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CONTENTS

Differential Fertility and Family Allowances *

THE Registrar-General is a maker of castes: he divides his people into classes according to the social status of the occupations which they follow, but his classes are to be distinguished also by differences in wealth, in culture, and in reproductivity. It is this differential reproductive rate that alarms the eugenist.

The number of children per married couple represents the contribution of a social or occupational class to the next generation, and this contribution differs very markedly from class to class as one passes in review from the teachers on towards the occupational class of the general labourer. It matters not whether one uses the yard-stick of social status, of wealth, or of culture, one finds that, on the average, the most socially eminent, the wealthiest, and the most cultured classes exhibit a much lower reproductive rate than do the socially submerged, the poor, and the uneducated.

The relative reproductivity of the different classes will be determined by differences amongst them in the birth-rate, which is a true reflection of the operation of all those agencies which raise or reduce fecundity, which condition the frequency of mating, which render fertilisation more or less certain, and which influence the viability of the embryo and fœtus. In this connexion, therefore, the birth-rate, the abortion-rate, the infantile mortality-rate, the marriage-rate, and the age at marriage all have to be considered. But since it has been shown that differences in the amount of marriage and in infantile mortality (so far as contributions to the next generation are concerned) are not so important as are differences in the birth-rate itself, and further, that differences in the number of children born to married women irrespective of age are of more importance than are differences in age at marriage, it is possible to disregard all else but differences in the actual birth-rate, and to seek reasons other than the marriage-rate and the age at marriage in order to explain the fact that, on the average, the wealthy, the cultured, and the socially eminent make distinctly smaller contributions to the next generation than do their opposites.

A social class can continue only through reproduction or else through reinforcement from without. So long as the State continues to regard the middle-class as a desirable constituent of its population, so long must parentage on the part of its members be

* The Social Selection of Human Fertility: the Herbert Spencer Lecture delivered at Oxford, 8 June 1932. By Dr. R. A. Fisher. Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 2*s*. net.

regarded as a social service. It appears, however, that the supply of children by this middle-class (which constitutes some 10-15 per cent of the total population) is sufficient only to replace one-half of the present parental generation. It is the case that the class is being reinforced continually by such as ascend to it from the less affluent social strata, but it has not yet been shown that the calibre of these reinforcements equals that of those whose company they join. It can be argued that the middle-class is the product of a very intensive selective process, that it created itself during the eighteenth and nineteenth centuries, its families usually having had their origin in individuals who wrenched themselves free from some harsh environment and gained social promotion in their own time through the exhibition of their own talents. It would seem that such as could exhibit abundant enterprise, thrift, and foresight were able, in those days, to attain a certain level of affluence, and that these were the founders of the middle-class.

This class is only worth saving if the qualities which distinguish it are socially desirable and are in any degree the peculiar true-breeding properties of the class. It is by no means improbable that this class has, through selection, come to be somewhat differentiated in certain respects from the general body of the population from which it sprang and from which it is recruited. Possibly it is not without significance that the children of this class are to be distinguished from those of others by differences in the intelligence quotient. Furthermore, though one should be accused of bias, it is possible to hold the view that in respect of perseverance, of ambition, of æsthetic taste, of grasp of moral principle—the very qualities that make for good citizenship—this class and its members are exceptionally well endowed.

If this be so, then it would seem that through a low reproductive rate the spread of these qualities is becoming more and more restricted with each successive generation. In this there is furnished a major problem awaiting the attention of the serious statesman. The problem would seem to be that of dissociating a low reproductive rate on one hand and the estimable qualities that make for good citizenship on the other. At the present time, and in the existing social system, it is an obvious fact, recognised by all, that it is a distinct advantage to the individual so to choose his parents that he is either an only child or else one of two; for in these circumstances he can expect to be better tended, better educated, and secure a better financial launching into some chosen competitive professional career, and thus more quickly obtain that social promotion which is so universally desired than can one of a family of five to ten. To choose parents of low fertility is to choose not only one's parents but also one's environment—plentiful food, ample shelter, rest, and attractive recreation.

Infertility has an economic value, and social promotion is favoured by a low reproductive rate. In all ranks of society, infertility, whether pathological in its causes or the result of deliberate voluntary choice, endows its possessor with definite social advantages. The question to be asked and answered is this: Is relative infertility a cause of social success, or is it a consequence? Must one be sterile to be socially successful, or does success bring sterility in its train? Dr. R. A. Fisher, in the Herbert Spencer Lecture recently delivered at Oxford, deals with this question. The subject of his lecture was "The Social Selection of Human Fertility", and it is an attempt to create a substructure for eugenic optimism out of the genetics of populations. He presupposes that the qualities which have made for success within the social organisation that has existed during the last two hundred years in Great Britain are genetic, and is of the opinion that social promotion is gained through the expression of characters which make for useful citizenship. He makes out a very strong case for the adoption by the State of a system of family allowances. It is shown that such a system provides no economic motive either for having children or for refraining from having them, but that it merely abolishes the economic bonus for childlessness and permits parents to regulate their reproductive rates.

It is not generally recognised that a family endowment system already exists in Great Britain, but that the allowances are paid only to children of the unemployed and to those who are in receipt of poor relief. It is the case that a man with a sufficiently large family in certain of the occupational groups is actually better off when unemployed than when in employment. It is indeed provocative of thought to note that if two couples are compared, one of them childless and the other with four children, but both receiving the same income for equivalent social services, their effective incomes available for personal expenditure and savings stand in the ratio of 3 : 2, the childless couple receiving a bonus amounting to one-third of their income in consequence of not having four children.

Dr. Fisher improves upon the cry of 'equal pay for equal work', for he advocates an equal standard of living for equal work. He claims that a wage including family allowances sufficient to meet the

entire cost of children would secure this end and would cut out the heavy bonus for childlessness which is an outstanding feature of the present system. In this lecture the details of accountancy which the institution of such a system would demand are not discussed, but Dr. Fisher advocates that in general the allowance payable to parents in each social grade should be proportional to the basic salary in that grade—that is to say, that the allowance should be equivalent to the actual cost in expenditure and savings incurred on the average on behalf of each child in the group.

Brief reference is made to the system of family allowances which was instituted after the War by a group of French industrialists and which is now extended to include all the wage-earning classes throughout the country. In Great Britain, the beginnings of such a scheme are seen in the establishment by Sir William Beveridge of a system of family allowances for the teaching staff of the London School of Economics. In the University of Edinburgh, parentage is made less of a burden by the fact that the children of the staff are excused class fees.

Dr. Fisher possesses all the qualifications of the really good propagandist. If he wears a professional label, it is that of the statistician; if he has a hobby, it is biology. He is a propagandist in human biology and rides his hobby in a most attractive fashion. His blandness is really dangerous; nothing is easier than to accept his views without question. However, his persuasiveness is not greater than his knowledge. If there be an alternative to this simple, lucid, concise suggestion, then it must undoubtedly come from a skilled economist who is also a confirmed bachelor.

If, as Dr. Fisher implicitly states, a system of family allowances encourages a rise in the reproductive rate, then much of the infertility of the middle-class can be nothing more than unexploited fertility—that is to say, middle-class parents could readily have more children if they should so choose. This controlled fertility may result from the habitual use of contraceptives, or, as seems more probable, it may be due to the fact that in this class the frequency of sexual intercourse is relatively low. It appears that a child that is not a burden is quickly conceived. If this is the case, if, in the opinion of the State, a higher reproductive rate on the part of the middle-class is to be desired, then it may well be that if and when prosperity returns the deduction from the salaries of civil servants and others which were recently made will not be restored, but instead a system of family allowances will be instituted.

It has to be recognised that the efforts of the many who wish to correct what they regard as the evils of the differential birth-rate by endeavouring, through an appeal to idealism, to induce others of their own group to beget larger families have not met, and will not meet, with any discernible success. It is quite useless offering the alternatives of the present comfort of the reproducers on one hand and the indefinitely future welfare of society in general on the other. This latter appeal possesses no strength.

It was true, and possibly is still true, that a man may be so moved by his idealism as to be willing to die for his country, but it is not to be expected that he will be equally willing to procreate in her service until he has been convinced that his children will enjoy the advantages that have meant so much to him. Economic security means more to the average man of the middle-class than does the decline of the Empire or the suicide of the race.

A Synthesis of Medieval Science

Introduction to the History of Science. By George Sarton. Vol. 2: *From Rabbi ben Ezra to Roger Bacon.* (Carnegie Institution of Washington, Publication 376.) Part 1. Pp. xxxvi + 480. Part 2. Pp. xvi + 481-1251. (Baltimore, Md.: The Williams and Wilkins Co., 1931.) 12 dollars.

THE first volume of Dr. Sarton's "Introduction to the History of Science", already reviewed in NATURE, was universally and deservedly acclaimed as a major contribution to our knowledge of the growth of civilisation. The second volume, which follows after a brief interval of four years, covers the twelfth and thirteenth centuries—or, as Dr. Sarton puts it, the period from Rabbi ben Ezra, "one of the greatest Biblical commentators of the Middle Ages", to Roger Bacon, the *Doctor Mirabilis*. There is probably no single scholar competent to subject the book to a thorough and authoritative critical analysis, but the general verdict can scarcely be other than that the author has fully maintained, and, indeed, in several notable respects, surpassed, the high and exacting standard he set himself in the first part of the work. One finds it difficult to decide whether Dr. Sarton is more to be praised for his courage in attempting so stupendous a task, or for his unflagging determination in carrying it to so successful a conclusion; it is at least certain that no future historian of science, of learning as a whole, or of civilisation itself, will consider his library adequately equipped unless a copy of Sarton is within arm's reach.

It would be an egregious mistake to regard the "Introduction" as nothing more than an elaborate, comprehensive, and conveniently arranged bibliography. Dr. Sarton's ambition—achieved with a degree of completeness that must afford him the keenest satisfaction—was to provide a framework for the study of medieval science and medieval thought, and to express as exactly as possible the state of our present knowledge on each topic. While full bibliographical references are clearly essential to such a framework, in themselves they are but the unit bricks that have to be classified, arranged, and mortared together in orderly fashion before the significance of each and of all can be appreciated. It is in this synthesis of scholarship that Dr. Sarton excels. Enthusiastic for the widest vision (but no less for accuracy in detail), he is free from that intensive predilection for any particular period or problem which, necessary and laudable in other circumstances, would seriously disturb the balance of such a scheme of integration as is undertaken in this book. As a consequence of his catholicity of interest, he has been able to maintain, between the divers and manifold aspects of the medieval corpus of knowledge, an equilibrium that even the most narrow specialist must recognise to be just.

Yet we fancy that many specialists will be astonished at the intimate acquaintance that Dr. Sarton shows with the recondite details of their particular fields. Such a trivial question, for example, as the suggested identification of the Latin writer Artephius with the poet and vizier Al-Tughra'i does not escape him, while a host of similar instances might be adduced to prove that his conscientiousness has extended into every section and every subject. His picture of medieval learning, indeed, is not the work of a poster artist, or even of an impressionist; it shows rather the Pre-Raphaelite characteristic of minute accuracy in detail, and if the minutiæ do not unduly obtrude themselves, it is because the broad features of the canvas are too truly designed and too skilfully limned. This dual excellence is rarely found in such perfection as in Dr. Sarton's book, where the reader desirous of a bird's-eye view of wide stretches of territory will find equal satisfaction with the scholar who seeks specific information upon some individual point.

Of the twelfth century, Dr. Sarton remarks that it was essentially a period of transition and compromise, when exchanges between the three main civilisations of Europe and the Mediterranean world—the Jewish, the Christian, and the Muslim—were more intense than they had ever been before. The work of translation from Arabic into Latin was fervently undertaken by scores of accomplished and indefatigable men—Gerard of Cremona alone translated nearly a hundred treatises, some of them of immense size—and the foundations of a new, composite, Greco-Arabic-Latin culture were laid down. In mathematics, the use of Hindu numerals was introduced, and Muslim algebra was transmitted to the West by the efforts of such men as Adelard of Bath, John of Seville, and Robert of Chester. The first Latin translation of Euclid—also from the Arabic—was made about 1142, while in 1149 the trigonometrical tables of Al-Battani and Al-Zarqali were adapted, for astronomical purposes, to the coordinates of London. The Almagest of Ptolemy was available in Latin by 1172; fifteen years later Jabir ibn Aflah's "Correction of the Almagest" was added—again by Gerard of Cremona—and although a flood of astrological treatises simultaneously deluged the Latin West, it was in the twelfth century that European astronomy showed its first real activity since the days of classical Greece.

Chemistry, in the guise of alchemy, was another twelfth century importation from Islam, and by the end of the century original treatises were beginning to appear. Dr. Sarton places Geber's "Sum of Perfection" towards the end of the thirteenth century, but it is more probably to be regarded as the culminating point of the previous century's alchemical acquirements. Physics, geography, and natural history shared in the general reawakening of learning, while medicine benefited by the translations of Hippocrates and Galen, among the Greek authors, and of Rhazes, Avicenna, Al-Zahrawi, and Ibn al-Wafid (Abenguefit) among the Muslims.

By the middle of the thirteenth century the intellectual centre of the world had definitely moved. Islam and Israel were still doing a large share of the work, but Christian scholarship had at length established that preponderance which was only to increase with the passage of time. In the second half of the century "the hegemony of Christendom . . . was absolutely indisputable". Baghdad was sacked by the Mongols in 1258, and though the culture of Islam was not thereby completely destroyed, it nevertheless suffered a grievous blow. The Jews were nearly everywhere reduced to minor importance, and almost ceased to have international significance in the world of learning. Finally, this "time of Roger Bacon, of Jacob ben Mahir ibn Tibbon, and of Qutb al-Din al-Shirazi" marked the triumph of Aristotelianism in the form of Thomist philosophy.

It is not surprising that Dr. Sarton has selected Bacon as one of his eponymous heroes for chrono-

logical characterisation. "Bacon", he says, "was essentially an encyclopædist; that is, he was tormented with the idea of the unity of knowledge, and his life was a long effort better to grasp and to explain that unity." Shall we substitute 'Sarton' for 'Bacon'? Then the truth of the statement is in no wise diminished. E. J. HOLMYARD.

Australian and New Zealand Ornithology

(1) *What Bird is That? a Guide to the Birds of Australia.* By Neville W. Cayley. Second edition. Pp. xx + 319 + 44 plates. (Sydney: Angus and Robertson, Ltd.; London: The Australian Book Co., 1931.) 12*s.* 6*d.*

(2) *New Zealand Birds.* By W. R. B. Oliver. Pp. viii + 541 + 6 plates. (Wellington, N.Z.: Fine Arts (N.Z.), Ltd., 1930.) 30*s.*

(1) AUSTRALIAN ornithological workers have been very active during this century. Campbell opened in 1901 with his book on the "Nest and Eggs"; this was followed (1901–14) by a much larger work by North on the same subject, which also included the descriptions of the birds. In 1906, Hall issued a second edition of his "Key" of 1899; this edition was illustrated by photographs of the birds, taken from Gould's folio work. This led up to the famous "Australian Bird Book" by J. A. Leach, which ran into seven editions. Leach gave a small reproduction in black and white of all the birds, and a few coloured plates depicting in miniature many forms, of which nine went to a full plate.

In this present volume, Mr. Cayley, an artist, has drawn coloured figures of all the birds of Australia and these have been reproduced in the best style, thus enabling a student to identify any bird seen on a ramble by the water or inland. This book can be called the 'big brother' of the "Australian Bird Book", but the colour process of reproducing the plates has much improved since the latter was published and Cayley's plates are admirable.

We learn from Cayley's book that it was sponsored by the Gould League of Bird Lovers to celebrate the coming of age of that useful society. The purpose of this volume is to assist and encourage those Nature lovers who desire to gain a more intimate knowledge of the birds of Australia.

The work is divided into four main sections: forest-frequenting birds; birds of the heath-lands and open country; birds of the lakes, streams, and swamps; and birds of the ocean and shore. These are again divided into small groups, such as birds of the brushes and big scrubs, birds of the open forest, etc.

Finding ourselves in any type of country and seeing a bird unknown to us, we turn up our book to the chapter dealing with the kind of territory we occupy: there we find a coloured plate depicting the birds of that region. Having identified our picture and noting its number, we turn to that number in the letterpress, where we find the name of the bird, its distribution, notes on its habits and a description of its nest and eggs, and the months of the year when the eggs are to be found. Thus we are able to answer the oft-repeated question: What bird is that?

On p. 32 we find the only subspecies admitted, and that a new one, a form of masked owl, called *Tyto novæhollandiæ troughtoni*, a cave-dweller in that part of Australia where trees are absent, called Nullarbor Plain, to emphasise the fact. We doubt the wisdom of describing a new bird in this kind of book, especially as there are so many journals devoted to ornithology, which the compiler of the *Zoological Record* must examine. On p. 197 we find the genus *Emblema* superseded by *Cayleyna* with no explanation, and as this is the first time we have come across this word, we wonder why. We know *Emblemus* of Dejean, 1821, but here it is a nude name; perhaps it was quickened before 1842.

The author claims his volume to be "a Guide to the Birds of Australia". This it certainly is, and if we can answer the question on the title-page he can be satisfied that he has fulfilled his mission. The nomenclature followed is modern, as is the English name of each bird. The printing and paper are good, and the coloured plates leave little or no room for improvement. In the appendix, eleven introduced birds are treated, and the index of twenty-three pages seems complete.

This volume is a good example of the 'evolution' of a bird book. It will be rather difficult for a successor to think of the next 'stage' in development of a popular work. The size of the volume renders it easy to carry with us on our journeys.

(2) New Zealand! What visions of far-away places the name brings before us, and of tattoo-faced Maoris, savage and cannibalistic, at times; a fierce warrior race, but always an honourable foe. New-comers, comparatively speaking, to this paradise in the Pacific, from the 'Islands of the Unknown', they landed in five different places and settled in both North and South Islands—

and, 'tis said, devoured the original inhabitants. They also exterminated the large struthious birds known as 'moas'.

Our vision goes back to Tasman the Dutchman, who after discovering Tasmania, in the middle of the seventeenth century, sailed on east, and on Dec. 13, 1642, discovered New Zealand and named it after a small, flat province in Holland. This explorer never landed, for when he sent a boat off to obtain fresh water the Maoris killed some of his men, so he sailed north, to discover the Friendly Islands. About this time we have reason to believe that the moas had not long become extinct —indeed, some may have lingered on into the seventeenth century.

Now we come to the voyage of Capt. Cook, who was the first white man to land on the island; he, too, at first met with hostility from the Maoris, in Poverty Bay, in October 1769. On his second voyage, however, Cook had with him the Forsters (father and son) and Dr. Sparrman. These men collected birds at Dusky Sound, and that was the beginning of New Zealand ornithology. The sea birds collected on the first voyage are common to both Australia and New Zealand. Then we have the French landing from the *Coquille*, the *Astrolabe*, and this latter ship again with the *Zelee*; Gray, who did the birds in Dieffenbach's "New Zealand", 1844, as well as in the account of the *Erebus* and *Terror*, the bird parts of which were published in 1844–45; then Peale, whose work was published in 1848; thus leading up to Buller's "Birds of New Zealand", 1872–73, the second edition in 1888 and the supplement in 1905–6. In this work are the observations of Potts, who probably did more than any other observer in New Zealand to complete the life histories of the birds. In the New Zealand avifauna is included that of the Kermadec Islands and the Chatham and Antipodes Islands. This brings us to the book under review, Oliver's useful volume, a complete and up-to-date work, of which every ornithologist should possess a copy.

In the beginning we have a history of ornithology in the islands; chapters on the ecology, migration, changes in the fauna; the economic value of birds, and on the classification. This is followed by a history of the moas, leading to all the known forms, copiously illustrated with photographs of the heads and sterna.

Then we come to the living birds, all of which are carefully worked up in the modern method. The orders, families, and genera are discussed, followed by the species, of which a full history is detailed, the bird described, its affinities and mutants, if any, given; the nestling and egg are described where known, and the breeding season indicated. Then follow the distribution, habits, food, voice, and breeding habits, and its relation to man.

The list of birds thus treated, of purely New Zealand forms, is 230, excluding the moas and introduced birds. All through the work, the extinct birds are given their place, as well as those birds introduced from Australia, etc. A complete index is added.

At the end of the book, about fifteen European, one Indian, and two Australian birds are also treated in the same way as those in the body of the work. Most people will regret the introduced birds, as in so many cases they depose the native-born and may eventually become harmful.

The new forms described are *Pachyptila turtur fallai*, *Cyanoramphus novæzelandiæ chathamensis*, *Bowdleria punctata stewartiana*, *Prosthernadera novæseelandiæ chathamensis*. This last form was described by Dr. E. Hartert two years before, under the same name. Amongst the extinct forms we find a new family, Anomalopterygidæ; a new genus, *Pachydytes*, and two species of extinct penguins, *P. ponderosus* and *P. novæzealandiæ*; and new genus and species, *Euryanus finschi*, for the extinct New Zealand teal. To the list of the birds of New Zealand must now be added *Sterna macrura*, the arctic tern; *Pisobia melanotos*, the pectoral sandpiper; *Crocethia alba*, the sanderling; *Lobipes lobatus*, the northern phalarope; *Microtribonyx ventralis*, the black-tailed water-hen; *Threskiornis molucca*, the white ibis (Australian); and *Graucalus novæhollandiæ*, the black-faced cuckoo shrike.

G. M. MATHEWS.

Italian Fisheries

Ministero dell' Agricoltura e delle Foreste: Direzione-Generale dell' Agricoltura. La pesca nei mari e nelle acque interne d' Italia: notiziario tecnico e legislativo e repertorio della industria e del commercio dei prodotti pescherecci. Vol. 1. Pp. xvi + 356. Vol. 2. Pp. x + 710. Vol. 3. Pp. ix + 412. (Roma: Istituto Poligrafico dello Stato, 1931.) 3 vols., 100 lire.

FASCIST Italy has been quick to recognise that in its fisheries, no less than in any other branch of the nation's commerce, future progress depends upon the efficiency with which the industry is conducted. As an initial step towards rationalisation, therefore, an exhaustive survey of the fisheries situation in all its phases has been under-

taken, in which no relevant subject appears to have been overlooked. Testimony to the thoroughness of this official 'stock-taking' is provided by these three remarkable volumes recently issued by the Italian Ministry of Agriculture and Forestry, the government department responsible for the administration of the fisheries. It is impossible here to give more than a bare indication of the contents of the three volumes, which comprise nearly 1500 pages of text, accompanied by a wealth of photographs, diagrams, charts, and plates, both coloured and uncoloured.

