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Benefactions to Universities: British and American.

ANY attempt to apply to such matters as gifts and bequests to universities the methods of scientific investigation is beset by peculiar difficulties. To begin with, no complete tabulated statistics of such benefactions are in existence. Many of them are not in the form of money, and their money value is not easily ascertainable; public announcements of gifts of houses and lands often do not indicate their value, and bequests are often subject to indeterminate charges, or in the form of residuary estates regarding which no further public announcement is made. The figures to be given in this article have, therefore, no pretensions to exactitude. Further, if we proceed to use available data, such as they are, for purposes of comparison, inference, and prediction, it is soon apparent that the flow of benefactions is as little subject to ascertainable laws and its course as difficult to predict as if it were "the gentle rain from heaven." An illustration of this difficulty is afforded by comparing the benefactions, as recorded in the "Universities Yearbook," of the years 1913–14 and 1923–24.

The high cost of living, the crushing weight of taxation, and the general exhaustion entailed by our huge war expenditure, seemed bound to affect adversely the stream of benefactions; a stream fed from that comparatively small portion of private fortunes which is left over after the more imperative claims have been met. This margin at the free disposition of the possessor has, in too many instances, been squeezed out of existence. Nevertheless, the stream shows no signs of drying up. The tale of gifts and bequests to universities and university colleges in Great Britain and Ireland during the year 1923–24 amounts to 898,000*l.*, while the corresponding total for the last pre-War year is 292,000*l.* The former total includes, it is true, gifts from the Rockefeller Foundation of America, amounting to 243,000*l.*, but, even when these are deducted, the balance, 655,000*l.*, represents an effort far greater, presumably, than was exerted ten years ago in the same way. Two large recent gifts, one of 250,000*l.* by the Right Hon. T. R. Ferens, Lord High Steward of Hull, as a nucleus of a fund for the founding of a university college for that town, and an anonymous gift of 50,000*l.* to the Royal Technical College, Glasgow, suggest that the record of 1924–25 is not likely to show a falling off.

Substantial though these figures are, they do not bear comparison with the record of transatlantic benefactions. Last December, within one week, gifts for university purposes in the United States amounting to more than 11,000,000*l.* were announced: Mr. James B. Duke, of Charlotte, in the State of North Carolina,

created a trust fund of forty million dollars for the establishment of a university in that State, and Mr. George Eastman, founder of the Eastman Kodak Company, made gifts of eight and a half million dollars to the University of Rochester, N.Y., to which he had already given many millions, four and a half millions to the Massachusetts Institute of Technology (bringing the total of his gifts to this Institute to fifteen millions), and two millions, contingent on gifts of a like total amount from others, to the Hampton Institute, the Tuskegee Institute, and other institutions for the education of negroes.

The United States Bureau of Education has recently published a bulletin, No. 20 of 1924, containing statistics of universities, colleges, and professional schools for the year 1921–22. These include the following particulars of benefactions: total of gifts and bequests reported for the year—77 million dollars, or, say, 16,000,000*l.*; number of institutions which received gifts of more than 100,000 dollars, 105; amount of such gifts, 66 million dollars. The corresponding figures for the universities and university colleges of Great Britain and Ireland are, for 1923–24: total (as already stated)—898,000*l.*; number of institutions which received gifts and bequests amounting to 20,000*l.* or more, 13; amount of such gifts and bequests, 748,000*l.* It will be seen that the total is about one-eighteenth, or, deducting Rockefeller gifts, one twenty-fourth part of the American total.

One may safely attribute this disparity in some measure, at any rate, to the effects of the War: the damage suffered by Britain being enormously greater than that suffered by the United States, whilst the annual payments on account of our war debt to America enormously diminish that freely disposable margin of wealth from which alone our benefactions can come, and swell *pari passu* the corresponding margin in the United States. It is perhaps not too fanciful to suppose that one may discern in the recent very large gifts from the Rockefeller Foundation Trustees and other American benefactors to British universities a magnanimous effort to redress the balance. An examination of statistics for 1913–14, however, indicates that even before the War, benefactions to British universities were but a small fraction, one-fourteenth of those to American.

Tribute should here be paid to the generosity of those American benefactors who have recently founded numerous valuable fellowships tenable in the United States by British graduate students. The latest and largest of these foundations, that of the Commonwealth Fund of America, will, when fully in operation, maintain some 50 British graduate students in universities in the United States.

Statistics relating to higher education in the United States are very comprehensive. The "Universities Yearbook" of the British Empire, from which the figures given above for Great Britain and Ireland are taken, includes no returns from colleges or professional schools which are not either incorporated in or schools of the universities or in receipt of Treasury grants. Mr. Simpson Gee left 20,000*l.* last year to one of these excluded colleges (Leicester), and there were no doubt other similar bequests and gifts to such institutions. Comparison with American statistics is further vitiated by the circumstance that much of the work of the colleges which send returns to the United States Bureau of Education corresponds more nearly with that of the higher forms of British public and secondary schools than with work done in our universities. A better basis of comparison is obtained by dividing the total amount of benefactions by the number of students in the institutions included in the returns. This gives: for the United States in 1910 and 1920 respectively, 70 and 165 dollars per student, and for Great Britain and Ireland in 1913–14 and 1923–24, 7*l.* and 12*l.*

A very large number of the gifts and bequests received by American universities, especially the private universities, come from their alumni, and not only are these much more numerous than the alumni of British universities (the number of university and college students in the United States, excluding those in preparatory departments, was 550,000 in 1921–22), but also a much larger proportion of them make their careers in commerce and industry. Commenting on the attachment which links every American "college man" to his Alma Mater, Prof. Caullery wrote in 1917 (in "Universities and Scientific Life in the United States"): "Its force and prevalence are one of the undeniable marks of an idealistic side in the American mentality. And of course the universities are carefully on the watch to maintain it. . . . The university becomes the centre of a vast family, so much the more powerful, the more numerous it is. . . . Gifts to universities have thus become a normal element of the civic activity of the wealthy class. . . ." So important and so normal a source of income have such gifts become that one of the principal functions of the president of a (private) university is, says Caullery, to "adroitly rouse the generosity of the alumni."

There are signs that as industry and commerce attract, as they are doing, more and more men from British universities, and among them, doubtless, more and more potential millionaires, this particular source of university income is likely to be more productive than it has been in the past. When, a few weeks ago, Lord Balfour, as Chancellor of the University of Edinburgh, addressed a meeting of the recently formed

Alumni Association, he pointed out, in the course of an eloquent appeal which ought to be broadcasted wherever university men are to be found, that the university "has a right to ask those who are not millionaires, especially those who in their day have profited from her services, now to aid in maintaining the provision for the successive generations that pass through her class-rooms" and, an American would add, her halls and stadia. On the same occasion, Sir Harold Stiles, the first president of the Association, was able to announce a gift of 1000*l.* from one of his former pupils, now resident, by the way, in the United States.

A characteristic of British as compared with American benefactions is the greater particularity with which benefactors specify the purposes to which they desire their money to be applied. Of 150 benefactions in 1923–24, 83 were for the encouragement of the study of specified subjects, 25 were for scholarships or bursaries, 9 for libraries, 9 for objects connected with corporate life such as hostels, unions, and sports grounds, and 5 for scientific or industrial research.

The whole subject of the influence of philanthropy in the history of higher education in the United States has been explored recently by Associate Prof. J. B. Sears, of the department of education in Stanford University, California, and the results of his researches were published by the Bureau of Education in Bulletin, 1922, No. 26. He directs attention to the steady increase in the benefactions for higher education during the forty years 1875–1915 from 3 million to 20 million dollars, but points out that the rate of growth of wealth of the United States was somewhat greater, and that of the *per capita* wealth far greater. Since 1915 the benefactions have increased almost fourfold. It would seem that on both sides of the Atlantic the War has led to a wider recognition of the national importance of higher education, as the great increase in the number of students indicates a wider recognition of its value to the individual. A belief in the value of education, alike to the nation and to the individual, has been general in the United States from their earliest times and may be traced to the character of the New England settlers. It is reflected strikingly in one of Prof. Sears's tables showing for the years 1893–1916 gifts and bequests classified under five heads: (1) educational institutions, (2) charities, (3) religious organisations, (4) museums, galleries, and public improvements, and (5) libraries. No less than 43 per cent. fall under the first head. A glance at the lists of bequests in "Whitaker's Almanack" shows that to the British testator educational institutions appeal much less strongly. To this difference of prevalent sentiment and estimation of values must be due in large measure the difference in magnitude between British and American benefactions to higher education.

The Greatness of Galton.

The Life, Letters and Labours of Francis Galton. By Prof. Karl Pearson. Vol. 1: Birth 1822 to Marriage 1853. Pp. xxiv+246+66 plates. Vol. 2: Researches of Middle Life. Pp. xii+425+54 plates. (Cambridge: At the University Press, 1914–1924.) Vol. 1, 30*s.* net; Vol. 2, 45*s.* net.

THESE two stately volumes, which will be followed by a third, form a worthy memorial of a great man. It has been a labour of love to Prof. Karl Pearson to write them, a piety which must have cost him much, especially in the case of the second volume when the outer eye began to fail. He has earned the deep gratitude of all students of science, for besides giving us a living portrait, he has brought together a readable account of all the more important, not too technical, contributions that Galton made to science. The value of this is inestimable, for Galton scattered his papers widely, and many are not readily accessible.

The work is a sympathetic tribute to a master and a friend, and it is a fortunate fact that such a biographer was available. No one else could have done it with anything approaching the same success. The canvas is large, but every corner is significant and painted with the same loving carefulness. That the artist shows himself as well as his subject is the touch of perfection. It is also fortunate that it has been possible to reproduce so many photographs which would otherwise soon have been lost. The volumes are two galleries, showing us not only the development of the man and his many moods, but also his ancestry, and his own photographic experiments. The drawback is the inevitable, though marvellously moderate, expensiveness of the volumes. They are so exceptional and so rich in inspiration that we venture to suggest to some benefactor that copies should be sent to the departmental libraries of the relevant laboratories in the universities and colleges of Great Britain. It would sow for a big harvest.

The first volume was published about a month before the outbreak of the War, and has not received the attention that was its due. It begins with a careful and detailed account of Galton's noteworthy ancestry in many lines—an impressive study in heredity. Who, as he reads, can help feeling the value of good stock; and even if Francis Galton and Charles Darwin stand out as the pre-eminently happy combinations, they are certainly not alone in this lineage. This is not the place for argufying, but the biographer provokes it a little by the prominence he gives to Darwin's opinion—it has a whole page to itself—"I am inclined to agree with Francis Galton in believing that education and environment produce only a small effect on the mind of any one, and that most of our qualities are innate."

We must confess that this does not strike us as wise. No doubt, the fundamentally important thing is good seed, and neither soil nor sunshine can change bad seed into good. Yet they count for much, and Darwin was speaking of the individual. Galton was a happy blend of many very fine ancestral traits, but a good stock with fine hereditary "nature" usually secures for its progeny a generous "nurture"; and the outcome is a product of the two. We believe that psychical qualities are inherited like and along with the physical, but we do not feel at all convinced that what we call "the mind" develops altogether as "the body" does. The biographer admits that there was a period when Galton's fate seemed to hang in the balance. He might have subsided into a country gentleman, famous for his geniality and shrewdness, introducing ingenious devices in agriculture, probably a member for the county, possibly a M.F.H. We cannot produce any statistics, but experience suggests that the nurture of the innate qualities tipped the balance in the favour of science.

The story of Galton's school years makes one ashamed. Certainly this part of his nurture counted for little. "Anxious and willing to learn, he was given stones instead of the bread that he hungered for, and thus his chief school years were years of stagnation." Then came some stimulating holiday travel, a little medical education when he was 16 and 17 years of age, a journey down the Danube to Smyrna, and three years of mathematical education at Cambridge, which did not suit him particularly well and ended in over-strain and breakdown. So ended his apprenticeship, not too brilliantly. Of the "journeyman" years, 1844–1849, there is very little record, but there must have been much ferment and change. He deserted medicine and drifted from orthodoxy towards agnosticism; he visited Egypt and Syria; a chance meeting with a distinguished French exile, Arnaud Bey, had important consequences in suggesting scientific motives for Galton's future wanderings. But the shaping influences of this period are vague and the case for nurture is weak. Somehow, we know not how, Francis Galton grew into a purposeful man with re-awakened scientific interests. In 1853, at the age of thirty-one, he married Miss Louisa Butler, daughter of the Dean of Peterborough, and this calmly happy union lasted for forty-three years.

