well. We are both growing old men, and I feel as old as Methuselah".

G. D. HALE CARPENTER.

Oxford.
Feb. 1.

Hæmocyanin in Heavy Water

INFORMATION concerning the influence of heavy water on proteins is of interest from both a physiological and a physico-chemical point of view. One is inclined to assume that the observed effect of heavy water on living cells is to some extent due to a change in the protein molecules of the protoplasm. On the basis of the physico-chemical sensitivity of the protein molecule to changes in the environment, one is led to suspect that the replacement of ordinary water by heavy water as a solvent might cause dissociation or association of the molecules. The easiest and most direct way to detect effects of this kind is to submit the protein solutions to an ultracentrifugal study.

As first material for investigation we have chosen the hæmocyanin contained in the blood of *Helix pomatia*. It has the advantage of being a protein of well-defined molecular weight showing marked dissociation-association reactions influenced by hydrogen ion concentration. A series of measurements of the sedimentation constant s for solutions containing various amounts of heavy water gave the result shown in Fig. 1. The experimental values of s corrected for the density and viscosity effects of the salt present (1 per cent NaCl), and reduced to 20° C., decrease continually with increasing D_2O content (full curve). In 100 per cent H_2O, s is about 100×10^{-13}; in 100 per cent D_2O it is about 55×10^{-13}. If we recalculate the data assuming the change in s to be solely due to the increase in density and viscosity of the solvent, we obtain the values of the dotted

line of Fig. 1. Here there is no change in s with the D_2O content (mean $s = 99{\cdot}6 \times 10^{-13}$), showing that at the hydrogen ion concentration used, the hæmocyanin molecule has the same weight and shape in heavy as in ordinary water.

According to previous investigations of the *p*H stability range of the hæmocyanin of *Helix pomatia* in ordinary water, the molecule begins to dissociate reversibly into half molecules at a *p*H of 4·2 on the acid side, and at *p*H 7·6 on the alkaline side of the isoelectric point; and these are further split into quarters at *p*H 8·4. We have repeated these determinations in 94·5 per cent heavy water: the dissociation reactions were found to occur at exactly the

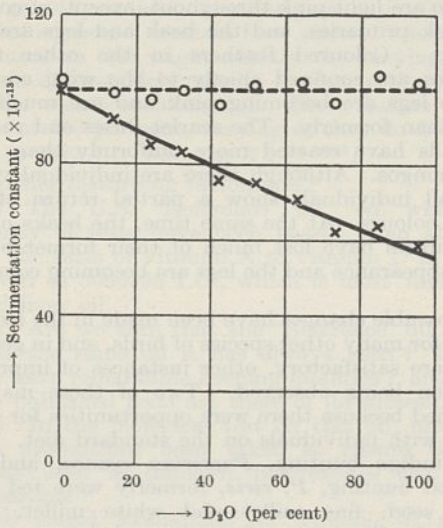

FIG. 1.

same buffer salt concentrations as in ordinary water. Now the deuterium ion concentration must be different from the protium ion concentration in solutions containing the same amounts of buffer salts, and therefore the dissociation points have in reality shifted.

In order to find the amount of this shift a special electro-chemical study was carried out by Prof. C. Drucker of this laboratory, to whom we are much indebted for kindly undertaking these determinations; a complete account of his investigation will be given elsewhere. Using a calomel electrode in ordinary water, in conjunction with, first a deuterium electrode in heavy water, and second a protium electrode in ordinary water, measurements were made of the electromotive force developed in the cells when they contained, in turn, the buffer salts in question (0·2 *M* acetate and phosphate buffers, 0·06 *M* borate buffer with 1 per cent NaCl). Over the range of buffer concentrations used in the ultra-centrifugal study, the observed differences in electromotive force may be interpreted as a shift in hydrogen ion concentration of 0·5 *p*H units, that is, the buffers in heavy water are, according to this interpretation of the measurements, 0·5 *p*H units more alkaline than the corresponding ones in ordinary water. If, therefore, a diagram is traced using *p*H and '*p*D' as abscissæ and the sedimentation constants as ordinates, the stability curve for hæmocyanin in heavy water will appear to be shifted 0·5 units towards the alkaline side compared with the stability curve for hæmocyanin in ordinary water. The simplest way of explaining this result is to assume that the isoelectric point of hæmocyanin has changed by the same amount. We hope to be able to test this hypothesis later and to have, also, the opportunity of extending the investigation to other proteins.

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Jan. 18.

Colloid Osmotic Pressure of the Hæmolymphs of some Terrestrial Invertebrates

As reported some months ago[1], measurements of the colloid osmotic pressure of the body fluids of marine animals gave results which arranged themselves in the order of phylogenetic development. This fact suggested that there exists a rather close relation between the general organisation of an animal and the colloid osmotic pressure of its body fluids. Such a hypothesis requires further confirmation; there arose, in particular, the important question whether this relation subsists when the organisms compared are living in a different surrounding medium.

I have, therefore, measured the colloid osmotic pressures of the hæmolymphs of some terrestrial invertebrates for comparison with the results previously obtained for marine invertebrates.

A series of measurements of the hæmolymphs of five species of pulmonate Molluscs (*Helix vermiculata*, *H. pisana*, *H. aspersa*, *H. aperta* and *H. lucorum*) has given an average value of 1·7 cm. H_2O (extreme values: 1·5 cm. and 1·9 cm. H_2O). The average pressure previously measured of the hæmolymphs of prosobranch Molluscs (*Murex trunculus* and *M. brandarus*) was 1·5 cm. H_2O (extreme values: 1·2 cm. and 1·9 cm. H_2O). The colloid osmotic pressure of the body fluids of marine and of terrestrial gastropod Molluscs is consequently practically identical.

The investigations have been extended to the measurements of the colloid osmotic pressure of the hæmolymph of some Tracheates. Two species of Arachnoids (*Argiope Brünnichi* and *Araneus diadematus*) have shown pressures of 4·1–4·5 cm. H_2O, with an average value of 4·4 cm. The hæmolymph of one species of insects (*Mantis religiosa*) exerts pressures of 5·0–5·4 cm. H_2O. The earlier measurements of the body fluids of seven species of decapod Crustaceans (*Carcinus mœnas*, *Dromia vulgaris*, *Maia squinado*, *Xantho rivulosus*, *Eriphia spinifrons* and *Portunus corrugatus*) had shown values of 3·1–4·3 cm. H_2O (average value: 3·6 cm.). The rise of the colloid osmotic pressure occurring in the arthropod phylum is in striking accord with phylogenetic evolution.

It may be concluded from these results that the relation between the general organisation of an animal and the colloid osmotic pressure of its body fluids is not affected by the transition from one surrounding medium to another, at least so far as sea water and air are concerned. As for fresh water, corresponding measurements are in hand and will be published shortly.

The results obtained with the Arthropods are interesting from still another point of view. From decapod Crustaceans to Tracheates there is a functional regression of hæmolymph, which loses its role in oxygen transport and becomes a mere nutrient solution. This functional regression of the hæmolymph

does not affect its colloid osmotic pressure (not more, incidentally, than the diminution of body size). It seems, therefore, that the colloid osmotic pressure of the body fluids of an animal reflects merely the total of its general organisation, the sum of all particular modifications, progressive and regressive, which have appeared during its evolution.

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[1] NATURE, **136**, 757 (1935). *Compt. rend. Soc. Biol.*, **120**, 303, 305 (1935).

Diet and Colour of Birds

DURING the past year (1935), work was begun to improve the feeding routine of all animal groups at the Zoological Garden in Philadelphia. Efforts are being made to devise food mixtures that are complete in all known essentials, contain a wide variety of materials and allow for seasonal abundance so as to be economical, and are similar in general physical characters to natural foods. From time to time, various factors have necessitated modifications of formulæ, so that complete descriptions of the diets to which reference will be made are better postponed. Eventually records of these studies will be used as the subject matter of a report on methods of feeding wild animals in captivity. In spite of the present incompleteness of the investigation, however, certain effects of changes in diet upon the colours of the plumage of several species of birds seem worthy of record at this time.

It is common knowledge that some species of birds tend to lose colour more or less completely when they are exhibited in zoological gardens. There have been many instances of this change among the avian collection of the Zoological Society of Philadelphia, the more conspicuous examples being the flamingos (*Phœnicopterus ruber*), scarlet ibises (*Eudocimus rubra*) and roseate spoonbills (*Ajaia ajaia*). Under former conditions, the natural colours of these birds began fading with the first moult in captivity. After completion of the second or third moult, the plumage contained practically none of the red colours, and beaks and legs became dirty grey and scaley.

The usual routines of feeding these and other species of birds in zoological gardens naturally omit many elements which serve as food in the wild. At the same time, modern knowledge of nutrition has not been extensively utilised in planning diets. Accordingly, faded plumage may be regarded as evidence of malnutrition.

At the Zoological Garden in Philadelphia, the flamingos, scarlet ibises and roseate spoonbills are exhibited in a large indoor cage, together with ducks, geese, pheasants, sea bulls, gallinules, bitterns and a number of passeriformes. Prior to June 1935, food for this group consisted of chopped meat and fish, cracked corn and wheat, boiled rice, millet and canary seed and chopped apples, bananas and lettuce. The amounts of the different foods were not standardised, so that proportionate parts cannot be stated. The various materials are listed to show availability. Most of the birds in this group, including the varieties mentioned, were known to take portions of each food offered, but records of preferences and consumption were not made.

On June 20, 1935, the diet for the group of birds with which the flamingos, ibises and spoonbills were exhibited was changed to one which supplied a greater variety of proteins, including those from milk and certain legumes, more abundant minerals, especially calcium and phosphorus, and much greater amounts of the fat-soluble vitamins.

At this time there were four flamingos, four scarlet ibises and two roseate spoonbills in the group. These birds began moulting within three months after the food was changed. During the first week of September there appeared to be a slight recolouring of some of the specimens, a change that has progressed, so that after approximately six months on the new rations colours are much more distinct. The feathers of one flamingo are light pink throughout, except, of course, the black primaries, and the beak and legs are also coloured. Coloured feathers in the other three flamingos are confined chiefly to the wing coverts, but the legs are becoming pink and are much less scaley than formerly. The scarlet ibises and roseate spoonbills have reacted more uniformly than have the flamingos. Although there are individual variations, all individuals show a partial return of the natural colours. At the same time, the beaks of the scarlet ibises have lost much of their former black, scaley appearance and the legs are becoming coloured also.

Comparable changes have been made in the feeding routine for many other species of birds, and in general results are satisfactory, other instances of improved coloration being observed. Two of these may be mentioned because there were opportunities for comparison with individuals on the standard diet.

The indigo bunting, *Passerina cyanea*, and the nonpareil bunting, *P. ciris*, formerly were fed with canary seed, fine millet and white millet, with occasional allowances of apple and lettuce. On May 10, 1935, these grains were replaced by mixed foods that were essentially the same as those already mentioned for the first group. The colours in the winter plumage of male indigo buntings, which developed after the change in diet, are typical of the species, instead of the slate grey usually found on birds fed with the seed ration. The depth of colour in the plumage of male nonpareil buntings has also strikingly improved. Particularly noticeable is the deep red of the breast. Formerly this colour was much diluted with yellow.