Vol. 1 commences with a descriptive catalogue of the various institutions and corporate associations which are directly interested in fisheries matters, whether these be scientific institutions such as marine laboratories and fish-hatcheries, schools, museums, and learned societies, or industrial syndicates, either national or local. Not the least instructive part of this section is the grouping of the different institutions and associations in relation to the particular department of the government to which they appear to be responsible. The second part of vol. 1 is devoted to the laws governing national fishing, and to the international conventions honoured by the State.

Vol. 2 is a detailed treatise on fishing technique. Beginning with the sea fisheries, descriptions and illustrations (many coloured) of the exploited fishes, crustaceans, and molluscs are first given, and then follows a most interesting and detailed account of fishing methods and results. In this volume, the charm which old-time methods of fishing excite is unusually evident because of the rich variety in boats and gear used in the Italian sail fishery. Nevertheless, this does not detract from the interest aroused by the description of the more modern if more prosaic steam fishery. Leaving the sea and turning to the fresh water, the subject matter is very complete.

The third volume is concerned with the marketing of fishery products, either as fresh commodities or after some form of conservation. Of the three volumes, this one is the most domestic, in that it deals with matters which are more the concern of the home government and the fishing industry than of the lay reader outside Italy. Yet it demonstrates in a very simple way the thoroughness with which the survey has been conducted. Thus, more than seventy pages are devoted to an enumeration of the common names used at different places for the economically valuable fishes, in order, it is assumed, to leave no room for doubt on account of local differences. In many instances, indeed, the common name, dialect name, and scientific name are given for one and the same locality. Or again, whereas it would not have been an unusual procedure if the volume gave estimates of the number of fish merchants, salesmen, boatbuilders, and personnel of other ancillary occupations, it is noteworthy that *individual* merchants and salesmen, etc., are named and classified according to the locality in which they are operating.

Altogether, this 'blue-book' on the Italian fisheries—for such is the most appropriate description of it—is a publication of a character almost unique, in that it is a State guide to the fisheries, prepared by a government, lavishly illustrated, and printed in the State Printing House. The work which it most closely resembles is the great "Handbuch der Seefischerei Nordeuropas" published in Germany, to which, it must be confessed, nationals of Great Britain must refer for the most complete description of British fishing. Certainly there is no comprehensive account of our fisheries written in English which can claim to be equivalent to either the Italian or German works. E. FORD.

The Internal Combustion Engine

The Internal Combustion Engine. By D. R. Pye. (Oxford Engineering Science Series.) Pp. xii + 250. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 15*s*. net.

UNDER this heading, two books on internal combustion engines, one by Prof. W. E. Dalby and the other by Mr. H. R. Ricardo, were recently reviewed in these columns (NATURE, Nov. 28, 1931, p. 886). Mr. Pye's book differs considerably from either of these in scope and outlook. It is a very complete monograph on the theory of the engine. It is written in the clear and attractive style which those who are familiar with Mr. Pye's previous writings have learned to expect from him. The author deals fully with the practical nature and the comparative efficiency of combustion at 'constant volume' and 'constant pressure'; the nature of fuels; detonation; combustion in the cylinder; and the effect of various factors on thermal efficiency. There is a final useful chapter on the testing of engines. There is no unnecessary matter in the book, which undoubtedly presents the fullest and at the same time most concise description of the theory of the engine so far as it has been developed by modern research. Mr. Pye naturally draws most of his illustrations of the theory from the results of his own experience with high-speed engines; he does not touch on the special practical

problems of slow-running engines, but the underlying theory is common to all types.

There is little in the book to which a critic could take exception. Perhaps too much value is attached to the measurement of the air consumption of engines. When the fuel is largely or mainly composed of hydrocarbons, whether gaseous or liquid, there is a point at which the consumption of air per horse power developed is a minimum. This point occurs when the mixture is rich, that is, when there is too much fuel for complete combustion. Over a wide range of mixtures the air consumption per horse power remains practically constant, so it is comparatively easy to measure accurately in practice. The minimum air consumption gives a measure of the overall efficiency of the engine, but it does not give a measure of the minimum fuel consumption of the engine, or of the amount of fuel that may be lost by imperfect distribution in a multi-cylinder engine. Mr. Pye, following Mr. Ricardo, assumes that it does, and arrives (on p. 135) at certain conclusions which appear to the reviewer to be wrong, although perhaps not far wrong. But it is accidental that they are not far wrong. Again (p. 154), in the course of a general discussion on thermal efficiency referred to fuel or air, it is not strictly true to say that in gas engines operating on carbon monoxide or hydrogen, the heat output and the efficiency is the same for a mixture containing 80 per cent of the gas required for complete combustion as for a mixture containing 80 per cent of the air required.

These, however, are minor blemishes in a first-class work, which has been needed for some time; it can be strongly recommended to all serious students of the subject, and particularly to those who are engaged in unravelling some of the many properties of the internal combustion engine that are still imperfectly understood. It is unfortunate that the price of the book will prevent its purchase by many who would gain by having it on their shelves, but this is a general criticism applying to most scientific books.

Colloidal Properties of Smokes

Smoke: a Study of Aerial Disperse Systems. By Prof. R. Whytlaw-Gray and H. S. Patterson. Pp. viii + 192 + 12 plates. (London: Edward Arnold and Co., 1932.) 14*s.* net.

IN this book the authors give a connected account of the large body of work on disperse systems in air which they have for some years been carrying out at Leeds, together with the relevant researches of other investigators. The subject is one of considerable theoretical and practical interest. On the theoretical side, the contrast in properties between a substance dispersed in a liquid medium and one dispersed in a gas throws light on the mechanism of general processes in sols, such as that of coagulation; on the practical side, the coagulation of smokes assumes particular importance in the industrial precipitation of fumes and in the consideration of urban fogs; while as an example of the bearing of the subject on the world of atomic physics, we may quote the experiments of Ehrenhaft on the sub-electron, the fallacious conclusions of which our authors trace to a neglect of the processes of coagulation common to all smokes.

The technique of all observations on smokes—counts of particles, size of particles, density of particles, to quote some of the most important—is a difficult one, and, very wisely, much of the space is devoted to a discussion of the experimental methods by which the authors have been enabled to obtain reproducible smokes and consistent measurements. The particular ultra-microscopic method by which certain earlier errors of counting have been eliminated is described in detail, as well as other methods by which it has been checked. Very ingenious is the way in which the velocity of fall under gravity, combined with the velocity of rise of the charged particle in a known electric field, has been used to determine the density of the particles; it is, of course, reminiscent of Millikan's method of determining e, but in this case e is taken as known, within an integral multiple, which is in its turn determined by carrying out four or five experiments, and selecting integers which give a consistent result. Some of the results of this method are very striking. It is, perhaps, only to be expected that the density of the solid particles should be very much below the bulk density of the substance in question, but, turning to liquids, whereas with oil droplets the density comes out in good agreement with the bulk density of oil, for mercury droplets the observed particle density is about 1·7. The reason for this the authors do not discuss.

While it is shown that Smoluchowski's theory of coagulation in liquid media can be adapted to give a good account of the very careful measurements of coagulation of smokes carried out by the authors, many of the problems described in this book are still in the early stages of investigation rather than in the stage of final solution. The movement of the particles under the influence of light, known as photophoresis, is still, when it comes to the point, quite obscure: the electrification of smokes, as

the authors point out, needs much further work before the distribution of charge with particles of different substances, and different methods of production, can be tolerably understood. A very sound beginning has, however, been made, and it is not the least merit of the book that, while what has been achieved is soberly set down, no attempt is made to gloss over the very grave difficulties still to be met in many parts of the subject.

E. N. DA C. A.

Short Reviews

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 25: *Geophysik.* Teil 2: *Physik des festen Erdkorpers und des Meeres.* Unter der Redaktion von G. Angenheister. Pp. xiv + 823. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 74 gold marks.

THIS book is good in places. Prof. Tammann discusses geochemistry. His article contains a needed warning against the too ready acceptance of the hypothesis of a sulphide shell of considerable thickness. On the other hand, he asserts that there is a critical pressure, above which the melting point decreases with pressure, and makes no mention of Bridgman's criticism of this hypothesis. G. Kirsch deals with radioactivity, age determinations, and heat supply, on the whole well, but gives on p. 51 a misleadingly incomplete statement of the nature of Jeffreys's objections to the theory of periodic melting. Kossmat's article on tectonics is useful and critical, though too short for the subject, and there is a shortage of quantitative data on the topics discussed.

The figure of the earth is treated by Schmehl; this article is notable for a correct statement of Stokes's formula, which has been misquoted in several recent German works. This section and that of K. Jung on the interpretation of gravity variation are uniformly good. E. Tams gives a good account of the distribution of earthquakes in place and time, and O. Meisser of the theory of elastic waves. Krumbach's article on seismology, however, shows some serious omissions. There is no mention of the Milne-Shaw seismograph, with which so many observatories are now equipped. In dealing with dispersion of surface waves, there is no mention of the distinction between wave-velocity and group-velocity, or of the important work of Stoneley and Tillotson. On p. 520 the author makes the surprising statement that Jeffreys agrees with S. Mohorovičić and Gutenberg that the thickness of the upper layer is 40 km., though there is a correct, but incomplete, reference to one of the papers in which Jeffreys estimated it as about 12 km.

The articles on oceanography, by Defant, and on tides, by Hopfner, are excellent summaries of existing knowledge, including recent British and American work.

The index shows lack of care. Three references to J. C. Adams should be to L. H. Adams, and "R. L. Lawson" covers the identities of A. C. Lawson and R. W. Lawson. Some reluctance to believe that a Christian name can begin with the letter I has affected the references to Newton, Bromwich, Taylor, and Lehmann; and H.M.S. *Challenger* seems to be thought to be a person. Several other authors have their names misspelt or wrong initials given. H. J.

Vital Records in the Tropics. By P. Granville Edge. Pp. xi + 167. (London: George Routledge and Sons, Ltd., 1932.) 7*s.* 6*d.* net.

THIS little book may be recommended with confidence to the consideration of medical officers, administrators, and officials in tropical countries whose duties bring them in contact with a backward indigenous population. The case for the record of vital statistics is argued convincingly but temperately, and, as appears, with a full appreciation of the difficulties involved.

When dealing with methods of obtaining and recording statistical material, the author warns his readers that the trials of the recording officer go far beyond the suspicion, indifference, or stupidity which hamper, for example, the census among the civilised illiterate. These elements are indeed present, but to them must be added the effects of exaggerated rumour, taboos, social regulations, and an unlimited number of magical and religious concepts and prohibitions. It is made abundantly clear that the census officer and vital statistician must know something more than a smattering of anthropology and the bearing of anthropological data on his work, if his duties are not to lead him into trouble. At the same time he must be an acute judge of native character in the individual, in order that he may keep a check on the idiosyncrasies of his native assistants.

It is in view of these difficulties that the author, wisely it would seem, favours, at least in the initial stages, "small scale inquiries", that is, the intensive investigation and detailed record of single units (in native social organisation), of which the results can afterwards be combined in larger and larger unities until the frontiers are ultimately reached. The difficulties due to migratory habits of the native, whether normal or in an emergency, such as illness, are noted, and certain remedial measures suggested; but the author deals with a village population only, and does not indicate a method of approach when a population is nomadic, as, for example, the Masai.

Handbuch der Geophysik. Herausgegeben von Prof. Dr. B. Gutenberg. Band 1, Lieferung 1. Pp. vii + 308. 54 gold marks. Band 2, Lieferung 1. Pp. viii + 564. 102 gold marks. Band 3, Lieferung 1. Pp. ix + 570. 64 gold marks. Band 6, Lieferung 1. Pp. v + 312. 63 gold marks. (Berlin: Gebrüder Borntraeger, 1930–1931.)

FOUR more sections of this learned work by numerous authors are now available. It would be easy to find defects in it, but it would be very difficult to do it better. What strikes the reviewer

particularly is the inevitable fact that, in a comprehensive work of this character, sections are liable to become out of date owing to later work while the book is in the press; and most of the faults that one might find would be of this nature.

Prof. Nölke gives a thoughtful account of theories of the origin of the solar system, but does not appear to have grasped the essential difficulty of explaining how the comparatively small masses of the planets succeeded in holding themselves together for a long enough time to be able to condense. In places also he seems to have misunderstood the work of other investigators. Berg, writing on geochemistry, supports the eclogite-sulphide constitution of the rocky shell, but Gutenberg himself seems to agree with the reviewer that the evidence is in favour of dunite. Other chapters deal with the figure of the earth, its age, geological history, thermal history, igneous activity, movements of the crust, effects of ice, and geophysical prospecting.

Special mention may be made of Gutenberg's theory of continental spreading. He admits the force of the mechanical objections to continental drift as usually understood, but notices that the weight of continents implies shearing stresses within them of the order of magnitude of the strength, and consequently supposes that they may have spread out under their own weight. H. J.

Business and Science: being Collected Papers read to the Department of Industrial Co-operation at the Centenary Meeting of the British Association for the Advancement of Science, London, September 1931. Edited by R. J. Mackay. Published by Authority of the Council of the British Association for the Council of the Management Research Groups of Great Britain. Pp. xvi + 312. (London: The Sylvan Press (Henderson and Spalding, Ltd.), 1932.) 5*s*.

THE various papers collected in this volume form a valuable contribution to the study of problems of management. Mr. B. Seebohm Rowntree points out in a foreword that good management is the most important and most dependable factor in the prosperity of a business. He emphasises that business management is a complicated science which must be studied as laboriously as one studies chemistry, medicine, or engineering, and on the extent to which individual employers succeed in mastering that science will depend not only the prosperity of their own firms but also that of the nation to which they belong.

The field covered by the papers is very wide, and includes contributions from some forty speakers, grouped into five sections, entitled "The Study of Management", "Preparation for Management", "Body and Mind at Work", "Some Higher Management Problems", and "The Development of Invention". In the section "Preparation for Management" an interesting account is given of various educational institutions which aim at providing training for the higher administrative posts in industry. Viscount Leverhulme describes the Staff Training College and the 'Trainee System' of Messrs. Lever Brothers; M. Pierre Jolly explains the methods adopted at the Business Preparation Centre recently inaugurated by the Paris Chamber of Commerce, of which a special feature has been the establishment of a bureau to collect and prepare materials drawn from actual business problems to be used as 'cases' for demonstrating to students the application of theoretical principles to practice; Dr. Bowie details the methods adopted in the College of Technology, Manchester, where the first Department of Industrial Administration was established in Great Britain; Prof. Florence describes the commerce course of the University of Birmingham, while Prof. McNair tells of the work carried out at the Graduate School of Business Administration, Harvard University.

Sexual Life in Ancient Greece. By Hans Licht. Translated by J. H. Freese. Edited by L. H. Dawson. Pp. xv + 557 + 32 plates. (London: George Routledge and Sons, Ltd., 1932.) 42*s*. net.

THE late Dr. Licht's study of the sexual life of the Greeks of antiquity is a marvel of erudition. He ransacked Greek literature from end to end—from Homer to the latest writers in the Greek tradition of the beginning of the Middle Ages—and there is no side of eroticism to which any reference is made that he did not bring under review. The attitude of the Greeks towards the human body, their clothing, their marriages, the place of sex in festivals and games, in the theatre, and in religion are demonstrated by reference to, or quotation from, their own statements; while sexual activities in the relations between men and women, prostitution, homosexuality, and a variety of other matters pertaining to sex are described in detail on the basis of material from the same source.

Although it must be admitted that sensuality in the broader and original sense played a large part in the life of the Greeks, it may seem that Dr. Licht is inclined to attach too much importance to eroticism. He regards it as "the prime cause of old Greek culture and the centre of Hellenic life". It is easy to attach too much weight to their frank admission of certain facts. Dr. Licht is also inclined to misinterpret the reticence of classical studies on these matters. The facts were recognised, at any rate in more recent scholarship, if not treated with the minuteness and particularity of the present study.

A History of Later Greek Literature: from the Death of Alexander in 323 B.C. to the Death of Justinian in 565 A.D. By Prof. F. A. Wright. Pp. xi + 415. (London: George Routledge and Sons, Ltd., 1932.) 18*s*. net.

THIS most helpful compendium of the later Greek literature seems to us to throw much light on the intellectual atmosphere of the period covered. The Alexandrian school of philosophers and scientific workers, such as Euclid, Aristarchus, Archimedes, Eratosthenes, and Hipparchus, is given all the prominence it deserves. It is, however, the prose writers and poets who interest the author most; and the quotations he gives from their works add to the value of his criticisms. T. G.

Scientific Research and Industrial Development

IT is difficult if not impossible to appreciate the potentialities of science in industry or in society, or to assess accurately any plan which science can offer us, apart from the consideration of the relations between science and industry which have developed in the past and as they exist to-day. Nor is this a simple task of history. It is immensely complicated by the dynamic character of both science and industry. Society itself does not change its aspects more completely or rapidly than science or industry under the impact of science. For this reason prediction as to the results of planning industry or society on scientific lines is extremely rash. All that can be said is that the scientific method offers a reasonable chance of arriving at an unprejudiced solution of many of our problems and that its technique is sufficiently elastic to be adapted to the solution of new problems as they arise.

The most rapid review of the relations between industry and science during the last century provides convincing evidence of the power of science to assist in the development of industry and the amelioration of society. Of this there are few more striking examples to be found than in the field of fuel economy. A century ago Great Britain was passing through a depression fully comparable with that of the past two years and probably involving even more acute distress. The outlook in the coal and iron industries was gloomy in the extreme, yet at that very time the researches of Michael Faraday on electromagnetic induction were preparing the way for the immense development of the electrical engineering industries with their many branches to-day. The scientific discovery of the production of electric current by mechanical rotation in a magnetic field is the germ from which the dynamo and through it all the numerous branches of electrical power and electric light have sprung. Simultaneously, the engineer was applying his science to the development of railway transport and the advantages of gas lighting were slowly spreading over the country from London and the larger cities.

All these developments themselves induced large demands for coal and iron and finally steel, but as Prof. W. A. Bone pointed out in a recent brilliant lecture, it was the continuous application of scientific methods in the utilisation of fuel that made for progress. James B. Neilson's invention of the hot blast in iron smelting, Whitwell's development of the regenerative principle in blast furnaces, Bessemer's and Thomas and Gilchrist's discoveries in steel making, the Siemens gas-fired open hearth regenerative furnaces—these were all advances in economic production based upon the application of scientific principles to the daily problems of industry, and often upon a scientific study of fundamental laws of heat exchange economy or the complex chemical reactions occurring in the furnace, such as Lowthian Bell carried out for blast furnaces. The gas and coke industries show a continuous record of expansion which is inextricably linked with scientific method and discovery; the Bunsen burner, the Welsbach incandescent mantle, incandescent surface combustion, are all examples of independent scientific discoveries the utilisation of which has profoundly affected the development of the industry.

Similarly in power production the scientific work of Carnot, the experimental researches of Joule, the thermodynamic work of Clausius, Rankine, and Thomson led to the evolution of a scientific theory of the steam engine on which later developments were based. Sir Charles Parsons' invention and development of the steam turbine, perhaps the greatest mechanical achievement of the century, cannot be separated from scientific method and its application to industrial problems. The internal efficiency of the turbine itself has since been increased by the scientific study of nozzles, 'bleeding' and the use of higher velocity ratios, while other scientific work with higher boiler pressures, higher vacuum in the condenser, superheating, regenerative 'cascade' fuel-heating, etc., has increased the thermodynamical efficiency of the cycle. Nor have these achievements exhausted the possibilities. It is probable that the opportunities for pioneering in this field for the next generation are as great as ever; much yet remains to be done, particularly in extending scientific control in the utilisation of fuel, which incidentally lies at the root of the smoke abatement problem.

In spite, however, of the convincing demonstration in the past of the power of scientific investigation to alleviate the difficulties of the coal and fuel industries, a hiatus between knowledge and action persists which adds considerably to the difficulties in which the coal industry finds itself to-day. Not even the growing seriousness of atmospheric pollution or the intensity of the unemployment situation has driven Parliament to consider co-ordination in the utilisation of our coal resources in the form of smokeless fuel or oil fuel as a possible economic policy worthy of development. The fuel problem and the competition between raw coal, gas, and electricity is still allowed to develop along haphazard lines, without any attempt to plan and enact a scientific and economic national policy. To this position no contrast could be more startling than the discussion on fuel subjects at the jubilee meetings last year of the Society of Chemical Industry, which was planned to elucidate definite answers to such questions as the probable effect upon the amount of coal raised of the increasing use of oil, of the future development of the gas and electrical industries, of a large development of low-temperature carbonisation, or of a general improvement of the standard of living.

Only upon the considered answers to such questions can an adequate fuel policy be based, yet here again it is science and industry and not Parliament which is conducting the inquiry. The conference indeed took a sombre view of the prospects

of any increased demand for coal, Dr. Lessing considering that a decrease in consumption is more probable; and even in the development of the hydrogenation process, prospects of an increased output of raw coal are not bright. Although international agreements might secure more lucrative prices, they are unlikely to affect the tonnage of coal raised. Lieut.-Commander Kenworthy's suggestion that scientific workers, economists, and business men should set up a representative body to examine the economic side of the coal problem was itself a confession that Parliament is not the instrument which will put the coal-mining industry on its feet. Essentially the plea was an admission that the fuel problem demands scientific treatment as an organic unit by the best brains of the country, unfettered by political ties.

In closely related industries the same story of the fundamental dependence of industrial progress upon scientific research is told. Long and patient investigations led Ludwig Mond to the discovery of nickel carbonyl, and the remarkable progress in the metallurgical industries during the last two decades is also based on purely scientific investigations—metals such as tungsten, molybdenum, vanadium being little more than curiosities when they were discovered. The 'Silal' heat-resisting alloys developed by the Cast Iron Research Association are finding a number of successful uses in industry, and it is claimed that the application of the knowledge of moulding sands and refractories acquired as a result of the Association's investigations represents an estimated saving to the industry of about £100,000 a year. Important advances in our knowledge of aluminium castings have come from the investigations of the Non-Ferrous Metals Research Association, while the investigations carried out by the British Refractories Research Association to improve the durability of refractories react on developments in the ceramic, the iron and steel, and other industries concerned with high temperature operations.