The second volume takes up the tale when Francis Galton was thirty-two, married, leisured, disciplined, much-travelled. "His experience had been such that he knew more of mathematics and physics than nine biologists out of ten, more of biology than nineteen mathematicians out of twenty, and more of pathology and physiology than forty-nine out of fifty of the biologists and mathematicians of his day." There was always catholicity in his scientific interests, but his central enthusiasm was still for geography. This was the period of his "Art of Travel" (1855), with its wealth of practical ingenuity and penetrating insight, his attempts to lessen some of the gratuitous tragedies of the Crimean War, his secretaryship of the Royal Geographical Society, his invention of the hand heliostat and how many other devices, and his climatic and meteorological studies (including the suggestion of weather-charts and the discovery of "anticyclones"). Busy as he was, he found time to start (with Spencer and Norman Lockyer) a short-lived weekly journal called the *Reader*, which indirectly led to NATURE. "Pereat Lector, Natura resurgat."

During this period also Galton showed his open-mindedness by taking some interest in spiritualistic claims. His biographer speaks forcibly of those who do not doubt that the methods used for solving the problems of the phenomenal universe are adequate as instruments of research in "the unknown vast of the hyper-phenomenal."

"Such a man of science, possibly owing to a lack of epistemological study, forgets that his senses have been developed to grasp physical phenomena, that his concepts are deductions from his sensuous perceptions, and that neither his sensuous nor mental outfits are adapted for sensating, perceiving and conceptualising the hyper-phenomenal. Some men grasp this truth by the logic of reasoning, others by the logic of experience, others by a healthy instinctive appreciation, and some never grasp it at all. To the first group we may, perhaps, say Huxley belonged, to the second Galton, to the third Darwin, and to the fourth Crookes and Alfred Russel Wallace."

The centre of gravity of Galton's interests gradually shifted from man's environment to man himself. "About the time of the appearance of Darwin's 'Origin of Species' I had begun to interest myself in the Human side of Geography." We find him keenly interested in the domestication of animals, propounding the view that wild animals were tamed as pets or even kept for religious purposes before they were domesticated for food or transport. He was pondering over man's early gregariousness and he was thoroughly gripped by Darwinism. He laid the foundation-stone of his future anthropological work—the equal inheritance of psychical and physical characters—and he was profoundly moved by the ideal of the improvement of the human breed. His anticipations were remarkable; witness his grasp of the idea of the continuity of the germ-plasm, his rejection of the theory of the transmissibility of acquired characters, his emphasis on the survival value of affection, for animals as for man, his Law of Ancestral Heredity, and his investigation of heredity in twins. The biography gives us a very impressive picture, its Holbein detail contributing to reveal Galton's many-sidedness.

"Galton the Cambridge mathematician, Galton the ox-rider, Galton of the wave-machine, and Galton the eugenist, seem at first sight so widely incongruous and yet, rightly estimated, are necessary features of that all-round individuality—observant, constructive, calculating, and enthusiastic—of Galton the anthropologist, using that term in its widest sense, who by originality of method, wide experience of men and ripe judgment of affairs, influenced the development of many younger men in the last quarter of the nineteenth century."

The next period was largely occupied with the study of heredity, and the biography gives us the gist of Galton's correspondence with Alphonse de Candolle. The Swiss botanist was interested in the history of men of science and was inclined to ascribe to environmental influence a larger rôle than Galton had allowed for in his "Hereditary Genius." After a certain amount of friction, the two men, who were emphasising complementary factors, became good friends and mutually inspired each other's work. The correspondence led to Galton's "English Men of Science; their Nature and Nurture" (1874). This was the period of Galton's prolonged experiments on the transfusion of blood, his criticism of Darwin's provisional hypothesis of pangenesis, and his further recession from the Lamarckian belief in the transmission of somatic modifications. There have been many great letters in NATURE, but there never was a finer than Galton's of May 4, 1871, a fresh revelation of the bigness of the man. We are glad to see prominence given to Galton's very important Royal Society paper of 1872 on "Blood-relationship," which has not been adequately appreciated; but we think there should have been more recognition of Weismann's later, but independent, work (1885) which struck the elusive mark of biologists' attention, missed, we think, by Galton.

There is inspiration for us all in the masterly chapter on Galton's psychological investigations, and he must be rather easy-going, we think, who can read it without reproaching himself for not having made more of Galton's suggestiveness and "generosity of ideas." Galton was one of the first, if not absolutely the first, to insist that anthropometry cannot make real progress without psychometric observation and experiment, and Prof. Pearson definitely claims for him a pioneer position in experimental psychology in Great Britain. The chapter deals with Galton's psychometric instruments, observations, and experiments, and with the conclusions reached in the "Inquiries into Human Faculty and its Development" (1883).

The possibility of some sort of communion with an indwelling divine Spirit was to Galton an almost life-long subject of thought.

"There is no subject more worthy of reverent but thorough investigation than the objective evidence for or against the existence of inspiration from an unseen world, and none that up to the present time has so tantalised the anxious and honest inquirer with unperformed promise of solution."

We do not ourselves understand how an individual can hope to find nowadays any objective evidence of an unseen world which seems to some to be spiritually discernible, but Galton struck the religious note when he spoke of the possibility of "inspiration from an unseen world." His own tendril towards the absolute was a kind of pantheism; he asks whether "our part in the universe may possibly in some distant way be analogous to that of cells in an organised body, and our personalities may be the transient but essential elements of an immortal and cosmic mind." Apparently finding little satisfaction in this, Galton concentrated on an ethical evolutionism. In Prof. Pearson's words, Galton's position was:

"If the purpose of the Deity be manifested in the development of the universe, then the aim of man should be, with such limited powers as he may at present possess, to facilitate the divine purpose. Darwin for the first time gave a real history to living forms, and Galton following him said: Study that history, study the Bible of Life, and you will find your religion in it, and a new and higher morality as well. Thereby he raised Darwinism on to a higher, a spiritual plane."

This is well said, but when we contrast it with, for example, the phrase "inspiration from an unseen world," we see that the religious note, unless we are to rewrite history and redefine the term, has almost ceased to sound. "A new religion based on scientific knowledge"! It seems to us a contradiction in terms, for religious activity has always meant some kind of appeal—practical, emotional, or intellectual—that man, at the end of his tethers, has made to an order of reality beyond sense and science, "hyper-phenomenal," as Prof. Pearson would say. We have said that the religious note had almost ceased to sound in Galton's ethical evolutionism, but there was just a faint resonance inasmuch as he believed that man's application of the doctrine of evolution to the betterment of the human race meant bringing himself into line with the purpose of the universe.

In the closing chapter, which follows an account of Galton's photographic researches, there is an account of his many-sided statistical work. Here we find, to select one point only, a very interesting interchange of letters with Florence Nightingale, who was not only the "Lady of the Lamp," but also the "Passionate Statistician." She was full of the idea of a professorship of "Applied Statistics" and wrote to Galton on the subject. Here we may well quote Prof. Pearson again:

"For Galton and for Florence Nightingale the end and the means were the same: men must study the obscure purpose of an unknown power—the tendency behind the universe; and the manner of our study must be statistical. Therein, according to Francis Galton, lay the way to that unsolved riddle of 'the infinite ocean of being'; therein, according to Florence Nightingale, lay the cipher by which we may read 'the thoughts of God.' Men of the twentieth century may fail to appreciate the doctrine of either great Victorian, but of one thing they may be sure, the belief in both of them amounted to a religion. What was a religion to both became at once in both a motive for action."

It would indeed be a fine thing if Galton's purpose in founding a school of eugenics were continued in the establishment of a Nightingale chair of applied statistics. It is a pity that millionaires have so little imagination.

There are many impressions left after reading this biography—the versatility of the man, his generosity of ideas, his originality in blazing trails, his clearness of vision, his intensity of mental process, his magnanimity and kindliness, and his sense of citizenship. We cannot end better than by endorsing the biographer's own words:

"Of one thing we are certain, that the reader, who will follow patiently our hero through the great and the little, the apparently trivial and the apparently vital incidents of this story, cannot fail to fall in love with a nature which met life so joyously, and from childhood to extreme old age was resolved to see life at its best and be responsive to its many-sided experiences."

Colloid Chemistry.

(1) *Les colloïdes*. Par J. Duclaux. (Actualités scientifiques.) Ouvrage couronné par l'Académie des Sciences. Troisième édition, entièrement revue et augmentée. Pp. viii+290. (Paris: Gauthier-Villars et Cie, 1924.) 15 francs.

(2) *The Elements of Colloidal Chemistry*. By Prof. Herbert Freundlich. Translated by Prof. George Barger. Pp. vii+210. (London: Methuen and Co., Ltd., 1925.) 7*s*. 6*d*. net.

(3) *Colloid Chemistry: an Introduction, with some Practical Applications*. By Jerome Alexander. Second edition, revised and enlarged. Pp. viii+208. (London: Chapman and Hall, Ltd., 1925.) 9*s*. 6*d*. net.

THE reviewer confronted with three works on the same subject, written by authors belonging to three different nationalities, is almost irresistibly tempted to enlarge on national character in scientific writing. To escape this temptation he has adopted the prudent course of leaving it to the reader to decide what part racial and what part individual characteristics bear in determining the difference in treatment.

(1) The author is one of the earliest and most determined representatives of the purely chemical school, and his work is an admirably lucid and elegant attempt to present the properties of colloids from this point of view. His type substance is colloidal ferric hydroxide sol, the particles of which are complexes of n molecules of ferric hydroxide to one of ferric chloride, which is ionised and causes the positive charge. n may vary from about 25 to 800, though with $n>400$ the sol becomes unstable. A similar "condensed" composition is postulated for other colloids, though the ionising group may be absent in those which are electrically neutral. Where this view encounters obvious difficulties, as in the sols of the noble metals, the author falls back on the impurities which are essential constituents of stable sols. He complains that many colloid chemists appear to have no use for the balance and the burette, and it is therefore curious that the work of Pauli, to whom this (not quite unjust) reproach certainly does not apply, receives no mention. More especially his work on silver sols is of fundamental importance; incidentally his careful investigations of ferric hydroxide sol lead to conclusions which differ from those of the author.

Adsorption receives critical treatment in the second half of the work; the author justly points out how much of the theoretical work has been done with so extremely ill-defined a body as charcoal, and on the whole concludes that the importance of adsorption in colloidal phenomena has been overrated. A reference to Freundlich's great "Kapillarchemie" leads up to the delightful statement, italicised in the original: "il n'y a pas de chimie capillaire distincte de la chimie ordinaire."

The author's very original views on gel structure and on hydration unfortunately do not lend themselves to a short summary, but deserve careful study.

(2) Freundlich's "Elements" follows the general plan of the larger work mentioned above. After an introductory chapter, the phenomena at the various types of interfaces are described, and only then are colloid systems discussed in some detail. Both the electric charge on particles and electrolyte coagulation are ultimately traced back to adsorption. Even the less familiar disperse systems, like foams, smokes and solid dispersions, are not omitted, and, without devoting excessive space or special chapters to "applications," the author manages to give many striking instances to show how the study of colloids is providing explanations of natural phenomena.

Prof. Barger's translation is a faithful and—apart, perhaps, from a few hyphenated adjectives—idiomatic rendering of the original. In a note, which must command the sympathy of everybody who has had to write about the subject, he suggests that "a determined

attempt" should be made to find equivalents for the German verb "quellen" and the noun and adjective derived from it. The usual rendering "swelling" is certainly unsatisfactory, and the lack of an adjective and noun—though not by any means confined to this verb—leads to painful circumscriptions. It is to be hoped that purists will not be too violently upset by Prof. Barger's suggested terms: turgesce, turgescible, and turgescence.