Which one of the factors, or which combination of factors supplied by the new foods and lacking in the former mixtures, influences the colour or plumage remains to be determined.

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Estimation of Vitamin A

THE correspondence upon this subject which has appeared in NATURE during the last few weeks has directed attention to the extremely unsatisfactory state which those of us who are interested in the matter from a commercial as well as from a scientific aspect have long known to exist.

Although the spectrographic is an accurate and reproducible method of determining vitamin A, in order to eliminate the possibility of the presence of

a second absorbing factor at λ3280 A., the biological test is a necessary check on the physical. It is also a necessity, since it is the biological action of vitamin A which determines its value. (Incidentally, it has been found in this laboratory that while the crest of the absorption band for high vitamin oils lies at λ3280 A., that for certain concentrates, some of them of extremely high vitamin content, lies farther in the ultra-violet in the region of λ3130 A.).

The modern biological test depends upon the measurement of growth, but it is at least doubtful whether vitamin A is primarily a growth-promoting vitamin. It seems possible that the healthy state of epithelial and absorbing surfaces, induced in the animal by vitamin A, enables the absorption of the true growth vitamin, whether present in the oil or in the supposed vitamin-free ration. Some such argument as this might explain the varying factors used in different laboratories for converting spectrographic values to biological. These factors cover a range of 100 per cent, varying as they do from 1100 I.U. to 2113 I.U. for each $E\ \frac{1\ \text{per cent}}{1\ \text{cm.}}$.

Further disturbing factors are :

(1) The U.S. 'Reference' oil, on which the majority of tests have been based, is an abnormal oil. The ratio of vitamin A to vitamin D in this oil is given as 3000–95 I.U., which is most unusual in a cod liver oil.

(2) Are we sure that the 'Reference' oil now in use is the same oil it has always been ? If so, it must have remarkable keeping qualities ; and if not, what published tests are there of its successor ?

(3) In the biological test on this oil, have sufficient precautions been taken to ensure that the rations used in different laboratories are strictly comparable ?

The recent availability of supplies of pure β-carotene should lead to a clearing up of the matter provided the material in question is really standard in composition and gives uniform results.

With regard to the previous correspondence in respect to the 'Reference' oil, may we say that we are in hearty agreement with the suggestion made by Bacharach, Drummond and Morton, that all subsidiary standards should have their spectrographic assay stated as well as their biological, and that their keeping properties should be checked regularly by the spectrograph.

Everyone admits the importance of vitamin A in everyday life, and the task of the manufacturer of vitamin A products who endeavours to supply a genuine article would be enormously assisted if a satisfactory solution of this problem could be provided in the near future.

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The New Ergot Alkaloid

DURING the first half of the year 1935 communications appeared from four different laboratories, in three different countries, each describing the discovery and isolation of a new alkaloid from ergot, very different in its properties from those previously known. These communications dealt with researches which had been proceeding concurrently and independently, and in each case the authors gave a name to the alkaloid which they had obtained, so that four new names were put forward—Ergometrine[1], Ergotocin[2], Ergobasine[3] and Ergostetrine[4].

There was an obvious general resemblance between the substances thus variously named, but preliminary analytical indications, and certain minor discrepancies in the earlier published physical constants and chemical properties, left some doubt as to whether the four were really identical, or only closely related alkaloids. Later and more detailed publications have removed most of these discrepancies. It appeared to us, however, that the question of identity ought to be settled finally by an exchange of specimens, a careful comparison of them in the laboratories concerned, and, if possible, an agreed statement of the resulting conclusion. This exchange and comparison have now been carried out by the undersigned, of whom H. King has acted in the place of the late H. W. Dudley (who died on October 3, 1935).

Our comparisons of the melting-points and mixed melting-points of the four alkaloids and of certain of their salts, and of their optical activities in different solvents in cases where sufficient material was available, leave us in no doubt that the alkaloid obtained in the four different laboratories was the same substance, and that the four names given to it are synonyms. Having reached that conclusion, we are content to leave to the world of science the choice of one of these names, for adoption into scientific literature as the recognised name of the one alkaloid.

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H. KING.
A. STOLL.
MARVIN R. THOMPSON.

[1] Dudley, H. W., and Moir, C., (Ergometrine), *Brit. Med. J.*, **1**, 520 (1935) ; *Science*, **81**, 559 (1935). Dudley, H. W., (Ergometrine), *Proc. Roy. Soc. London*, B, 810, **116**, 478 (1935).
[2] Kharasch, M. S., and Legault, R. R. (Ergotocin), *Science*, **81**, 388 and 614 (1935) ; *J. Amer. Chem. Soc.*, **57**, 956 and 1140 (1935). Davis, M. E., Adair, F. L., Rogers, G., Kharasch, M. S., and Legault, R. R. (Ergotocin), *Amer. J. Obstet. Gynaec.*, **29**, 155 (1935).
[3] Stoll, A., and Burckhardt, E. (Ergobasine), *C.R. Acad. Sci.*, **200** 1680 (1935) ; *Bull. Sci. Pharmacol.*, **42**, 257 (1935).
[4] Thompson, M. R. (Ergostetrine), *J. Amer. Pharm. Assoc.*, **24** 24 and 185 (1935) ; *Science*, **81**, 636 (1935).

A Small Chemical Separation of the Chlorine Isotopes

A SMALL chemical separation of the chlorine isotopes has been observed by heating carbon tetrachloride with sodium amalgam, when the reaction

$$4\,Na + CCl_4 = C + 4\,NaCl$$

occurs almost quantitatively[1] and the light isotope reacts preferentially. Carbon tetrachloride (A.R.) was fractionated eight times (twenty-four fractions) and the densities of the middle fractions after drying with purified phosphorus pentoxide were compared by the flotation method, using a cylindrical pyrex float. After four successive fractions the density became constant. The float was controlled by means of a small piece of enclosed soft iron. The ground-stoppered vessel containing the carbon tetrachloride was placed in an outer vessel containing phosphorus pentoxide and supported by brass clamps in a thermostat at 23°. An intermittent Gouy regulator[2] controlled the temperature, which was read on a Beckmann thermometer by a travelling microscope reading to 0·002 mm., so that 0·00025° could be easily read. The thermometer varied 0·00019° per mm. with change of pressure. The velocity of the float varied linearly with temperature, 0·001° in set point corresponding with a density change of $1{\cdot}9 \times 10^{-6}$ and a velocity change of 0·0024 cm. per sec.

Electrification was avoided by keeping all movements of the float slow, and its absence was shown by the constancy of the set point for pure carbon tetrachloride after repeated distillation; the same considerations apply to the influence of dissolved air. The greatest care was taken to avoid contamination, decomposition of the tetrachloride by particles of phosphorus pentoxide at the boiling point and by hot glass. Ground joints were used, and all apparatus was cleaned by acid potassium permanganate.

It is clear that no isotopic separation occurs on distillation, using an efficient column, as found by Grimm[3] to 1 in 10^5. About 30 gm. of pure carbon tetrachloride was refluxed with excess sodium amalgam for some hours, until about half of the tetrachloride was decomposed. On distilling the residue at 77°, the density of the product was 6×10^{-5} greater than that of the original carbon tetrachloride, but this difference was rapidly reduced to a constant value of $(6 \pm 0{\cdot}5) \times 10^{-6}$ after repeated fractionation. Hence the reaction is not entirely quantitative, but the impurity must have a boiling point differing greatly from that of tetrachloride. The residual difference in density is probably due to isotopic separation. A repetition of the whole experiment with about one third decomposition gave a density change of $(4 \pm 0{\cdot}5) \times 10^{-6}$. Repeated readings were made on the set points.

The molecular species $C^{35}Cl_4$, $C^{35}Cl_3{}^{37}Cl$, $C^{35}Cl_2{}^{37}Cl_2$, $C^{35}Cl^{37}Cl_3$ and $C^{37}Cl_4$ are present according to the binomial frequency distribution $(\frac{1}{4}+\frac{3}{4})^4 \times 100$ to the extent of 31·6, 42·2, 21·1, 4·7 and 0·4 per cent, with 25 per cent ^{37}Cl and 75 per cent ^{35}Cl. Moreover, density will be very nearly proportional to molecular weight (this holds to within 0·4 per cent for H_2O and D_2O). Hence the density of the various molecular species can be calculated from that of the mixture, assuming additivity of volumes. It can be shown that for a small increase in percentage of Cl equal to α, $100/D - 100/D' = -\alpha[-4q^3/d + 4(q^3 - 3q^2p)140/142d + 6(2q^2p - 2qp^2)140/144d + 4(3qp^2 - p^3)140/146d + 4p^3 140/148d]$, where $p = \frac{1}{4}$, $q = \frac{3}{4}$ and d, D and D' are the densities of $C^{35}Cl_4$, and the initial and changed mixture. Hence $\alpha = 7{\cdot}3 \times 10^3 (D' - D)d/D^2$ and from the above change in density, 6×10^{-6}, $\alpha = 3 \times 10^{-3}$, or ratio of percentage of ^{37}Cl in the heavy and light tetrachloride is $1 + 1{\cdot}3 \times 10^{-3}$. The percentage of ^{13}C is too small to enter into consideration.

Probably the separation proceeds because of a difference in activation energies, which has the advantage over 'physical' methods of introducing an exponential factor. Activation of the tetrachloride probably involves transition to a polar state similar to that conceived by Ogg and Polanyi[4], who observe a parallelism between activation and bond energy. Variation in the latter may be roughly calculated[5] from the Raman frequencies, the symmetrical mode giving $\Delta\nu = 3{\cdot}15$ cm^{-1}, which gives a difference in zero point energies of about 5 cal. per gm. mol. for $C^{35}Cl_4$ and $C^{35}Cl_3{}^{37}Cl$.

The separation, although small, is large relative to that produced by repeated fractionation, and on an industrial scale is capable of yielding much greater separations.

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[1] Fetkenheuer, *Z. anorg. Chem.*, **117**, 281 (1921).
[2] Sligh, *J. Amer. Chem. Soc.*, **42**, 60 (1920).
[3] *Z. phys. Chem.*, B, **2**, 181 (1929).
[4] *Trans. Faraday Soc.*, **31**, 1375 (1935).
[5] Langseth, *Z. Phys.*, **72**, 350 (1931).

Chemical Reaction in Ionised Gases

IT is frequently assumed that the chemical reactions which take place in ionised gases are reactions in which one or more of the reacting atoms or molecules react whilst ionised. Many years ago Kirkby adduced evidence, which still remains strong in our opinion, that this could not be the case for discharges through electrolytic gas[1]. The necessity for a reaction mechanism involving ions has also been questioned more recently by H. S. Taylor[2], and in at least one other important paper a contrary view has been considered favourably[3].