Much has been written in recent years on the dependence of the dyestuffs industry on scientific research and on the part which neglect of scientific research and development played in the decay of the British industry in the latter part of last century. It is, however, by no means generally realised that it was the rapid development of theoretical organic chemistry through the successive ideas of Berzelius, Gerhardt and Laurent, Liebig and Wohler, Dumas, unified by Cannizzaro, Williamson and Kekulé, which laid the foundations upon which the immense edifice of modern organic chemistry is based. Only in the order thus established could the significance of the fundamental discoveries, such as Perkin's mauve, the first azo dye of Peter Griess, Bayer's phthaleins and synthetic indigo, be appreciated and the development of dyestuffs, synthetic drugs, and other branches of chemical industry become possible.

These industries thus owe a double debt to science. Not only were these developments contingent on chemical science opening up the field and establishing some sort of order among the immensely complicated compounds of carbon, but also the fundamental discoveries leading to definite technical advances have frequently been made, often fortuitously, in scientific laboratories.

The renaissance of the British dyestuffs industry under the operation of the Dyestuffs (Import Regulation) Act is in itself a striking example of industrial development through the continuous intensive application of scientific research. Not content merely to tread in the footsteps of its foreign competitors, in 'caledon jade green', the 'duranol' colours for acetate rayon and the 'soledon' colours, the British industry has been responsible for three out of the five major discoveries in the chemistry of dyes in post-War years.

Moreover, it is interesting to note that, so far from the field being exhausted or its potentialities limited by the discoveries and developments of last century, although the main structure of organic chemistry has remained essentially unchanged during the last three decades, within that period the view that chemistry is a static science has been confounded by discoveries and industries in almost every branch of organic chemistry. The technical production of indigo essentially dates from the Deutscher Golstand Silberscheide-anstalt or Roessler sodamide fusion patent of 1901, the Sandmeyer process from indigo being still more recent. The oldest section of the dyestuffs field, the triphenylmethane or aniline colours formerly regarded as comparatively fugitive, was found in 1915 to be capable of yielding with phosphotungstic acid a series of lake or pigment colours of surprising fastness to light, whilst the azo section is still providing new dyes for overcoming the dyeing difficulties presented by the new synthetic fibres.

Closely parallel with the development of the dyestuffs industry is that of synthetic drugs and fine chemicals. Here again the industry may be traced back to much purely scientific work such as Kolbe's synthesis of salicylic acid, and its expansion has invariably been connected with external scientific work, like Knorr's discovery of antipyrine, Ehrlich's salvarsan, Fourneau's 309, Kraut's aspirin, Molle and Kleist's veronal, the isolation and synthesis of adrenaline, Banting and Best's isolation of insulin, Kendall's preparation of thyroxin and its brilliant synthesis by Harington. Pasteur's scientific investigations on yeast were prompted by a brewing difficulty and led him to the discovery of the whole theory of fermentation, the existence and action of bacteria, thence to the pasteurisation process, and finally to the discovery of the antitoxin of hydrophobia. These discoveries have not merely transformed the brewing, yeast, dairy, and cheese industries, but also have led to the rise of important new branches in the production by fermentation of solvents such as acetone and butyl alcohol. It would be difficult to measure the debt of either the fermentation industries or, indeed, of humanity to the scientific work of Pasteur.

Even in the older industries, scientific research has been responsible for revolutionary changes and developments. The art of soap-making has been

transformed into a science. Sabatier's observation of the hydrogenating properties of finely divided nickel is the germ from which has developed the industrial hydrogenation or hardening of oils and fats and innumerable processes in almost every section of organic chemistry, including the Berginisation process for obtaining liquid fuels from coal. Scientific investigations on nitrocellulose and cellulose acetate and their solvents have led to the discovery of lacquers which have not only revolutionised the paint and varnish industry, but also made possible the enormous expansion of the automobile industry. The leather substitute used extensively in upholstering motor cars has itself been produced as an outcome of the scientific investigation of nitrated cellulose. Equally important is the development of the whole rayon industry from scientific investigations and observations in the same field of cellulose—Chardonnet's discovery of nitrocellulose silk and Cross and Bevan's viscose. The technical possibilities of any one of these discoveries were scarcely dreamed of by industry when the first investigation was commenced. Finally, the great fertiliser industry, including the fixation of atmospheric nitrogen, is essentially based on Liebig's discovery of the superphosphate process and Lawes and Gilbert's patient investigations on the effect of fertilisers on plant growth.

The above brief review of the creative influence of science on industry might be extended by reference to the radio industry, which is similarly the outcome of the scientific researches of Clerk Maxwell and Hertz on the properties of the electric waves. The telephone originated with the experiments of Bell, and the cinematograph industry, the automobile, the aircraft, the synthetic ammonia industries, are all the outcome of fundamental investigations, the practical significance of which was undreamt of at the time, and each now gives employment to thousands of workers.

Admittedly, society must look to creative science for the best hope of an ultimate solution of the unemployment situation. Indirectly, therefore, the problem of unemployment is linked with the problem of fostering the most vigorous intellectual activity among scientific workers and attracting into the service of science the most able minds the present generation can provide. Conditions which tend to lower the standard of recruitment for the various branches of the profession of science may react dangerously upon the welfare of the community. If full contact is secured between the finest type of such scientific work and industry, a fertilisation of industrial research will result from which all branches of the community will benefit. So competent an observer as Prof. Henry Clay remarks in this connexion that industrial expansion takes place less as the result of the establishment of entirely new firms to exploit new processes and new demands than as a result of existing firms, which are making profits by the efficiency of their management, applying these profits to finance expansion in new directions. It would seem that only through the rationalisation of industry can creative science exert its full influence in expanding employment.

(*To be continued.*)

The Structure of Wind over Level Country *

ABOUT seven years ago, in connexion with the construction and navigation of airships, the Meteorological Office was called upon to conduct further investigations into certain problems of wind structure. The work was taken up with energy and ability by M. A. Giblett, the already distinguished young meteorologist who afterwards in 1930 lost his life in the ill-fated *R101*. The researches on wind structure were completed by members of the meteorological staff of the Royal Airship Works at Cardington, and the results are now issued in an impressive volume as Geophysical Memoir No. 54.

The data discussed in this memoir were derived mainly from four anemographs, three of which were set up at the corners of an equilateral triangle of 180 feet side—approximately the length of the airship *R101*—and a fourth at the middle point of one side of the triangle.

The instruments could be arranged to use recording drums turning at the normal rate, that is, once in 24 hours, or at 12 times the normal rate, or at 144 times the normal rate. A time-marking device could be set to operate simultaneously upon the individual records. The instrumental arrangements were in charge of B. C. V. Oddie ; a complete description of the equipment, together with photographs and a discussion of possible instrumental errors, is given in Part I.

After that, the work falls naturally into two main branches—the facts of observation and the discussion of the observations. Parts II. and IV. contain results dealing respectively with the horizontal fluctuations in wind in time and space and with the variation of wind with height ; seven appendices are devoted to the statistics, whilst the work, in all, includes no less than 95 figures, containing, in particular, reproductions of numerous records, ordinary, quick-run, and ultra-quick run. All this is a valuable store of information which probably will afford material for the discussion of further problems. The discussion in this work is contained mainly in Parts III. and V.

In Part III., C. S. Durst outlines an attractive theory of eddies. The gusts, lulls, and changes of direction in an air current are commonly ascribed to more or less circular eddies embedded in the general flow, but in the study of the ultra-quick runs it has been noted that " the wind velocity does not change regularly backwards and forwards between gusts and lulls, but that the velocity rises

* Geophysical Memoir No. 54. By the late M. A. Giblett (Superintendent of the Airship Division of the Meteorological Office), and other Members of the Staff of the Office. Pp. 119 and plates xxi. (London : H.M. Stationery Office.) 10*s*. net.

rapidly to a maximum (the gust), then falls off slowly to a minimum (the lull), and superposed on this general change there are many smaller irregular oscillations". Moreover, "the main gust and lull do not affect the direction greatly; in fact, the changes in direction produced by the rapid irregularities are as large if not larger than the changes produced by the main gust and lull". Of these two types of disturbance, the first-mentioned varies in magnitude according to the gradient of temperature in the vertical direction, and tends to vanish under conditions of extreme stability. This large scale type of disturbance Durst associates with convectional eddying in cells of a depth of perhaps 1500 feet, of length in the direction of the wind of the order of 3000-8000 feet, and of a width of perhaps 600-2000 feet. The small scale disturbances he considers to be of frictional origin, eddies set up by contact of the air stream with the surface of the earth; the diameters of these frictional eddies are of the order of 50-100 feet, and the axes may be oriented in all directions.

In Part V., A. F. Crossley takes up the discussion of the effect of the present theory of eddies on the variation of wind with height, and finds that simple equations of motion can be applied to the atmosphere only above a height of 1500 feet if superadiabatic conditions are present in the surface layer, and above about 50 feet when there is an inversion. A. H. R. G.

Sadi Carnot, 1796–1832

ON Aug. 24, 1832, a hundred years ago, Sadi Carnot, the author of the famous memoir "Réflexions sur la puissance motrice du feu et sur les machines propres à développer cette puissance", died in Paris at the early age of thirty-six years. For some weeks previously he had been very ill with fever, and was only just beginning to recover when he fell a victim to the cholera epidemic which claimed some 18,000 persons in Paris alone.

Little notice was taken of Carnot's death, and no one realised that he had made a contribution to science which was destined to render his name immortal. His essay had been printed in 1824 by the minor Parisian publisher Bachelier, and had it not been for the comments on the views of Carnot by his countryman, Clapeyron (1799–1864), the engineer, who in 1834 wrote a paper entitled "Sur la théorie méchanique de la chaleur" for the journal of the École Polytechnique, it might well have been lost sight of altogether. It was Clapeyron's essay which attracted the attention of Kelvin when studying in Regnault's laboratory in 1845, and it was Kelvin who first mastered the principle enunciated by Carnot; as he was also the first to realise the merits of the work of Joule.

Carnot's essay was reprinted in 1871 in the *Annales scientifiques de l'École Normale supérieure*, and in 1878 it was again reprinted by the publishers Messrs. Gauthiers-Villars, together with a letter from Carnot's brother Hippolyte (1801–88) to the Paris Academy of Sciences, dated Nov. 30, 1878, a biographical sketch and extracts from Carnot's manuscripts. The centenary of the publication of the essay was celebrated at the P.N. Russell School of Engineering, University of Sydney, on Oct. 23, 1924; and again on Jan. 20, 1926, at a special meeting of the Société des Ingénieurs Civils de France, which was attended by the President of the Republic and many officials, savants, and engineers.

Except for two incidents, the life of Carnot was uneventful. He was born in Luxemburg on June 1, 1796; but before he had reached manhood, Napoleon had been overthrown, and a career which might otherwise have been spent on the battlefield was passed in the barracks and the study. He was taught mathematics by his father, and attended the Lycée Charlemagne; in 1812 gained admission to the École Polytechnique, and in October 1814 passed into the Corps of Engineers at Metz. Earlier that year he had, with his fellow students, served in a battalion formed for the defence of Paris, but he saw nothing of active service. For five years he was employed on routine work in various towns; in 1819 he entered the staff corps in Paris, in 1827 was made a captain of engineers, and the following year retired from the army.

A born student, Carnot when in Paris followed courses at the Collège de France, the Sorbonne, and the Conservatoire des Arts et Métiers, his scientific studies being interwoven with others on music, the arts, literature, and political economy. He made himself familiar with mechanical engineering and various industries, and it was the absence of any exact theory of the steam-engines of Newcomen, Watt, Smeaton, and Trevithick which led him to the study of heat and to writing his "Réflexions". Towards the end of his life he joined the Association polytechnique started by old students of the École Polytechnique for popularising knowledge, and had he lived longer he would no doubt have taken a prominent part in its proceedings.

Carnot came of a celebrated family of Burgundy, his father being Lazare Nicolas Marguerite Carnot (1753–1823), the mathematician and engineer who earned for himself the title of "the organiser of victory". Nicolas Leonard Sadi Carnot was his second son; an older one who had also been given the name of Sadi, after a thirteenth century Persian poet, died in infancy. Hippolyte was the third son, while his son was Marie François Sadi Carnot, who became President of the French Republic and was assassinated at Lyons on June 24, 1894.

Of the character of Sadi Carnot, his brother gives a pleasing sketch. Energetic, courageous, with few prejudices and many amiable qualities, Carnot left behind him manuscripts which not only contain

his ideas on heat, gases, vapours, and such matters, but also his thoughts on conduct and life. Thus he writes, on various occasions:

"Régler le matin l'emploi de sa journée et réfléchir le soir à ce qu'on a fait."

"La promptitude des résolutions s'accorde le plus souvent avec leur justesse."

"Parler peu de ce qu'on sait et point du tout de ce qu'on ne sait pas."

"La vie est un passage assez court. Je suis à la moitié du chemin. J'achèverai le reste comme je pourrai."

"Les lois de la guerre, dit-on; comme si la guerre n'était pas la destruction de toutes les lois."

Carnot had had an uncle, a magistrate who, stricken with apoplexy in court, had exclaimed, "Vous allez voir comment on passe courageusement de la vie à la mort". It was in that spirit that Carnot had faced the long illness which led to his own death.

Obituary

MR. GEORGE BARROW

MR. GEORGE BARROW, who died at his home in London on July 23, at the age of seventy-eight years, was a well-known geologist, who served for thirty-nine years on the Geological Survey of Great Britain. His earliest work was carried on in the north of England, especially in north Yorkshire. Afterwards he was transferred to Scotland, where he spent many years in surveying the southern Highlands, especially Aberdeenshire, Kincardineshire, and Forfarshire. This work brought him into prominence and placed him in the first rank of British authorities on metamorphic rocks and the tectonics of ancient crystalline provinces.

In 1900, Barrow returned to England and was entrusted with the mapping of parts of Cornwall and Devon, including Bodmin Moor and the southern flanks of Dartmoor. On his promotion to District Geologist in 1909, Barrow took charge of work in the London district, and interested himself greatly in economic geological problems, such as water supply and underground railways. He retired from the Geological Survey in 1915, and thereafter devoted his energies, to a considerable extent, to the local administration of the district in which he lived.

In his official work, Barrow was responsible for contributions to a large number of maps and memoirs published by the Geological Survey. Of these we may mention Cheadle (1903), Whitby (1882), Braemar (1912), Blair Atholl (1905), Scilly Isles (1906), Tavistock (1911), Bodmin (1909), Dartmoor (1912). This list might be considerably extended, but is sufficient to indicate the variety of his work. He was an active member of the Geological Society, the Mineralogical Society, and the Geologists' Association, served on their councils, and published papers in their transactions. In 1912 he received the Bolitho Gold Medal from the Royal Geological Society of Cornwall, and in 1913 the Murchison Medal from the Geological Society of London.

Barrow was a remarkably original field geologist, with a very acute eye for surface features and their relations to geological structure and history. His work on the high-level platforms of the west of England and the Pliocene features of the country around London is a good example of this. He was exceedingly painstaking and thorough, and was one of the first in Britain to perceive the importance of microscopic investigation of the older crystalline rocks. Working under the influence and tuition of Allan Dick, he applied these methods to Scottish Highland problems and obtained results of great value. In this he was really a pioneer. He was endowed with constructive imagination and a wonderful intuition, which led him often to arrive at conclusions very rapidly and in a manner which even his colleagues had some difficulty in understanding. Yet often these hypotheses, which seemed at first mere guesses, turned out to be sound. Consequently he had a very stimulating personality, and his conversation on geological topics was very inspiring, especially to younger men who had not his wide experience in the field. A genial companion and a generous opponent, he knew how to enjoy life, and retained his wide outlook, his courage, and his enthusiasm to the end of his days.

J. S. F.

MR. R. STAPLES-BROWNE, M.B.E.

RICHARD STAPLES-BROWNE, of Butler's Court, Alvescot, Oxfordshire, who died on June 5, was born in 1881, and from Rugby School went up to Emmanuel College, Cambridge, taking his degree by the Natural Sciences Tripos of 1902. He then commenced the medical courses, but the endocrine trouble which afflicted him throughout life called for a voyage round the world before he passed his second M.B. examination in 1906. About this time he came under the influence of William Bateson and relinquished medical study for biology, always his chief interest.

Staples-Browne's experimental work on inheritance in pigeons is among the best pioneer studies engendered by the rediscovery of Mendel's papers; he showed that Darwin's inquiry into the origin of the domesticated races of pigeons was unnecessarily complicated, and that his results are capable of simple explanation on Mendelian lines. Sex-linked heredity in doves was demonstrated by Staples-Browne just after this important condition had been discovered in poultry, and he may be said to have laid the foundation of our genetical knowledge of pigeons. During the War he joined up with the Medical Corps of the New Zealand Expeditionary Force, and, with the rank of captain, he did four years' service in its clerical and statistical branches in England, for which he was awarded the M.B.E.

Descended from a long Oxfordshire ancestry, Staples-Browne inherited a country gentleman's love for ornithology, fishing, and shooting, but biological research was always foremost, and up to his last illness he was planning improvements in the laboratory which he added to the Tudor house he had modernised during the happy married life of his later years. He will be remembered as a most loyal friend, for his charming and courtly manner, for his wide interest in life, and for an early developed power of shrewd criticism in biological subjects. Hampered by long periods of bodily discomfort and occasional disabling illness, the amount and intrinsic value of his contributions to inheritance are a remarkable record of enthusiasm and moral courage defeating odds which would cause most men to relinquish original work.

WE regret to announce the following deaths:

Prof. J. C. Fields, F.R.S., research professor of mathematics in the University of Toronto, president in 1924 of the International Mathematical Congress, on Aug. 9, aged sixty-nine years.

Dr. T. H. Gronwall, known for his mathematical works, especially on theories of elasticity and differential and integral equations, on May 9, aged fifty-five years.

Dr. George F. Kunz, known for his work in mineralogy in the U.S. Geological Survey, and especially for his work on precious stones, on June 29, aged seventy-five years.

Capt. Poulett Weatherley, one of the earliest explorers of Northern Rhodesia, the Belgian Congo and Tanganyika Territory, and the discoverer of the source of the Congo, aged seventy-two years.

News and Views

Archæological Research and Government Control

A RESOLUTION of the first International Congress of Prehistoric and Protohistoric Sciences recently held in London expressed deep regret at the attitude of the Egyptian Department of Antiquities in putting obstacles in the way of the scientific study of Egyptian prehistory; and while expressing respect for the rights of the Egyptian nation to preserve and arrange its documents, requested the Egyptian Government to ensure facilities for study and precautions against action detrimental to research. The opinion of British archæologists, that the attitude of the Department towards archæological exploration by extra-territorial investigators is not in the best interests of science, has frequently been brought to the notice of the Egyptian Government. A resolution which expresses the opinion of a body so widely representative as an international congress may perhaps carry conviction that dissatisfaction with the methods of the Department is not merely the view of sectional interest.

THE situation is admittedly a difficult one. Nor does Egypt stand alone. Similar difficulties are bound to arise whenever a country which calls for exploration in the interests of archæological science is neither financially competent nor intellectually equipped to undertake such exploration on its own behalf. Preservation of finds intact and accessibility of the material for the purpose of study are also important factors in the situation. Archæological investigation unquestionably is being checked in several directions in present conditions. Financial assistance, which in any event is difficult enough to obtain at the present day, is being still further restricted by the uncompromising attitude of those in authority, who are in a position to dictate conditions. The institution of a body such as the Congress of Prehistoric and Protohistoric Sciences, which is above sectional interests, would seem to afford opportunity for the formulation of a settled policy which would reconcile, on an equitable basis, the claims of scientific study and research and the rights of national authority, even with the admitted reservation that, other things being equal, national antiquities are best preserved, exhibited, and studied in their own regional environment.

Future Research Work in Prehistory

BEFORE rising, further resolutions were adopted by the Congress of Prehistoric and Protohistoric Sciences. The invitation to hold the next meeting at Oslo was accepted; and the president-elect, Prof. A. W. Brögger, of Oslo, who has acted as joint general secretary of the first meeting, was inducted into the chair by Sir Charles Peers, the retiring president. It was then resolved that research committees should be appointed to investigate specific problems and carry out certain specified pieces of work. One committee will investigate the relations which subsisted between the Ægean world and the Balkans and Danubian countries. Another is to study problems related to the civilisation of the western Mediterranean. Prof. Gordon Childe has been entrusted with the compilation of an international vocabulary of technical terms in archæology, with the co-operation of all countries represented at the Congress; while it is an instruction to the organising committee of the next Congress to investigate the possibility of a report on the systems of classification adopted by different schools of archæology.

Dental Mutilation in Early Times

ON page 284 of this issue we publish a summary of Sir Arthur Keith's report to the first International Congress of Prehistoric and Protohistoric Sciences on the human skeletal remains discovered by Miss Garrod in Palestinian caves in association with a mesolithic culture. The report directs attention to certain cultural practices for which the skeletal material affords evidence, such as the evulsion of the upper incisors and the practice of cannibalism. In the discussion which followed the presentation of the report, Prof. Elliot Smith expressed doubt as to chronology, and questioned the high antiquity of the practices to which Sir Arthur had referred the conditions observed in the skeletal material. In a letter on the Oldoway skeleton, which appears in the August issue of *Man*,

Prof. Elliot Smith, writing before the positive evidence pointing to the recent origin of that specimen was available, argues that the cultural evidence, upon which reliance had been placed in support of the antiquity of the remains, in effect tells against it. In particular, he maintains that the deformation of the teeth exhibited by Oldoway man, a filing away of the anterior surface of the lower incisors, first appears, with other forms of dental deformation, in human remains from a Ptolemaic-Roman cemetery near Dacca, in Lower Nubia, recorded by Dr. D. E. Derry and himself. He suggests, further, that the process of filing was the original device for removing the teeth, and was almost immediately superseded by lateral filing, or the more drastic evulsion. Therefore, he thinks, the practice of dental mutilation was not introduced before about 300 B.C. In this connexion we may direct attention to the recently published account of the fossil man of Asselar (Sahara) by MM. Boule and Vallois (see p. 280), in which the authors interpret the condition of the upper jaw as due to the evulsion of the upper incisors in early life, and refer to a similar condition in the fossil human remains of Afalou-bou-Rhummel (Algeria). The apparent age of the Asselar man at the time of the operation conforms to its generally accepted relation to puberty ceremonial; while the geological and palæontological evidence, if correctly recorded and interpreted, points unquestionably to a Pleistocene dating.