The serious student of colloids cannot do better than to study Duclaux's and Freundlich's books together. If he finally arrives at the conclusion that his attitude for the present must be that defined by the venerable motto, "Nullius in verba," he will have no reason to regret the time spent on them.

(3) The plan of this book differs radically from that of either of the works just discussed. Nearly three-quarters of the total space is devoted to "applications" covering pretty nearly the entire range of human activities, and falling under the three heads with which the reader of the literature of colloids must be becoming familiar: problems which have been elucidated, problems which may some day be solved, and a large mass of material which is restated in a new terminology. This is not to say that these chapters do not contain many interesting things, but it is unreasonable to expect any sense of proportion in approaching them from a reader who has been provided with merely 54 pages of theory. The first section of this inadequate part, curiously entitled "Material Units," wastes space on brief excursions into relativity, isotopes, the size of the electron, and other topics the bearing of which on the subject is difficult to discover. Equally difficult is it to find any plan in the chapter on the general properties, which begins surprisingly with protection, and ends with half a page on viscosity. The whole book gives the impression of having been written with the intention of assisting in the very active propaganda for colloid chemistry which has for some time been carried on in the United States.

One feature, which could have been noticed in about a dozen books in recent years, may conveniently be mentioned here. In his first publication on the subject, Zsigmondy gave a plate showing various microscopic objects, and gave the magnification as "1 : 10,000." This singular way of describing a *magnification* has been copied religiously with the plate by a number of authors; in the book under review the figure has, in addition, been reduced to about two-thirds of the original size. These things are probably not sufficient (as Macaulay wrote on a similar occasion) "to make one despair of the human species," but they do throw a curious light on the way in which books are made.

E. H.

Water Plants.

Biologische und morphologische Untersuchungen über Wasser- und Sumpfgewächse. Von Prof. Dr. Hugo Glück. Vierter Teil: Untergetauchte und Schwimmblattflora. Pp. viii + 746 + 8 Tafeln. (Jena: Gustav Fischer, 1924.) 45 gold marks.

THE extreme variability which water plants show under varying environmental conditions is well known. Almost equally well known are Dr. Glück's monumental studies on these plants, of which a further contribution is now available. This fourth volume of the series deals chiefly with the submerged and floating leaved floras of Europe and the Mediterranean regions, but it also contains a supplement to the third volume, which dealt with marsh plants. While reference is made to all the more important genera of water plants, the larger genera like Ranunculus, Potamogeton, and the water lilies naturally receive most attention.

Dr. Glück's method is to describe quantitatively, so far as is possible, the form variations observed either in Nature or under cultural conditions. He recognises these variations as being either of genetic origin or else as due to environmental conditions. Like its predecessors, this volume is noteworthy for the mass of new material recorded. The treatment of variation in Nuphar and Nymphæa is exceedingly well done, including as it does descriptions of the variability of the pollen grains and carpels. In dealing with other genera, the author points out that the summer leaf forms of many species are often strikingly different from those produced during winter. For example, the form of *Potamogeton crispus* known as *P. serratulus* Schr. (=*P. serratus* Huds.), with relatively narrower leaves, serrated margins, and longer internodes, has been grown in culture as the winter form of type plants. The forms found in running water often differ in a similar way from those of standing water. The internodes and leaves are relatively longer in running water, according to Dr. Glück, a good example being provided in *P. perfoliatus* var. *lanceolatus* Blytt.

It may be urged that the rôle of light intensity or of duration of exposure to light has been somewhat neglected by Dr. Glück. Many of the types described as winter forms or running water forms (as in the examples quoted) may occur in summer or in standing water if the water is sufficiently deep. Some of these forms have been produced recently by culture in light of low intensity. It is probable that this factor, which would operate in water, in running water or in deep standing water, is the common feature which produces longer internodes and smaller and narrower leaves under these natural conditions. The changes are those which, in more extreme form, are produced in etiolation.

For comparative purposes, therefore, the value of the numerous tables given in this book would have been greatly enhanced if data as to the depth of the water (and hence indirectly the light intensity), in which the various forms occurred, had been always included. This single criticism need not, however, prevent us from congratulating Dr. Glück on an exceedingly valuable contribution to the study of form variation and to aquatic biology.

Our Bookshelf.

Wettervorhersage: die Fortschritte der synoptischen Meteorologie. Von Prof. Dr. Walter Georgii. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, Band 11.) Pp. viii+114. (Dresden und Leipzig: Theodor Steinkopff, 1924.) 4·50 gold marks.

THE title chosen by Dr. Georgii for this work—"The Progress of Synoptic Meteorology"—is perhaps rather ambitious for a work which runs to no more than 111 pages. It is largely an account of the meteorological theories of V. and J. Bjerknes and of F. M. Exner, one might almost say of the Norwegian and Austrian schools of meteorology, but it contains also short accounts of certain lines of research not especially associated with these schools.

After the first introductory chapter, which describes the construction of synoptic weather charts, there follows a summary of the views of V. and J. Bjerknes on the origin and structure of the cyclones of temperate latitudes, together with a short account of Exner's theory of cyclonic formation as a result of the obstruction of the circumpolar easterly winds by mountain ranges. The third chapter deals with the travel of pressure and wind systems and of the weather associated with them; in other words, with the phenomena upon which the practice of synoptic forecasting rests. This discussion is in terms of the two schools of thought to which reference has already been made; the moving streams of air are regarded as more fundamental than the pressure-systems with which they are associated, a conclusion which had been reached many years ago by Sir Napier Shaw in Great Britain as a result of his investigation into the life-history of surface air currents. The account of Ficker's idea of "high" and "low" cyclones and anticyclones towards the end of this third chapter is a timely reminder that no theory of cyclones and anticyclones is complete which relies on temperature differences in the troposphere for explaining the differences of pressure between these systems, for it is well known that at a height of about ten kilometres, *i.e.* near the top of the troposphere, variations of pressure occur at least as large as those observed on the ground, and these are potent factors in the determination of the pressure at the level of the ground. It is natural, however, that in dealing with progress in synoptic weather forecasting, greater stress should be laid on the phenomena of the lower layers, about which we have abundant information.

Meteorologists will no doubt be grateful to Dr. Georgii for condensing into so small a space material scattered in numerous separate papers in several languages, and where abbreviation has been perhaps excessive, references are always given, which enable the reader to consult those papers for fuller information.

The Synthesis of Nitrogen Ring Compounds containing a Single Hetero-Atom [*Nitrogen*]. By Cecil Hollins. Pp. 423. (London: Ernest Benn, Ltd., 1924.) 55*s.* net.

IT would be interesting to know how much time is annually expended in chemical laboratories in the preparation of carbon compounds, already recorded in the literature, but which their would-be discoverers believe to be new substances. The considerable waste of energy involved will, however, appear small if compared with that resulting from the choice of the less suitable methods of attack of a defined problem in organic synthesis. It cannot be said that existing safeguards, Beilstein, Richter, Stelzner, Meyer-Jacobsen, and the general indexes, are sufficient to protect us from these dangers.

Elb's "Kohlenstoffverbindungen" (1889) was an early attempt to meet this need, but the basis of the work was so broad that the execution of the plan seems a prodigious task at the present time, and only possible to a Mellor of organic chemical literature. Mr. Hollins has chosen a section of the heterocyclic compounds, cyclic substances with one ring nitrogen member, and has produced a compilation of very considerable utility, especially to those whose investigations touch the chemistry of the derivatives of pyrrole and pyridine. The arrangement of the material is excellent, and the information which the book can give is very readily accessible. The claim that the treatment is exhaustive is on the whole justified, but there are nevertheless omissions, for example, the list of *o*-nitrobenzaldehydes which have been converted into indigotins is incomplete. There are also inaccuracies such as the formula for dehydracetic acid given on pp. 188, 212, but neither the gaps nor the mistakes are so numerous as to detract seriously from the value of the book. The analogies which the author perceives as existing between certain synthetical methods are often suggestive, but the theoretical aspect is here of subsidiary interest and, though some of the views expressed can be vigorously contested, it is not an important criticism that the work is scarcely adequate as a treatise on reaction mechanism. Not only the author but also the publishers are to be congratulated on an enterprise unusual in English organic chemical literature.

R. ROBINSON.

League of Nations: Committee on Intellectual Co-operation. Index Bibliographicus: International Catalogue of Sources of Current Bibliographical Information (Periodicals and Institutions). Arranged and edited by Marcel Godet. Pp. xvi+233. (London: Constable and Co., Ltd., 1925.) 4*s.* net.

THE work before us is an International Directory of current periodical publications and card-indexing institutions which profess to keep their clients abreast of current progress in their respective branches by means of abstracts of papers, book reviews, or book lists. The work has been clearly conceived, and the material collected is well arranged, edited, and printed. Entries are numbered and classified by the Dewey

system, then rearranged by country of origin, and finally indexed alphabetically by titles.

A weak point in the past in all international ventures has been the inadequate central control. Here M. Godet deserves our commiseration rather than our censure. In his preface he shows that he has striven to infuse into his contributors his spirit of enthusiasm for international service. Nevertheless, he has failed—notably, we regret to say, in the case of the British contingent. Omissions we expected to find, but not omissions of the principal national sources of reference. Indeed, in many broad highways of literature, *e.g.* history, theology, education, law, geology, etc., we have failed to find a single British publication recorded. The following list of omissions will be sufficient to justify our criticism: as will be seen, it includes a few foreign entries. Bodleian Quarterly Record, Bulletin of the John Rylands Library, Special Libraries, *New Statesman* (Digest of Parliamentary Papers), *English Historical Review, Geographical Review, International Journal of Psycho-Analysis, Eugenics Review, Lancet, Hermes,* Architectural Association's Journal (Analytical Digest), Geological Society's Geological Literature, Royal Horticultural Society (Analytical Digest), Jahrbuch der Radioaktivität, *Science Progress, The Analyst, Zeitschrift für analytische Chemie, Zeitschrift für anorganische Chemie,* and the Zoological Society's Record. The list could be extended if space allowed. An exception to our remarks, however, should be made in the case of the British contributor to the Useful Arts. This section is fairly well covered.

North Star Navigation. By L. M. Berkeley. Pp. 86. (New York: The White Book and Supply Co., 1924.) 3·75 dollars.

IT may be taken as an axiom in practical navigation that, so far at least as the northern hemisphere is concerned, no pair of observations can be depended upon to furnish with greater readiness and simplicity the true position of a ship than an altitude of Polaris—the Pole-star—in combination with that of some other star, observed about the same time on a reasonably large azimuth, and preferably in the neighbourhood of the prime vertical.

This is the problem dealt with in Mr. Berkeley's volume upon somewhat novel lines. The general practice is to reduce the altitude of Polaris to meridian by one or other of the numerous tables supplied for that purpose in the almanacs and collections of nautical tables, thus obtaining the latitude at once by simple inspection; while the zenith distance of the second star, that is, the complement of the altitude, forms the third side of a triangle in which the polar distance of the star, and the co-latitude, obtained as above, represent the other two sides. From these three sides the hour angle of the star can be calculated by the ordinary formulæ of spherical trigonometry, whence ship mean time and longitude easily follow.

The author of "North Star Navigation" employs methods of his own which, as compared with the procedure described above, can scarcely be said to gain anything in brevity or simplicity. Moreover, several special tables are required in the process proposed, two of which would appear to need recalculation year by year. The mathematical basis of the methods, however, is stated in the volume in minute detail, and will perhaps arouse interest amongst astronomers and mathematicians, but it is scarcely likely that any great number of practical navigators will be tempted to exchange their old lamps for the new ones here set before them.

Fundamentals of Bio-chemistry in relation to Human Physiology. By T. R. Parsons. Second edition. Pp. xii+295. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1924.) 10*s.* 6*d.* net.