For some years we have been examining the kinetics of reactions in discharges; we hope to publish our conclusions in detail very soon. In the course of this work, we have found scarcely any reaction which cannot be accounted for qualitatively to our satisfaction on the assumption that the reacting particles are all *neutral*. One reacting particle is usually one of the main atoms or molecules present independently of the passage of the current, and the other a neutral atom or molecule or molecular fragment, in a normal or excited state, produced by electron collision with one of the main atoms or molecules. In other words, the reactions appear to be related to the conductivity of the gas only incidentally, in the same way as a great part of the luminosity of the discharge. In those cases where all the relevant data are known with sufficient accuracy (unfortunately these are few), the observed reaction rate agrees closely with that predicted on the excitation hypothesis.

Although we have not yet considered so fully the reactions initiated by α-particles and fast electrons, we believe (with Krüger[4]) that these are likewise mainly reactions involving neutral particles only.

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Jan. 14.

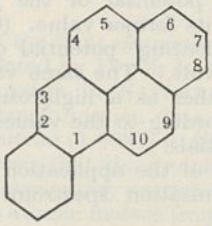
[1] Kirkby, *Proc. Roy. Soc.*, A, **85**, 151 (1911)
[2] *J. Amer. Chem. Soc.*, **52**, 1121 (1930).
[3] Linder, *Phys. Rev.*, **38**, 679 (1931).
[4] *Ann. Physik.*, **78**, 113 (1925).

Carcinogenic Activity and Substantivity

THE significant work of J. W. Cook and his collaborators[1] on the relation between the structure and carcinogenic activity of the higher aromatic hydrocarbons prompts the observation that a similar type of relation holds between the structure of an anthraquinone derivative and the affinity of its leuco-form for textile fibres. With few exceptions, Cook *et al.* have found that, of the hydrocarbons related to anthracene, those derived by attachment of alkyl groups or hydrocarbon rings to the 1 : 2- or 1 : 2 : 5 : 6-positions possessed carcinogenic activity, whilst other orientations were inert.

The same angular orientation of fused rings appears to be equally significant in determining the dyeing properties of anthraquinone derivatives. Whilst 1 : 2-benzanthraquinone is a feeble vat dye, neither anthraquinone nor naphthacenequinone has affinity. The same relation appears to hold for the heterocyclic

derivatives of anthraquinone. Each of the anthraquinone dihydroazines has affinity, but the property is most developed in indanthrone (*trans-bisang.* configuration).



The 1 : 2-benzpyrene nucleus appears to be equally potent whether regarded as a carcinogenic structure or as a unit in the structure of vat dyes. 1 : 2-Benzpyrene itself is a much more powerful carcinogenic agent than is either 1 : 2-benzanthracene or 1 : 2 : 5 : 6-dibenzanthracene. Similarly, 1 : 2 : 6 : 7-dibenzpyrene-3 : 8-quinone (*trans*) is a much more effective dye than is 1 : 2-benzanthraquinone. The *cis-* configuration (2 : 3 : 6 : 7-dibenzpyrene-1 : 8-quinone) has weaker affinity than the *trans-* form.

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[1] Cook, Hieger, Kennaway and Mayneord, *Proc. Roy. Soc.*, B, 111, 455 (1932). Cook, *ibid.*, 485. Barry, Cook, Haslewood, Hewitt, Hieger and Kennaway, *ibid.*, B, 117, 318 (1935).

Stability of Emulsions

EMULSIONS of one liquid or gaseous phase in another usually collapse, returning to the initial state, that of two co-existing phases in bulk. Stabilisation, however, may be obtained by adding an 'emulsifyer', capable of forming films around the particles which inhibit the exchange of molecules between the internal and the external phase.

The stability of the emulsion, therefore, depends on the stability and impermeability of the film.

Since the film is in equilibrium with the adjacent phases, the thermodynamic potential of the emulsifying agent is the same through the whole system. This quantity is affected by the capillary pressure exerted upon the internal phase, and may be written in the form :

$$\mu_r = \mu_0 + \frac{2\sigma}{r(D_{in} - D_{ex})}.$$

Here μ and μ_0 designate the potential of the curved and the plane film respectively, σ the interfacial tension, r, the radius of the particle, D_{in} and D_{ex} the density of the emulsifying substance in the internal and the external phase respectively.

Since the film is stable only if $\mu_r < \mu_0$, it follows that D_{ex} must be larger than D_{in}. This is the well established rule of Bancroft, governing the inversion of emulsions. The thermodynamic theory also accounts for the fact that the stability will be increased by 'homogenisation', that is, by decreasing the radius.

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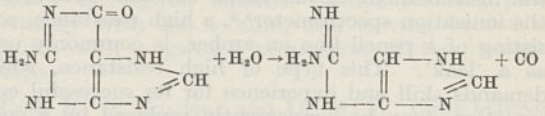
A New Cleavage Product of Guanine

BY heating guanine in an autoclave with acid, about 20 per cent of the purine is converted to a base of the composition $C_4H_7N_5$, from analysis of the two salts $C_4H_7N_5.H_2SO_4$ and $C_4H_7N_5.2HCl$. By oxidation with bromine, guanidine picrate has been obtained from the base, and by oxidation with potassium permanganate a yield of approximately 47 per cent of guanidine has been obtained by colorimetric estimation. After boiling with barium hydroxide, the resulting acidified solution yielded a blue colour when made alkaline, or when treated with a small amount of potassium permanganate ; it gave a deep red nitroprusside test in alkaline solution ; after treatment with nitrous acid solution gave a deep brown colour when mixed with a solution of β-naphthol in sodium hydroxide : all of which tests are probably given by 4- (or 5-) aminoglyoxaline[1]. This acidified solution when allowed to stand in contact with air also yields a marked ninhydrin test, which is highly probably traceable to glycine, since this amino acid was found amongst the autoclaved guanine products.

Fargher[2] isolated glycine from the reduction products of 4- (or 5-) nitroglyoxaline, and its appearance here can be regarded as further evidence for the existence of a glyoxaline nucleus in the new base. The base itself gives an intense green colour with diazotised sulphanilic acid in sodium carbonate solution, and if sodium hydroxide is added soon after coupling the colour changes to a beautiful blue. It is concluded that the base is likely to be 4- (or 5-) guanidinoglyoxaline, and that it arises from guanine as represented by the reaction :



Guanine 4- (or 5-) guanidinoglyoxaline

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[1] Fargher and Pyman, *J. Chem. Soc.*, 115, 217 (1919).
[2] Fargher, *J. Chem. Soc.*, 117, 668 (1920).

Continuous Spectrum of Nova Herculis

IN NATURE of January 25, p. 150, Dr. W. M. Cohn refers to the spectrophotometric observations of Nova Herculis 1934 by Barbier, Chalonge and Vasy. In the earlier stages of the Nova these investigators find a secondary maximum in the energy distribution of the continuous spectrum, and Dr. Cohn attributes this feature to electron radiation, and deduces that "the early stage of a nova seems to permit the generation of free electrons of high speed".

The secondary maximum is not shown in the results of Beileke and Hachenberg[1], neither is it shown in the Greenwich results (at present unpublished). Part, if not all, of the discordance between our results and those of Barbier, Chalonge and Vasy is to be ascribed to the difficulty in deciding exactly what is the continuous spectrum. The spectrum of the Nova is rich in emission and absorption lines, the former are strongly 'winged',

and the drawing of the continuous spectrum on a microphotometer tracing is, to a large extent, a matter for individual judgment. This is especially true in the Hγ region and near λ4500, and it is perhaps significant that the secondary maximum found by Barbier, Chalonge and Vasy is based on measures at these wave-lengths.

The Greenwich measures for December 31, 1934, were taken in the spectral regions surrounding Hα, Hβ, Hγ and Hδ. The results when plotted form a curve continuous with Barbier, Chalonge and Vasy's values for the ultra-violet (λ3400–λ4000) and no secondary maximum is shown. The continuous curve is, however, not a Planck curve.

In view of the part played by individual judgment, it would be rash to maintain that any particular observer's idea of the 'continuous spectrum' is the correct one. But one thing at least is clear. It is dangerous to base a physical theory on a feature, such as a secondary maximum, which has been noted by one set of investigators, and which is entirely absent in the results of others.

W. M. H. GREAVES.

Royal Observatory,
Greenwich.
Feb. 5.

[1] *Z. Astrophys.*, **10**, 5, 366, October 1935.

The Electrometer Triode Valve as a High Resistance and as an Earthing Key

WHEN the electrometer triode valve is used for the measurement of ionisation currents obtained in the ionisation spectrometer[1,2], a high resistance, consisting of a pencil line on amber, is commonly used as a 'leak'. This type of high resistance, which demands skill and experience for its successful construction, may be conveniently replaced by a commercial electrometer triode valve.

The grids of two electrometer triode valves are connected together and to the source of charge to be measured. The normal anode potential is about 5 volts, but if the anode potential on one of the valves is raised above 7½ volts, then the valve acts as a high-resistance leak. Within the experimental error, the change in anode current of the 'measuring' valve is found to be directly proportional to the current leaking away through the 'high-resistance' valve, over the range investigated, namely, 0 to 2×10^{-12} amp. The error in measuring the integrated reflections from the crystal planes is ±2 per cent for the larger reflections and more for the smaller. The value in ohms of this high resistance is quite reproducible and depends only on the filament, grid and anode voltages applied to the valves. Since an increase of anode or filament voltage reduces the resistance, its value is easily changed.

When the leak is increased sufficiently, the 'high-resistance' valve behaves as an earthing key, which is unique in our experience, in that on opening it introduces no spurious deflection of the galvanometer.

Two electrometer triode valves coupled in this way have been used to measure the total charge collected in an ionisation chamber during the transit of a crystal plane through a reflecting position. Normally the filament current is passing in the 'earthing key' valve, but when the charge is to be collected the filament current is cut off. The grid of the 'earthing key' valve then has no appreciable leak and the change in anode current of the 'measuring valve' is proportional to the charge collected. On switching on the filament current of the 'earthing key' valve, the potential of the grids is rapidly brought back to its former value. (Over a period of six hours this 'floating' potential does not change more than 0·02 volt.) The same valve may, therefore, be used either as a high-resistance or as an earthing key according to the values of the filament and anode potentials.

A full account of the application of this work to an automatic ionisation spectrometer will shortly appear elsewhere.

W. A. WOOSTER.

Crystallographic Laboratory,
Cambridge.

A. J. P. MARTIN.

Nutritional Laboratory,
Cambridge.

[1] W. A. Wooster, NATURE, **131**, 545 (1933).
[2] B. W. Robinson, NATURE, **131**, 546 (1933).

Conditions in Cumulus Cloud

IN a note in NATURE of February 1, p. 194, reference is made to a theory of supersaturation, which, it appeared, observations did not support. I would point out that the theory is possibly unsound in any event. Apart from the question whether there could be an equilibrium between liquid water and vapour in the supersaturated state, there is the question whether vapour in the supersaturated state is lighter than air. I suggest that at twofold saturation the effective molecular weight may be nearly 36, owing to overcrowding of the simple molecules which must then aggregate in (presumably) unstable groupings smaller than the smallest liquid drop.