Radio Communication with very Short Waves

IT is announced in the *Times* of Aug. 15 that the experiments which are being carried out by Senator Marconi on communication by means of radio waves of very short wave-length have been successful. As communication was established between two places 170 miles apart, and as the wave-length he used was only 57 cm., the result is of great importance. Hitherto it has been considered impracticable to use such short wave-lengths for transmission owing to the curvature of the earth. The experiments prove that the range of communication with very short waves must extend much farther than the visible horizon. Many experiments, including some by Marconi himself, using very short waves, have been made previously in attempts to reach stations beyond the visible horizon, but all proved unsuccessful. The apparatus now used is of low power and is fitted with portable reflectors. In the recent tests, clear communication was established from Rocca di Papa, near Rome, to Cape Figari, in Sardinia. The transmitting apparatus is quite light, and can now be easily transported anywhere. Formerly the apparatus used was very heavy and cumbersome. It will be of great scientific interest to learn the greatest distance over which this new method can be used.

West Indian Hurricane Season

IN connexion with recent reports that a hurricane has swept along the Gulf coast of the United States, it may be noted that August is the first of the three months into which a very large proportion of West Indian hurricanes is concentrated, and that at least one of these tropical cyclones occurs in that month rather more often than not. Most of the storms that arrive early in the hurricane season sufficiently far west to cause serious damage in Texas, as has happened in the present instance, enter the mainland moving north-westwards and then northwards along a characteristically curved path, and begin to diminish in intensity on leaving the sea, but a great many of the August storms first appear farther east and pass across or to the east of the Florida peninsula. It is not yet possible to gauge the exact path followed by the recent storm, but Galveston and Freeport and, to a less extent, Houston were all affected by it. The deaths caused by it have apparently not been very numerous, considering the large amount of material damage, a fact which is attributed to the timely evacuation of the coastal lowlands. This suggests that the section of the forecast service of the United States Weather Bureau which issues hurricane warnings for the Gulf region deserves great credit for effective warnings issued in good time to be of practical service.

Laboratory for Freshwater Biological Research on Windermere

THE laboratories of the Fresh Water Biological Association's Station at Wray Castle, Windermere, were opened to public inspection on Aug. 10. A succession of microscopes was used to show the consecutive life stages from the plankton or microscopic plants through equally microscopic insects to the smallest fish. Exhibits, in tanks, of the small fish which feed on these and of the larger fish completed the life series. In addition, there were tanks containing leeches, fly larvæ, fish-like stage of the newt, and so on. The uses of nets and grabs for obtaining samples of life, water, and bottom material were also demonstrated. Diagrams showed the relations between wind direction, shoals, and the quantity of life, and the consequent variation in the number of fish an angler might catch. An ingenious and newly evolved apparatus involving a light-sensitive potassium cell and a two-valve amplifier, used in the evaluation of the light intensity at various depths, was shown. Research in progress was represented by an ingenious apparatus enabling the researcher to discover the variation in velocity with which a tape worm moves against, or with a constant current. The same water was circulated continuously, but owing to the necessity of keeping it untainted by metals it was pumped round by a water-suction pump. In addition there were numerous cultures of fly larvæ, which are being bred in order to discover which flies develop from named larvæ—flies and larvæ having been originally named irrespective of their relationship. The Fresh Water Biological Association is to be congratulated on the excellent arrangement of the laboratory, and on the great enthusiasm of the staff, and—a most encouraging sign—of the youthful and very keen body of research workers gathered together there.

Dungeness Preservation Fund

THE promontory of Dungeness is unique on the south-east coast of England as being the last level area of any size remaining in a natural and undisturbed

state. It is of particular interest for its bird life, notably as the sole British breeding ground of the Kentish plover. Other uncommon birds also nest there, such as the stone curlew, and there is a large colony of terns. All this may soon be irretrievably lost if a threat of bungalow building along the sea-front cannot be averted. To secure the position, therefore, efforts are being made to raise £9000 for the purchase of 271 acres as a bird sanctuary and Nature reserve, to be administered either by the National Trust or by the Royal Society for the Protection of Birds. This area, with its half-mile of shore frontage, is the part immediately in danger, and its price is, unfortunately, already that of a building site. Its acquisition, however, would increase the sanctuary value of adjacent land that is already preserved, and would make inaccessible to development a further stretch of coast lying beyond. The area is thus a key position, and the success of the scheme for its security is very greatly to be desired. The treasurer of the fund is Mr. Percival Jackling, Lloyds Bank, Folkestone.

The Grid and the Cost of Electricity

IN connexion with Sir Archibald Page's speech, a résumé of which was given in NATURE of Aug. 6, p. 212, Col. H. L. Crosthwait, late R.E., writes asking whether the advent of the 'grid' is likely to reduce the price of electricity or not. So far as can be seen at present, it will reduce the price to numerous consumers. The large stations recently built are generating electricity with far greater economy than the older stations which they replace. The use of the grid will be a great help in securing continuity of supply, and will make it unnecessary to keep a large number of costly machines in reserve in case of breakdowns. The standardisation of the pressures and frequency of supply has cheapened the cost of machines, apparatus, and lamps. We have not heard complaints from any consumer that the electricity companies have been raising the price of electricity; on the contrary, many of them have recently made substantial reductions. It is probable that some consumers will be little affected by the advent of the grid, but many will get their electricity cheaper, and very many dwellers in towns and villages will be able to get electric light and power which they otherwise would not have obtained. The grid is the logical engineering outcome of Ferranti's scheme for lighting London, using electricity at high pressures, first put into operation about forty-four years ago. Its critics have suggested nothing better ; as a rule, they desire progress to be made by costly competitive methods. In the future the grid will probably be considerably modified, but at present consumers can look forward to a gradual lowering of the price of electric light and power.

Monument to Otto Lilienthal

ON Aug. 10 a monument to Otto Lilienthal, the German pioneer of gliding flight, was inaugurated at East Lichterfelde, Berlin, on the mound from which Lilienthal made many of his flights forty years ago. The mound, which was piled up for the purpose by Lilienthal, is some forty-nine feet high, and a photograph taken some years ago shows its sides covered by shrubs and the top surmounted by a small temple-like construction consisting of pillars supporting a slightly sloping round roof. According to the *Times* for Aug. 10, the mound has now been cleared of the trees and shrubs, while in the monument at the top, and beneath the central opening in the roof, is a silver globe inscribed with particulars of famous flights. The globe is mounted on a basalt block. A photograph of the inauguration of the memorial appeared in the *Times* for Aug. 11. Lilienthal was a successful engineer and manufacturer. He was born on May 23, 1848, at Anklam and died on Aug. 10, 1896, at Rhinow through an accident while gliding. Another monument to Lilienthal was inaugurated at Lichterfelde in 1914. This consists of a stone pyramid, bearing on one side a bust and on the summit a figure of a man with outstretched arms supporting a pair of wings.

The Workers' Educational Association and Science

AT the Annual Conference of the Workers' Educational Association last year, it was resolved " to investigate the possibilities of stimulating further interest in the study of science [that is, natural science] on a non-vocational basis ", and the result of the investigation by the Executive Committee has now been circulated. To a scientific worker, it seems in some respects a strange document to be produced in 1932. It says, " The Adult Education Movement cannot afford to neglect scientific thought and knowledge. Ignorance of the influence of science should belong to the past " ; and then, " The study of science, in some of its branches, provided the approach is of the right character, is as attractive and has as great a bearing on social conditions as some of the social sciences ". As if the very foundations of social conditions did not rest upon heredity, and health, and the fight against disease, and the production of food, whether from the fisheries or agriculture, and the growing of the raw materials of commerce, and the constant battle against pests, whether they be parasites or plagues, and upon life itself ! The Report says, further, " It is only in relation to the question as to how far and in what ways natural science influences and affects society, that our classes can maintain their interest in subjects of this character ". It is on strong ground, however, in holding that the teaching of natural science, in so far as it is to be promoted, should avoid the formal lines of a university degree course, and should be of such a character as to attract the uninitiated.

THE Committee, basing upon its district reports, finds that " there is a lack of interest so far as the adult population is concerned in the study of science ". We think this may be due partly to the ignorance of people as to what natural science means, and partly to the failure to offer suitable courses. But we congratulate the Committee on its unanimous opinion " that the Association should seek to stimulate further interest amongst adult students in the study of science on a non-vocational basis ". Towards this end it makes several recommendations, of which the most

promising seem to be the organising of district panels of suitable lecturers, the inclusion of provisional science courses in the programmes of classes, and propaganda to encourage interest in the study of science, by printed leaflets and by peripatetic lecturers capable of interesting popular audiences. Two interesting "general recommendations" are added: that there should be "a rapid and progressive improvement in the supply of films and slides applicable to science teaching", and that for this purpose "the Association should investigate the possibilities of the setting up of a national organisation for the production and distribution of educational films".

The Science Museum during 1931

THE Report of the Advisory Council of the Science Museum of 1931 is the first issued since the Council was reorganised on lines suggested by the Royal Commission on National Museums and Galleries. With Sir Richard Glazebrook as chairman, the Council now includes three representatives appointed by the Board of Education, and twenty-six representatives of various scientific, technical, and industrial institutions. The Royal Commission also recommended that the Advisory Council should be assigned a more active part in the management and development of the Museum, and the adoption of this recommendation has already resulted in the appointment of a Standing Committee which will meet four or five times annually, and of three small sub-committees which are to report on the Science Library, the development of the Electrical Engineering Section, and on an exhibition of pottery and porcelain manufacture. The Report contains details of the attendances, lectures, temporary exhibitions, acquisitions, and of the Library. It also contains a tribute to the late Sir Hugh Bell, who was chairman of the Advisory Council from 1912 until 1931, and to the Director, Sir Henry Lyons, and his staff. Among the acquisitions during the year are the apparatus used by Sir William Ramsay in his work on the rare gases of the atmosphere, the fine collection of optical instruments, numbering nearly 600, given by Mr. T. H. Court, and the cinematographic apparatus invented in 1887–89 by Louis Augustin Le Prince, who disappeared while travelling in France in 1890.

Safety in Mines

THE Safety in Mines Research Board has just issued Paper No. 74, which contains an account of an important conference on safety in mines held at Buxton last year. There seems no adequate reason why information about this important conference should have been so long delayed, though there may have been difficulty in getting the authors of the various papers to correct their contributions. The meeting derives its great importance from the fact that it was the first international conference of this kind. In addition to the British representatives, there were delegates from Belgium, France, Germany, and the United States. A number of important papers on mining explosives were read, and proposals were made for future international meetings, subject to ratification by the organisations concerned—a ratification which, we presume, will certainly be forthcoming. Perhaps the most important of the suggested future arrangements was that "Periodical meetings of the directors of research shall be arranged at each research station in rotation". This arrangement would thoroughly ensure the international character of future conferences, and it is a most welcome sign that the question of safety in collieries is for the future to be treated as an international question and not as one possessing local interest only.

Geodetic Surveying in the United States

THE annual report of the Director of the United States Coast and Geodetic Survey for the year 1930–31 (Washington, 1931, 45 pp., 60 cents) describes briefly the wide range and large extent of the activities of this important and progressive organisation. It has as a frontispiece a photograph of the new surveying vessel (one of several possessed by the Survey) *Hydrographer*, commissioned in March 1931, and fully equipped with sound-ranging apparatus for depth-surveys; sound-ranging is also used for locating the position of the ship from the shore at the time of each depth-measurement. The use of these methods has greatly increased the rapidity of the coastal survey work. The control survey work on land has also been rendered much more rapid and less expensive by abandoning the erection of the large wooden towers formerly used in flat or rolling country, at points about ten miles apart, to enable the observers to see across such distances over intervening trees and other obstructions. These towers were often 100 feet or more in height, each being double, so that the observer could walk on the outer platform, unconnected with the inner tower carrying the instrument. They contained large quantities of material, used once only, and required much time to erect. They are now replaced by portable steel towers, which can be erected by five men in less than a single working day, and used many times, their transport from one place to another being made by trailer trucks. An improved and smaller theodolite has also been devised and brought into use.

Czechoslovakian Contributions to Science

THE scientific communications to the Czech Academy of Sciences during 1928 and 1929 have now been published in French or English in volumes 29 and 30 of the *Bulletin International* of the Academy. Among the papers presented are several by Dr. F. Němejc dealing with his palæobotanical investigations on some quaternary deposits in the district around Ružomberok in Slovakia. Dr. R. Kettner has made a similar study of the geological formations in the Hron Valley, and Prof. Ulrich describes the minerals variscite and barrandite from Třenice and also a Slovakian rutile. Dr. J. Hahn's account of the life history of *Monocystis Mrazeki* is illustrated with some fine photomicrographic plates, whilst M. Uher's communication dealing with the genesis of nerve elements cultivated *in vitro* is similarly illustrated. Dr. O. Jirovec has succeeded in observing and recording on a coloured plate some twenty stages in the nuclear

division of *Trypanosoma evansi*. His observations apparently contradict the earlier ones of Roskin. In pure chemistry, Prof. Tomiček and Dr. Janský have made an exhaustive study of the methods available for determining mixed halides in connexion with the analyses of bromides and iodides in spa and thermal waters. The improvements which they have introduced enabled them to give more accurate and detailed results. It was long supposed that the waters from Darkov, Silesia, were the richest in iodine, but according to these authors the waters from Čiz in Slovakia and Bad Hall in Austria are still richer, with a total iodine content of more than 28 mgm. per litre.

Colloid Aspects of Textile Materials

A GENERAL discussion on "The Colloid Aspects of Textile Materials" has been arranged by the Faraday Society to be held in the Department of Chemistry of the University of Manchester on Sept. 21–23, under the presidency of Sir Robert Mond. An introductory address will be given by Prof. F. G. Donnan. The general subjects to be discussed include cellulose and its derivatives, lignin and keratin; fibre particles, their production, deformation, and degradation; and manufacturing processes. Among the foreign guests who will speak at the discussion are: Prof. H. Mark (Ludwigshafen), Prof. H. Staudinger (Freiburg), Dr. S. E. Sheppard (Rochester, U.S.A.), Dr. J. J. Trillat (Paris), Prof. K. Freudenberg (Heidelberg), Prof. O. Roehrich (Paris), Prof. Herzog (Berlin), Prof. J. R. Katz (Amsterdam), Mr. C. R. Nodder (Lambeg), Prof. E. Elöd (Karlsruhe), and Prof. P. Krais (Dresden). Further particulars of the meeting can be obtained from The Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

Swedish Meteorology

THE State Meteorological and Hydrographical Service of Sweden has published as Part 2 of the Årsbok for 1932 the meteorological statistics of the country for the year 1929. The data are collected from more than two hundred stations, for each of which pressure, temperature, humidity, wind direction and force, cloud, and rainfall are given in three records on every day of the year. For some forty stations, monthly and yearly means are also given for each hour of observation. There is no discussion of the data, but the usefulness of this publication is enhanced by the headings and notes being given in French as well as Swedish.

Announcements

PROF. F. WOOD JONES, professor of anatomy in the University of Melbourne, will go to Peking as head of the Department of Anatomy at the Peking Union Medical College, during the absence of Prof. Davidson Black on leave in Europe and America during the next six months.

THE valuable collection of Australian Coleoptera, containing a great store of 'types', of the late Mr. A. M. Lea, who died at Adelaide on Feb. 29 (see NATURE for May 28, p. 786), has recently been purchased by the Governors of the South Australian Museum, partly as a memorial of his work.

THE "Achema VII" (the German Chemical Plant Exhibition, Ausstellung für chemisches Apparatewesen), arranged by the "Dechema" (Deutsche Gesellschaft für chemisches Apparatewesen, of Seelze, Hannover), will be held at Cologne in 1933 (probably on June 2–11, 1933) at the same time as the conferences of the Verein Deutscher Chemiker, the Deutsche Kautschukgesellschaft, the Deutsche Brennkrafttechnische Gesellschaft, and the Dechema. Other scientific and technical societies will also hold their annual meeting at Cologne during the same period.

THE following awards for the year 1932–33 have been made by the Salters' Institute of Industrial Chemistry: Fellowships renewed to: D. J. Branscombe, University College, Exeter; H. G. Simpson, East London College; J. L. Sweeten, St. Catherine's College, Cambridge; P. Chisholm Young, Trinity College, Cambridge. Fellowships awarded to: S. C. Britton, Pembroke College, Cambridge; E. H. T. Hoblyn, Imperial College of Science and Technology; R. H. McDowell, Jesus College, Oxford; G. Pearce, University of Birmingham. The Salters' Institute has also awarded 107 grants-in-aid to young men and women employed in chemical works, to facilitate their further studies.

POPULAR science book lists, 27 in number, have been prepared by a special committee of the American Association for the Advancement of Science, aided by some 300 specialists in colleges, libraries, and museums. The object of the series is to offer to the general reader reliable guidance in the choice of a few elementary science books, and in following up such reading by systematic study. The lists are annotated, and cover the whole field of elementary physics and chemistry, natural history and physiography, the history of science, and the teaching of science.

THE Arctic Institute of Leningrad has prepared a new map of the polar areas of the Soviet arctic regions. The map shows the regions discovered by recent Soviet expeditions, and has been compiled in both Russian and English.

MESSRS. Watts and Co. announce the early publication of "The Universe of Science", by Prof. H. Levy, in which recent pronouncements of Sir James Jeans, Sir Arthur Eddington, and General Smuts regarding the universe are critically examined.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in metallurgy and applied chemistry at the Royal Naval College, Greenwich—The Adviser on Education, Admiralty, Whitehall, S.W.1. (Aug. 22). An assistant lecturer in engineering at the School of Mines, Treforest—The Director of Education, County Hall, Cardiff (Aug. 26). A de Beers professor of mining and surveying at the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner, South Africa House, 73 Strand, W.C.2 (Sept. 7).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Theory of Induced Polarities in Benzene

THE letter from Dr. E. and Prof. W. Hückel in these columns [1] explains that "H^+" on page 326 of Dr. E. Hückel's original paper was a misprint for "H-atom". The misprint, occurring at a crucial point, was unfortunate, and in the light of this explanation we naturally withdraw all such criticism as was based on the misapprehension that Hückel postulated extrusion of proton during the ordinary "substitution of hydrogen" in the aromatic series.

Our objections to Hückel's theory as we now understand it are no less serious than when our first letter [2] was written. E. and H. Hückel now say that "the assumption in Hückel's theory is . . . only that for a definite reaction the heat of activation is smaller for a hydrogen atom bound more loosely and greater for a hydrogen atom bound more strongly. It cannot be denied that for all simple substitution reactions which have been investigated *quantitatively* up to the present time, this assumption—taking the charge density calculated by Hückel—leads to results which are in agreement with observation."

We may point out that the apparent agreement is real only if Hückel's additional assumption relating to the direct connexion between the strength of the bond in C-H and the Coulombic attractive force on the nucleus of the H-atom can be justified. Even if it could be justified, it has not been shown that the few data quoted by Hückel are inconsistent with the theory of aromatic substitution which we support. In contrast to this state of things, there is a vast body of data which fit in most satisfactorily with our own ideas but not with Hückel's, and no better illustration of this statement is needed than the statement made by Dr. E. and Prof. W. Hückel that "We cannot see what connexion there is between the dissociation of acids and bases and substitution reactions in benzene".

That there is, nevertheless, a very close connexion between these phenomena has, we believe, been widely recognised, in English-speaking countries perhaps more particularly, since the publication of the classical paper [3] of Flürscheim on the subject, and although organic chemical theory has undergone revolutionary changes during the interval and many of the examples, such as aliphatic acids, quoted by Flürscheim are now considered inappropriate, the paper embodied a discovery of first-rate importance, which is only emphasised by addition of new examples that are even more convincing than those given by the discoverer.

We would direct attention first to the mono-substituted phenols. Adequate data for use in the above connexion are available only in three cases: (*a*) the cresols (methylphenols), (*b*) the dihydroxybenzenes (hydroxyphenols), and (*c*) the nitrophenols. Of the three cresols, the meta-derivative is the most acidic.[4] Of the hydroxyphenols, the meta-derivative has a higher ionisation constant than the ortho-derivative,[5] and partition measurements made in the laboratories of the University of Manchester prove that the meta-derivative is also a more powerful acid than the para-derivative. Of the three nitro-phenols, on the other hand, the meta-derivative is much the weakest acid.[6] These cases represent typical alternate effects as this expression is now most widely used, no reversals in sign being required or implied.

The significance of the data relating to the acidities of isomeric substituted phenols can best be appreciated by reference to a well-known generalisation illustrated by the following quotation from G. N. Lewis: [7] "If we consider corresponding hydroxides of nitrogen, phosphorus, arsenic, antimony, and bismuth, we see the effect of the diminishing pull of electrons by the central atom as we proceed from nitrogen to bismuth. The hydroxides become progressively weaker acids and stronger bases."

The application of this generalisation to the arrangement C – OH in isomeric phenols leads to the conclusion that, other things being equal, the acidity of the hydroxyl group will be most pronounced when the group is attached to that carbon atom in the neighbourhood of which the electrons are most under the control of the central system either of the carbon atom or of the aromatic ring as a whole—in other words, at the carbon atom where the negative charge density is least or the positive charge density is greatest. In the three trios of substituted phenols above mentioned, the data, combined with Lewis's generalisation, show that the distribution of the charge densities in E. Hückel's two pictures (loc. cit., p. 301) must be incorrect.

Relationships between isomeric substituted benzoic acids are more complicated. Nevertheless, as was pointed out by Flürscheim, the ionisation constant of the meta-substituted acid is greater than that of the para-substituted acid when the substituent is of the '*o-p*-directive' type, while the converse is true when the substituent is of the 'meta-directive' type. This generalisation holds good for the chloro- and nitro-benzoic acids [8] cited by Dr. E. and Prof. W. Hückel in evidence against our views, and is quite independent of whether the acids are weaker or stronger than benzoic acid, a question which depends mainly on the magnitude and orientation of the dipole moment associated with the introduction of the substituent into the aromatic system.

Our idea that attachment of the substituting agent to aromatic carbon precedes elimination of proton and is not simultaneous with the latter process is admittedly not proved, but it has served as a useful working hypothesis which has helped to correlate known data and to foresee others. Our fundamental thesis is that substituting agents of the electron-seeking type, such as halogens, sulphuric acid and sulphuric anhydride, nitric (or nitrous) acid, enter *most readily* into reaction with those carbon atoms of the aromatic ring at which there is an electronic excess, whilst agents such as alkalis, amines, metallic cyanides and sulphites, which act normally through their anions or by using their own electrons to form new covalencies, enter into reaction *only* with aromatic carbon atoms at which there is a decided electronic deficiency.