THE appearance of a second edition of this little work eighteen months after the first is itself a good recommendation, and this favourable impression is confirmed on closer acquaintance. It fills a definite gap in biochemical literature as a short, readable, and up-to-date account of the theoretical aspect of the subject as distinct from the practical. The chief additions made to this edition are a short account of the preparation and properties of insulin and a section on Werner's views of the constitution of urea. No criticism can be levelled at the subject matter or its presentation, which is admirable as a short introduction to the subject of biochemistry. Apart from a few typographical errors, there are one or two other lapses to be noted: thus the phrase "the excitation passes from muscle to nerve" is not particularly happy, whilst insulin is *not* administered "in the form of repeated *intravenous* injections" (the italics are ours), nor is the method of standardising insulin mentioned likely to prove satisfactory. These faults detract but little from the general high level of the book. The subject matter includes chapters on the chemistry, digestion, and metabolism of the foodstuffs, on physical chemistry, including the activity of enzymes, and on the respiratory gases.

Mélanges de mathématiques et de physique. Par Émile Picard. Pp. v+366. (Paris: Gauthier-Villars et Cie, 1924.) 25 francs.

THIS is a very miscellaneous volume. There are some obituary notices and discourses on anniversaries; an essay or two from reviews and reports; a chapter of a book; and two original papers. Everything that M. Picard writes is worth reading, but here he is usually reproducing arguments and views familiar to all who know his work. The personal articles are more distinctive; M. Picard excels in a form in which so many of his countrymen are eminent; the account of Abel's life and work is a model of concise scientific biography.

As the title indicates, the relations between mathematics and physics form the thread connecting all this very varied matter. This is not the place to discuss M. Picard's views; but so much has now been written round this theme that we wish that some acute but painstaking person would endeavour to reduce it all to order, and explain to us what is common to all writers and what is still in dispute. Perhaps the task is impossible; the question is really that of the relations between two types of mind, and may be eternally inexplicable; it may be that the views of M. Picard, or of any other, if reflected in any other mind, would cease to be his views. But unless some such co-ordination is possible, the deep learning and keen insight displayed in these discussions must be largely wasted.

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.*]

The Effect of the Earth's Rotation on the Velocity of Light.

PROF. MICHELSON has now relieved his Newtonian mind by carrying through his heroic experiment, reported in NATURE of April 18, p. 566. He finds, as he anticipated, that the ether around the earth is not disturbed into a whirl by the earth's rotation. This was to be expected, has seemed in fact inevitable, if the ether is the universal medium in which matter subsists as independent small atomic structures, each with its field of main activity purely local, in the manner vividly illustrated in less abstract days by the vortex atoms of Lord Kelvin. Like the aberration of light, the effect under notice is of the first order (v/c), and so is conspicuous far above the very refined modern relativity so called, which is founded on second order (v^2/c^2) experiments and theory.

To those who still cherish the belief, as above expressed, that the result arises naturally from actual rotation of the earth relative to the surrounding ether, and so are not reduced to ascribing it to occult mutual influence of the universe as a whole (for the effect revealed, whether it is called rotation of the earth or not, must be relative to something other than a surrounding vacuity), a main interest of this *tour de force* will perhaps lie in a different direction. The astronomical aberration of light was discovered and elucidated by Bradley, while Newton was still living, on a basis which required the ether to be stagnant—or at most to move irrotationally near the earth as Stokes indicated. Until recently, perhaps still, this criterion has remained uncertain to about one-fifth of one per cent., for the constant of aberration remained unsettled, and so might be a varying quantity, within that degree. Prof. Michelson and Prof. Gale seem to have here missed, not very widely, a full decision on this fundamental astronomical datum by a single purely terrestrial experiment, for their margin of uncertainty as now announced appears to be only twelve times that of the most refined determinations of astronomy. (Some of the recorded deviations from the mean are, however, large, with preponderance in one direction, so as to suggest weighting which would improve the result.)

The finite velocity of light, after resting for two centuries on indirect, but of course adequate, celestial evidence, was brought down to earth by direct measures by Fizeau, Foucault, Newcomb, and Michelson. It seems noteworthy that the present experiment has just missed, by no great margin, fixing the distance of the sun, the base line of astronomy, by measurements purely optical, free from need of confirmation by other determinations whether directly parallactic or indirect results of gravitational astronomy.

JOSEPH LARMOR.

Cambridge, April 19.

THE experiments of Profs. Michelson and Gale, described in NATURE of April 18, are of such fundamental consequence that it is important to express their physical implications in the simplest possible way.

Prof. Michelson's original mathematical discussion of the experiment (*Phil. Mag.* 8 (1904), p. 716) appears to be inadequate; it wrongly supposes the path of a ray of light relative to rotating axes to be a straight line. The essential features of the problem are all reproduced if the ray of light is imagined, instead of describing a rectangle as in the actual experiment, to describe a circle, or rather a many-sided polygon inscribed in a circle. Let a be the radius and A the area of this circle. To a first approximation, the time required for a beam of light to get round the circle in either direction is $2\pi a/c$, where c is the standard velocity of light. On account of the earth's rotation, the material circle rotates in space with an angular velocity $\omega \sin\theta$. Thus while the beams of light are moving once round the circle, the mirror which constitutes both starting-point and winning-post moves round the circle a distance $2\pi a^2\omega \sin\theta/c$ to meet the ray which is travelling in the clockwise direction, thereby lengthening the course for the anti-clockwise ray by an equal amount. The difference of path for the two rays is accordingly twice this amount, or $4A\omega \sin\theta/c$, and this formula can be shown to be equally valid for the rectangular path of the actual experiment.

If the velocity of each ray in space is precisely c, the phase-difference between the two rays (in complete fringes) will be

$$\Delta = \frac{4A\omega \sin\theta}{\lambda c},$$

which is the formula used by Michelson and Gale, and verified by their experiments. If the two velocities are equal to one another, although not precisely equal to c, the formula holds as an approximation. If the velocities are unequal, the formula fails.

Freed of all hypotheses about the ether, the experiments appear to show that the velocity of light in space is the same (to within one part in 10^{11}) whether the light travels in the direction of the earth's rotation or in the contrary direction. This is in accordance with the theory of relativity. Thus the experiments do not affect the position of this theory, although a contrary result would have destroyed the theory. The experiments show either that there is no ether or else that, if there is an ether, the earth does not drag this ether into motion by its rotation.

The original Michelson-Morley experiment admits of three separate interpretations: (*a*) there is no ether; (*b*) there is an ether which accompanies the earth in its motion; (*c*) there is an ether which is at rest in space, bodies moving through it undergoing contraction in accordance with the Lorentz-Fitzgerald formula. The present experiments dispose of interpretation (*b*), which, however, is generally supposed to be adequately disposed of already by the phenomenon of astronomical aberration. Interpretations (*a*) and (*c*) remain open, and the experiments do not appear to provide the means of deciding between them.

J. H. JEANS.

The Dinosaur Region in Tanganyika Territory.

MR. C. W. HOBLEY'S interesting article in NATURE of April 18 (p. 573) ought to carry conviction as to the importance of the small collecting expedition which has been organised by the Trustees of the British Museum. In a short note published in this journal a year ago (March 8, 1924, p. 361) Gigantosaurus (or Tornieria), the main object of this expedition, was referred to in a manner which seems to be almost playful. The animal which is described as having "more slender limbs" than the American Diplodocus is a giant of stupendous size, possessing a humerus seven feet long, in its massiveness by no means suggestive of a creature of graceful or slender build. Without further qualification the description scarcely does justice to this wonderful animal.

Size is in fact a consideration of very practical importance. In the present instance everything must be done on a large scale—the excavation of the bones, their treatment on the spot, their transport to the coast and their freight to London. It is obvious that the work must be expensive, and I venture to hope that practical assistance will be given to the Museum, to enable it to continue and to make more complete the work already in progress. The excavation of the site can be carried on, until the end of the present year at least, by means of funds in the hands of the Trustees. It can only be done, however, on a very modest scale, by restricting the number of workers, and their remuneration, to a minimum. Even with this restricted programme it cannot be continued long enough to derive all the results obtainable from the bones which are lying on the surface, or close beneath it, in great profusion. What variety of life is represented by the fossils is at present uncertain, but the consignment just received from Mr. W. E. Cutler, who is in charge, indicates that the bones are in an excellent state of preservation and that they are by no means all of one kind. The extent of the Dinosaurian fauna of Africa has yet to be explored, and it must be remembered that this Continent has constantly yielded fresh surprises in animal life.

The study of African dinosaurs is almost at its commencement, but we know that the material is there, ready to be picked up by any one provided with a sufficiently long purse. Certain friends of the Museum have already sent generous contributions, by means of which a fund of some hundreds of pounds has been raised. It is a very welcome addition to our resources, and it will materially help us to carry out the work more satisfactorily than would otherwise have been possible. It falls far short, however, of our actual requirements, and I appeal for a material enlargement of the fund. Contributions, large or small, may be sent to me at the Natural History Museum, marked "Tanganyika Fund."

SIDNEY F. HARMER.

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Method of Measuring Deep Sea Tides.

IN a letter to NATURE of April 4 under this heading Prof. R. W. Wood suggests the use of a subsurface buoy as an "artificial island" for supporting recording tidal gauges, in order to study the tidal rise and fall in the open sea. Many readers of NATURE are, of course, aware that a similar contrivance was worked out by Swedish oceanographers more than fifteen years ago, and has been repeatedly used with very satisfactory results, in order to take continuous records of the subsurface currents from points in the open sea off the coasts of Sweden.

A large buoy of half a cubic metre capacity with a net buoyancy of some 300 kgm. is kept submerged at a depth of from five to ten metres below the surface (the depth being fixed so as not to interfere with shipping) by double anchorage, the cables diverging by about 120°. From the buoy one or two recording current meters of the Pettersson type are suspended at the desired depth, taking observations of the direction and the velocity of the current every thirtieth minute for a fortnight without recharging. As many as three such "Ekman buoys" have been used simultaneously at different localities, while the research vessel was otherwise engaged. As the point of suspension, that is, the buoy, is practically without any proper motion, the observations thus obtained are perfectly free from the errors inherent in current observations taken from ships swinging at anchor, and thus the tidal currents as well as the residual current can be computed correctly. A large number of such current observations which have been taken in the course of the last few years are at present being worked up for publication.

For some time it has been the intention of the Swedish hydrographers to use the same arrangement for establishing a kind of submarine hydrographic station in the open sea, the water temperature being taken by thermographs, the horizontal movements by recording current metres, and the vertical movements by means of balanced submarine floats rising and falling with the boundary of the layer in which they float, and recording its vertical movements by means of pressure-gauges, such as have already been used at our coastal stations. By means of two such buoys marked with flag-staffs showing above the surface and anchored some distance apart in the open sea, a base-line can be obtained serving to define the movements of large subsurface drifters marked with small surface buoys, and thus one should be able to follow directly the movements of the water during a tidal period. The rise and fall of the water level should at the same time be studied by means of recording pressure-gauges, and the currents, as usual, by our registering current meters. By means of one or two such mid-sea tidal stations anchored at representative points, and supplemented by continuous observations from lightships, the intricate problems related to the tidal wave in the North Sea might be brought considerably nearer their solution. This scheme, which has been on the Swedish programme for some time, can obviously be carried out only by the co-ordinated efforts of the nations interested.

Regarding the use of the submerged buoy for observations over great depths, no experience has so far been gained, the greatest depths at which it has hitherto been used being about 100 metres. At depths much greater than a few hundred metres, the weight of the anchors and wire-rope required would probably be a serious obstacle. For particulars of the apparatus I may refer to *Svenska Hydrografisk-Biologiska Kommissionens Skrifter*, 5, and Quarterly Journal of the Royal Meteorological Society, June 1914.

HANS PETTERSSON.

Oceanografiska Institutionen,
Göteborgs Högskola.

An Amphoteric Substance in the Radula of the Whelk (*Buccinum undatum*).

THE experiments of J. Loeb ("Proteins and the Theory of Colloidal Behavior," New York, 1922) have shown that the iso-electric point of amphoteric substances is readily determined by staining them with basic or acidic ions or dyes at known hydrogen-ion concentrations. The method has since been applied for the determination of the iso-electric point of the mycelium of Rhizopus (Robbins, W. J., 1924, *Journ. Gen. Physiol.*, 6, 259) and of bacteria (Stearn, E. W., and Stearn, A. E., 1924, *Journ. Bacteriol.*, 9, 463) by staining with dyes.