The reports of glider flights suggest that cumulus need not be in static equilibrium at all but may be supported on a rising column of air, as the little balls we used to shoot in fair-grounds were supported on rising columns of water.

W. BARRETT.

Fuglestemmen,
Layters Way,
Gerrard's Cross,
Bucks.
Feb. 3.

MR. BARRETT has misunderstood the main point of the note to which he refers. Meteorologists do not expect cumulus clouds to be in static equilibrium, but on the contrary to be associated with rising air currents composed normally of air that is less dense than its environment at the same level. If observations showed that the rising air were warmer than its environment, the lower density of the former would be easily explained, but observations show that it is often colder, and the problem is to explain the anomaly of cold air rising as a result presumably of convection, since these clouds are normally regarded as of convectional origin. The reports of pilots of gliders merely confirm what has long been known to meteorologists, for example, from the behaviour of pilot balloons on encountering cumulus clouds.

THE WRITER OF THE NOTE.

Points from Foregoing Letters

The masses of the light elements as far as fluorine have been calculated by Dr. M. L. Oliphant from the data given by Aston in NATURE of February 29, together with transformation data. The large mass found for the neutron (1·0091) is difficult to reconcile with the hypothesis that the proton and neutron are interconvertible elementary particles. By plotting the departure of the atomic masses from a whole number against the mass-number, Oliphant makes interesting deductions concerning the stability of several atomic species and predicts the probable existence of helium of mass 5·0125, the only mass-number missing from the list.

X-ray diffraction photographs obtained with bent crystals of sodium chloride are submitted by Dr. A. P. Komar, who compares them with diagrams derived from theoretical considerations. The good agreement between the two supports the view that the crystal in the process of plastic deformation behaves as a mosaic aggregate of blocks, which change their orientation nearly independently.

From the amount of γ-rays excited by fast neutrons S. Kikuchi, H. Aoki and K. Husimi have constructed a table showing the relation between the atomic number and the capture cross-sections for fast neutrons in various elements ; they point out certain discontinuities which may be connected with the internal structure of the atomic nuclei of light elements.

From the frequency with which certain sex-linked characters (colour-blindness, light sensitivity of the skin, etc.) are inherited through the father's father or the father's mother, Prof. J. B. S. Haldane draws a tentative 'map' of the order in which the genes responsible for those characters are present in human chromosomes.

The rates of sedimentation of hæmocyanin (blood pigment of snails) in ordinary and in heavy water of varying hydrogen ion concentration have been determined by Prof. The Svedberg and I.-B. Eriksson-Quensel, by means of the ultra-centrifuge. From these determinations and from the effect of heavy water upon the electrical potential, the authors surmise that the iso-electric point (pH at which suspended particles lose their charge and become stationary in an electric field) and stability of hæmocyanin are somewhat different in heavy water from those in ordinary water.

Dr. P. Meyer shows that the hæmolymph of terrestrial gastropod Molluscs has the same colloid osmotic pressure as that of marine gastropod Molluscs. On the other hand, colloid osmotic pressure of the hæmolymph rises steadily from decapod Crustaceans to Arachnoids and insects. This supports his hypothesis of a close relation between the general organisation of an animal and the colloid osmotic pressure of its body fluids. The transition from one surrounding medium to another, in particular, does not seem to affect this relation, at least so far as sea water and air are concerned.

The colouring of many birds fades when they are kept under the usual caged conditions. Dr. H. L. Ratcliffe reports that an increase in the variety of food (including milk proteins, legumes, mineral salts and fat-soluble vitamin) brings back to flamingos, ibises, spoonbills and buntings much of their natural colouring.

Commenting upon methods of assay of vitamin A, J. F. Ward and R. T. M. Haines point out the need for uniformity in the ration food of test animals ; there are indications that vitamin A acts only indirectly upon the growth of the animals, inducing a healthier state of the epithelial and absorbing surfaces, thus enabling the absorption of the true growth vitamin, whether present in the vitamin-containing oil or in the supposed vitamin-free ration.

A new ergot alkaloid was independently discovered last year in four different laboratories and described under the names ergometrine, ergotocin, ergobasine and ergostetrine. In a joint letter, several of the discoverers, who have exchanged and compared the substances isolated in the various laboratories, state that these substances are identical ; they leave it to the world of science to adopt one of the four suggested names for the new active principle.

A slight, but definite, increase in the density of carbon tetrachloride after some of it has been decomposed by metallic sodium is reported by R. S. Bradley. The author considers that this increase in density is due to a small chemical separation of the chlorine isotopes, the carbon tetrachloride which contains the lighter chlorine isotope reacting preferentially with the sodium, and leaving behind a mixture with a greater proportion of the heavier isotope.

Prof. K. G. Emeléus and Dr. R. W. Lunt believe that there is no need for the frequently made assumption that ionised atoms and molecules are involved in gaseous reactions, when the gases as a whole are ionised (electrically conducting). In the authors' view, the reactions are only incidentally related to the conductivity of the gases and the velocity with which such reactions take place can be accounted for on the assumption that the reacting particles are neutral.

Dr. W. Bradley points out that a certain type of molecular arrangement which has been found in several cancer-producing substances is also effective in determining the dyeing properties of organic substances, being present in 'substantive' dyes (that is, dyes which can be used without a mordant).

The reactions and probable structural formula of a new basic compound $C_4H_7N_5$ obtained from guanine (a substance resulting from the decomposition of nucleic acids and other compounds present in animal tissues) are described by Prof. G. Hunter.

Drs. W. A. Wooster and A. J. P. Martin describe how, by adjusting the filament and anode potentials, the electrometer triode valve can be used either as a high resistance (for the measurement of ionisation currents such as obtained in an ionisation chamber used in connexion with X-ray study of crystals) or as an earthing key. In this latter case, it has the advantage that, on opening, it introduces no spurious deflection of the galvanometer.

Research Items

Classification of Races in India

A FURTHER contribution to the discussion of the ethnological problems presented by the peoples of India was made by Mr. H. C. Chakladar in his presidential address to the Anthropological Section of the Indian Science Congress held at Indore on January 2–8 (Calcutta: Asiatic Society of Bengal). Mr. Chakladar agrees with other modern investigators that little value is attached to the conclusions of Risley and others of his day, owing to the unscientific character or the insufficiency of the data on which they were based. He also agrees with the views of Dr. B. S. Guha in the recent Census Report (see NATURE, Feb. 29, p. 368) that the classification of Predravidian and Dravidian in the form in which it has generally been accepted is no longer tenable, though he finds himself unable to agree with the views put forward in the report as to Australoid affinities or evidence of Mesopotamian origins to be found among the jungle peoples or in the skeletal remains of the early inhabitants of India respectively. Dr. Chakladar's own investigations in Bengal have definitely established for the first time the existence of the 'Brown Race' in that province in the low caste leptorrhine mesocephalics, who are contrasted with the brachycephalic Brahmins. In an examination of the problem of the physical characters of the people by whom the Vedic culture and Aryan language was introduced into India, an ingenious use is made of Vedic literature and its cultural evidence to show that the original Aryans in India were not the dolichocephalic Proto-Nordics of the Punjab, as held hitherto, but a brachycephalic people or peoples from Central Asia, who came to be widely distributed over a great part of India and possibly suffered some modification by contact with non-Aryan peoples. Through these a wedge of later arrivals in the north, cruder dolichocephalic nomads, probably of strongly conservative tendencies, was driven, thus accounting for the present eastern and western distribution of the brachycephals.

A Rock-Boring Barnacle

PROF. H. GRAHAM CANNON makes some very interesting observations on the rock-boring barnacle *Lithotrya valentiana* from the Great Barrier Reef (British Museum (Natural History) Great Barrier Reef Expedition 1928–29. Scientific Reports, 5, No. 1; 1935) by which he clears up a complex mass of errors relating to the two species *Lithotrya truncata*, Quoy et Gaimard, and *L. valentiana*, Gray (as Conchotrya), showing that the two names should be regarded as synonymous. The Great Barrier Reef collection consists of thirty complete specimens, all from the Boulder Zone of Low Island Reefs. In general shape, they show every gradation, from forms which closely resemble the original specimens of *C. valentiana* and the original figure of *A. truncata* to those which are similar to the form described by Darwin in his cirripede monograph as *L. truncata*. The text figures are drawn with the author's usual skill, and these and the excellent photographic reproductions show clearly that there is a large range of variation in all the characters previously taken as diagnostic. Even in this small collection it is possible to copy any of the published figures of either species, and also to produce a complete series of intermediate forms. By very careful dissections and clear drawings, Prof. Cannon shows that the sublateral styles, the so-called latera, are not true lateral plates in *L. valentiana*, but are almost certainly modified scales of the girdle; that they may be absent or that there may be more than one pair; and that their presence or absence probably depends on the cuticular split on the moulting of the peduncular covering.

Vitamin D in New Zealand Fish Oils

FISH-LIVER oils are, as a class, the most potent of all known natural sources of vitamin D, and Dr. Marion M. Cunningham has analysed the potencies in this respect of representative New Zealand fishes (*N.Z. J. Sci. Tech.*, 17, 563, Dec. 1935). The liver of the groper (*Polyprion oxygeneios*) has the high potency of 2,250 international units per gram; ling-liver (*Genypterus blacodes*) 500; and skate (*Raiia nasuta*) only 15 units per gram. This agrees with Schmidt-Nielsen's finding that elasmobranchs are inferior to teleosts in vitamin D potency, and compares with a halibut liver oil potency of 900–1,400 international units, varying according to season. An oil obtained from the whole body of an eel (*Anguilla australis*) had a potency of 47 units per gram; and two samples of mammalian oil from the blubber of hump-backed whales were practically devoid of any anti-rachitic potency. The author adduces evidence of the reliability of the prophylactic method of biological assay of vitamin D.

Nitrification in Acid Soils

THE nitrifying power of soils in the Philippine Islands has been studied by M. M. Alicante, and has led him to repeat certain investigations on the process of nitrification in acid soils (*Phil. J. Sci.*, 58, No. 2, 163–170, Oct. 1935). Micro-organisms with nitrifying properties can only perform that function in artificial media of neutral or alkaline reaction; but in the soil, they may be active under quite acid conditions, if there are sufficient carbonates present. It is shown that both acid and carbonate radicals can exist at the same time in soil, and the occurrence of nitrification is due to the presence of carbonates, rather than to the absence of acid.