A. LAPWORTH.
University of Manchester.
R. ROBINSON.
University of Oxford.
July 25.

[1] NATURE, **129**, 937; June 25, 1932.
[2] *Ibid.*, **129**, 278; 1932.
[3] *Trans. Chem. Soc.*, **95**, 718; 1909.
[4] Boyd, *ibid.*, **107**, 1538; 1915.
[5] Boeseken and van Rossem, *Rec. trav. Chim.*, **30**, 392; 1911.
[6] "International Critical Tables," **6**, 272; 1929.
[7] "Valence and the Structure of Atoms and Molecules." Amer. Chem. Soc. Monograph Series, 138; 1923.
[8] Ostwald, *Z. phys. Chemie*, **3**, 369; 1889.

Emulsification

In 1925, Seifriz[1] made a number of interesting observations on the emulsification of hydrocarbon oils with water, using casein as emulsifier. He showed, for example, that oils ranging in density from 0·664 to 0·820 gave stable emulsions of the oil-in-water type; those of density 0·857 to 0·895 gave stable emulsions of the water-in-oil type; while oils intermediate in density gave emulsions which separated immediately. So far as we are aware, no adequate explanation of these results has been offered, but a simple explanation is possible on the basis of recent developments in the study of the liquid state.[2] The hypothesis to be advanced has important consequences for the theory of emulsification and detergent action.

Liquids are no longer to be regarded as structureless, and in the case of aliphatic compounds, the tendency to incipient crystallisation increases with the length of the carbon chain. The resistance to dispersion of liquids composed of long-chain molecules must therefore increase with the chain length, that is, in the case of the paraffins, with the density of the oil. Hence the inversion of emulsion type observed by Seifriz is due simply to the increased resistance to dispersion of paraffins of high molecular weight, caused by incipient crystallisation.

When oils and related compounds are spread as a thin film on a solid surface, the tendency to incipient crystallisation manifests itself in the form of adhesion to the surface. In this case, removal of oil by means of soap solution is conditioned by the magnitude of adhesion and interfacial tension, as shown by the following experiments.

A mineral oil was subjected to repeated fractional distillation to obtain nine fractions of increasing boiling point. Each fraction was then used to oil a wool fabric, which was afterwards scoured with soap and soda solution, using a standard mechanical technique. The amount of oil remaining in the fabric was found

Percentage by weight of Oleyl Alcohol in mixture.	Oil-water Interfacial Tension (dynes/cm.).	Residual Oil (per cent on weight of wool).
0·0	47·9	2·50
2·5	20·9	1·81
5·0	19·1	0·61
6·0	18·9	0·58
10·0	20·2	0·57
15·0	19·6	0·83
20·0	19·1	1·14
40·0	..	2·20
55·0	16·1	2·88
70·0	15·5	3·25
85·0	14·7	3·36
100·0	14·4	2·66

to increase with the boiling point of the fraction, according to a law which indicates that the difficulty of removing oil increases in proportion to the length of the molecule.

Although the preceding results serve to indicate the importance of the adhesion factor, the difficulty of removing mineral oil from a solid surface such as wool is due mainly to high interfacial tension. Oleyl alcohol on the other hand, possesses a low interfacial tension, but is even more difficult to remove than mineral oil. This result must be referred to adhesion of a very high order, due to the polar character of the molecule and its high molecular weight.[3] Mixtures of mineral oil and oleyl alcohol are as a rule more easily removed than either oil alone. This important result serves to discriminate between the two factors of adhesion and interfacial tension, and is illustrated by the data of the accompanying table, obtained by oiling a wool fabric with 5 per cent by weight of each mixture, the fabric being then scoured as before, and the residual oil estimated by ether extraction.

As might be expected from the preceding results, both mineral oil and oleyl alcohol were found to be difficult to emulsify with soap solution, but the mixture of mineral oil and 6 per cent oleyl alcohol, for example, gave an extremely stable emulsion under similar conditions.

In conclusion, it is evident that the formation of emulsions, especially in the case of oils and related compounds of high molecular weight, is not determined simply by the magnitude of the interfacial tension and the formation of a stable adsorbed film at the interface. The cybotactic condition of the liquid to be dispersed is of equal importance in ordinary emulsification; while, in scouring processes, related adhesion phenomena acquire exceptional significance.

J. B. Speakman.
N. H. Chamberlain.

Textile Chemistry Laboratory,
The University, Leeds,
July 14.

[1] Seifriz, *J. Phys. Chem.*, **29**, 587; 1925.
[2] Stewart, *Reviews of Modern Physics*, **2**, 116; 1930.
[3] Hardy, *Phil. Trans.*, A, **230**, 1; 1931.

Inhibition of Enzymes by Carcinogenic Compounds

Experiments carried out in this laboratory[1] have shown that 1 : 2 : 5 : 6-dibenzanthracene and 5 : 6-*cyclo*-penteno-1 : 2-benzanthracene are the most carcinogenic of pure compounds yet described. The action of these compounds and of certain non-carcinogenic hydrocarbons on the oxidising enzymes of yeast and muscle has been studied. The carcinogenic and other hydrocarbons dissolved in benzene or toluene were shaken up with enzyme preparations, and the effect on the activity of the enzyme measured. In no case was indophenol oxidase of yeast or muscle affected by any such treatment.

The oxidation of lactate by lactic dehydrogenase of yeast or muscle was, however, inhibited by a dilute solution of the hydrocarbon in benzene or toluene which had been exposed to air and light. Exposure to air in the dark, or to light out of contact with air, was ineffective. Solutions activated by exposure to ultra-violet light became coloured yellow or brown and non-fluorescent. The amount of inhibition produced in this way on a yeast lactic dehydrogenase by several hydrocarbons treated in a comparable manner was as follows:

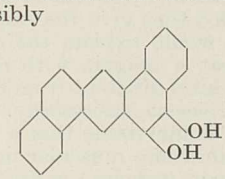
	Percentage Inhibition of Enzyme.	
Toluene control . . .	0	
(1) Anthracene	30	Non-carcinogenic.
(2) 1 : 2-Benzanthracene . .	28	,,
(3) Chrysene	26	,,
(4) 5 : 6-*cyclo*-Penteno-1 : 2-benzanthracene	55	Carcinogenic.
(5) 1 : 2 : 5 : 6-Dibenzanthracene	62	,,
(6) Polycyclic hydrocarbon from coal tar	74	More carcinogenic than (4) and (5).

In each case, 0·005 mgm. of the hydrocarbon was added to 1 c.c. of enzyme solution, which reduced 1 c.c. of 1/5000 methylene blue in the presence of lactate in 10 minutes at 40°. The maximum concentration of hydrocarbon is thus 1 part in 400,000.

The inhibitory action is greatest in the case of the carcinogenic compounds. The inhibition in the case of anthracene is not due to the presence of dianthracene, as this compound is quite inactive. 1 : 2 : 5 : 6-Dibenzanthracene was recovered unchanged after treatment which converts anthracene into dianthracene.

The inhibitory factor was slightly soluble in water and more soluble in alkali, as was the colouring matter produced by exposure to light.

The chemical nature of the inhibiting factor is under investigation. It is possible that it is an *o*-hydroquinone; it does not appear to be an oxidation product in which *meso*-carbon atoms are involved. Comparison with reduced β-naphthaquinone and a reduced 1 : 2 : 5 : 6-dibenz-3 : 4-anthraquinone[2] showed the activity to be similar to that developed by the compounds named in the table above. The active compound derived from 1 : 2 : 5 : 6-dibenzanthracene is therefore possibly



Such a compound would have the structure —C(OH)—C(OH)— which is similar to one of the groupings considered by Quastel and Wooldridge[3] to be necessary for the inhibition of lactic dehydrogenase. Full details of these experiments will be published shortly.

E. BOYLAND.

Research Institute,
The Cancer Hospital (Free), London,
July 28.

[1] The Production of Cancer by Pure Hydrocarbons, (Pt. 1) by J. W. Cook, I. Hieger, E. L. Kennaway, and W. V. Mayneord, (Pt. 2) by J. W. Cook, *Proc. Roy. Soc.*, B (in the press).
[2] J. W. Cook. Unpublished results.
[3] *Biochem. J.*, **22**, 689; 1928.

Isolation of Chemically Unstable Substances from Animal Tissues

IN the course of a study of some chemically unstable constituents of muscle tissue, we have made successful use of the following method for obtaining protein-free extracts of muscle. It has the merit of yielding, without departure from neutrality, a protein-free solution of the water-soluble constituents of muscle in a concentrated form. We have been unable to find a description of this technique in the literature, but should be grateful for information as to earlier examples of its use.

The method is based upon the facts that at 32° C. the solubility of sodium sulphate in water is at its maximum—50 gm. of the anhydrous salt to 100 gm. of water—and that if such a solution is cooled to 0° C., 96 per cent of the salt crystallises out as the decahydrate.

If muscle tissue, which contains water to the extent of 80 per cent of its weight, is minced with 40 per cent of its weight of anhydrous sodium sulphate, about three-quarters of the water of the muscle can be expressed without difficulty in the form of a saturated solution of sodium sulphate at 32° C. The solution contains no protein. The mother liquor poured away from this solution after chilling would be expected, on the basis of the figures given above, to contain the water-soluble constituents of the muscle in a concentration about three times greater than in the muscle. The following table, taken from a typical experiment, shows that this is the case.

The yield, unless special precautions are taken, is not very good—50-60 per cent—but in view of the ease and rapidity of the process and the high concentration of the extract, this is, for most purposes, not a serious drawback.

We have applied this technique so far only to the isolation of creatine, which can be precipitated immediately from the extract by addition of acetone, and of carnosine and anserine, which can be prepared from the extract by the use of copper carbonate,

	Concentration in Muscle. Mgm. per 100 gm.	Concentration in Na_2SO_4 Extract. Mgm. per 100 gm.	Concentration ratio.
Carnosine (by Pauli reaction)	35	112	3·2
Non-protein nitrogen	247	690	2·8
Lactate	250	700	2·8
Total phosphorus	118	303	2·6

acetone, and ammonia. The yield of crystalline copper carnosine or copper anserine compares favourably with the yields recorded by investigators using more elaborate methods. We have obtained in this way anserine from the muscles of sheep, goat, and rabbit, and carnosine from ox and frog muscle.

M. G. EGGLETON.
P. EGGLETON.

Physiology Department,
University, Edinburgh,
July 20.

Observations on Filmed and Filtered Vowels

SOME specimens of film curves of German vowels obtained by the Vienna method of recording (wire in magnetic field slantways across a slit [1]) are reproduced in Fig. 1. Inspection of the curves reveals the following facts: (1) A vowel is made up of a series of adjacent vibration profiles; (2) the profiles differ progressively in length, amplitude, and form; (3) each

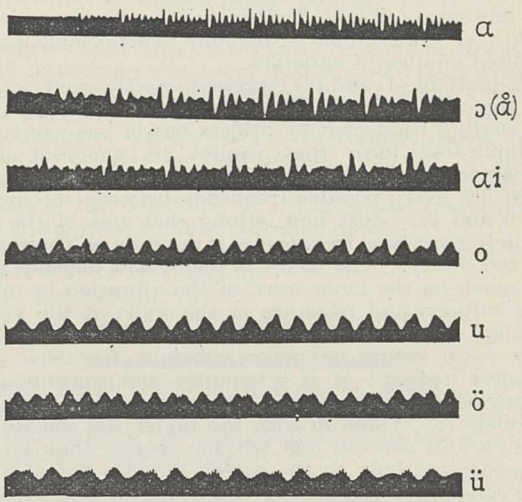


FIG. 1.—Film curves of vowels.

profile begins strong and becomes steadily weaker; (4) within each profile various characteristics, for example, maxima, are repeated; (5) different vowels show systematic differences of profile. Measurements reveal the following additional facts: (6) the frequencies of the inner repetitions change within each profile; (7) the rate of weakening changes within each profile.

These facts lead to the following conclusions: (1) The vibration profile is initiated by a sharp impulse that does not appear in the curve of the profile; (2) the profile consists of a more or less rapidly fading free vibration of complicated form.

The numerous systems of inner repetition suggest that the free vibration constituting the profile might

be considered as the sum of a series of component free vibrations. Let us make this supposition and indicate the radian frequencies of the component vibrations by $\omega_1, \omega_2, \omega_3, \ldots$. Analyses of the profiles show that *all* the frequencies from 0 to ∞ are present to a greater or less degree. The profile is therefore not a sum of a few discrete free vibrations as ordinarily supposed, but an integration of an infinite number of such vibrations differing infinitely little from one another. The profile is therefore not a sum of discrete frequencies, but an integration over $d\omega$ between 0 and ∞. Each free vibration has a decremental index p. The analyses show that the decremental indices are infinitely variable, and that not one or a few but an infinite number of decremental factors are present between 0 and ∞. The decrement for each of the inner frequencies is therefore an integration over dp between the limits 0 and ∞. The amplitude of each inner vibration determines the amount of its contribution to the profile. The amount of the particular amplitude for a given frequency depends on the forces that control the formation of the profile. For a given profile it is determined by an integration over the particular frequency with the form of the profile $f(t')$ as amplitude within the limits α, β of the profile.

A complete expression for a vowel profile requires the formula :

$$y = f(t) = \frac{1}{\pi}\int_0^\infty d\omega \int_0^\infty dp \int_\alpha^\beta f(t')e^{-\omega p t'} \cos \omega(t' - t)dt'. \quad (1)$$

The change of the radian frequency and the factor of decrement as established by the measurements reported above require the additional equations :

$$\omega = f_\omega(t') \text{ and } p = f_p(t'). \quad . \quad . \quad . \quad (2)$$

The process that is expressed by formulæ (1) and (2) is a continuous affair that cannot be represented by any sum of discrete factors except as an approximation. A vowel profile is therefore unanalysable into a limited number of variables.

Equations (1) and (2) represent exactly what occurs in the vocal cavity. This does not consist of a set of cavities connected by orifices but of one cavity of complicated form that cannot be analysed into separate cavities. A sharp blow arouses a vibration that has every possible frequency between the limits of 0 and ∞. Just how strong each one of the infinitely numerous frequencies is depends on the shape of the cavity. The factor of decrement depends not so much on the inner work of the vibration as upon the softness and moisture of the walls of the vocal cavity. These may have any values. The shape of the vocal cavity is never constant for even the briefest instant ; it is constantly and continuously changing according to the muscular movements that regulate it. These in turn are under the control of the various nervous and psychic centres that act in response not only to the speech impulse but also to the constant regulation by the entire nervous system and intellectual and emotional forces. This continual change results in the changes of inner frequency and decrement expressed by the equations in (2).

The essential characteristic of a vowel profile is its form. This view has recently received striking confirmation. At a recent demonstration by the British Post Office the attendant was good enough to carry out the following experiment. With a gramophone record of speech in connexion with a loud speaker various regions of frequency were filtered out as follows : (1) all frequencies above 1350 ; (2) all frequencies below 750 ; (3) all frequencies above 1350 and below 750 ; (4) all frequencies between 750 and 1350. The musical character of the speech changed with every alteration, but the specific characters of the vowels remained unchanged. This leads to the rather startling conclusion that *the character of a sound as a vowel does not depend on the presence of any special frequencies.* The differences among the vowels therefore do not depend on the presence or absence of any particular tones or regions of tone. Any region of frequency assigned to any particular vowel can be filtered out with no change in the vowel except in regard to its musical character. Moreover, a small region of frequency anywhere is sufficient to give the vowel character. The conclusion cannot be avoided that the vowel character depends on the general shape of the vibration profile and that any frequencies of any kind may be present provided they give the same general form of profile. This would explain the otherwise unexplainable fact that a magpie with extremely small vocal organs of a kind different from human ones can imitate a man's voice so successfully.

The conclusion is inevitable that a vowel profile is a course of air vibration, muscular movement, nerve currents, and inner (psychic) activity. Any representation by a Fourier analysis, a physical analysis or synthesis, or otherwise into a limited number of variables can be only an approximation. A vowel profile, like a face profile, is recognised by its *form* ; the one is a form in time, the other a form in space. Neither is recognised as a series of numbers. In both cases the form may be enlarged or diminished—the one in time (pitch), the other in space—without loss of recognition provided there is no distortion.

E. W. SCRIPTURE.

University of Vienna.

[1] See *Z. Experimental-Phonetik*, vol. 1, p. 96.

Diffraction of Gas Atoms

THE development of molecular ray technique makes possible investigations of the scattering of one beam of gas atoms by another. It is therefore of considerable interest to examine the conditions under which effects characteristic of the wave nature of the atoms would be observed. The angular distribution of the scattered atoms may exhibit maxima and minima, due either to the usual diffraction phenomenon or to the identity of the colliding particles if the atomic beams are composed of similar atoms.

We have therefore investigated theoretically the elastic collisions of two helium atoms with kinetic energy of relative motion (taken as kT) corresponding to temperatures of 20° C. and − 185° C. respectively. For this purpose we have used an interaction energy given by Slater and Kirkwood,[1] and the theory of collisions due to Faxen and Holtsmark,[2] in which the scattered amplitude is given in relative co-ordinates by the series

$$f(\theta) = \frac{\lambda}{4\pi i}\sum_{n=0}^{\infty}(2n+1)(e^{2i\delta_n} - 1)P_n(\cos\theta),$$

the phases δ_n depending on the interaction energy and the energy of impact. λ is the associated wave-length.

For gas atoms a large number of terms of this series is required, and the evaluation of the phases by numerical integration of differential equations becomes very tedious. We have therefore used an approximate method of solution due to Jeffreys [3] for small values of n, and Born's approximation [4] for large values of n, intermediate values being given by interpolation. This method was tested by applying it to the calculation of the angular distribution of elastic scattering of 54 volt and 122 volt electrons in mercury vapour, good agreement being obtained with the experimental results of Arnot.[5] Since the completion of these calculations there has appeared a note by Henneberg,[6] who has obtained good agreement

with the experimental results for 135, 480, and 812 volt electrons by using a similar method.

In a co-ordinate system in which one atom is initially at rest, the number of atoms scattered between the angles Θ and $\Theta + d\Theta$ will be of the form $I(\Theta) \sin 2\Theta d\Theta$. The function $I(\Theta)$ obtained for the helium atom collisions is illustrated in Fig. 1, showing the existence of marked diffraction effects.

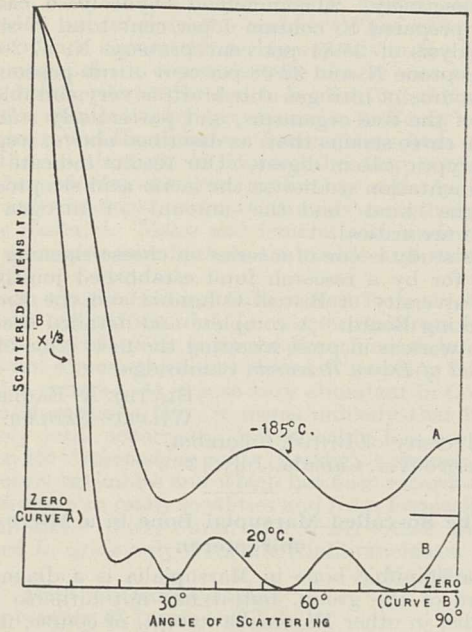


FIG. 1.—Angular distribution of function $I(\theta)$ for helium atoms scattered by helium atoms with relative velocities corresponding to temperatures of 20° C. and −185° C.

Allowance has been made for the identity of the helium atoms.[7] The collision diameter is very nearly the same for both relative velocities, being 2·4 A.

Unfortunately, direct experimental verification of these curves is difficult, owing to the necessity of obtaining monochromatic molecular beams. However, the effect should be apparent in the viscosity and other transport phenomena in helium. It is hoped to investigate this later.

H. S. W. MASSEY.
C. B. O. MOHR.

Trinity College, Cambridge,
July 25.

[1] *Phys. Rev.*, **37**, 682; 1931.
[2] *Z. Phys.*, **45**, 307; 1927.
[3] *Proc. Lond. Math. Soc.* (2), **23**, 428; 1924.
[4] Vide Mott, *Proc. Cam. Phil. Soc.*, **25**, 304; 1928.
[5] Arnot, *Proc. Roy. Soc.*, A, **130**, 655; 1931.
[6] *Naturwiss.*, **30**, 561; 1932.
[7] Mott, *Proc. Roy. Soc.*, A, **126**, 259; 1930.

The Velocity of Light

IN articles in NATURE and elsewhere, M. E. J. Gheury de Bray has proposed and defended the suggestion that the velocity of light may be a decreasing function of time, varying at present by about 4 km. a second a year. He bases this idea on an examination of the published results of measurements by a number of experimenters over a period of several decades, and concludes that all the results are in good agreement with his hypothesis.

I have obtained experimental proof that no such variability of velocity exists; the work was an offshoot of an investigation carried out at the California Institute of Technology to test whether time conforms to the requirements of the theory of relativity. An interference arrangement was employed in which the retardation of the interfering beams was 318 mm. or 582,000 wave-lengths of the mercury line used as the source. It proved feasible and easy to measure shifts in the interference pattern with a probable error of a thousandth of a fringe. This accuracy was attained by photographing the interference rings and comparing each photograph directly with a nearly identical one used as standard of reference for the whole series. The interference apparatus was built almost entirely of fused quartz and kept in a vacuum at an accurately controlled temperature, while the source, which was an electrodeless high-frequency discharge in unsaturated mercury vapour, was so contrived as to be free from spurious frequency shifts such as might result from Doppler effects, pressure variations, and so forth. The apparatus and procedure are described in detail in a paper entitled "Experimental Establishment of the Relativity of Time", by myself and E. M. Thorndike, to appear in the *Physical Review*.

The number of waves retardation in any interference arrangement is

$$n = \frac{\nu \Delta s}{c}$$

where ν is the frequency and c is the velocity of light, while Δs is the path-difference. If ν and Δs are supposed constant while c is a function of time, the rate of variation of n is thus

$$\frac{dn}{dt} = -\frac{\nu \Delta s}{c^2}\frac{dc}{dt}.$$

$\Delta s = 318$ cm., $c = 3 \times 10^{10}$, $\nu = 6 \times 10^{14}$, and according to de Bray's hypothesis $\frac{dc}{dt} = -4$ km. per sec. per year $= -1100$ cm. per sec. per day. Hence we should find

$$\frac{dn}{dt} = 0{\cdot}023 \text{ fringe per day.}$$

Three series of data were taken over periods varying from 8 days to a month, and the computed daily rates of change, expressed in thousandths of a fringe a day, are $0{\cdot}050 \pm 0{\cdot}020$, $0{\cdot}007 \pm 0{\cdot}013$, and $-0{\cdot}015 \pm 0{\cdot}021$. Their mean is $0{\cdot}014 \pm 0{\cdot}011$. This value stands in the ratio 6×10^{-4} to the amount required by the hypothesis of variable velocity, and of course definitely disposes of the possibility of it, unless the frequency itself is supposed to vary correspondingly.