The radula of Buccinum appears to consist of two zones, a young newly formed part (chitin A) and an older part (chitin B). Passing along the radula, the change from chitin A to chitin B is sudden, though a small portion of chitin A persists in the base of each tooth throughout. The reactions of A and B differ entirely and will be fully dealt with in a forthcoming paper by one of us (T. H. R.).

Radulæ were soaked in buffer solutions of known P_H to which had been added a few drops of a solution

containing one of the following ions, Ag^+, Cu^{++}, CNS', and $Fe(CN)_6''''$. The radulæ were then washed so that the ions were only retained where they had combined with the chitin. The presence of the combined ions was readily detected by the usual reagents, the silver going black on development with hydroquinone, the copper being converted into the brown ferrocyanide by $K_4Fe(CN)_6$, and the CNS' and $Fe(CN)_6''''$ giving the usual red and blue colours respectively with ferric chloride.

Since an amphoteric substance is basic on the acid side of the iso-electric point and acidic on the alkaline side, the basic copper and silver ions should combine with it only if the solution is more alkaline than the iso-electric point. Conversely, the acid ions CNS' and $Fe(CN)_6''''$ will only combine with the substance on the acid side of its iso-electric point.

The results of a typical experiment are shown in the table.

Ion present	P_H of Solution. 1·0	2·2	2·6	3·0	3·6	
Ag^+	All deep black					Chitin A
	White	Faint grey	Grey	Black	Deep black	,, B
$Fe(CN)_6''''$	All deep blue					Chitin A
	Deep blue	Blue	Pale blue	White	White	,, B

Chitin A and chitin B are seen to be very different. Whereas chitin A combines with both anions and cations irrespective of the P_H, chitin B appears to be an amphoteric substance with an iso-electric point at about P_H 2·6 : in a more acid solution it is basic, and combines with the ferrocyanide anion but cannot combine with the silver cation ; in a more alkaline solution it is acidic, and combines with the silver cation but cannot with the ferrocyanide anion.

Identical results were obtained with fresh radulæ and with those which had been previously boiled in strong potash to remove adhering tissue.

From these experiments, the change undergone by chitin A on conversion into chitin B appears to be profound.

C. F. A. PANTIN.
T. HOWARD ROGERS.
The Marine Biological Laboratory,
The Hoe, Plymouth,
March 21.

Ball Lightning Phenomena.

AT dawn on the morning of the last day in 1924 there occurred in the neighbourhood of Aberystwyth, in Cardiganshire, a thunderstorm of short duration but of unusual violence, and people were alarmed at what they saw and heard. News reached me that a " ball of fire " had been seen during that storm at a village called New Cross, some 4 miles south-east of Aberystwyth. On hearing this I went over to interview the observers. I found three at once ; Mr. and Mrs. Pugh and Mr. Morgan at the inn. Mr. Pugh's attention was first attracted by a terrific noise. On looking out his bedroom window what he saw he described as " falling lumps of fiery material " and as a " scattering of fire as from a centre " about level with the ground, and, apparently, not far from the house. The house shook, and the effect was alarming. The three did not venture out for half an hour after the event. At Penywern, a farm-house near by, a window pane shown to me was cracked by the explosion.

I found another observer, Mr. Davies. He said that whilst dressing he looked out to see what kind of weather it was, and whilst at the window saw a brilliant ball of fire at some height from the ground in a direction 30° or 40° from the horizon. The " ball " was more or less round but with luminous protuberances. The direction in azimuth tallied with that of Pugh. It is likely, therefore, that Davies saw the same object as was seen by Pugh but at an earlier epoch. Unfortunately Davies withdrew his gaze, involuntarily, owing to the startling brightness and strangeness of the vision and, consequently, saw no more. Had he continued observing the story might have been complete.

Whilst at New Cross I was told that strange things had been seen by Mr. Edwards, of Glanrhos, four and a half miles away in direct line. I proceeded there, and Mr. Edwards very kindly and readily described all he had seen and experienced. Many things happened on the premises, but the following is the most important. Mr. Edwards was in the barn when the crash happened. He was thrown bodily backward but not in any way damaged. On looking out he saw what appeared to be three distinct luminous masses dropping on the manure heap in the yard. This was followed by a column of smoke or vapour rising from the place of impact. This occurred during a shower of hail. The hailstones were unusually large—half an inch or even an inch across, and of very irregular shape.

In these accounts there appears to be one point of interest common to both. Mr. Edwards saw the luminous volumes *after* he had been thrown. At the instant of being thrown he was in the act of bending to lift into a vessel some chaffed material that was lying on the floor of the barn, and had his eyes fixed on the job. Similarly Mr. Pugh also, he *heard the crash first* and on looking out saw the luminous objects. There was an interval, therefore, between hearing and seeing in both cases which cannot be explained on the assumption that what occurred was an ordinary single electric discharge. Either there must have been at least two discharges with an interval between, or something happened in a much more leisurely manner than an ordinary electric discharge. Are these luminous objects likely to be identical with the ball lightning ? It is not suggested in the account given that the luminous objects were solid bodies.

BEN DAVIES.
Llys Teg,
Pont-rhyd-fendigaid,
Cardiganshire.

Sound Production by Insects.

UNDER this heading in NATURE of March 21, p. 437, there was a short notice of a paper published by Dr. F. E. Lutz in the Bulletin of the American Museum of Natural History, vol. 50, p. 333, 1924. I have not been able to avail myself of the original paper, but the review brings forward several interesting points. The view expressed is : that our present knowledge does not furnish good grounds for believing that the few cases in which we hear insect sounds are exceptions to a rule, namely, that insects do not communicate by that means; that in the case of Orthoptera the presence of extreme specialisations for making sounds, accompanied by what appear to be definite ears, are grounds for thinking that here communications may be carried out by sound; but the fact that termites, *which are not known to stridulate*, have the same sort of ear as that possessed by crickets and long-horned grasshoppers, weakens the argument somewhat.

I should like to direct attention to a recent paper which I published in the Trans. Ent. Soc. Lond., Parts III. and IV., p. 492, 1924, on the habits of Brazilian insects. In the course of this paper I mentioned that I had observed termite soldiers making

noises by two different means, (1) by vibrating their bodies up and down and hitting their hard " chins " against the ground (*Cornitermes similis*, Hag.), (2) by sharply crossing one mandible over the other (*Mirotermes fur*, Silv.). In some species the mandibles have even been modified for the purpose and are asymmetrical. So far as my observations went, the termites only made a noise when there was danger about, such as when I broke open their nests, and then each Cornitermes soldier would tap violently for perhaps half a minute, pause as though listening to the tappings of its neighbours, and then recommence.

Other insects, for example various beetles, will stridulate when attacked. Whether this has the effect of frightening its enemies is difficult to prove. Others again, for example various bugs, only possess functional stridulating organs in the male sex. I believe I am right when I say that some of these have been heard in action when the sexes have been placed together. In spiders a parallel state of affairs is found. I have myself made some of those which possess stridulating organs in both sexes (Aviculariidæ) produce sounds by teasing them and putting them on the defensive, while the only occasion on which I have observed the other type stridulating, in which the organs are present in the male alone (Theridiidæ), is when he is in course of his courtship.

No conclusive experiments have been performed to show that spiders can hear. In the first case, where the spider is merely trying to frighten its enemies, this is not a necessary supposition, but, if the sound-producing organs are to be of any value in courtship, the female must possess some kind of ears, even if they consist merely of a few hairs which vibrate in such a way that she can recognise his presence. Are we to explain the facts to our satisfaction by a series of strange coincidences, or by admitting our inability to discover the organs of hearing in insects and spiders up to the present time ?

One has got the impression that Dr. Lutz would like to explain the origin of stridulating organs by the mutational theory. Something of a Lamarckian nature would probably fit the facts more easily.

W. S. BRISTOWE.

Winnington Hall, Northwich, Cheshire,
March 23.

A Method of Determining the Frequency of a Tuning Fork.

IN an experiment performed in this laboratory on the determination of surface tensions of liquids by the method of ripples, a tuning fork, provided with a dipper and slits on the two prongs, was used to produce the ripples as well as to illuminate the surface of the liquid by intermittent light, obtained by passing a narrow beam of sunlight through these slits and reflecting it on the surface by a plain mirror. It thus became necessary to determine accurately the frequency of the tuning fork with all its encumbrances. Evidently the ordinary graphic method could not be used without introducing more complications and thus altering the frequency, and means were not available of utilising the stroboscopic method. The frequency was, therefore, determined in terms of the length, or the time of vibration, of a simple pendulum hung in front of the slits of the prongs. The light, after passing the two prong slits, passed immediately above the bob of the pendulum, illuminating a small cross which connected the bob to the suspending thread. The light ultimately fell on a drum round which could be wrapped an ordinary photographic film.

On setting the prongs and the pendulum in oscillation, and revolving the drum and at the same time moving it at right angles to the path of the light, a record was obtained on the film consisting of alternate patches of light and darkness, on which, at regular intervals, was impressed the shadow of the above-mentioned cross. The frequency of the fork could thus be determined by counting and estimating or measuring the whole and fractional number of bands between two successive impressions of the cross. In the absence of any other mechanical devices, the drum can be set in rapid revolution by the hand and moved across the path of the light, again with the hand. The fork has of course to be electrically maintained.

It may be worth while to direct attention to the fact that in all previous experiments on the determinations of surface tensions by the method of ripples, two forks have been used, one for producing the ripples and the other for illuminating the disturbed surface intermittently, the forks being driven electrically in the usual way so that the vibrations of the two were synchronous. In the present experiment, only one fork was used for producing the ripples as well as making them visible. The values obtained of the surface tensions of water and dilute salt solutions were consistent among themselves and agreed with those given in the Tables, etc. The experiment was carried out by Mr. Jai Kishen, one of my M.Sc. students of last year. J. B. SETH.

Physics Laboratory,
Government College, Lahore,
February 26.

Change of Linkage in Poultry with Age.

Two dominant sex-linked Mendelian factors in the domestic fowl are known from the work of W. E. Agar (*Journ. Genet.*, vol. 14, pp. 265-272, 1924), J. B. S. Haldane (*Sci.*, vol. 54, p. 663, 1921), and G. S. Serebrovsky (*Amer. Nat.*, vol. 56, p. 571-572, 1922), to exhibit partial linkage during spermatogenesis, as was to be expected if both are carried by the same chromosome. One of these, B, causes barring of the feathers ; the other, S, causes silver as opposed to gold hackles. We have synthesised five cocks of composition, BS bs, *i.e.*, receiving both these factors from one parent only, and mated them with bs hens. Thus each of the four possible types of spermatozoon gave rise to a different type of chick. So far 648 chicks have been counted. We find that the linkage between B and S becomes progressively weaker with the age of the cocks. In their first, second, and third breeding years respectively these have given $22{\cdot}9 \pm 1{\cdot}4$ per cent., $36{\cdot}9 \pm 2{\cdot}9$ per cent., and $47{\cdot}6 \pm 3{\cdot}6$ per cent. of cross-overs. Thus by the third year linkage has practically disappeared.

So far C. B. Bridges (*Journ. Exp. Zool.*, vol. 19, pp. 1-19, 1915) has found a slight increase of crossing-over with age in one chromosome only of Drosophila, J. S. Huxley (*Brit. Journ. Exp. Biol.*, vol. 1, pp. 29-96, 1924) a decrease with age in Gammarus, and Castle (Castle, W. E., and Wachter, W. L., *Genetics*, vol. 9, pp. 1-12, 1924) no change in mice and rats. The variations recorded in plants may be due to temperature and other causes besides age. The change observed by us might be due to diminished rigidity of the chromosomes, increase of the forces tending to break them, or other causes. But it is of interest as pointing to pre-senile changes in the behaviour of the dividing nucleus, and as being the clearest case so far recorded in vertebrates of a change with age of the " germ-plasm " of an individual. The experiment is being continued, but will probably require another two years for completion.