Practical Applications of Vernalisation

THE Imperial Bureaux of Plant Genetics, Aberystwyth and Cambridge, have recently brought out a new joint publication entitled "Vernalisation and Phasic Development of Plants" (Bull. 17, price 10*s*.). The issue of their earlier bulletin in 1933 ("Vernalization or Lysenko's Method for the Pre-Treatment of Seed") aroused widespread interest in the subject, as previously little was known of this method or theory, largely owing to the fact that the original papers were available in Russian only. Since then, research workers in practically every European country and also in countries so far apart as Canada, Australia, Ceylon, Brazil and China have been stimulated to investigate the matter for themselves and have

either confirmed or challenged the results or theory. Many of these observations have been communicated to the Bureaux direct, and close touch has also been maintained with the Russian workers. The present publication sets out in full the theories of Lysenko and other schools of thought and provides an up-to-date summary of the results obtained in all parts of the world. The practical application of vernalisation, so far as it has been tried, is discussed, with special reference to breeding, drought and frost resistance and the possibility of extending crops farther north than has hitherto been practicable. In some countries and with certain crops, notably cereals, practical success seems evident, but under other climatic conditions and with other crops the results are less encouraging. The subject, however, is still in the experimental stage, and although much headway has already been made, notably as to the effect of factors such as light and temperature, the physiological processes involved are still far from clear. The publication of this documented review will be welcomed by all plant physiologists and geneticists, particularly as its arrangement permits of easy reference, whether information is required regarding crops, countries or physiological aspects.

Rock Compressibilities

THE observed speeds of propagation of seismic disturbances through the interior of the earth allow the elastic properties of the materials through which they are propagated to be estimated. The results have as a rule been higher than would have been expected for materials at the high temperatures and pressures which exist in the earth's interior. Observations made in the laboratory have generally shown that the compressibility of material increases as the temperature and pressure increase, and the speed of propagation of elastic waves through it should therefore decrease. Vol. 46 of the *Bulletin of the Geological Society of America* contains an account of the experiments on lead, aluminium, silica glass, obsidian and diabase up to temperatures of 300° C. and pressures of 10,000 atmospheres made by F. Birch and R. R. Law in the Dunbar Laboratory at Harvard with apparatus and methods due mainly to Prof. P. W. Bridgman. They find that while for the metals the compressibilities increase with rise of temperature and pressure, for the rocks and the glass they begin to decrease again in an unexpected way at temperatures above 150° C., which would imply higher elasticities and higher speeds of propagation of seismic waves. The observations are to be pushed to higher temperatures.

Electrostatic Energy

IN the supplementary issue of the *Philosophical Magazine* of February, Prof. Taylor Jones examines the possibility of explaining the electrostatic energy of two neighbouring equally charged particles as due to the train of waves of frequency ν determined by the quantum equation $h\nu = mc^2$ which accompanies each particle (h is Planck's constant, m the rest mass of the particle and c the velocity of light). Regarding the particle itself as a vibrator having this free frequency, he assumes that when two are in the same neighbourhood each is acted on by an additional force directed towards its mean position, which is proportional to the distance of the other from *its* mean position and inversely proportional to the mean distance of the particles apart. In these circumstances, the possible oscillations of each are of two frequencies, one above and the other below their free frequency. If the frequency is the higher, the two move in the same phase, and if the lower they move in opposite phases. In the former case, if the particles approach each other their frequency and energy increase; if they recede both decrease, according to the electrostatic law. For several other simple arrangements of particles the same result follows and Prof. Taylor Jones is investigating whether the law holds for more complex systems.

Experiments on Piston Rings

IN a paper read before the North-East Coast Institution of Engineers and Shipbuilders on February 7, Eng.-Comm. C. J. Hawkes and Mr. G. F. Hardy gave the results of their experiments, made during the last five years at Armstrong College, on the extent of frictional resistance and leakage occurring at piston rings. In the apparatus, specially constructed for this purpose, a reciprocating sleeve, driven by a crank having a speed range of 120–650 r.p.m., gave mean 'piston' speeds of 2–11 ft. per second. The small movements of the stationary piston against calibrated springs were recorded on a diagram and showed the value of the frictional resistance encountered. Measurements were made of this resistance as affected, separately, by viscosity (inferred from piston temperature), gas pressure, piston speed, and the number of rings in use. The authors conclude that the resistance F varies as the square root of the viscosity Z, but the curves given appear rather to show that F varies as Z^n where n, which is approximately 0·5, is, for a given gas pressure, a function of the speed. From their tests on the influence of gas pressure, the authors deduce that ring resistance is proportional to the sum of the square roots of the net radial ring loads, and they incline to the view that it also varies as the square root of the speed. The tests on leakage showed that it is controlled mainly by the sealing capacity of the last ring and that, in any event, greater losses occurred than could be accounted for by ring gaps alone, thus pointing to leakage past the ring faces.

A Very Remote Globular Cluster

THE globular cluster N.G.C. 2419 is of special interest owing to its unusually great distance. This distance is particularly surprising on account of the position of the cluster, which lies in a direction opposite to that of the centre of our galaxy in a region where only nearby clusters would be expected. An attempt to obtain a more accurate value of the distance of this object has been made by W. Baade (*Astrophys. J.*, **82**, 396) who has been able to photograph thirty-one short-period Cepheids, the maxima and minima of twenty-five of which lead to a fairly reliable result. No selective absorption of light was found from the colour-index and spectrum of the cluster, nor was there any sign of local obscuration, but a correction had to be applied for the general absorption of light within our galaxy. The final results indicate a distance of 56,000 parsecs, which is considerably larger than that previously suggested by Shapley. The possibility is discussed of N.G.C. 2419 being an independent intergalactic object, but the observations at present leave this matter indeterminate. If it is supported by later results, then such a case of a globular cluster occurring in intergalactic space must be very exceptional.

India's Geologists

THE thirty-first annual presidential address to the Mining and Geological Institute of India, delivered in Calcutta by Dr. C. S. Fox, on January 3 last, deals with the "Story of Geology in India and the Evolution of the Geological Survey of India". It is of the nature of an index of all the officers concerned, marshalled in order with the precision of a "Civil List", but gives no connected account of their labours in the slow preparation of the geological maps of the Indian Empire, or of their influence on the growth of geological knowledge in general.

Brief introductory remarks on prehistory and a summary of the scanty data on medieval mining are followed by references to some of the topographical surveyors of the East India Company and the geologists who occasionally accompanied them.

The question of domestic coal supplies led to the appointment of a committee by Lord Auckland's administration exactly a century ago, but it was not until 1845, after experimenting with imported miners, that the Court of Directors in London was recommended to undertake "a Geological Survey of the Coal Formation of India". D. H. Williams, then mapping in South Wales, was engaged and sent out to Bengal, the first of a succession of more than a hundred geologists who have since found employment under the Government of India. He examined the Raniganj and Ramgarh fields, and moving on to Karanpura, died of malaria in 1848. Dr. J. McClelland, secretary of the Coal Committee, continued the programme outlined by Williams and submitted the first annual report of the Geological Survey of India for 1848–49.

The creation of the Survey as a separate entity really dates from the arrival of Dr. T. Oldham, formerly professor of geology in Trinity College, Dublin, in 1851. He found "that the establishment of the Geological Survey then consisted of one peon and one writer, with no European assistant, and no preparation for any field work. The few existing records were kept in a box in a small room in the Surveyor-General's Office". Dr. Oldham soon acquired suitable professional help, and retiring after twenty-five years' service in 1876, had the satisfaction of leaving an efficient staff of fifteen geologists, and of having founded the publications of the Department—*Memoirs* (1856), *Palæontologia Indica* (1861), *Records* (1867)—in their permanent form. He also commenced the training of Indian apprentices, the forerunners of the majority of the officers to-day. Malaria and other tropical diseases taxed the ranks of the pioneers severely; of thirty-nine individuals who served up to the end of 1876, thirteen died on duty, three were compelled to resign through ill-health and seven transferred to less exacting occupations.

The year 1902 marks, in the opinion of Dr. Fox, the closing stage in the construction of the Survey, and in the intervening years, three directors had followed the first: H. B. Medlicott (1876–87), co-editor with W. T. Blanford of the "Manual of the Geology of India" (1879); W. King, discoverer of the Singareni coalfield; and C. L. Griesbach (1894–1903), known as an explorer of Afghanistan, Persia and Turkestan.

During the directorship of Sir Thomas Holland (1903–10), the academic aspects of Indian geology continued to receive full attention and the study of the country's mineral resources assumed great importance. The methods of collection and publication of statistical information were reorganised; the rules relating to prospecting and exploitation of the State-owned mineral deposits of British India were overhauled, and a series of researches initiated which have led to some of the existing ore-mining and metallurgical industries.

Under Sir Henry Hayden (1910–21), joint author with Sir Sidney Burrard of "A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet", the Survey, with twenty gazetted officers, was stronger than it had ever been. Following the diversion of its routine activities to martial needs during the War, its cadre was increased to thirty-six in 1919, actual appointments being delayed until demobilisation supplied suitable recruits. Its normal duties were now resumed; surveying unmapped regions, re-examining important tracts, and attending to the increasing number of economic problems which the geologist has to solve. Thus it continued through the directorship of Sir Edwin Pascoe (1921–32), until under retrenchment orders, ten officers, including some of the most experienced, were retired and some of the junior ones reduced to a lower grade. This action recalls the statement of Medlicott, the second director, in 1881, that the Government geologist "is instituted more as a concession to what seems but a rising fashion, than from any faith in his knowledge or any understanding of his functions".

Sir Lewis Fermor directed operations from 1932 until 1935 and was succeeded by Dr. A. M. Heron, who, with twenty-seven years' field work to his credit, holds the Department's records for mapping and for the extent of area covered. The Survey is now entering another phase of its existence, in which a growing burden of responsibility must be shouldered by Indians themselves, for they now form more than half the diminished staff. To them descends by right the tradition of successful accomplishment, and they undoubtedly possess the ability to hand it on worthily.

Dr. Fox's list is limited to official geologists, but there have also been many amateur workers in India, as for example, Lieut.-General C. A. McMahon, the petrologist. The geologists attached to various oil and mining companies are responsible for much detailed and specialised work. Again, a high position must be reserved for the distinguished palæontologists of Britain, France, Austria and India, who, from the days of T. H. Huxley to the present time, have made so many invaluable contributions to the *Palæontologia Indica*. With these exclusions remedied, Dr. Fox's address will save much searching of archives, if the impressive story of the rise and progress of geology in India is ever written.

Dr. Fox is the author of a series of recent memoirs on the coalfields of India, and his address concluded with another timely warning of the perilously small reserves of good quality coking coals, and of the waste entailed by existing mining methods.

The Pattern of Proteins

By Dr. D. M. Wrinch, Mathematical Institute, Oxford

ANY theory as to the structure of the molecule of simple native protein must take account of a number of facts, including the following :

(1) The molecules are largely, if not entirely, made up of amino acid residues. They contain —NH—CO linkages, but in general few —NH_2 groups not belonging to side chains, and in some cases possibly none.

(2) There is a general uniformity among proteins of widely different chemical constitution which suggests a simple general plan in the arrangement of the amino acid residues, characteristic of proteins in general. Protein crystals possess high, general trigonal, symmetry.

(3) Many native proteins are 'globular' in form.

(4) A number of proteins[1] of widely different chemical constitution, though isodisperse in solution for a certain range of values of *p*H, split up into molecules of submultiple molecular weights in a sufficiently alkaline medium.