ROY J. KENNEDY.

University of Washington,
Seattle, July 5.

Metabolic Rate and Habitat

WHILE innumerable adaptations in structure and habits of animals have been described, we have as yet little knowledge of the physiological causes and effects of distribution and habitat.

As regards metabolism, it is known that trout and mackerel, fishes confined to well-oxygenated waters, have hæmoglobins with a relatively small affinity for oxygen.[1, 2] Their blood cedes its oxygen readily to the tissues, permitting of an active life, but in water deficient in oxygen these fishes suffer. Carp, on the contrary, lead a sluggish life. Their hæmoglobin parts reluctantly with its oxygen, but it can capture the gas from poorly aerated waters and so enable the fish to survive. Trout, in effect, consume more oxygen than carp.[3, 4] The squid and the king crab offer a like contrast of blood with hæmocyanins.[5] Again, the oxygen affinity of respiratory pigments varies with temperature, and this circumstance may limit poikilothermal animals to different latitudes.[6]

Some marine invertebrates can live in brackish water, and it has been shown that these animals consume more oxygen in the fresher waters than in the

sea.[7, 8, 9] This suggests that freshwater animals may necessarily have a higher metabolic rate than their marine relatives. Data, however, are lacking on this score. We have therefore compared the oxygen consumption of marine and freshwater amphipods and isopods. To obtain significant data, nearly related anæsthetised animals of the same size and sex were used. We have found that the metabolic rate of the freshwater species *Gammarus pulex* is 1½ times that of the marine *G. locusta* and *G. marinus*; and the metabolic rate of the freshwater *Asellus aquaticus* is 3 times that of the marine *Idotea neglecta*.

There is an equal absence of physiological data concerning freshwater animals limited in their distribution to swift streams and to still waters. Comparing the oxygen consumption of the larva of the mayfly *Bœtis rhodani*, an animal living in rapid streams, with that of its pond relative *Chlœon dipterum*, we find that the former has a value 3-4 times the latter. Moreover, the rates of their heart beats are as 3 : 1. Again, the metabolic rate of the caddis worm *Hydropsyche* sp., from rapid streams, is 1½ times that of *Molanna* sp., from ponds. Finally, an unexpected difference in oxygen consumption was found between members of one and the same species from two such habitats. The ratio of the metabolic rate of *Asellus aquaticus* from a swift stream to that of members of this species from slow water is as 3 : 2. It is hoped that breeding experiments will decide whether the last-mentioned difference is inherited or not.

H. MUNRO FOX.
B. G. SIMMONDS.

Zoological Department,
University of Birmingham,
July 16.

[1] Krogh and Leitch, *J. Physiol.*, **52**, 288; 1919.
[2] Root, *Biol. Bull.*, **61**, 427; 1931.
[3] Gardner and Leatham, *Biochem. J.*, **8**, 374; 1914.
[4] Gardner, King and Powers, *Biochem. J.*, **16**, 523; 1922.
[5] Redfield, Coolidge and Hurd, *J. Biol. Chem.*, **69**, 475; 1926.
[6] Fox, NATURE, **130**, 92, July 16, 1932.
[7] Schlieper, *Biol. Rev.*, **5**, 309; 1930.
[8] Beadle, *J. Exp. Biol.*, **8**, 211; 1931.
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Nitrogen Requirements of the Lactic Acid Bacteria

IN view of the importance attached by Orla-Jensen to the nitrogen source employed in the study of the lactic acid bacteria—an importance emphasised by the results of our own studies—we have investigated the nitrogen distribution in some thirty-seven sources of nitrogen, and have determined the influence of these sources on the production of acid from glucose, mannose, and lactose by five strains of lactic acid streptococci after fourteen days' incubation at 23° C. For the nitrogen distribution determinations we used the method of Wasteneys and Borsook. In the subsequent preparation of the sugar broths for the fermentation work and in the recording of the results we proceeded after the manner of Orla-Jensen. Certain of the nitrogen sources investigated are available commercially; many, principally peptic, digests of casein and some tryptic digests of casein, are such as may readily be prepared by laboratory workers.

Each of the streptococcus strains studied produces an amount of acid comparable with that produced by certain strains of *Sc. cremoris* when a peptic digest of casein, 1 per cent total nitrogen content, is used as the nitrogen source; the broth thus prepared containing 57·69, 20·36, and 17·39 per cent of proteose N, peptone N and sub-peptone N respectively. If the total N, content be 0·5 per cent, the total titrable acidity is not more in each case than from one-half to one-third the amount already cited. A tryptic casein digest containing 1 per cent total nitrogen proves to be quite unsuitable as a nitrogen source for each of the organisms under study. When the total nitrogen content is 0·5 per cent, however, two strains are still feeble in the production of acid, but three strains produce from 6·0 to 8·6 grams acid (calculated as lactic acid) per mille. The tryptic casein digest broth contains 0·0, 27·68, and 69·82 per cent proteose N, peptone N, and sub-peptone N respectively. A commercial 'hydrolysed casein' broth prepared to contain 1 per cent total N shows an analysis of 35·84 per cent proteose N, 27·26 per cent peptone N, and 32·08 per cent of sub-peptone N. As a source of nitrogen this broth is very suitable for each of the five organisms, and particularly suitable for the three strains that, as described above, respond to a tryptic casein digest. Our results indicate that in fermentation studies on the lactic acid streptococci both the 'kind' and the 'amount' of nitrogen employed are critical.

This study is one of a series on cheese-ripening provided for by a research fund established jointly by the University of British Columbia and the Empire Marketing Board. A complete and detailed account of the work is in press awaiting the next issue of the *Journal of Dairy Research*, Cambridge.

BLYTHE A. EAGLES.
WILFRID SADLER.

University of British Columbia,
Vancouver, Canada, July 13.

The So-called Marsupial Bone in a Microchiropteran

THE epipubic bone in Marsupialia is a diagnostic feature of the group, but it has not hitherto been recorded in other Mammalia except, of course, in the Monotremata. Recently I have collected *Rhinopoma microphyllum*, a small bat, from Agra Fort near the famous Taj, during the last departmental annual excursion. This bat possesses an epipubic bone which looks exactly like that of the kangaroo (Fig. 1). The whole skeletal system in *Rhinopoma microphyllum* is very peculiar and will be discussed elsewhere.

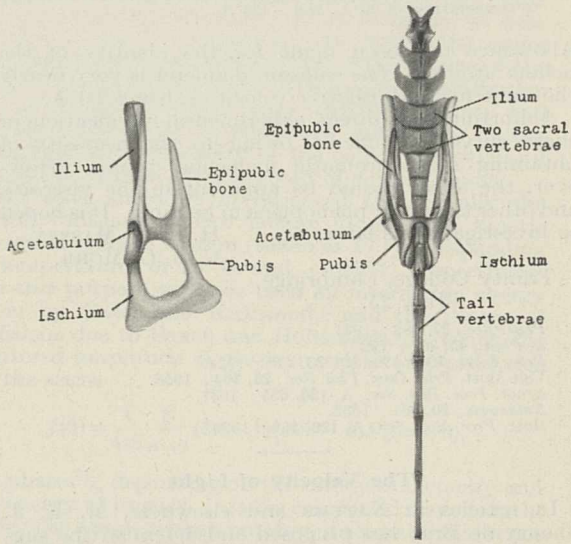

FIG. 1.—Pelvic girdle of *Rhinopoma microphyllum*. On the left, side view, ×2; on the right, ventral aspect, ×⅔.

HIMADRI KUMAR MOOKERJEE.

University College of Science and Technology,
35 Ballygunge Circular Road, Calcutta,
June 9.

Occurrence of the Cyclopoid, *Herrmannella rostrata* Canu, in *Cardium edule*

WHILST examining *Cardium edule* isolated in bowls and obtained from Morecambe Bay, Lancashire, Prof. Orton found an abundance of copepods and gave them to me for examination.

The copepod proved to be *Herrmannella rostrata* Canu,[1] one of the Lichomolgidæ leading a semi-parasitic existence in the cockle. When the cockles were opened separately in finger-bowls in the laboratory many of the copepods were clearly seen to leave their hosts ; they appeared to be distributed throughout the mantle cavity but showed a tendency to congregate round the siphons. Tow-nettings from gulleys on the cockle beds in Morecambe Bay revealed a number of *Herrmannella* swimming actively in the sea-water amongst various Calanoids and other planktonic material. Males and females with and without egg sacs were seen both in the cockle and swimming freely.

Canu records *Herrmannella rostrata* from the mantle cavities of *Cardium edule* L., *Mactra stultorum* L., and *Pecten opercularis* L., from the French coast, but there does not appear to be any record of its being found in British waters. As it is so very abundant in *Cardium* from Morecambe Bay, it seems unlikely that it is of merely local occurrence, but possibly has been mistaken for *Lichomolgus agilis* (Leydig), a species which it closely resembles and which has been recorded from *Cardium* from many localities and from Lancashire by Thompson.[2] Sars, Canu, and many other writers[3] record *L. agilis* only from the Nudibranchiata.

J. H. FRASER.

Dept. of Oceanography,
University of Liverpool, July 9.

[1] Canu, E., "Les Copépods marins du Boulonnais", *Bulletin Scientifique de la France et de la Belgique*, Tome xxiii., 1891.
[2] Thompson, I. C., "Revised Report on the Copepoda of Liverpool Bay", *Trans. Liverpool Biological Soc.*, vol. vii., 1893.
[3] Canu, E., "Copépods du Boulonnais", *Travaux du Laboratoire de Zoologie Maritime de Wimereux-Ambleteuse*, Tome vi., Lille, 1892.

Habits of the Toad, *Ceratophrys*

A MISHAP which throws additional light on the voracious habits of the South American toad *Ceratophrys* deserves to be put on record. Four of these creatures were received here at the end of June and at the same time two small alligators. When they came, only one vivarium was ready for use, and for a week the toads and alligators shared accommodation in it. They appeared to ignore one another and to be perfectly content. The alligators spent much of the time basking on the top of a small wooden penthouse or immersed in the water trough : the toads dug themselves comfortable burrows and were soon effectively concealed. Both took the food that was offered to them, the toads showing an appetite for the common frog and the alligators for a diet of beef and worms.

Meanwhile a new vivarium was prepared. But when the day came to transfer the alligators to it, it was found that one of them had completely vanished during the previous night. A thorough search revealed no trace of the missing animal, and the suspicion grew that one of the toads was responsible for its disappearance. On the pampas they are reputed to steal chickens, and Gadow reports an instance of cannibalism even, on the part of one of a pair sent to him by a friend (cf. Cambridge Natural History—"Amphibia and Reptiles", p. 217). The four toads in this case were subjected to a screening examination with X-rays, and in one of them a large dark shadow distinctly disclosed the presence of the missing alligator.

The length of the alligator was 11 in. over all (head 2 in., body 3 in., tail 6 in.). Its maximum breadth was $1\frac{1}{4}$ in. The corresponding dimensions of the toad are : length 6 in., maximum breadth $3\frac{1}{2}$ in.

It remains to be said that the toad is digesting its unusual meal with the utmost complacency.

C. W. PARSONS.

Zoology Department,
University of Glasgow.

The Andean Eruption and Sunset and Sunrise Glows in South Africa

THE first sunset glow due to volcanic dust from the Andean eruption was seen in Cape Town on April 21. The glow, which was of remarkable intensity, started about fifteen minutes after sunset and lasted fully an hour, the colour being a deep fiery red. There were many inquiries that evening at the *Cape Times* office and at the Central Fire Station whether a large fire was raging in the suburbs ; there were also numerous telephonic inquiries at the Royal Observatory as to the cause of the phenomenon. I therefore gave a statement to the *Cape Times*, which appeared in the following morning's paper, attributing the phenomenon to volcanic dust from the Andean eruption, and anticipating that it would be followed by sunrise and sunset glows for several weeks.

The glows have continued to be visible in Cape Town up to the present time, eight weeks since the appearance of the first glow, with varying but on the whole decreasing intensity. None, however, has been so striking as the sunset glow on the evening of April 21 and the sunrise glow the following morning.

I have collected some information as to the region over which the glows have been visible. It appears that they have been generally observed throughout the Union of South Africa and the Bechuanaland and Basutoland Protectorates. The effects appear to have been even more striking in the clear air of the Karroo and the high veldt than here. At Mafeking, one month after the appearance of the first glow, a trustworthy observer stated that the glow was of a fire-red colour stretching right across the sky, even long after darkness.

The speed of the easterly moving current of air which carried the volcanic dust across from South America would appear to be about twelve miles per hour.

H. SPENCER JONES
(H.M. Astronomer).

Royal Observatory,
Cape of Good Hope, July 14.

Aurignacian Flint Implements from Raised-Beaches underlying the Brown Boulder Clay

RECENTLY, in conjunction with Mr. J. Reid Moir, I recorded my discovery within the Thames valley of a Middle Mousterian occupation-floor overlain by gravel and brickearth (70 ft. above O.D.) and post-dating the formation of the Coombe Rock.[1]

I have since been engaged in a series of excavations in the estuarine gravels at Kirmington (90 ft. above O.D.) and to the west of Barton-on-Humber, Lincolnshire (50 ft. above O.D.). At both these sites the Brown Boulder Clay caps the estuarine gravel.

In addition to derived artefacts belonging to earlier periods, these estuarine gravels contain implements of Aurignacian age likewise exhibiting a rolled condition.

These specimens will be described before the Society of Antiquaries of London in November next.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2.

[1] NATURE, **130**, 95, July 16, 1932.

Research Items

Fossil Man of Asselar (Sahara).—A study of a fossilised human skeleton, discovered at Asselar, Cercle de Kidal, French Sudan, in 1927, has been published by MM. Marcellin Boule and Henri Vallois (*Mém. 9, Arch. Inst. Paléontologie humaine*). The palæontological and geological data of the discovery, though the latter are to some extent a matter of inference, warrant an Upper Pleistocene dating (Europ. Âge du Renne), and point with certainty to a period when the Sahara was well watered. No implements were found associated with the skeletal remains, but surface finds of upper palæolithic, mesolithic, and neolithic types, obviously later in date, were made not far away. The skeletal remains were neither water-borne nor buried, and appear contemporary with the fauna, now extinct in the area, found in identical deposits nearby. The skull, including the face, is well preserved. The principal parts of the skeleton which are missing are about two-thirds of the femora and tibiæ. It is probably the skeleton of a male of at least forty and possibly more than fifty years of age. The most striking characteristics are the dolichocephaly of the skull, the broad and dysharmonic face, platyrhiny, the size of the teeth, and primitive features in the jaw. The cephalic index is 70·9. The skull is high and the cranial capacity approximately 1520 c.c. There is distinct sub-nasal prognathism, though this character is not specially marked when the face is taken as a whole. When compared with other types of early and recent man in Africa, Asselar man is seen to resemble most closely types found in South Africa, especially the Hottentot and Bantu, more particularly in the features in which these can be regarded as unspecialised and primitive. It is suggested, therefore, that Asselar man and Grimaldi man are derivatives, perhaps to be associated with the Capsian industry, from an earlier less specialised type, which divided, one branch going north and evolving in the direction of Cro-Magnon man, while the other, going south, became the ancestral type of the Bushmen and the less specialised Hottentot.

The Royal Tombs, Monte Alban, Southern Mexico.—An interesting article by Mr. Herbert J. Spinden on the recent discovery of a treasure of gold in one of the tombs opened by Dr. Alfonso Caso on Monte Alban, Southern Mexico (*Brooklyn Mus. Quart.*, vol. 19, No. 2), stresses the cultural evidence of the finds as of more importance than their intrinsic value. For example, they bear out the derivation of metal, gold and copper, and the methods of working metal among the ancient inhabitants of Mexico from Colombia and Costa Rica. One of the interesting facts which emerge from the Monte Alban finds of gold ornaments is that the paddle-shaped feet-of-frog amulets from Costa Rica contribute to the shape of elaborate Mexican amulets dealing with very different subjects, such as a remarkable piece with dates on the flanged base. Mr. Spinden is unable to follow Dr. Caso in his attribution of these tombs to Mixtec temporarily in occupation of Monte Alban. He himself is of the opinion that they are Zapotec and that the site is the ancient Zaachila, famed as the capital of the Zapotecs, and called Teozapotlan by the Mexicans. This opinion is based very largely on the character of the architecture of the tombs, which are regarded as comparable to others which have been excavated on Zapotecan sites at Xoxa and Cuilapa; but the engraved human bones found in heaps in the treasure tomb are certainly very close to Mixtec work, and are probably connected with the war cults of the Jaguars and Eagles. As regards the date, it is clear, Mr. Spinden thinks, that the architecture and ceramics fall before the last pre-Spanish period, and after, rather than before, Toltec times.

Damage by Deer and its Control.—In Scotland, damage to crops by deer is a desultory and not very extensive occurrence, but in California the last decade has seen the problem gradually gaining in economic importance, until the State departments concerned have been compelled to take up the matter of control. One line of investigation prosecuted by Gordon H. True promises good results where damage is extensive, that of determining the efficiency of repellants (*California Fish and Game*, p. 156, 1932). The repellants tested consisted of various chemical substances playing upon the senses of smell or taste, and physical devices intended to play upon the natural wariness of the deer. It may be said at once that the latter, of the scarecrow or automatic flash gun type, soon lost any scaring effect they may have possessed at first. But the dusting or spraying of various chemical substances produced good results. For example, the spraying of blood upon orchard trees afforded 50-100 per cent protection. Other materials used were the proprietary *D*4, a mixture of whale-oil soap and liquor cresolis, naphthalene flakes, asafœtida, and each of these proved effective to some degree, although creosote and creosote dips met with little success. It was found, however, that the effectiveness of any repellant depended upon a number of conditions, such as temperature, rainfall, intensity of deer population, and the situation of crops to be protected with reference to wild country. So that a substance successful in one case may prove a failure in another. But the author is of opinion that where deer are causing extensive losses, the saving brought about by the use of repellants will more than counterbalance the cost.

Hybrid between Wolf and Dingo.—From a correspondent we learn that pairing between a male European wolf and a female Australian dingo in the Adelaide Zoological Garden resulted in a litter of six hybrid pups, all female. The hybrids more resemble the dingo than the wolf, and one has been sent to Melbourne Zoological Gardens for further experiments in hybridisation. Although it is stated that the cross is a rare one, if indeed it is not unique, the fact that dingos breed freely with the domesticated dogs of the settlers makes it not unlikely.

Madras Medusæ.—Mr. M. G. K. Menon, in a paper, "The Hydromedusæ of Madras" (*Bull. Madras Gov. Mus.*, New Series—Nat. Hist. Sec., vol. 3, No. 2, 1932), investigates the species from the surface layers of the shallow waters off Madras within three miles of the coast, the collections being made every other day, early in the morning, for a year. Out of 35 species obtained, belonging to 28 genera, 6 are new and there is one new genus. Most of the medusæ recorded are littoral, and there is every reason to think they were generated on the coast. After a general dearth of organisms in the sea in the late summer, roughly corresponding to the hottest time of year, an outburst of planktonic growth takes place and the hydromedusæ begin to appear, steadily increasing until January, in which month the maximum is recorded. After March there is a steady decline in numbers and, with few exceptions, a scarcity of species. The present collection adds considerably to our knowledge of the medusæ of the Indo-Pacific, and it is interesting to find such typical Atlantic species represented as, for example, *Amphinema dinema* and (probably) *Leuckartiara octona*. The author notices that in the canal system of some examples of *Æquorea parva* a number of radial canals have lost their connexion with the stomach and

have developed on their ventral surfaces openings surrounded by minute lips which are capable of functioning as accessory mouths. This is in agreement with *Mesonema pensile*, in which Browne observed that the canal system had taken on the function of the stomach, in this species the lower wall of the stomach being quite rudimentary. Browne has suggested that this may apply to other Æquoridæ and account for the large number of radial canals and excretory pores on the circular canal.

Crystalline Style in Large Molluscs.—The crystalline style which occurs in all bivalves and in many herbivorous gastropods is usually a gelatinous rod continually being secreted in a style sac and pushed forward so that its free end is in the stomach, where it is dissolved and sets free a powerful amylase and an oxidase. Dr. C. M. Yonge (*Proc. Malac. Soc.*, **20**, pt. 1, pp. 44, 45, March 1932) has examined the largest living bivalve, the giant clam, *Tridacna derasa*, on the outer reef of the Great Barrier Reef of Australia, and found that the style was 34 cm. in length and 0·5 cm. in breadth. The style had to be preserved in strong alcohol for two days before there was opportunity to weigh it accurately, and its weight was no doubt substantially reduced by this dehydration; its weight was then 3 gm. The length of the *Tridacna* from which it was obtained was 3 feet. At Bermuda, Dr. Yonge examined *Strombus gigas*, the largest of the herbivorous gastropods, which feeds on fine filamentous algæ, and found that in specimens 11½ in. and 10 in. long the respective styles were 22·25 cm. and 20·6 cm. long and 0·6 cm. broad, and weighed 2·8 gm. and 2·5 gm.

A Braconid Parasite of the European Corn Borer.—*Technical Bulletin* No. 294 (May 1932) of the U.S. Department of Agriculture is entitled "The Biology and Morphology of the Braconid *Chelonus annulipes* Wesm., a Parasite of the European Corn Borer", by Mr. Arlo M. Vance. The genus *Chelonus* includes a large number of species, many of which occur in Britain, but little detailed study of any of its members has been undertaken. The species in question parasitises the European corn borer (*Pyrausta nubilalis*) in Italy, and the present investigation has been made in connexion with its introduction into the United States, where the corn borer is well known as an immigrant pest of first importance. Mr. Vance gives a very thorough account of the external and internal structure of the *Chelonus* larva. The most notable feature seems to be the absence of Malpighian tubes, usually present in hymenopterous parasites. Small outgrowths, or buds, originating from the hind intestine, are considered to be rudiments of these organs. The process of excretion appears to be performed by special urate cells found in the fat body. The female *Chelonus* deposits an egg in that of the corn borer, and the larva passes through three instars within the growing larva of the host. At its last stage the parasite larva leaves its host and, after devouring the remaining tissues of the latter, spins a cocoon and pupates. At a constant temperature of 77° F. two days are required for the incubation of the parasite egg, about 20 days are occupied in larval development, and 9½ days are passed as a pupa. The period from egg to adult is estimated to require about forty days in the field.