J. B. S. HALDANE.
F. A. E. CREW.

The Biological Action of Light.[1]

By Prof. LEONARD HILL, F.R.S.
From the National Institute for Medical Research.

WHILE the heat spectrum, including infra-red, visible and ultra-violet rays, extends from a wave-length of some 60,000 $\mu\mu$[2] to one of 100 $\mu\mu$, beyond the outer dark heat rays are the Hertzian waves used in radio with wave-lengths extending to a thousand metres or more. The inner dark heat rays merge into the visible, which are of wave-lengths from 700 $\mu\mu$ (red) to 400 $\mu\mu$ (violet). Beyond the visible lie the invisible ultra-violet rays with wave-length from 400 $\mu\mu$ to 100 $\mu\mu$, and beyond these come the soft X-rays and then the hard X-rays and the γ rays of radium with wave-lengths so short as 0·01 $\mu\mu$.

The body of a man is surrounded with a horny layer of skin beneath which lies the living cells of the epidermis in thin layers and myriad in number. Beneath them circulates the blood through close woven networks of capillaries, in streams some 0·01 mm. thick. The epidermis reflects and scatters rays which fall upon it, but some part of the visible rays penetrate and are absorbed by the blood beneath, warming it. The dark heat rays, on the other hand, absorbed mostly by the epidermis, warm it more than the blood in the dermis. Set as windows in an almost impenetrable skin, the eyes have been evolved with extreme sensitivity to a narrow portion of the spectrum, namely, the visible rays. To Hertzian waves we are insensitive; their energy has to be converted into sound and heard. Likewise we cannot feel ultra-violet, X- or γ rays: a latent period of two or three weeks follows exposure to X- or γ rays before an erythema of the skin and irritation results. A latent period also follows exposure to ultra-violet rays, but one limited to hours. While the hard X-rays and γ rays and secondary rays started by these penetrate in part to deep tissues, the active ultra-violet rays are wholly absorbed by the epidermis and exert their effect there.

Sonne found that if dark heat rays are brought to bear on the skin up to the just endurable sensation of burning, the temperature just beneath the skin will be raised to about 43° C. On the other hand, if visible rays alone are concentrated on the skin to the just bearable degree, the temperature just beneath the skin will be raised even to 47° C. This result, confirmed by Argyll Campbell and L. Hill, is due to the greater absorption of dark heat by the surface layer of the skin and a deeper penetration of the visible rays. Sonne ascribes heliotherapy to the local heating effect of the visible rays and has tried to find evidence that such local heating of the blood increases specific antibodies of the body, *e.g.* the diphtheria antitoxic content of the serum. However, P. Hartley has reinvestigated this matter with great refinement and accuracy of method, both in regard to the diphtheria antitoxin content of the serum and the agglutinin content of the serum against *B. typhosus*, and finds that light baths have not the least effect on such a specific immunity. The baths have power, on the other hand, to increase the general resistance of the body to infection, as was shown by L. Colebrook, A. Eidinow, and L. Hill, who found that a light bath intense enough to produce erythema put up the hæmo-bactericidal power of the blood as tested *in vitro*. Blood which before the bath killed say 80 per cent. of staphylococci mixed with it, two hours after a light bath killed 100 per cent. Such an effect followed no less when a *lasting* erythema was produced by exposure to heat or a mustard poultice.

In the case of the light bath the relative activity of visible and ultra-violet rays is proved in the following way. If an arclight with "white flame" carbon poles (direct current and about 2500 kilowatts) is focussed sharply through a quartz lens on to the arm, an unendurable burning sensation results almost at once. If the arm is immersed in a quartz vessel full of cold water and the experiment is repeated, no burning sensation results, but if the exposure is continued for five minutes, erythema develops some hours later at the exposed spot, and this may advance even to a blister, to be followed by a long, lasting, brown pigmentation. Repeating the last experiment with a quartz screen filled with 3 per cent. quinine solution interposed between the arc and the arm, all ultra-violet rays shorter than 330 $\mu\mu$ are thus cut out, as can be shown by the quartz spectrograph. In this case no erythema results even after over an hour's exposure. The visible rays then, apart from their heating effects, have no effect on the skin. The ultra-violet rays, acting on the cooled skin, have, on the other hand, a profound effect.

Using a quartz spectroscope and a blackened thermopile for measuring the energy of various parts of the ultra-violet spectrum, it was found by Hausser and Vahle that the maximal power for producing erythema of the skin was with the wave-lengths 300-290 $\mu\mu$, just the region which comes through with the high sun on clear days. Little effect was given by rays 313 $\mu\mu$ and 250 $\mu\mu$. A screen of uric acid (1 in 40,000 solution) in a quartz container absorbs rays shorter than 306 $\mu\mu$ (Dhéré). The mercury vapour lamp through this screen produces no erythema even after giving six times the erythema dose for the unscreened lamp. Lines 275 and 257 $\mu\mu$ of the cadmium spark spectrum produce erythema, but not line 232 $\mu\mu$. Such short rays do not penetrate the horny skin but actively kill infusoria.[3]

How slight is the penetrating power of the ultra-violet rays is shown by interposing in place of the quinine solution a thin film of the horny layer of the skin taken off a blister, or the mesentery of a rabbit. Such a film protects the skin no less than the solution of quinine.

The active ultra-violet rays penetrate to the deeper epidermic cells but no farther. Among these cells there takes place multiplication and growth, formation of pigment and transition into the horny material which is pushed outwards by the growth of cells within. In these cells the ultra-violet rays provoke changes which we may assume are similar to those which have been photographed in living anthrax bacilli by Mr. J. E. Barnard, using a microscope with quartz lenses and a band of ultra-violet rays from the cadmium spark. Under the ordinary microscope they have been observed

[1] Substance of two lectures given at the Royal Institution on March 12 and 19.

[2] $\mu\mu$=0·000001 mm.

[3] I am indebted to Messrs. J. E. Barnard and J. Smiles for the use of the spark.

by A. Eidinow and L. Hill on infusoria. An increasing aggregation of particles takes place in the bioplasm; in the case of infusoria this leads to cessation of movement, death, rupture, and setting free of the particles. So, too, the surface film of egg white exposed in a quartz chamber is coagulated by ultra-violet rays. Positive particles are dispersed and negative ones aggregated (Clark).

These rays displace electrons in atoms according to present physical theory and so alter the charge of the particles, some of which are to be seen in bioplasm by dark ground illumination and high microscopic magnification in active Brownian movement. This leads to aggregation started by the displacement of electrons in the atoms. Chemical change in molecular structure ensuing in the epidermal cells after a latent period, reaches such an irritative nature as to lead to dilatation of the subcutaneous blood vessels, exudation of lymph, increase of lymphocytes, and rise in the hæmobactericidal power of the blood. In cases of rickets the abnormally low inorganic phosphorus content of the blood which is significant of this condition is put up also in a striking way. Subsequent to these reactions there results desquamation, due to death of some epidermal cells followed by pigmentation. The pigment melanin is laid down as granules in that layer of living cells which lies close underneath the horny layer. Melanin is stated to be formed by the action of an oxydase in the deeper epidermic cells, as may be seen in the fresh sections of skin (cut frozen) when radiated and wet with a solution of dioxyphenylalanin; this substance is said to be the specific precursor (Bloch). The closely allied compound, tyrosin, is said to diminish in amount in the blood at the time when melanin is being formed in the skin after a light bath.

Ultra-violet rays act more quickly on warm than on cold skin. Tested on infusoria the coefficient for temperature (for a rise from 10° C. to 20° C.) is about 2-3 (A. Eidinow and L. Hill); for the frog's mesentery it is less, about 1-2 (Argyll Campbell and L. Hill). While heat of the sun may aggravate a sun burn, it is not a necessary adjuvant. Ultra-violet radiation can intensely burn the cooled skin; it is well known that glacier sun-burns may be very severe. Dewar killed microbes with ultra-violet rays at the temperature of liquid air.

The power behind the sun was worshipped by the heretic pharaoh, Akhnaton, and modern science leads us back to veneration of this power. The imagination tries to think of the infinitely intricate energy complex which goes to form a living cell, of electrons being displaced in atoms by ultra-violet rays, of molecular movement enhanced by heat rays, of radiation provoking reactions which manifest themselves as life, of the spirit of man ensuing in the evolution of energy transformations.

The law holds that absorption of rays precedes action. Rays which pass through a cell have no action upon it at all. The skin screens itself from excessive light by its horny layer and by pigment. Pigment by absorbing visible and ultra-violet rays screens the deeper cells and blood. It absorbs dark heat rays and converts visible rays into heat, and this heat, stimulating the nerve endings in the skin, may reflexly lessen body heat production while provoking sweating and dilatation of cutaneous blood vessels.

Melanin is a screen, not a sensitiser, transforming light into heat. It is present in a fine particulate form and scatters and diffusely reflects rays. The spectrograph shows that melanin in fine suspension and thin layers screens off and greatly weakens but does not wholly absorb the ultra-violet spectrum. This is in sharp contrast to a 3 per cent. solution of quinine which in an equally thin layer wholly absorbs rays shorter than 330 $\mu\mu$. A layer of sweat wetting the skin helps to reflect light, while a layer of evaporating moisture surrounding the skin helps to absorb heat rays. The pigmented naked body with sweating skin is thus favourable to the cooling of the native in the tropics, while clothing retards heat loss of the white man.

By local concentration of an arc light on a rabbit's head, it is easy to heat its fur up to 150° F. and its brain even to 107° F. while with the body in the shade the rectum is only 101° F. (Argyll Campbell and L. Hill). Pith helmets prevent local heating of the head and sunstroke in the tropics. There is rarely any danger of sunstroke in Great Britain. The sun is powerful enough only on few summer days, and bare heads offer no risks except on these rare occasions. Heatstroke from overheating of the whole body due to exhaustion of sweating in warm stagnant air is much more common—overclothed as we are for withstanding hot weather.

Downes and Blunt (1877) proved that the bactericidal action of light was due to ultra-violet rays, and much has been made of this. It has been claimed recently by Wiesner that the infra-red rays, apart from their heating effect, have a bactericidal action, but this is not so (A. Eidinow and L. Hill). The only rays which kill, apart from any lethal heating effect, are the ultra-violet rays. The bactericidal power of these rays is not nearly so important as has been thought, for the rays can only kill the surface bacteria. They cannot penetrate into filth any more than through the epidermis. In their curative effect on lupus these rays act, not by directly killing the bacilli, but by increasing the immunising powers of the tissues. This is so, even when the rays are focussed as in the local Finsen light treatment. Nodules so treated, when injected into guinea-pigs produce tuberculosis.

Mr. J. E. Barnard, by photographs taken with ultra-violet rays and a quartz-lensed microscope, has shown structures hitherto unrevealed in living yeasts, bacteria, and blood cells. This is due to the selective absorption by the outer membrane, the nucleus, and certain other granules in the cells. Infusoria vary in their susceptibility to the lethal effect of ultra-violet rays, and this probably bears a relation to the age, nutritional state, and absorptive particles within them. The lethal power on cells increases with shortening of the ultra-violet rays; for example, using the cadmium spark, a 20-minute exposure sufficed to kill infusoria placed in the 275 $\mu\mu$ band, and a 3-minute exposure in the 232 $\mu\mu$ band. The penetration of the shorter rays, however, is far less, and these, therefore, have no action on the skin. Thus, as stated above, while bands 275 and 257 $\mu\mu$ of the cadmium spark produce erythema of the skin, the intense 232 $\mu\mu$ band has no effect.

In the case of the very short rays, Mr. J. E. Barnard finds one anthrax bacillus screens another lying beneath it. With rays of weak intensity, processes of repair may keep pace with injury, and no effect be produced in living cells. A screen which allows ultra-violet rays to pass so as to give an excellent spectrum, as photo-

graphically recorded by means of the quartz spectrograph, may be found to reduce biological action very greatly, as is shown when the lethal power of the screened rays is tested against that of the unscreened on infusoria or the skin. The photographic method is so exceedingly sensitive that deductions cannot safely be drawn from it alone.