The facts cited suggest that native protein may contain closed, as opposed to open, polypeptides, that the polypeptides, open or closed, are in a folded

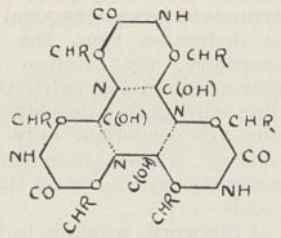
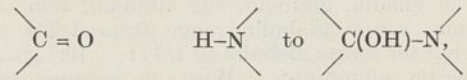


FIG. 1. The 'cyclol 6' molecule.

state, and that the type of folding must be such as to imply the possibility of regular and orderly arrangements of hundreds of residues.

An examination of the geometrical nature of polypeptide chains shows that, *since all amino acids known to occur in proteins are α-derivatives*, they may be folded in hexagonal arrays. Closed polypeptide chains consisting of 2, 6, 18, 42, 66, 90, 114, 138, 162 . . . $(18 + 24n)$ . . . residues form a series with threefold central symmetry. A companion series consisting of 10, 26, 42, 58, 74, 90, 106, 122 . . . $(10 + 16n)$ . . . residues have twofold central symmetry. There is also a series with sixfold central symmetry : others with no central symmetry. Open polypeptides can also be hexagonally folded. The number of free —NH_2 groups, in so far as these indicate an open polypeptide, can be made as small as we please, even zero if we so desire. The hexagonal folding of polypeptide chains, open or closed, evidently allows the construction of molecules containing even hundreds of amino acid residues in orderly array, and provides a characteristic pattern, which in its simplicity and uniformity agrees with many facts of protein chemistry.

The stability of these folded polypeptide chains cannot be attributed to electrostatic attractions between the various CO,NH groups, for the appropriate distance between carbon and nitrogen atoms in these circumstances[2] lies between 2·8 A. and 4·2 A., whereas the distance in our case is at most 1·54 A. By using the transformation* suggested by Frank in 1933 at a lecture given by W. T. Astbury to the Oxford Junior Scientific Society,



which has already proved useful in the structure of α-keratin[3], the situation is at once cleared up and we obtain (Fig. 1) the molecule 'cyclol 6' (the closed

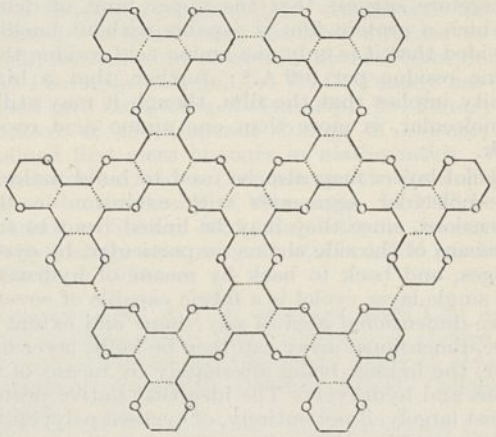


FIG. 2. A 'cyclol 42' molecule.

polypeptide with six residues), 'cyclol 18', 'cyclol 42' (Fig. 2) and so on, and similarly open 'cyclised' polypeptides (Fig. 3).

Hexagonal packing of polypeptides suggests a new *three dimensional* unit, —CHR—C(OH)—N<, which may be used to build three-dimensional molecules of a variety of types. These are now being investigated in detail. At the moment we direct attention only to

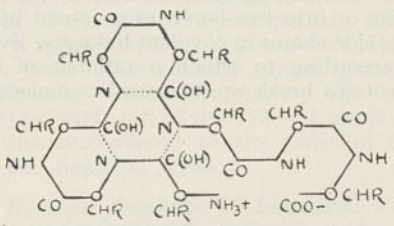


FIG. 3.

single cyclised polypeptides forming hexagons lying approximately in one plane. The cyclol layer molecule is a fabric the thickness of which is one amino acid residue. *Since all naturally occurring amino acids are of lævo type*[4] this fabric is dorsiventral, having a front surface from which the side chains emerge, and a back surface free from side chains. Both front and back carry trios of hydroxyls normal to the surface

* The application of this transformation to these molecules was suggested to me by J. D. Bernal.

in alternating hexagonal arrays. Such a layer molecule and its polymers, formed also by the same transformation, can cover an area of any shape and extent. It offers suggestions as to the structure of the solid protein film when it is one amino acid residue thick. In its most compact form, the cyclol layer molecule gives an area per residue of about 9·9 A.^{2}. Less dense layers can be built, for example, from polymers of cyclol 18 and of cyclol 66 respectively, where the corresponding areas per residue are 13·2 A.^{2} and 16·2 A.^{2} respectively. The figures for unimolecular films of gliadin, glutenin, egg albumin, zein, serum albumin, serum globulin range from $1·724 \times 10^{-7}$ gm./cm.^{2} for serum globulin to $1·111 \times 10^{-7}$ gm./cm.^{2} for serum albumin[5,6,7]. With an average residue weight of 120, these densities give an area per residue ranging from 11·48 A.^{2} to 18·82 A.^{2}. On the basis of the proposed hexagonal packing of polypeptides I therefore suggest that the upper limit of density of which a protein film is capable without buckling, provided that it is only one amino acid residue thick, is one residue per 9·9 A.^{2}; further, that a higher density implies that the film, though it may still be unimolecular, is more than one amino acid residue thick.

Cyclol layers may also be used to build molecules and molecular aggregates with extension in three dimensions, since they may be linked front to front by means of the side chains, in particular, by cystine bridges, and back to back by means of hydroxyls[8]. The single-layer cyclol is a fabric capable of covering a two-dimensional area of any shape and extent; a three-dimensional array can then be built, layer upon layer, the linkage being alternately by means of side chains and hydroxyls. The idea that native proteins consist largely, if not entirely, of cyclised polypeptides therefore implies that some native proteins, including those of 'globular' type, may have a layer structure.

Linkage by means of hydroxyls recalls the structures of graphitic oxide and montmorillonite, etc. Such a structure suggests a considerable capacity for hydration, an outstanding characteristic of many proteins. Further, since alternate layers are held together by means of hydroxyls, and contiguous molecules may also be held together in the same way, a protein molecular aggregate will, on this theory, necessarily be sensitive to changes in the acidity of the medium; in particular, a sufficiently high *p*H will cause such an aggregate to dissociate into single-layer units or into two-layer units joined by cystine bridges or side chains in covalent linkages. Svedberg's results, according to which a number of different native proteins break up into smaller molecules with sub-multiple molecular weights[1], here find a simple interpretation. The particular sub-multiples which occur may be regarded as affording evidence as to the type of symmetry possessed by the layers out of which the molecular aggregates are built.

The hypothesis that native proteins consist essentially of cyclised polypeptides thus takes account of the facts mentioned in (1), (2), (3), (4) above. Further, it derives support from the case of α-keratin, for with Astbury's 'pseudo-diketopiperazine' structure[3] the polypeptides may be regarded as partially cyclised since they are cyclised at regular intervals, one out of every three (CO,NH) groups being involved. It is also suggestive in relation to a variety of other facts belonging to organic chemistry, X-ray analysis, enzyme chemistry and cytology. I cite the following:

(1) The rhythm of 18 in the distribution of amino acids in gelatin found by Bergmann[9], and the suggestion of Astbury[10] that in gelatin "the effective length of an amino acid residue is only about 2·8 A.".

(2) The low molecular weight not exceeding 1,000 found by Svedberg[11] for the bulk of the material from which lactalbumin is formed.

(3) Secretin[12], a protein with molecular weight of about 5,000, containing no open polypeptide chains.

(4) The nuclear membrane, which, consisting of proteins and lipoids, plays an important part in mitosis on account of its variable permeability.

(5) Bergmann's findings[13] with respect to dipeptidase; these suggest that the dipeptide substrate, upon which this enzyme acts, has a hexagonal configuration.

Finally, the deduction from the hypothesis of cyclised polypeptides, that native proteins may consist of dorsiventral layers, with the side-chains issuing from one side only, suggests that immunological reactions are concerned only with surfaces carrying side-chains. Hence, such reactions depend both on the particular nature and on the arrangement of the amino acids.

Full details of the work, which is to be regarded as offering for consideration, a simple *working hypothesis*, for which no finality is claimed, will be published in due course.

[1] Svedberg, *Science*, **79**, 327 (1934).
[2] International Tables for the Determination of Crystal Structure.
[3] Astbury and Woods, *Phil. Trans. Roy. Soc.*, **232**, 333 (1933).
[4] Jordan Lloyd, *Biol. Rev.*, **7**, 256 (1932).
[5] Gorter, *J. Gen. Phys.*, **18**, 421 (1935); *Amer. J. Diseases of Children*, **47**, 945 (1934).
[6] Gorter and van Ormondt, *Biochem. J.*, **29**, 48 (1935).
[7] Schulman and Rideal, *Biochem. J.*, **27**, 1581 (1933).
[8] Bernal and Megaw, *Proc. Roy. Soc.*, A, **151**, 384 (1935).
[9] Bergmann, *J. Biol. Chem.*, **110**, 471 (1935).
[10] Astbury, Cold Spring Harbor Symposia on Quantitative Biology, 2, 15 (1934).
[11] Sjogren and Svedberg, *J. Amer. Chem. Soc.*, **52**, 3650 (1930).
[12] Hammersten *et al.*, *Biochem. Z.*, **264**, 272 and 275 (1933).
[13] Bergmann *et al.*, *J. Biol. Chem.*, **109**, 325 (1935).

Association of Technical Institutions

Annual Meeting in London

THE annual meeting of the Association of Technical Institutions was held in the Goldsmiths' Hall, London, on February 28–29. The Right Hon. Lord Plender was installed as president for 1936. In his presidential address he surveyed such changes in the structure of the business world as the development of large stores, the grouping of railways and the general trend towards amalgamation of small units of business. He referred especially to costing and its scientific application which have been so useful to industry, and he emphasised the need for skilled persons in such branches as accountancy, foreign exchange, advertising, etc.

In a paper on "Technology and the Community" Councillor Wright Robinson touched a question already adumbrated in the recent "Report on Policy

in Technical Education" prepared by the Association in collaboration with the Associations of principals and teachers in technical institutions. He reproduced figures from various reports which showed the growth of unemployment in relation to increasing mechanisation. He indicated that there is yet no limit of work which mankind must yet perform: "Apart from more immediate tasks . . . we have the problem of making places like the Sahara into gardens, and of making Australia less like a huge plate with a scanty population clinging to stretches of the seaboard that represents only the rim."

However that may be, Councillor Robinson insisted that we should face some of the devastating social implications of our industrial development: ". . . that an increasing number of the jobs open to boys have no future and hold out no prospect of employment was amply demonstrated by statistics which appear in Jewkes and Winterbottom's 'Juvenile Employment'." One table therefrom showed that the cotton industry is becoming a blind-alley industry, taking in juvenile labour at the same time as it is pushing it out a year or so later. It would be difficult to deny Councillor Robinson's comment: "No greater disillusionment for the normal boy or girl is possible than to find out that there is no part to play or that their chief value is their cheapness." He dealt also with the problem of leisure which is being set by our age. Here he suggested technologists might oust the devil who finds things for idle hands to do. Technical institutions must cater for the type which will want to express itself in problems of "the attraction of power applied to new use, to new experiments and inventions, to new transformations and manipulations of matter".