Sclerotial Diseases of Rice.—Messrs. Malcolm Park and L. S. Bertus are working at the Royal Botanic Gardens, Peradeniya, Ceylon, upon the sclerotial diseases of rice (*Ann. Roy. Bot. Gardens*, **11**, pt. 4, pp. 319-332 and pp. 343-359; 1932). *Rhizoctonia* (*Corticium*) *Solani* not only gives trouble in the potato fields of England, but also causes a disease of rice in Ceylon. The symptoms of the malady are described in the first paper, and the characteristics of the fungus in pure culture are noted. Practical aspects of control have been considered, but, owing to the longevity of sclerotia in soil, the ordinary methods of crop rotation are inadequate. Experiments are to be directed towards finding a specific soil treatment. The other disease investigated is caused by *Sclerotium Oryzæ*, and has been studied with as much detail as the *Rhizoctonia* malady. It is possible to grow varieties of rice which are resistant, but irrigation water should never be allowed to flow through a diseased field, since it might carry infection. The disease occurs in patches in the rice-growing areas, and the crop growing on the patches should be burned at harvest time.

Gas without Oil.—The phenomenon of extensive accumulation of natural gas without associated petroleum is not by any means new, especially in certain parts of the United States and Canada. A somewhat unusual example is furnished by the Jackson Field, Mississippi, where a daily open flow of gas totalling 1,250,000,000 cubic feet from 42 wells has been estimated. The actual amount drawn from the field last year was about 13,000,000 cubic feet a day, a comparatively small proportion of available supplies. This gas has a high calorific value and contains a large percentage of methane—in one case 64·45 per cent, in another case 90·23 per cent; other constituents are ethane, carbon dioxide, and nitrogen, the latter in sufficient quantity to suggest a possibility of helium content, though the report of this area by Mr. Watson H. Monroe (*U.S. Geol. Sur.*, Bull. 831-A, 1931) makes no specific mention of this.

Coal of the Northumberland Area.—The Department for Scientific and Industrial Research has issued Paper No. 22 of the Physical and Chemical Survey of National Coal Resources, dealing with the 'Main Seam' of the Northumberland Area (London: H.M.S.O. 1*s*. 6*d*.). The report contains detailed analyses of samples taken from 16 points over the whole area, which is an important one, producing 50,000,000 tons annually and largely for export. The coal is frequently of high quality, but varies in caking properties. The association of a high sulphur content where the caking properties are good has prevented the development of a Northumberland coking industry. The coals are marketed primarily for home and steam purposes.

International Colorimetry.—The discussions which have been going on for some time in Great Britain and other countries as to the best method of measuring and specifying colour have for the present been settled by the decisions of the International Illumination Congress which met in September last at Cambridge. A report and discussion of these decisions by Mr. T. Smith, who was chairman of the Committee on Colorimetry, and Mr. J. Guild appear in part 3 of vol. 33 of the *Transactions of the Optical Society*. The trichromatic specification of colours is to be adopted as the standard one, but the three primary colours are to be such that the amounts of each necessary to match a colour occurring in practice shall always be positive. This involves a departure from the system of primaries adopted previously by the National Physical Laboratory, the *R*, *G*, and *B* of which were the spectral lines 7000, 5461, and 4358 respectively, and the equations specifying *R*, *G*, and *B* and the standard white light in terms of the international primaries are given. The standard white is that transmitted from a gas-filled incandescent lamp operating at a colour temperature of 2848° absolute through two blue solutions of specified compositions.

Optical Diffraction by Sound Waves.—Supersonic waves in liquids have a space periodicity sufficiently small to be comparable for diffraction purposes with

the wave-length of light, and if the density changes are sufficiently large, should be able to act as a grating. This effect, which was predicted by Brillouin, has now been observed by P. Debye and F. W. Sears (*Proc. U.S. Nat. Acad. Sci.*, June 15) and made the basis of a method for finding the speed of supersonic waves, the wave-length being found by the optical experiment in terms of the wave-length of light, and the frequency by a radio wave-meter. The theory is not given in full, but leads to the ordinary diffraction formulæ, so far as the angular deviation of the light is concerned. The diffraction pattern in its higher orders provides a test of the constancy of the speed of the supersonic waves. By measuring the intensity of the diffracted beams when the light is passed through the liquid at different distances from the source of the waves their attenuation can be calculated, but so far has been found to be appreciable only for glycerine, which probably acts in this way from its high viscosity.

Optical Absorption of Solutions of Sulphur.—An example of the value of a study of optical absorption spectra for obtaining information concerning the molecular condition of a dissolved substance is given by Prof. Campetti in a paper published in parts 6-10 of the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere for 1932 (vol. 65). Results are given of determinations of the absorption limits for solutions of sulphur in *m*-xylene and carbon tetrachloride at temperatures ranging from 20° to 130°. The curves connecting the limits of absorption (ordinates) with the concentrations of sulphur in the two solutions at any one temperature intersect near the absorption axis. If, however, the initial ordinate is made the same for both curves, the curve for the carbon tetrachloride solutions lies wholly above that for the *m*-xylene solutions, so that a given weight of sulphur dissolved in the former solvent exerts a somewhat greater absorbing effect than when dissolved in *m*-xylene. Since the formation in solution of molecular groups of greater complexity than S_8 is improbable, the obvious and almost necessary explanation of such behaviour is that sulphur and *m*-xylene give rise to molecular associations with absorption less than the sum of those of the components separately. This conclusion appears to be related to the fact that, at temperatures which are not too high (about 195°), the two liquids—liquid sulphur and *m*-xylene—are miscible in all proportions.

Astronomical Topics

New Comet.—A comet of magnitude 7½, visible in an opera glass, was discovered independently by Mr. L. Peltier at Delphos, Ohio, and by Dr. Whipple photographically at Harvard. It is Mr. Peltier's third cometary discovery and Dr. Whipple's first, though his name is very well known as a cometary observer and computer. He and Mr. L. E. Cunningham have computed the following orbit for the comet:

T	1932 Sept. 1·510 U.T.	
ω	38° 10′	1932·0
Ω	344 40	
i	71 49	
log *q*	0·01662	

The comet is in high northerly declination, and visible all night; an ephemeris is given for 0h U.T.:

	R.A.	N. Decl.
Aug. 21	4h 7m 20s	64° 51′
25	5 5 12	73 38
29	7 5 58	79 22
Sept. 2	9 57 36	79 47
6	11 44 44	76 22
10	12 35 45	72 12
14	13 3 14	68 16

The following observations have come to hand; the first is by Mr. Möller at Copenhagen, the others by Dr. W. H. Steavenson at Norwood:

	U.T.	R.A. (1932·0).	N. Decl.
Aug. 10d	23h 7m 18s	3h 11m 35·25s	38° 27′ 27·6″
11	23 42 24	3 14 54·41	41 8 11·2
12	23 21 15	3 18 25·16	43 45 15·8
13	23 39 5	3 22 22·52	46 27 35·7

Dr. Steavenson saw a short tail, the shape of which resembled that of Halley's comet in miniature; it made a considerable angle with the radius vector produced.

Observations of Radio Signals during the Eclipse.—A Science Service Bulletin, dated July 25, invites the co-operation of all who have means of estimating the strength of radio signals in observing the effect of the eclipse on these signals. In a letter in NATURE of May 21, p. 757, Profs. S. Chapman and E. V. Appleton pointed out that the radio effect may be expected to precede the optical eclipse by two hours, so that the British Isles come within the affected region; observations should be continued during the whole of the afternoon of Aug. 31, but it is in the latter part that the eclipse effect is to be looked for. The main object of the investigation is to test theories about the upper and lower Heaviside layers; one theory ascribes both layers to the action of ultra-violet light from the sun; the other theory ascribes the lower layer to neutral particles streaming from the sun. In the former case the effect would be limited to the regions of optical eclipse; but in the latter view the slower motion of the particles would cause an eastward shift of the radio eclipse compared with the optical one. Also the streams of particles are supposed not to come from the whole sun, but from special regions; this would make the region of radio eclipse as broad as the diameter of the moon, as contrasted with the hundred-mile width of the zone of optical totality.

Lunar Computations for the *Nautical Almanac*.—An article by Dr. L. J. Comrie (*Mon. Not. R.A.S.*, May) illustrates in a vivid manner the immense aids to astronomical calculations that have been afforded by mechanical inventions in the present century. Prof. Brown's Lunar Tables were introduced into the almanacs for 1923. More than 1400 periodic terms are tabulated, and the computations up to the present have involved the continuous work of two skilled computers. Dr. Comrie noticed that much of the work could be facilitated by the use of the Hollerith tabulating machine, and was instrumental in obtaining the hire of a machine for the office of the *Almanac*; by its aid it has been possible to carry out the larger part of the lunar computations for the remainder of the present century at an aggregate cost of less than a quarter of what it would have been on the old method, and with considerably greater security against error. The details of the process are described in the paper. The first stage is to divide the period of each harmonic term into an integral number of parts, so chosen that the motion in a day is an integral number of these parts; the next stage is the preparation of cards, which are punched with holes in different columns, the height of the hole in each column indicating the corresponding digit. The cards for each harmonic term are then arranged in stacks. The top cards of each stack, representing the first date, are collected by hand into another stack; the addition of harmonics is performed by the machine, and the result printed. An important feature is the sorter, which automatically arranges the cards in groups according to the numbers punched in any selected column. The result is easily checked, since all the cards in each stack have a hole in the same place, so that there is a tunnel right through the stack.

The University of Rangoon

By Prof. D. H. PEACOCK

IN July 1931, the University of Rangoon held its annual Convocation for the first time in the new Convocation Hall, the Training College opened its new buildings, and in November of the same year University College and Judson College moved into the science wings of their new buildings, of which the arts wings had already been in use for some time. The work of building the University of Rangoon is thus virtually complete.

The buildings in existence in 1920 were quite unsuited to the needs of a modern university, and while the constitution of the new University was under consideration, tentative projects for new buildings were drawn up. Sir Spencer Harcourt Butler, when Lieutenant-Governor of Burma, had wisely reserved a site of some four hundred acres about five miles from Rangoon on the southern shore of the Victoria Lake, and, in December 1922, Sir Reginald Craddock, Lieutenant-Governor of Burma, laid there the foundation stone of the new Convocation Hall. No provision had at this time been made for funds for the new buildings and no body had been authorised to carry out the work, but both matters received early attention from Sir Spencer Harcourt Butler, who returned to Burma as Governor in January 1923. In 1925 the Government of Burma constituted a Building Trust of fifteen members, of whom four were elected by the University, to carry out the erection of the University buildings with the exception of the Medical College. The full-time services of Mr. M. J. Sheehy were placed at the disposal of the Trust as executive engineer, and as occasion arose the Trust was also able to utilise the services of Colonel Longdin and Mr. C. C. Codrington for the water supply, sanitation, and mechanical ventilation and of Mr. Eades for the electrical installation. The first chairman of the Building Trust was Sir Robert Giles, and he was succeeded by Sir Oscar de Glanville, who has completed the work. The University is also greatly indebted to Sir Charles Innes, Governor of Burma since 1928 and Chancellor of the University, to whose sympathetic consideration is largely due the provision of the necessary funds, and to Sir Benjamin Heald, Vice-Chancellor of the University.

The Government of Burma set aside a sum not exceeding £780,000 for the buildings and their ancillary services. The Building Trust had not only to erect new buildings for the existing colleges—University and Judson—but also to build a Convocation Hall for the University, a Training College for Teachers, and houses for the staff and servants of the colleges and the University. In addition, much that is usually provided by local authorities had to be provided by the Building Trust; roads had all to be made, wells had to be sunk and a waterworks erected, and septic tanks and a complete system of sanitation had to be provided. It should be mentioned that the American Baptist Mission defrayed half the cost of the erection of Judson College.

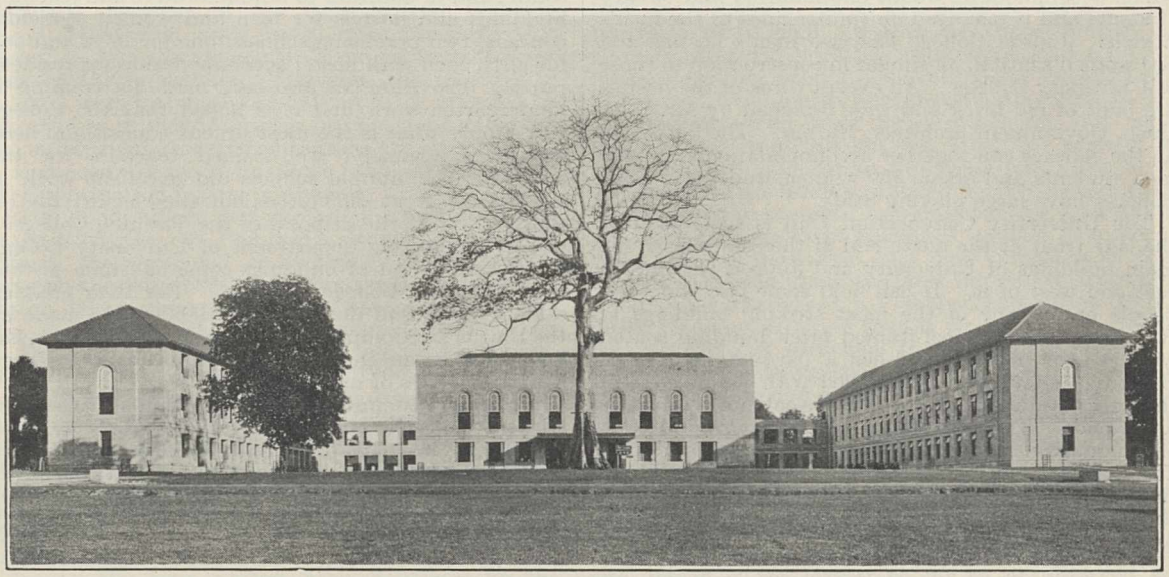

FIG. 1.—University College, Rangoon.

The Convocation Hall, the buildings of University and Judson Colleges, and the Training College for Teachers are of steel-framed brick coated with white plaster. University College (Fig. 1) consists of six blocks of buildings joined by a colonnade running north and south. The College Library is one hundred and forty feet long and thirty feet wide, and behind it are the College Hall and students' common rooms. On either side of the library block are the north and south arts wings; each is a three-storied building approximately two hundred and fifty feet long and forty feet wide. At the back of the College are the three science wings, which are of the same height and exterior appearance as the arts wings. The north science wing contains the physics department and, on part of the top floor, the geology department. The middle wing is devoted to the chemistry department. The south wing contains the departments of forestry, botany, and zoology and the institute of helminthology. All the science wings are approximately two hundred and twenty feet long, the north and middle wings are forty feet wide, and the south wing is thirty feet wide. Communication to rooms in all the teaching blocks is

by a deep verandah on the south side. All windows and doors are steel-framed; the floors are for the most part parquet floors of Burmese teak. The verandah floors, however, and the floors of some of the laboratories are of salemite. The physics and chemistry laboratories deal with some four hundred students a week, the majority being pre-intermediate students. Post-graduate work is undertaken by very few students. The buildings of Judson College are similar in plan to those of University College but smaller.

The College buildings are separated by a short distance from their hostels. University College has eight men's hostels, each able to accommodate about one hundred and twenty students and managed by a warden, an assistant-warden, and tutors. Five of these hostels have a central dining-hall, while the other hostels have their own dining-halls. The hostel fees of men students, which include board and lodging, amount to about £2 a month. In addition to these hostels for men, there is a hostel for women students, which accommodates about one hundred and twenty students and is managed on similar lines to the men's hostels. Judson College has two men's hostels and one women's hostel, all similar in construction to those of University College. All except three of the hostels are built of red brick and were designed by Mr. S. P. Bush, Government architect, Burma. The hostels of all the colleges can together accommodate about 1300 men students and about 300 women students. Both Colleges have large playing fields.

The University Convocation Hall is situated near the lake front at the north end of the estate, with the main buildings of University and Judson Colleges to east and west of it. It can hold some two thousand people and is one of the most striking buildings in Rangoon. It is a steel-framed brick building coated with cement plaster, and has a parquet flooring of Burmese padauk and is panelled with yinma, one of the most beautiful of the lighter-coloured Burmese hardwoods. The main doors are of bronze and open on to marble steps covered by a bronze marquise. The Convocation Hall, the main buildings of University and Judson Colleges, the University Library, and three of the University College hostels were designed by Mr. T. O. Foster.

The University Library was the gift of a generous donor who did much for the cause of education in Burma, Raja Dr. Reddiar, and has been built at a cost of some £15,000. The bookstack is to be fitted with an air-drying plant which will be, so far as is known, the first of its kind to be used in any library. The colleges already possess quite well-stocked general libraries, and the University Library is being devoted mainly to Oriental studies, including language, history, and art. In this connexion, University College has established a lectureship in Far Eastern history, and a considerable amount of work is being done in the University on the history of Burma.

The University Students' Union building and the University gymnasium, both designed by Mr. T. O. Foster, were the gifts respectively of Dr. Tun Nyo and Mr. Chan Chor Khine. Both buildings are well equipped for the purposes for which they are used.

The Teachers' Training College, designed by Mr. Armstrong, is situated in the southern part of the estate, and in addition to administrative and teaching buildings and hostels for men and women students, contains two practising schools, one for boys and one for girls, each with hostel accommodation for resident pupils. Provision has also been made for training in kindergarten work, and it is hoped that the College will supply what is the most urgent educational need in Burma, namely, well-trained teachers for the schools. The normal schools did excellent work in the face of great difficulties, but they lacked the resources now at the disposal of the Training College.

The engineering department of University College is housed in a set of buildings some half-mile distant from the main College buildings. For their erection a most munificent donation of £100,000 was made by the Burma Oil Company, and part of this donation has been used as an endowment towards the necessarily heavy expenses of upkeep.

Housing accommodation for the staffs of the constituent colleges and of the University has been provided by the Building Trust, which also has built a sanatorium for the students, a book-shop, a post office, a village for the servants of the colleges and the University, and quarters for the staff of the University training corps.

The Late Palæolithic Inhabitants of Palestine *

THE skeletal material of late palæolithic age from Palestine, upon which Sir Arthur Keith reported to the International Congress of Prehistoric and Protohistoric Sciences at a meeting held on Aug. 3, was collected by Miss Dorothy Garrod from deposits in caves at Shukbah in the Judæan Hills in 1928, and on Mount Carmel in 1929, 1930, and 1931. For the industry with which the remains were associated, a new mesolithic industry, Miss Garrod proposes the name 'Natufian', after one of the sites on which it was found. An account of this industry was communicated to the Congress by Miss Garrod at a subsequent meeting held on Aug. 5.

Sir Arthur proposes that the people represented by these remains should also be known by the name of 'Natufian'; for, in his opinion, they were a peculiar people, not to be identified with any living race. They have affinities with the neolithic people of Malta, with the negroid element represented among European peoples in the Aurignacian period, and, more distantly, with the predynastic inhabitants of Egypt and the late palæolithic people of North Africa. Among living peoples they approach most nearly to the Mediterranean race.

At Shukbah, remains of 45 individuals were found—25 adults (9 males and 16 females), 17 children, and 3 adults of indeterminate sex. At Mount Carmel, on the terrace in front of the cave, was a veritable cemetery: 87 individuals were represented—35 adult males, 23 adult females, 23 children, and 6 indeterminate. The proportion of the remains representing a complete skull or skeleton is small. Only 20 individuals afford skull size and shape, and in many cases allowances have to be made for distortion due to pressure.

There are, however, several features which stand out definitely. They were a dolichocephalic people with a cephalic index varying from 72 to 78; they had cap-shaped occiputs; the dimensions of the head are greater than in the predynastic Egyptians. They were prognathous, the sub-nasal prognathism being marked. The nasal bones formed a wide low arch; and the chins were not prominent. Many had big heads.

The stature was low, few men exceeding 1·650 m. (5 ft. 5 in.), most being about 1·600 m.; the women were about 1·524 m. (5 ft.). A striking character is the strong development of the bones of thigh and leg

* Substance of a paper read before the First International Congress of Prehistoric and Protohistoric Sciences, London, Aug. 1–6, by Sir Arthur Keith, F.R.S.

in contrast to those of the arm, forearm, and shoulder. The thigh bones have a prominent linea aspera, the tibiæ are platycnemic. In more than half the humeri there is a perforation of the olecranon fossa.

Some interesting observations were made on the cultural practices of the Natufians, for which evidence was afforded by the skeletal remains. The two upper incisors of the women were extracted in youth. Evidence for the same practice was found by Mr. Turville-Petre at Kebara, between Shukbah and Carmel. The Natufians also seem to have practised cannibalism. The bones are cut and fractured, the cut and broken surfaces showing that this was done when the bones were in a fresh state. This was at Shukbah only. No evidence of mutilation of the dead was found at Carmel or Kebara.

Evidence of a curious practice was found at Kebara. In the mesolithic deposits were found an assortment of bones which had been burned—not when fresh, but after they had been freed from animal matter by burial or exposure. The bones thus treated, which were collected by Mr. Turville-Petre, represent at least 75 individuals, mostly women. A similar collection had been forwarded to Sir Arthur by Mr. Leonard Woolley, which had been obtained from under the foundations of Ur. Here, too, women's bones preponderated. Further, Miss Caton-Thompson had obtained two skulls (female) from Zimbabwe which had been burned after the flesh had disappeared from the bones. Is this evidence, asks Sir Arthur, of a custom in ancient times of digging up the bones of ancestors and submitting them to the ordeal of fire?

Recent Archæological Field Work in England

THOSE members of the International Congress of Prehistoric and Protohistoric Sciences who elected to join the excursions arranged for the week (Aug. 6–13) immediately following the meeting in London, were fortunate not only in being afforded an opportunity to visit a number of important sites, but also in having demonstrated to them the latest results of this season's work by those who are in charge where excavation is now proceeding.

After dividing into two parties, of which one made its headquarters at Cambridge and the other at Oxford, they rejoined at Salisbury. The Oxford party on the way to Salisbury visited Winchester and Easton Down, near Salisbury. At the latter, they were shown the flint mines discovered from the air by Dr. J. F. S. Stone two years ago, and since excavated by him. The site covers 100 acres, and has a system of V-shaped ditches with deep pits at their convergence, similar to those of Grimes Graves, and containing quantities of half-manufactured implements, antler-picks and shoulder-blade shovels. Within the last few weeks, Dr. Stone has discovered a fresh pit of two courses, each eight feet in depth, with a shallower work nearby, which indicate how the neolithic miner worked.