It is claimed that immunity is set up in the epidermis by one exposure to a subsequent one, and this long before pigment is formed (Perthes). Thus if an area of the skin be exposed for five minutes and again for five minutes some hours later, and a second area be given 10 minutes exposure all at one time, the erythema will be much more marked in the second area. Choosing a small dose, a second one given a few hours later increases erythema and soreness. Maximal erythema, of course, cannot be further increased by a second dose, but this seems to be true for soreness also. The immunity is no doubt due to coagulation of the outer layer of living cells, whence comes peeling. When pigmentation is still well marked weeks after an exposure, susceptibility of the epidermis may be shown to have returned by the erythema following a further dose of ultra-violet rays.

To measure the therapeutic action of the ultra-violet rays we can use the lethal dose for infusoria contained in a quartz cell at 15-20° C., or the erythema-producing dose for the skin of the average white arm, or the rate of bleaching of a standard solution of acetone and methylene blue. The last has been standardised against the two former, and each degree on the scale is twice to four times that required to produce a moderate erythema. (A. Webster, L. Hill, and A. Eidinow.) The acetone blue solution is exposed in a quartz tube of standard diameter, and after exposure the degree of bleaching determined by comparison with a set of blue tubes of depths of tint 10 to 3. The acetone solution absorbs the ultra-violet rays shorter than 360 $\mu\mu$, and the chemical reaction set up in it bleaches the blue. Observations have been taken daily with full exposure to sun and sky at various places and show the intensity of ultra-violet radiation in clean air and the effect of smoke and pollution. During a fine summer day the quartz tube may have to be changed two or three times in the day, and the highest total reading last summer at Peppard, Oxon, equalled 23. In the Alps a reading of 41 was obtained in one day. In dull cloudy weather of winter the reading may be 1 or 2 and in smoke polluted towns 0.

Using in addition a clock to keep moving the quartz tube together with a small screen to shade it from the sun but not from the sky except that immediately round the sun, we have found that the total ultra-violet radiation from the sky is far more than from the direct sun. Dorno at Davos showed that this was so using a cadmium photo-electric cell for recording the ultra-violet radiation. Even with the sun at its zenith, the ultra-violet radiation from it is only about 90 per cent. of that from the blue sky. With the low sun, the sky yields far the more.

Smoke pollution robs us of half or more of the ultra-violet rays. While seeking to abolish this evil, we require to make the loss good by the use of artificial sunlight baths. Screened as he is by window-glass, clothes, fog, and smoke, the citizen is cut off from ultra-violet rays almost wholly in winter, and in consequence his general health and resistance to disease goes down. The evil is enhanced by indoor life spent in heated stagnant air of rooms, and by lack of open air, exercise, and by a diet deficient in vitamins. Thus the resistance to catarrhal infections, which spread in the crowded stagnant air of rooms, is lowered. Those who live open-air lives and are well fed, exposed however much they are to weather, are far less often attacked.

It has already been stated that the hæmobactericidal power of the blood (as tested *in vitro*) is put up in an animal by an exposure to ultra-violet radiation which is sufficient to produce erythema. It has also been found by A. Eidinow that if a little blood is withdrawn from an animal, irradiated by rotation in a quartz flask, and then put back again into the animal, this puts up the hæmobactericidal power, and yet the irradiated blood itself has this power actually destroyed in itself by radiation. The hæmobactericidal power depends on the corpuscles and not on the serum. In man it is naturally high, and can be put up less than in such animals as rabbits and pigs. It is known that ferments, serums, agglutinins, and the anaphylactic power of blood are alike destroyed by ultra-violet radiation.

Recent research on rickets has shown that the diseased calcification of the growing bones results from a diet deficient in antirachitic substance and lack of ultra-violet rays. If young rats are put on a diet deficient in antirachitic substance and having a minimum of salts of phosphorus, the latter is not absorbed from the gut. Either the addition of antirachitic substance in cod-liver oil or ultra-violet radiation for a few minutes a day will wholly stop rickets developing and cause a minimal amount of phosphorus in the diet to be absorbed and utilised in bone building (A. Webster). It has been proved that the antirachitic substance present in cod-liver oil is not vitamin A, and that it can be put into an inactive food by ultra-violet radiation (Hess, Steenbock). Thus, inactive linseed oil, casein, flour, and lettuce leaves can be made effective as cod-liver oil in preventing rickets, by rotating them in a quartz flask in front of the mercury vapour lamp. Water, fat, starch, sugar, mineral oil, glycerine, cannot be so activated. Oils retain their acquired antirachitic power for months. It has been claimed that "active" food substance on oxidation gives off ultra-violet rays, but this is not so. The error has arisen through the fluorescence of certain quartz screens used in the photographic tests (A. Webster). Drummond has shown that radiated cholesterol makes an extremely active antirachitic substance, and possibly in all food stuffs shown to be activated by radiation this is the activated body. Possibly radiated rats absorb this from the skin.

We have no evidence so far that radiation can endow an inactive food with the growth qualities pertaining to vitamin A. If this prove possible, the margarine makers will have found a fresh source of fortune in being able to claim that their product is made equal to butter. Rickets can be prevented by making the diet more adequate, *e.g.* by cod-liver oil, and also by teaching mothers the need of exposing infants' and children's bodies to the sunlight and by the use of artificial sun-baths at infant welfare centres.

Prolonged exposure to intense ultra-violet rays either of the sun or an arc light produces destruction and sloughing of the white skin. While the visible rays, beside their heating effect, have no lethal effect on the

normal living animal cell, it is easy to produce a most powerful effect from these rays by sensitisation of the cells. Many fluorescent dyes have this effect, eosin, erythrosin, etc., forming a compound with the bioplasm and so making the latter absorb and be affected by rays longer than the ultra-violet.

The most interesting sensitiser is hæmatoporphyrin, an iron-free derivative from hæmoglobin, closely allied to phyloporphyrin, a derivative of chlorophyll. Traces of porphyrin (uro- or sterco-) are present naturally in the body and may possibly give to the skin some very slight natural sensitivity to visible rays. An excess of porphyrin is present in some rare individuals endowing them with an unfortunate sensitivity which causes skin eruptions and even ulceration of extremities on exposure to bright light—a disease called hydroa æstivalis, which has to be met by the greatest care against their exposure to sunshine or bright daylight.

When the mesentery is exposed in a cool glass irrigation chamber to concentrated visible rays of an arc, no effect results, the ultra-violet rays being filtered off by the glass. Add now a trace of hæmatoporphyrin to the bath (1 in 10,000) and in a very few minutes stasis occurs in the blood vessels. The lymphocytes gather to form thrombi which block the vessels (Argyll Campbell and L. Hill). While pigmented animals are protected, albinos made sensitive by injection of hæmatoporphyrin die after exposure to light. Meyer Betz was daring enough to inject some hæmatoporphyrin into himself and suffered from œdema of the face and hands on exposure to light. He remained sensitive for weeks. It seemed possible that sensitisation might prove useful in light therapy, but we have obtained no evidence of this. Animals do not stand well the exposure of the shaved skin to light after even very small doses of hæmatoporphyrin have been injected. Painting patches of lupus with glycerin and eosin has been tried so as to endeavour to secure a greater local effect from light treatment, but definite evidence for this has not been found (A. Eidinow and L. Hill).

Sudden exposure to ultra-violet rays stimulates to contraction such an organ as the uterus of the guinea-pig or the stomach of a frog. The excised iris by pigment is made sensitive and contracts on exposure to visible rays. Ultra-violet rays do not pass through the cornea or lens, and when the retina is damaged by over-exposure to an arc light or to sun (as in viewing an eclipse without smoked glasses) it is injured by excess of visible rays acting on its extremely sensitive substance. The specific sensitivity to different wave-lengths of the alkaline metals, sodium, potassium, etc., as shown in the photo-electric cell, is suggestive in regard to the theory of colour vision. Photo-electric effect produced by rays acting on a specific retinal substance or substances may be the first stage in the excitation of vision. Russ has claimed that the owl's eye transmits ultra-violet rays. This is not the case with the cat's eye, which has good nocturnal vision, nor with the cod's eye, a fish which swims in dim lights of somewhat deep water. Tested by putting the cornea in a band of active ultra-violet rays, using the cadmium spark, none reach a fluorescent screen placed at a window cut in the posterior part of the eye (A. Eidinow and L. Hill).

It has been suggested that there is a biological interference between infra-red, or visible rays, and ultra-violet rays. Hess found a longer daily exposure to the mercury vapour lamp necessary in order to prevent rickets in young rats (fed on a deficient diet) when a glass screen was interposed which let red and yellow rays through as well as ultra-violet, than was the case with a glass screen which only let ultra-violet rays through. The photographs of the spectra of the two screens seemed to show equality of the ultra-violet radiation, but a difference in intensity is the most probable explanation. Pech claims that both bleaching of cotton and production of erythema by ultra-violet rays is delayed by a concomitant beam of infra-red rays. Infusoria seemed to move actively longer in the light of a mercury vapour lamp when red rays were also thrown on them than without these rays. The lethal times, however, on further trial came out to be the same in the two cases, and further research on the circulation in the mesentery and on infusoria exposed to ultra-violet bands in the cadmium spark spectrum proved negative. Not the least evidence of interference with the lethal effect was found (A. Eidinow and L. Hill: Argyll Campbell and L. Hill).

Ultra-violet rays improve the growth and breeding power of fowls. Acting directly on embryos they produce monsters. The loss of breeding power in man and domestic animals such as cattle is probably due largely to indoor life. It has been established by abundant clinical experience that light treatment is excellent for surgical tuberculosis, rickets, and wounds (O. Bernhard, Rollier, Gauvain, and others). Trials recently made on many other diseases have shown that we have in artificial sun treatment a powerful stimulant to general health and in particular of the defensive mechanism of the body against chronic infections. Skin diseases such as psoriasis, ichthyosis, eczema, and boils, chronic anæmias of obscure origin, nutritional weakness and wasting in infants, chronic bronchitis and the fat flabby condition of the sedentary over-fed middle-aged person, chronic phthisis, the debility following acute infectious disease, etc., are alike greatly benefited (A. Eidinow and L. Hill; P. Hall, etc.). The open-air sanatorium and school have shown how ailing feeble children can be turned into happy vigorous ones.

A very great benefit to general health can at once be secured by the installation of arc baths in schools and public baths. If in winter all children stripped but for a loin cloth, danced to music for fifteen minutes twice a week a yard or two away from and round a powerful arc lamp, *e.g.* one taking 100 volts and 30 amperes with white flame carbons, a great improvement in vigour, alertness, and health would be obtained. It is by such means that our misty, smoky, winter climate can be immediately remedied. At the same time, we can set about to secure and use smokeless fuel and clean away the hideous smoke pollution of the air. We can also set into windows and sky-lights of schools, hospitals, and nurseries the new "vitaglass," which lets the ultra-violet rays through, and use such glass for the bulbs of incandescent tungsten filament lamps, which would then be a source of ultra-violet rays of mild intensity.

Many interesting experiments are now being carried out concerning the growth of plants and fruits with and without ultra-violet rays, and on the effect of continuous lighting.

The Continents and the Origin of the Moon.

By Dr. R. H. RASTALL.

DURING the last few years there has appeared a regular flood of literature, both abstrusely technical and more or less popular, dealing with such questions as the origin and form of the earth as a whole, the stages of its history, the formation of its crust, the building of land and sea, the uprise of mountain ranges, the form and displacement of continents, the physics and mechanics of vulcanicity, and a large number of other phenomena of cosmical and geodetical nature, as well as much speculation as to the birth of the moon and its relation to the earth. These subjects have been treated from every possible point of view — astronomical, mathematical, physical, chemical, and geological. It might seem, therefore, unnecessary to add to the number of writings in this much occupied field. Nevertheless, to a geologist there seem to be certain aspects of the case that have not yet been quite sufficiently co-ordinated and considered in their mutual relations. Let this be the excuse for the following somewhat theoretical and speculative discussion.