Mr. A. D. K. Owen (Secretary, Civic Division, Political and Economic Planning) in a paper on "Entrance into Industry" touched similar questions, but from a different angle. He repeated Councillor Robinson's point: "boys and girls fresh from school obtain jobs only to lose them again in a year or so when they claim higher wages". Moreover, many of the jobs are unsuitable and harmful. After-care and welfare work are very valuable; but they touch only a small proportion of young workers. Social provision falters at a vital phase in development. We must improve the quality of young workers. "Others may seem to prosper on cheap and low-grade labour. *We* can only hope to prosper with workers of the highest quality".

Mr. Owen insisted that the future well-being of Great Britain depends upon a considerable increase in the efficient output of goods and services. We have lost heavily in overseas markets through tariff and currency policies. "We need much more scientific and technical research into the raw materials, processes and products of industry. . . . We need to plan and guide our economic development on humane and scientific lines. . . . We need to improve the quality of our industrial and commercial personnel." With these points in mind, Mr. Owen believes that we shall have to concentrate more and more on finer and more complex products of high quality rather than on bulk products which our Eastern competitors can produce at extremely cheap rates with semi-automatic machinery and low-paid labour. A review of our educational methods is therefore essential, and Mr. Owen urged the raising of the age of full-time school attendance to fifteen years without exemptions, compulsory half-time attendance at day continuation schools between fifteen years and eighteen years, and the extension of more specialised junior technical and similar schools within the limits imposed by estimates of industries' absorbing capacity. It would follow that industries should be organised to make possible a far-sighted recruiting policy. Each industry should be able to make a broad statement of its labour requirements in the years immediately ahead.

Educational Topics and Events

CAMBRIDGE.—Mr. W. V. D. Hodge, lecturer in mathematics, and fellow of Pembroke College, has been appointed to succeed Prof. H. F. Baker as Lowndean professor of astronomy and geometry. Prof. Baker will retire at the end of the present academical year.

The Sheepshanks Exhibition, value about £39, for proficiency in astronomy, has been awarded to Max Krook, research student of Gonville and Caius College.

At Pembroke College, Dr. W. G. Penney has been elected into the Stokes studentship. Dr. Penney was educated at the Imperial College of Science, and obtained first class honours in mathematics. After graduation he held a Commonwealth Fund Fellowship at the University of Wisconsin. In 1933 he was awarded a Senior 1851 Exhibition; he entered Trinity College as a research student and graduated as Ph.D. in 1935.

LONDON.—Mr. A. C. G. Egerton, since 1921 reader in thermodynamics in the University of Oxford, has been appointed to the University chair of chemical technology. (Imperial College—Royal College of Science).

Mr. W. B. L. Trotter has been appointed as from October 1, 1935, to the University chair of surgery tenable at University College Hospital Medical School. Since 1913 he has been surgeon at University College Hospital.

Prof. William Bulloch has been appointed Heath Clark lecturer for the year 1936.

MR. NEVILLE CHAMBERLAIN, Chancellor of the Exchequer, has announced that he is prepared to seek the necessary Parliamentary authority for increasing from £1,830,000 to £2,100,000 the annual Government grant-in-aid to the universities of Great Britain for each year of the next five-year period. He will also propose a special additional increase of £150,000 for the first year. This actually means giving back to the University Grants Committee the reserve of £150,000 set aside out of the 1930–31 grant allocation which was surrendered to the national exchequer during the financial crisis.

THE National Institute of Industrial Psychology has arranged an Easter week-end study school to be held at Exeter College, Oxford, on April 9–13. The subject of study will be "Problems of Work and Leisure". Among the speakers will be Dr. A. T. P. Williams, dean of Christ Church, Oxford; Dr. E. K. Le Fleming, chairman of Council of the British Medical Association; E. J. Patterson, head of the Department of Extra-Mural Studies, University College, Exeter; Captain C. R. Coote; and Prof. J. H. Jones, professor of economics in the University of Leeds. Further information can be obtained from the Secretary, National Institute of Industrial Psychology, Aldwych House, London, W.C.2.

Science News a Century Ago

The Entomological Society

AT a meeting of the Entomological Society hold on March 7, 1836, various rare and singular species of insects were exhibited by different members, including a specimen of the kangaroo beetle from Mexico, an insect of great rarity, shown by J. G. Children, secretary of the Royal Society, by whom also some curious specimens of lepidopterous larvæ from New Zealand were exhibited. Five memoirs were presented including one on the Golofa beetle of Venezuela, another on a description of a new species of water beetle from Cambridgeshire and a third entitled "Description of New and Notes upon other Orthopterous Insects".

Fossil Remains of Mammalia in India

ON March 9, 1836, a paper by Captain Cautley was read to the Geological Society "On the Remains of Mammalia found in a Range of Mountains at the Southern Foot of the Himalayas, between the Sutlej and the Burhampooter". The hills to which the author referred lay between the Jumna and the Ganges; they did not reach more than 3,000 ft. above sea-level, and consisted of marls, sandstones and conglomerates. In the marl had been found remains of a species of anthracotherium bear, caston, deer, horse, gavial, crocodile, tortoises, fishes and fresh-water shells. The sandstones west of the Jumna had yielded a still greater number of mammalian remains, those hitherto determined belonging to the mastodon, elephant, rhinoceros, hippopotamus, hog, horse, deer, carnivora (canine and feline), crocodile, gavial, tortoise and fish. Captain Cautley's memoir was accompanied by a large collection of bones in a fine state of preservation which he presented to the Society's museum.

Magnetic Compasses in Iron Ships

WHEN iron steam vessels were first employed, two of the most serious objections to their use arose from the rapidity with which they became encrusted with marine growths and from the disturbance of the compass. When the vessels were employed only in rivers and narrow channels, these matters could be allowed for, but when vessels were sent overseas, the disturbance of the compass made navigation very difficult. Some of the first investigations into the question were made by Commander E. J. Johnson, and at a meeting of the Royal Society held on March 10, 1836, a memoir was read entitled "Report of Magnetic Experiments tried on Board an Iron Steam Vessel, by Order of the Right Hon. the Lords Commissioners of the Admiralty by Edward J. Johnson, Esq., Commander, R.N., communicated by Captain Beaufort by Command of the Admiralty".

The vessel used for the experiments was the *Garryowen*, 281 tons burden, built and engined by Lairds at Birkenhead and owned by the City of Dublin Steam Packet Co. The vessel was placed under the direction of Commander Johnson in Tarbert Bay in the Shannon on October 19, 1835. Various compasses were placed on the quay of the harbour, and as the *Garryowen* was warped from her anchorage towards them, head first and then stern first, observations were made on the deflection of the compasses. Further observations were made on compasses placed in various positions in the ship. Little resulted from these experiments; but they led to the more important ones made two years later by Airy in the S.S. *Rainbow*.

The Paris School of Medicine

ACCORDING to *The Times* on March 12, 1836, "in the midst of an immense concourse of the pupils of the School of Medicine, M. Sanson, the surgeon of the Hotel Dieu, was proclaimed Professor of Clinical Surgery as successor to Dupuytren, after a public competition which had lasted two months. The unsuccessful candidates, gentlemen of considerable eminence, were Messrs. Laugier, Blandin, Pelletier, Berard, Guerbois and Jaubert."

Societies and Academies

LONDON

Royal Society, February 27. W. R. GRAHAM, Jun., H. D. KAY and N. R. MCINTOSH: (1) A convenient method for obtaining bovine arterial blood. W. R. GRAHAM, Jun., T. S. G. JONES and H. D. KAY: (2) The precursors in cow's blood of milk fat and other milk constituents. S. J. FOLLEY and P. WHITE: (3) The effect of thyroxine on milk secretion and on some blood constituents of the lactating cow. The processes taking place in the mammary gland during milk secretion in the dairy cow have hitherto been difficult to investigate because no satisfactory method has been known for obtaining arterial blood without serious disturbance to the animal. Such a method has now been devised, and consists in puncture of the internal iliac artery through the wall of the rectum. The method is relatively safe and more than 150 arterial punctures have been made with only one fatal casualty. The following findings have been made: (1) the fat of cow's milk is derived in the main from the non-phospholipin fatty acids of the blood; (2) the phosphorus compounds of the milk derive their phosphorus from the *inorganic* phosphate of the blood plasma, and not from the phosphoric esters or the phospholipins of the blood; (3) relatively large quantities (up to 30 per cent) of the blood sugar are removed from the blood on passage through the mammary gland; (4) the number of volumes of blood required to produce one volume of milk is of the same order whether calculated from the fatty acid changes, inorganic phosphate changes, or sugar changes between arterial and venous blood. A rapid circulation of blood—probably at the rate of 300–400 volumes for each volume of milk secreted—takes place through the mammary tissue. There is a suggestion that one of the factors controlling the quantity and quality of the milk secreted is the arterial blood sugar level. This can be raised and kept above the normal level in the cow by thyroid feeding or thyroxin administration. The effect of thyroxin administration on the volume and quality of milk secreted by the cow has been carefully examined and the results subjected to statistical treatment. Under proper conditions a considerable increase in milk volume and in milk fat percentage and also in the percentage of non-fatty solids in the milk occurs. L. E. BAYLISS, R. J. LYTHGOE and KATHERINE TANSLEY: Some new forms of visual purple found in sea fishes with a note on the visual cells of origin. A number of new forms of visual

purple, which are found in sea-water fishes and which have maxima of absorption between 505 mμ and 545 mμ, are described. The absorption curves were obtained by a null-point photo-electric spectrophotometer. The instrument is capable of giving accurate readings with 0·5 c.c. of solution, and with a light intensity which is not sufficient to bleach the visual purple. It was found that there are alterations in the form of the absorption curves as a result of 'bleaching' of the yellow substances in the control solution, also there may be changes in the curve when the visual purple is extracted with distilled water. A histological examination of the retinæ was made on each of the species used. The variety of visual purple carried by a species cannot be related to the available data on the depth which that species normally frequents, to the ancestry of the species, or to the histology of the retina of origin.

DUBLIN

Royal Dublin Society, February 4. P. A. MURPHY: Some effects of drought on potato tubers. Ten forms of drought effect on potato tubers are defined and described, including cracking, hollow heart, prolongation, gemmation, chain tuberisation, independent tuber formation, premature sprouting, softening, glassy-end, and drought and heat necrosis; and the underlying physiological problems are discussed. Loss of water from developing tubers leads to the suppression of dormancy, and has an important effect on the value of seed potatoes. V. BARRY and T. DILLON: The preparation of alginic acid. Details are given of the method already described by the authors for the preparation of alginic acid from seaweed. Analysis of the barium salt and polarimeter measurements confirm the view already put forward that alginic acid is a polymer of a complete sugar acid $C_6H_{10}O_7$. V. BARRY, T. DILLON and P. O'MUINEACHAIN: The acetylation of alginic acid. This cannot be accomplished by any of the usual methods, but takes place readily when the substance is treated with hydriodic acid and acetic acid, and left standing for about twelve hours. Three products are obtained, one soluble in acetone, one soluble in alcohol, and one in aqueous alcohol. They are all diacetyl derivatives corresponding to the formula $C_6H_8O_7(COCH_3)_2$. They are probably diacetyl derivatives of alginic acid in different stages of degradation.