Among the sites visited from Salisbury by the members of the Congress were the Iron Age fortress on Yarnbury Plateau and the Early Bronze Age site at Windmill Hill, which is being excavated by Mr. Alexander Keiller. At Yarnbury the triple line of fortifications surrounds the largest prehistoric stronghold in Wiltshire. It is 28½ acres in extent, with ramparts 25 ft. high. Within the triple rampart is a single rampart, or rather its remains, and a ditch. Some surprising results achieved in the excavations of the past two months were described by Mrs. M. E. Cunnington. The inner fortifications are not neolithic, as has been thought, but Iron Age work of a period slightly anterior to the triple line. The area was strewn with Romano-British pottery. A cutting in the interior rampart has revealed the post-holes for a chalk revetment sustained against a wooden wall. In the causeway, the only entrance to the fortress, has been found the most impressive Iron Age ditch so far discovered, a V-shaped excavation 12 ft. deep, so acute in angle that it would be impossible for two ranks of attackers to stand on the bottom. In the past few weeks there have also been discovered the guard-house and store-house of the fortress, while above the site of the ditch was the skeleton of a man wearing leather boots with hob-nails and bronze decorative studs.

At Windmill Hill, Mr. Keiller described the results of recent work, which now centres upon the excavation of the outer ditch, some 20 ft. wide and 8-9 ft. deep. Mr. Keiller announced that one-third of the site, which is the largest so far to be observed as included in this type of Early Bronze Age camp, is to be placed in trust for a century so that its excavation may be delayed until the results can be interpreted in the light of the fuller information which will then be available for archæologists.

Submarine Gravity Survey in the Bahamas

AN interesting piece of geophysical investigation has just been completed by an expedition carried out jointly by the United States Navy and the Department of Geology, Princeton University, with the co-operation of the United States Coast and Geodetic Survey. The introduction, in 1923, by Dr. Vening Meinesz of the Dutch Geodetic Commission, of a gravity pendulum apparatus capable of operating on a base not absolutely free from disturbing oscillation, led to the use of a submarine for the determination of the force of gravity over sea-beds and ocean-beds. During the next three years, three voyages in Dutch submarines were made by Dr. Vening Meinesz, and in the course of these he added much to the knowledge of the distribution of the force of gravity over the earth's surface.

In 1928 the United States showed an official appreciation of this pioneer work by inviting Dr. Vening Meinesz to bring his apparatus and carry out a similar investigation in United States waters with the help of a submarine of the U.S. Navy. The cruise was carried out in the autumn of 1928 and covered an area of considerable geological interest in the Caribbean Sea, the Gulf of Mexico, and to the north of Porto Rico. With the land pendulum stations established in that region by the United States Coast and Geodetic Survey, a considerable body of evidence was thus made available for the study of questions of isostatic equilibrium and of tectonic development.

It was a natural consequence that a desire should be expressed by geophysicists for the extension of the investigation to cover the whole of the British West Indies. The consent of the British Government for a submarine of the United States Navy to operate in these waters was obtained, and Dr. Vening Meinesz once more placed his special pendulum apparatus and

his own services at the disposal of the expedition. The moving spirit in this work, and the director of the expedition, was Prof. Richard M. Field, of Princeton University. He has, since 1922, made a special study of the stratigraphy and structural geology of the continental borders of the Atlantic Basin. In the course of this study he has led three expeditions to the Bahamas region. Dr. Bowie, chief of the Geodetic Division of the United States Coast and Geodetic Survey, was also an active supporter of the expedition. An observer, Lieut. J. P. Lushene, from his department, accompanied Prof. Field in the yacht *Miami*, owned and sailed by Lieut. Hugh Matheson, U.S. Naval Reserve, and made pendulum observations at a number of island stations in the region covered by the submarine party. The U.S. submarine *S.48* Lieut.-Commander O. R. Bennehoff, with Dr. Vening Meinesz on board, left Guantanamo, Cuba, on Feb. 7, 1932, being accompanied by the parent ship U.S.S. *Chewink*, Lieut.-Commander G. A. Miller. In the course of the next two months a cruise of some 4000 miles, in three loops, was made by these vessels, a large number of soundings by the sonic and by the supersonic apparatus were made, and the force of gravity was determined at 53 stations.

This notable expedition was given an international character by appointing advisory committees of prominent persons to deal with the subjects: navigation, geophysics, tectonics, oceanography, sedimentation, marine micro-biology. The Royal Society made a grant of £400 towards the sinking of a bore-hole on Andros Island, Bahamas. In the capable hands of Prof. Field, Dr. Vening Meinesz, and others, the results of the expedition are likely to yield valuable information, not only as to the history of the region, but also in the sphere of tectonics, or the theory of present-day processes in the more active regions in the earth's crust. Gravity survey at sea has come to stay as a major geophysical research, and it is, happily, likely to figure in the not distant future as an object of co-operation between the Navy and scientific authorities of Great Britain.

Calendar of Geographical Exploration

Aug. 21, 1721.—Easter Island

Jacob Roggeveen sailed from the Texel with three ships. On April 6, 1722, he discovered Easter Island, and described for the first time the remarkable stone figures found on that island. A buccaneer, Edward Davis, was reported to have sighted the island in the previous century, but there is no conclusive evidence that he did so. Several other islands were discovered, though it is difficult to identify them from Roggeveen's description; Raiotea in the Society Group was certainly one of them.

Aug. 23, 1683.—A Survey of the Galapagos Islands

A party of buccaneers, among whom were Dampier and Cowley, sailed for the South Seas. They sighted land which they charted as Pepys Island, but which was probably a headland of the Patagonian coast. They were joined by a second ship under Eaton and visited the Galapagos group, where they made a long stay; Eaton and Cowley drew the first fairly accurate chart of these islands, and Cowley's journal long remained the standard authority on them. The islands were discovered by the Spanish in the sixteenth century and received their name from the giant turtles which have evolved there. Charles Darwin found valuable data for his "Origin of Species" in the Galapagos, which he visited in the *Beagle*, a large proportion of the fauna and flora being peculiar to the islands.

Aug. 24, 1499.—Coast of Venezuela

Alonzo de Ojeda discovered the great inland Gulf of Maracaibo, which he called San Bartolomé. Ojeda sailed with four vessels from Cadiz in May 1499, reached Surinam, and coasted past the mouths of the Essequibo and the Orinoco. Rounding the peninsula of Paraguana, they entered a large gulf where they saw pile dwellings, hence they named the gulf and its coasts Venezuela (Little Venice). They passed through the strait to Maracaibo, and after sailing west to Cabo de la Vela, returned home.

Aug. 24, 1897.—Gerlache Strait

Adrien de Gerlache left Ostend in the *Belgica* on an antarctic expedition, Roald Amundsen being mate and Arctowski accompanying it as geologist. Funds were raised mainly through the personal enthusiasm of Gerlache and his companions; the Brussels Geographical Society opened a subscription list and the Belgian Government gave a small grant. Soundings were made of the hitherto uncharted sea between Cape Horn and the South Shetlands. The strait named after Gerlache, between the Palmer Archipelago and the mainland, was discovered and Graham Land was followed to Alexander I. Land. Finally the vessel was frozen in for the winter in 71° 30′ S. For the first time, a party of scientific workers wintered in the antarctic night; the sun did not appear from May 15 until July 22. The party suffered severely and one died, but scientific observations were steadily continued. The *Belgica* brought back a wealth of data and specimens, and the Belgian Government published the results for which the expedition is justly famous.

Societies and Academies

DUBLIN

Royal Dublin Society, June 28.—**J. Joly**: A suggested mode of radiotherapy when long continued feeble gamma radiation may be desirable. Since all living beings are normally exposed to cosmic radiation, it is conceivable that a comparatively mild increase in the exposure to penetrating radiation might be beneficial in certain diseases. This may be effected by the application of a fabric coated with a radioactive paint prepared by mixing very finely powdered uraninite with acetone containing 10 per cent cellulose acetate. This paint adheres firmly to the surface of the fabric.—**E. J. Sheehy**: Effect of the conditions of storage on the vitamin D potency and on other features of cod liver oil. Storage in transparent bottles, or in tin-lined containers, or in partly filled barrels, does not materially reduce the vitamin D potency. Exposure to light bleaches the oil, whilst exposure to air deepens the colour and increases the rate of production of free fatty acid.—**William Hughes**: A study of *Phoma Lingham* (Tode) Tesm., and of the 'dry rot' it causes, particularly in swede turnips. A number of fungi occur on diseased plants which are considered forms of *Phoma Lingham*, but the one which is exclusively associated with typical dry rot of the roots in Ireland, and is predominant on other organs, is identical with the American cabbage black-leg organism and with Cunningham's Strain II.A from New Zealand. On plants other than swede and turnip, Strain II.B predominated. Strain II.A was the only one which consistently produced dry rot of swedes in the field and laboratory. Strains I.B and II.B (with one exception) failed to do so in the field, while producing a rot in the laboratory. Dry rot may originate from three sources, namely, (1) the seed, (2) from diseased roots of a previous crop which survive in the soil, (3) from similiar roots present in the farmyard manure.

Extensive field experiments, extending over a period of three years, show that infection present in the seed is not capable of producing outbreaks of dry rot so serious as those originating from contamination in soil or manure.

PARIS

Academy of Sciences, July 4 (vol. 195, pp. 1-84).—The president announced the death of Paul Vuillemin, *correspondant* for the Section of Botany, and of Bernhard Bang, *correspondant* for the Section of Rural Economy.—Henri Lecomte: Notice on Jean Paul Vuillemin.—Charles Richet: Organic memory (elementary memory, anaphylaxy, etc.).—Charles Achard, Augustin Boutaric, and Fernand Morizot: A method of studying sera according to their sensitising action in the flocculation of ferric hydroxide.—C. de la Vallée Poussin: The properties of harmonic functions in an open domain limited by surfaces with restricted curvature.—Paul Pascal and André Dupire: Contribution to the study of the esters of arsenious acid. The method adopted for removal of the water formed during the reaction between the alcohol and arsenious anhydride was the addition of benzene or toluene; the vapours after condensation were freed from water by anhydrous copper sulphate and the dry hydrocarbon returned to the reaction flask. Sixteen arsenites were thus prepared, of which the physical properties are given.—P. Vincensini: Certain families of surfaces.—Georges Darmois: The deformation of space in the theory of relativity.—Georges Calugaréano: The exceptional values (as defined by Picard and by Nevanlinna) of meromorph functions.—D. Wolkowitsch: The problem of a solid movable about a fixed point.—Salmon-Legagneur and Bertrand-Lepaute: The synchronisation of circular balance wheels of chronometers. A method for synchronising escapements with circular balance wheels by alternating current from the mains.—Jacques Valensi: The utilisation of ventilating fans with adjustable vanes for regulating the air velocity in an Eiffel blower.—Henri Mineur: The residual velocities of the stars and the problem of the temperature of the Milky Way.—Jacques Winter: Remarks on the integral equation of Bloch (electronic theory of metals).—R. Anthouard: The characters of the supply currents of a discharge in air under low pressure.—V. Posejpal: A general formula for absorption.—R. Freymann: The effect of dilution and of temperature on the infra-red absorption bands. Molecular associations. It has been previously shown that when an alcohol is diluted with a solvent the intensity of the band due to the OH group increases, passes through a maximum, then decreases. It is now found that this is not due to electrolytic dissociation, and the hypothesis of molecular association is discussed.—Servigne: The carrying down of polonium by crystalline oxalates in nitric acid solution. The oxalates of lanthanum, scandium, calcium, and strontium have been examined from this point of view. The results of the experiments are in favour of the view that polonium is trivalent in its oxalate.—Berthon: The displacement of some chemical equilibria based on the selective adsorption of the hydroxides by silica gel.—Jean Cournot and Jean Challansonnet: The primary graphitisation of cast irons containing molybdenum. It is possible to add up to 2 per cent of molybdenum to grey cast iron without the formation of free carbides. The castings remain grey in spite of rapid cooling after pouring.—Ernest Kahane: The estimation of arsenic in organic materials after destruction with perchloric acid. Full details are given of the method, which is based on the use of a mixture of nitric, sulphuric, and perchloric acids.—L. Debucquet and L. Velluz: Organic compounds with the sulphides of tellurium, arsenic, and tin. The compounds described are of the type $TeS_2 . C_4H_{10}N_2 . H_2S$.—André Duparque: The petrographic characters of coking coals.—J. P. Arend: The original mixture of oolithic Lorraine-Luxemburg minerals.—Raymond Furon: The schisto-calcareous series of the Sudan: its base conglomerate and its stratigraphical position with respect to earlier series.—N. Arabu: The existence of phenomena of overlapping in the gneiss zone of Sainte-Marie-aux-Mines (Alsace).—Louis Dangeard and Pierre Bout: Observations on the constitution of the Perrier mountain, near Issoire (Puy-de-Dôme).—L. Clariond: The Stephanian of Ida ou Zal (western Morocco).—Edouard Roch: The interpretation of the stratigraphical series of the region of Entifa and Beni Ayatt (central Morocco) and a hypothesis concerning other Moroccan regions.—Louis Dubertret: The structural forms of Syria and Palestine; their origin.—Edouard Salles: The value of the electrical field of the atmosphere at high altitudes. Reasons are given for supposing that the figures of Andrée (of the order of 12 volts) are much too low.—R. Bureau: The rôle of the phenomena of propagation in records of atmospherics.—A. Piccard, E. Stahel, and P. Kipfer: The intensity of the cosmic radiation at 16,000 metres altitude. At this height there is a large increase in the cosmic radiation as measured by an ionisation chamber and by the Geiger-Müller counter.—Ph. Joyet-Lavergne: Some characters of cytoplasmic sexualisation in Algæ and Fungi.—Fr. Rutishauser: The chemical composition of *Vinca minor*.—Louis Gallien: The evolution of the generation descended from the neotenic forms of *Polystomum integerrimum*.—A. Dehorne: The morphological value of the blood corpuscles of *Magelona papillicornis*.—René Wurmser and Mlle. Nelicia Mayer: The equilibrium between lactic and pyruvic acids.

COPENHAGEN

Royal Danish Academy of Science and Letters, Feb. 6.—Ojvind Winge: A new species, *Brassica napocampestris*, originated through species crossing and chromosome doubling. On crossing *Brassica napus*, with 18 chromosomes, and *B. campestris*, with 10 chromosomes (haploid), Mr. H. N. Frandsen, Taastrup, Denmark, succeeded in getting a new constant species with 28 chromosomes haploid. The new type owes its origin to a somatic doubling in the F_1 zygote, in accordance with the hypothesis of 'indirect chromosome binding' (Winge, 1917).

March 4.—Oluf Thomsen: Experimental investigations on the transmissible leucosis in fowls.—C. Wesenburg-Lund: Danish freshwater cercariæ, parasitic on the blood. Danish forms have not been examined in detail for some time. Recent research has shown that there are at least forty species. Several are true plankton organisms. Furthermore, the family Schistosomatidæ is represented by the parasite responsible for bilharziasis. During the past year, research in North America, England, France, Germany, and Poland has disclosed species causing serious disease amongst aquatic birds and various skin diseases amongst bathers. Presumably the same organisms are responsible for these diseases in Denmark. Such diseases were previously explained entirely differently.

April 29.—Niels Bohr: The properties of the neutron. The remarkably small interaction between neutrons and electrons is a simple consequence of quantum mechanics.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 289-342, April 15).—Edward W. Berry: The Miocene flora of

Idaho. Forty genera have been recognised, of which eighteen no longer exist in the north-western United States. Maples, oaks, beeches, and similar trees form the largest genera, giving evidence of well-distributed rainfall and mild conditions, which were presumably altered by post-Tertiary uplift of mountain ranges.—**Linus Pauling**: Interatomic distances in covalent molecules and resonance between two or more Lewis electronic structures.—**Matilda Moldenhauer Brooks**: The penetration of 1-naphthol-2-sulphonate indophenol, *o*-chloro phenol indophenol and *o*-cresol indophenol into species of *Valonia* from the South Seas. As with other species of *Valonia*, the first dye does not penetrate, and the other two enter in a colourless (reduced) form.—**James S. Potter** and **Maurice N. Richter**: Studies on mouse leukemia. (6) The predominating cell type in line 1. The chromosome number is forty, which is normal for somatic cells of the mouse, and none of the cytological methods used was able to differentiate these cells from similar cells in normal mouse tissue.—**R. J. Seeger**: A critique of recent quantum theories (2). A mathematical discussion directed towards the view that an incomplete interpretation of laws of physics would be preferable to the present principle of indeterminacy.—**Otto Beeck**: The ionisation of argon and neon by neutral argon beams. Argon ions formed by electron impact are accelerated and pass through argon gas, where they encounter atoms of argon and are neutralised; the neutral beam passes into an ionisation chamber containing argon or neon. In both cases, at 50-120 volts equivalent velocity of the neutral argon atoms, the intensity of ionisation produced is practically constant. The results indicate that ionisation by neutral beams is very efficient, and suggest that the neutral atom may play the rôle assigned to the positive ion in discharge through gases.—**F. Zwicky**: Ionisation in gases by ions and atoms. A theoretical discussion on which the experimental work of the preceding paper was based.—**William Duane**: (1) The mass of the electron. Using (*a*) Bragg's formula for reflection of X-rays by calcite, (*b*) Bohr's formula for the Rydberg constant, and (*c*) Einstein's quantum equation and the results of earlier X-ray reflection experiments, the rest mass (m_0) is found to be $9{\cdot}054 \times 10^{28}$; hence $e = 4{\cdot}773 \times 10^{-10}$ e.s.u. and $h = 6{\cdot}557 \times 10^{-27}$.—(2) An instrument for the photometering of the new X-ray lines. The negative of the spectrum is illuminated and a horizontal image of the lines to be examined is projected on to a horizontal slit before a photoelectric cell, through which there is a complete circuit including cell, battery, and galvanometer enclosed within metal boxes. The galvanometer deflexion is observed by a beam of light going to a horizontal slit behind which is a photographic plate. This plate and the photoelectric cell and slit are joined mechanically and move vertically. Thus a curve is traced out the points of which correspond directly to points on the negative of the spectrum under examination.—**Frederick G. Keyes** and **Samuel C. Collins**: The pressure variation of the heat function as a direct measure of the Van der Waals forces. A theoretical discussion and experimental observations. The gas is allowed to escape under a measured pressure through a platinum capillary to a lower pressure, while the capillary is heated electrically to maintain the system at a constant temperature. Experimental values for carbon dioxide and ammonia are in agreement with calculated values. The method is particularly suitable for low pressure and low temperature work.—**Eberhard Hopf**: Proof of Gibbs' hypothesis on the tendency toward statistical equilibrium.—**Hassler Whitney**: Regular families of curves (2).

Forthcoming Events

Congress

AUG. 28–SEPT. 3

INTERNATIONAL PHYSIOLOGICAL CONGRESS (Fourteenth Congress). To be held at Rome.

Official Publications Received

BRITISH

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 3: On the Determination of Hamilton's Principal Function. By Prof. A. W. Conway and Prof. A. J. M'Connell. Pp. 17-25. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Joint Board of Research for Mental Diseases: City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1932. Pp. 10. (Birmingham.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by Prof. H. Munro Fox. Vol. 7, No. 3, July. Pp. 181-273. (Cambridge: At the University Press.) 12*s*. 6*d*. net.

Birmingham Bureau of Research on Russian Economic Conditions. Memorandum No. 6: Wages of Industrial Workers in the U.S.S.R. Pp. 24. (Birmingham.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 25: Termites (White Ants) in South-eastern Australia; a Simple Method of Identification and a Discussion of their Damage in Timber and Forest Trees. By Gerald F. Hill. Pp. 28. (Melbourne: H. J. Green.)

Forestry Commission. Twelfth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1931. Pp. 43. (London: H.M. Stationery Office.) 9*d*. net.

Proceedings of the Royal Society. Series A, Vol. 137, No. A831, July 1. Pp. iii+242. (London: Harrison and Sons, Ltd.) 12*s*.

Journal of the British Wood Preserving Association. Vol. 2. Pp. viii+104+xvi. (London.) 7*s*. 6*d*.

Index to the Proceedings of the Royal Society of London (1905–1930), and to the Philosophical Transactions of the Royal Society of London (1901–1930). Pp. ii+231. (London: Harrison and Sons, Ltd.) 10*s*.

Medical Research Council. Twelfth Annual Report of the Industrial Health Research Board to 30th June 1932. Pp. ii+48. (London: H.M. Stationery Office.) 1*s*. net.

FOREIGN

The Genetical Factor in Endemic Goiter. By Charles B. Davenport. (Publication No. 428.) Pp. iv+56+4 plates. (Washington, D.C.: Carnegie Institution.)

U.S. Department of the Interior: Geological Survey. Bulletin 829: Geology and Coal, Oil and Gas Resources of the New Kensington Quadrangle, Pennsylvania. By G. B. Richardson. Pp. viii+102+9 plates. Professional Paper 172: Gold Quartz Veins of the Alleghany District, California. By Henry G. Ferguson and Roger W. Gannett. Pp. vi+139+58 plates. 2 dollars. Water-Supply Paper 638-B: Water-Power Resources of the Rogue River Drainage Basin, Oregon. By Benjamin E. Jones, Warren Oakey and Harold T. Stearns. (Contributions to the Hydrology of the United States, 1931.) Pp. vi+35-97+plates 3-25. Water-Supply Paper 708: Surface Water Supply of the United States, 1930. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+191. (Washington, D.C.: Government Printing Office.)

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1931. Pp. 12+2 plates. (Zomba.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the Year 1930. By R. S. Wimpenny. Pp. iii+113. (Cairo: Government Press.)

Bulletin of the National Research Council. No. 85: Physics of the Earth, 5: Oceanography. Prepared under the auspices of the Subsidiary Committee on Oceanography. Pp. v+581. (Washington, D.C.: National Academy of Sciences.) 5 dollars.

Records of Oceanographic Work in Japan. Vol. 4, No. 1, June. Pp. ii+244. (Tokyo: National Research Council of Japan.)

Proceedings of the United States National Museum. Vol. 81, Art. 3: A New Species of Cestode, *Crepidobothrium Amphiumae*, from *Amphiuma tridactylum*. By Clarke Courson Zeliff. (No. 2926.) Pp. 3+1 plate. Vol. 81, Art. 10: A Cache of Basket Maker Baskets from New Mexico. By Walter Hough. (No. 2933.) Pp. 3+3 plates. (Washington, D.C.: Government Printing Office.)

U.S. National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. The Philippine Land Mollusks of the Genus Opisthoporus. By Paul Bartsch. Pp. 323-327+2 plates. (Washington, D.C.: Government Printing Office.)

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