PARIS

Academy of Sciences, January 27 (*C.R.*, **202**, 257–360). HENRI DOUVILLÉ: The granitic sands in relation with tectonic accidents of the Eocene and with the limits of the stages. GABRIEL BERTRAND and LAZARE SILBERSTEIN: The comparative proportions of sulphur and nitrogen in plants cultivated on the same soil. Tabulated results of analyses of thirty-three plants, showing the percentage of nitrogen on the dry material and the ratio of sulphur to nitrogen. The nitrogen varies between 2·0 and 5·3 per cent, the ratio S/N between 0·052 and 0·495. ALEXANDRE BIGOT and RAOUL FORTIN: The test boring at Incarville, near Louviers (Eure). The thicknesses of the strata traversed are compared with the results obtained at Calvados and at Ferrière-en-Bray. CHARLES POISSON: The study of the magnetic anomalies at Tananarive. Description of the simplified method of taking the observations, necessitated by the large number of readings required. MARCEL VASSEUR: Laplace invariants and projective deformation of surfaces. R. O. KUZMIN: The method of quadrature of Tchebycheff. J. FAVARD: An extremal property of the integral of a periodic function. JULIEN KRAVTCHENKO: The problems of conformal representation of Helmholtz; the existence of solutions of the problems of the wake and bow in a perfect fluid limited by plane walls. ALEXANDRE GHIKA: Systems of orthogonal functions of one complex variable. ARMAND RAUCH: The extension of a theorem of M. Valiron on the directions of Borel. F. H. VAN DEN DUNGEN: A new principle of mechanics. WANG SHIH-KY: The diffusion of stellar light. HENRI CAMICHEL: The spectrum of Nova Herculis observed with the large Meudon telescope. LÉON CONVERS: The surface tension of calcium amalgam. The surface tension of calcium amalgams was measured by the drop method for twelve concentrations, the highest being 0·0033 per cent. Some irregularities were attributed to the effect of oxidation. FRÉDÉRIC JOLIOT, MOSHÉ FELDENKRAIS and ANDRÉ LAZARD: The use of carbon tetrachloride for raising the voltage of electrostatic generators of the Van de Graaff type. The limit in a given apparatus working in air was 650 kilo-volts: the introduction of carbon tetrachloride vapour into the air raised the limit to 1,250 kilo-volts. There is no explanation at present of how the carbon tetrachloride vapour acts. NICOLAS MINORSKY: A method of integrating some differential equations by electrical means. C. BUDEANU: The transfer of deforming phenomena. Mathematical analysis of alternating current circuits. PIERRE CARRÉ: An attempt at the interpretation of some differences of properties of the alkyl chlorosulphites and chloroformates, from the electronic point of view. PIERRE BARCHEWITZ: The application to absorption measurements of a simplified model of Jamin's apparatus with polarised light. MAURICE PARODI: The residual rays of magnesium oxide. By modifying the method of Born for cubical crystals of the type NaCl a result is obtained for MgO in agreement with the experiments of Barnes, Brattain and Seitz. HENRI BIZETTE: The electrical double refraction of compressed nitrogen. Kerr's constant for gaseous nitrogen, reduced to one atmosphere, for the radiation 0·578 μ of the mercury arc and at the temperature 22° C., is $B = 0{\cdot}02 \times 10^{10}$. W. BRONIEWSKI, J. T. JABLONSKI and ST. MAJ: The solidification diagram of the copper – tin alloys. Previous workers on this subject have not agreed on the interpretation of their results, probably owing to the extreme slowness in the establishment of the equilibria. The authors annealed their specimens for 200–400 hours, and studied the heating curve. JEAN BUREAU: The crystalline varieties of the hydrated barium and strontium nitrites. The hydrate $Sr(NO_2)_2,4H_2O$. GABRIEL VALENSI: The kinetics of the oxidation of spherules and metallic powders. MME. MARIE FREYMANN and RENÉ FREYMANN: The constitution of the oximes and their absorption spectrum in the near infra-red. The NH group and the OH group are characterised by definite bands in the infra-red; the application of this method confirms the view that oximes exist in two isomeric forms. The ratio of the two forms differs considerably with the nature of the alkyl groups. HENRI MOUREU: The electric moment of tantalum pentachloride and the structure of the compounds AX_5. Tantalum pentachloride, according to the results of the experiments cited, possesses an electric moment, and hence cannot possess a symmetrical formula. JEAN BRETON and PAUL LAFFITTE: The limits and velocities of

detonation of some gaseous mixtures. ANDRÉ KLING and MAURICE ROUILLY: A rapid method for determining the amount of carbon dioxide in gaseous atmospheres. LOUIS MÉDARD and ROBERT MARCHAND: The Raman effect of the neutral alkyl sulphates. The differences between the Raman spectrum of sulphuric acid and those of methyl and ethyl sulphates are greater than the differences between the spectra of the alkyl nitrates and nitric acid and suggest a peculiar molecular structure for sulphuric acid. MLLE. BLANCHE GRÉDY: Comparison of the Raman spectra of the 2-octene-1-ols and some of their *cis* and *trans* derivatives. VICTOR HARLAY: Some cupric and cuprous combinations of thiosemicarbazide and its derivatives. MARCEL GODCHOT and MLLE. GERMAINE CAUQUIL: The action of selenium dioxide on some cyclanones. MARTIAL FÉLIX TABOURY and ROGER PAJEAU: Beryllium bromide as a catalyst in the bromination of benzene. J. JUNG and E. RAGUIN: The petrography of an epicristallophyllian series of the Beaujolais. MAURICE ROQUES: The relations between the amphibolites and peridotites at Sarrazac (Dordogne). FERNAND JACQUET: The lower Eocene age of the phosphate deposits of Senegal. PIERRE COMTE: The Devonian of Léon (Spain). MLLE. MARIE CHAUBET: The certain presence of the Llandovery in the Gothlandian of the Montagne Noire. JOSEPH BOUGET: The distribution of aphis on the high ground and the lower parts of the Pyrenees valleys (Adour region). The greatly increased yield of potato plants exposed to high winds, as on hill-tops or on the coast, is explained as being due to the unfavourable effects of the wind on the plant aphis, the latter being known to carry disease. JULIEN COSTANTIN: Remarks on the preceding communication of J. Bouget. STEFAN JELLINEK: The parallelism of the physiological and morphological action of the cathode (commercial direct current on the human skin). RENÉ HAZARD: Sparteine, the antagonist of yohimbine on adrenaline hyperglycæmia. RAOUL MICHEL MAY: The duration of subcutaneous brephoplastic grafts of thyroid in the rat. ETIENNE RABAUD: Stereotropism of the hermit crabs. VICTOR PLOUVIER: The presence of amygdonitrile glucoside in the genus *Cotoneaster* and the leaves of *Cydonia vulgaris*. THÉOPHILE CAHN and JACQUES HOUGET: The transformation of glycogen into lactic acid in muscular extracts of normal and diabetic dogs. The experiments described show that diabetic muscle is capable of converting glycogen into lactic acid, but with a lower velocity. RAYMOND-HAMET: Bulbocapnine, a type of a new group of medicaments.

AMSTERDAM

Royal Academy of Sciences (*Proc.*, 38, No. 10, December 1935). L. RUTTEN: The Antilles arc. There is no distinction stratigraphically or tectonically between the Greater and Lesser Antilles. They are to be considered as a recent tectonic structure. J. G. VAN DER CORPUT: Distribution functions (2). F. A. H. SCHREINEMAKERS, MISS J. C. LANZING and C. L. DE VRIES: Influence of the nature of the membrane and the temperature on the osmotic system of water and oxalic acid. This system behaves quite differently according to whether the membrane is a pig's bladder or 'cellophane'. A. N. J. HEYN: Chemical nature of some growth hormones as determined by the diffusion method. The hormones from the coleoptile tips of *Avena* and the root tips of *Vicia Faba* are shown to be identical with auxin *a* and that from the sporangiophore of *Phycomyces nitens* with indolylacetic acid. J. J. WAKKIE: Notes on the possible structure of the chlorophyll granules in the plastid. Attempt to produce an anisotropic fluorescent chlorophyll model which will reproduce the properties of chlorophyll in the plastid. W. BEIJERINCK: Polymorphism and colour of the *Calluna* flower. Observations on the varieties found in the heath land of the Drenthe province of Holland. W. BEIJERINCK: The opening of the flower buds of *Calluna vulgaris*, L., Salisb. The influence of temperature and water-supply on the opening of the buds of this flower. B. VAN DER EYKEN: Denture and teeth development in the Irisforelle (*Salmo irideus*). (2) Tongue. Studies on embryos to determine the stages in the development of the teeth. C. P. RAVEN: Experimental investigations on glycogen metabolism of the organisation centre in the amphibian gastrula (2). C. P. RAVEN: Assimilatory induction in the dorsal lip of the blastopore of the amphibian gastrula.

Forthcoming Events

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

Saturday, March 7

BIOCHEMICAL SOCIETY, at 2.30.—(at University College, London, W.C.1).—Annual General Meeting.

BRITISH PSYCHOLOGICAL SOCIETY, at 3.—(at Bedford College, Regent's Park, N.W.1).—Symposium on "Appetites". Papers by Prof. David Katz, C. A. Mace and Dr. C. A. McCurdy.

Monday, March 9

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS, at 3.—(in Westminster Palace Rooms, 44, Victoria Street, S.W.1).—Annual General Meeting.
Discussion on "Bird Sanctuaries".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—E. R. Gunther: "Variations in Behaviour of the Peru Coastal Current".

Tuesday, March 10

ROYAL INSTITUTION, at 5.15.—Prof. Edward Mellanby, F.R.S.: "Drug-like Actions of Some Foods" (succeeding lectures on March 17, 24 and 31).

INSTITUTION OF CIVIL ENGINEERS, at 6.—D. Anderson: "The Construction of the Mersey Tunnel".

Wednesday, March 11

ROYAL SOCIETY OF ARTS, at 8.—Dr. G. W. C. Kaye: "The Acoustics of Halls".

Thursday, March 12

ROYAL SOCIETY, at 11.30.—Discussion on "Surface Phenomena—Films" to be opened by Prof. E. K. Rideal, F.R.S.

Saturday, March 14

ROYAL INSTITUTION, at 3.—The Right Hon. Lord Rutherford, O.M., F.R.S.: "Recent Researches on Transmutation" (succeeding lectures on March 21, 28 and April 4).

INSTITUTE OF METALS, March 11–12.—Annual General Meeting to be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

March 11, at 10.—W. R. Barclay: Presidential Address.

(March 10.—Special Discussion on "Metallic Wear", to be opened by Dr. H. W. Brownsdon.)