It is not proposed to discuss here the ultimate origin of the earth or of the solar system; for our present purpose it is immaterial whether the sun and the planets have been formed by condensation of a nebula or by accretion of planetesimals; it may now be taken as axiomatic that the earth, however formed, must have passed through a stage in which it was partly or wholly fluid. This is brought out quite clearly by recent writers, such as Jeans, Eddington, and Jeffreys. The word fluid is here used advisedly, so as to avoid complications induced by the consideration of critical temperatures and pressures. This fluid mass cooled by radiation, so that at some stage a temperature gradient must have been set up; whether this gradient was regular or not is of no importance. The significant point is that the physico-chemical laws of cooling of fused material become applicable. To make the matter clear, we will consider the state of affairs at the time when the first crystalline solid phase was formed at the cooling surface; the vapour phase (the primitive atmosphere) may be disregarded.

The cooling globe then constituted a complex system of many components, and the problem arises as to the number of phases which would be present under the given conditions. In order to gain information on this point, several lines of evidence are available, especially the theoretical laws of physical chemistry, and the actual ascertainable facts of observation. Some of the last-named will be considered first.

It is obvious that the density of the earth's interior is about twice as great as that of the accessible crust: earthquake observations further indicate more or less abrupt changes of density at certain depths. In discussions on this point it is sometimes assumed, either explicitly or tacitly, that there are only *two* density zones, and no particular reason is usually given for any such stratification: it is taken for granted, but not explained. A short consideration may here be given to this part of the subject.

The high density of the earth as a whole (about 5·5) suggests a prevailingly metallic core, although the figure is scarcely high enough to admit of a pure metallic core, unless we assume a very thick silicate crust, to reduce the *average* density. L. H. Barnett, in a recent paper, has endeavoured to calculate the thickness of the outer crust, but his reasoning is not trustworthy, since he postulates only two zones, an assumption which is by no means proved.

At this point some purely physico-chemical considerations come in. The simple facts of metallurgical practice show that molten metal and slag possess a very limited mutual solubility, and so do sulphide and slag. Vogt has shown that at furnace temperatures the mutual solubility of slags and sulphides is of the order of 5 per cent. or less, usually much less. Hence a system of metal and silicate must split into two consolute liquid phases, of which the lighter will obviously float on the top of the heavier: the relations are exactly analogous to those of phenol and water. Therefore a metal-silicate earth would separate on cooling into two zones. But the visible crust of the earth contains a good deal of the sulphides and oxides of the heavy metals, which are also very insoluble both in metal and in slag.

On this basis V. M. Goldschmidt regards the cooling earth as a three-phase system, with a central metallic core, an intermediate sulphide-oxide zone, and an outer silicate zone, which of course would begin to solidify first.

The observational facts of geology and the results of the detailed study of the distribution of gravity combine to show that the composition of this now solidified crust is by no means uniform, even when considered from the broadest point of view. Stated in the most general terms, the continents consist of heavier material than the floors of the ocean basins, the difference amounting roughly to something like 10 per cent. The data of historical geology also show that there are far-reaching variations in the relative levels of land and sea, as indicated by transgressions and emergences. Mainly on these grounds there has been built up the doctrine of isostasy, which regards the lighter continents as floating in the heavier material now exposed on the ocean floors; we can, if we like, visualise the position as continents of granite floating in an ocean of basalt: this generalisation is not very wide of the mark, since the known sediments form only a trifling skin, and may in reality be ignored in comparison with the total thickness of the continental blocks. From the measurable freeboard of the continents and the known relative densities, it can be calculated that the depth of the floating blocks is about 100 kilometres.

Here arises an apparent contradiction. It has just been said that there is *one* outer silicate zone in the three-phase system postulated by Goldschmidt, but the facts show *two*, an acid and a basic, or a light and a heavy zone. A good deal of work has been devoted to the study of the behaviour of silicate melts during cooling under ordinary laboratory conditions, since this has an important bearing on metallurgical practice. All authorities agree that under such conditions all fused silicates form a single homogeneous solution, and there is no evidence for separation into two consolute fractions of acid and basic composition. But the conditions of the laboratory do not tell the whole story.

It is difficult to take into account the effects of pressure, obviously an important factor, and with this is closely correlated the possible influence of volatile constituents, especially water, which is known to be abundant in natural silicate melts (magmas). It has therefore been suggested that, in the presence of water, there may be a separation into mutually insoluble liquid phases. This, however, is so far pure speculation, unsupported by any experimental evidence. It is to be hoped that investigations now being carried out at the Geophysical Laboratory of the Carnegie Institution in Washington on the behaviour of silicate melts under pressure may afford some information one way or the other.

However, it appears to be unnecessary to invoke any such purely hypothetical agency. From the known facts of observation and experiment it is possible to explain the existence of a differentiation of the kind required, taking place after the first appearance of a solid crystalline phase. It may be taken as proved that in the case of silicates the density of the crystalline form is greater than that of the liquid, and hence crystals formed at an early stage at the surface will tend to sink. Since the viscosity of fused silicate of mean composition and not far above the freezing-point is fairly high, the sinking will be slow and the crystals will be melted down again. But the same high degree of viscosity will prevent ready diffusion and restoration of equilibrium; hence certain constituents, especially the heavy silicates of magnesia and iron, as well as oxides of the heavy metals, will be concentrated in the lower layers of the silicate shell, while the upper layers are relatively enriched in the light constituents, especially silica, alumina, and the alkalies, as well as in volatile elements of low density. Eventually increasing viscosity will stop this mechanical differentiation altogether, and the crust will solidify with two more or less well-marked layers. As previously stated, a difference of density of only 10 per cent. is needed to account for the observed facts. Thus the outer silicate zone is differentiated into two layers, but this, with the lower zones, does not constitute a four-phase system, since the partial heterogeneity of the outer zone is due to a failure of equilibrium. This state of affairs, however, seems to be a necessary consequence of the conditions.

According to this theory, therefore, the whole of the earth's surface should be covered by a uniform shell of rock of granitic composition, having a thickness which may be estimated roughly at 100 kilometres. But it is a geographical commonplace that the continental blocks occupy only about one-third of the earth's surface, and this ratio is not materially altered if we take, as is now usual, the 100-fathom line as the true boundary between the continents and the ocean basins.

It is difficult to conceive any purely chemical or physico-chemical cause for this peculiar space-relation of the light and heavy silicate masses. Some mechanical cause is inevitably suggested, and it becomes necessary to look about for some such cause. Once more the problem may be stated in the simplest possible language, as follows: on physico-chemical grounds the earth should have a thin uniform granitic shell covering its whole surface. Actually such a shell covers only one-third of the surface: what has become of the rest?

Now the idea is by no means new that the moon has been formed by separation from the earth. This has been put forward by many mathematical cosmogonists, including Sir George Darwin. It has even been suggested that the vast oceanic Pacific basin represents the scar left by the departure of the moon. More recently a good deal of doubt has been cast on the possibility of such an origin for the moon; one of the latest writers on the subject, however, H. Jeffreys ("The Earth," 1924), says that the separation of the moon, *if it occurred at all*, must have taken place soon after the formation of the first solid crust of the earth. The possibility is therefore not totally excluded. It is suggested here that the facts of geology and the theories of physical chemistry afford a considerable measure of support to this speculation. To state the matter shortly, the suggestion here made is that the moon represents the missing two-thirds of the earth's earliest-formed granitic crust, stripped off by some form of tidal resonance, and rolled up into a ball while still more or less plastic. Whether such an event is possible is obviously a subject for mathematical investigation. A very similar idea has already been put forward by Prof. W. H. Pickering.

The purely arithmetical side of the question presents no difficulty. It is easy to calculate the thickness of crust required to be stripped off two-thirds of the earth's surface to form a globe of the size of the moon. When the calculation is made, it gives the surprisingly small result of only 41 miles or about 60 kilometres. This is less than the calculated depth of the isostatically floating continental blocks.

It is true that the present density of the moon, 3·46, is somewhat higher than that of the continental rocks, but it is probable that, at the time of the disruption, more or less of the underlying heavier material would be torn away along with the lighter portions, and there may of course have been also condensation by gravity-pressure in the moon, though this is unlikely to have been important.

Not only do the existing continents cover only one-third of the earth's surface, but their distribution is also very uneven. It is well known that by far the greater part of them are concentrated within the hemisphere having N.W. Europe at its centre. This concentration is so far favourable to the present theory. But it is necessary to take into account the significance of the ideas as to the wanderings of continental blocks as summarised by Wegener. If this theory, which is still very much *sub judice*, be accepted, it implies that, on the whole, most of the continents were once still more concentrated into one area than they are now. It is still too early to claim Wegener's theories as evidence in confirmation of the ideas here set forth, but at any rate there is nothing antagonistic in them. It is a somewhat natural inference that a large continental block, or group of blocks, left floating after the disruption in a viscous substratum, and obviously in a state of imperfect equilibrium, would tend to drift about. But the disruption must have happened at an early stage, while the movements postulated by Wegener belong to a comparatively late stage of geological history and are supposed to be even now in progress. Still, if we accept the doctrine of isostatic flotation at all, as most writers now appear to do, the continental blocks can obviously rise and sink, so they

may just as well be supposed capable of moving sideways also.

It may be noted that the formation of the moon by the segregation of a portion of the earth's crust bears a close analogy to the formation of planets from the sun by near approach of another star, as now held by many recent writers. If the aggregation to a spherical form is possible in the case just mentioned, it should be equally possible in the case of a crustal mass stripped off by tidal resonance; it is even conceivable that the disruption of the earth may have been caused by a similar cosmical disturbance due to the approach of some other body, but as to this there appears to be no evidence, and the tidal resonance theory offers the simplest explanation.

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Obituary.

SIR RICKMAN JOHN GODLEE, BART.

BY the sudden death of Sir Rickman Godlee on April 20, science loses a singularly open-minded man of varied gifts and wide interests, who was intimately associated with the great revolution in surgery accomplished by his famous uncle, Lord Lister. In fact, Godlee is now most widely known as the author of Lister's biography, which is not only a worthy record of one of the greatest incidents in the history of science, but also a graphic picture of the simple, homely society in which the sterling characters of Lister and of Godlee himself were moulded. During his long career Sir Rickman played many parts, as senior demonstrator of anatomy and afterwards professor of clinical surgery at University College, London, and honorary surgeon at University College Hospital, as president of the Royal College of Surgeons, as surgeon to the household of Queen Victoria, and surgeon-in-ordinary to King Edward VII. and King George V.

As an anatomist Godlee displayed exceptional skill in dissection, and in addition he was a superb draughtsman. These gifts were displayed not only in his contributions to "Quain's Elements of Anatomy," but also in his own "Atlas of Human Anatomy" (1880). But perhaps his chief contribution to anatomy was his investigation of cranio-cerebral topography, which his pioneer work in cerebral surgery impelled him to undertake.

At the Hospital for Epilepsy and Paralysis (then in Portland Terrace, overlooking Regent's Park) Godlee performed the hitherto unprecedented operation (in England) of removing a tumour from the brain, after its position had been determined on the evidence provided by Sir David Ferrier's experiments on animals. This milestone in the history of surgery was made more conspicuous still when particular attention was directed to it in the *Times* of December 16, 1884, for the purpose of rebutting Ruskin's attack on vivisection.

Godlee's interest in University College and its anatomy department was maintained with unabated vigour until the end. His loss will be particularly felt this year, not merely for personal reasons, but also because his intimate knowledge of the College and of University College Hospital and his rare literary gifts were being devoted to the preparation of the history to celebrate the centenary next year.

In spite of his seventy-six years, Sir Rickman had retained his mental and physical vigour unimpaired. After his retirement from surgical practice in 1920 he was free (at his beautiful home at Whitchurch, near Pangbourne) to devote himself with new zeal to those interests in Nature—geological, botanical, and zoological — concerning which his knowledge was amazingly wide and exact. Nor did he allow these interests to affect his devotion to art. An exceptionally gifted draughtsman himself, he was keenly interested in etchings and engravings, of which he had a characteristically critical but appreciative knowledge.

Frankly outspoken and always open-minded, Sir Rickman Godlee's opinions and advice were much valued by his friends.

SIR D. GOLDSMID-STERN-SALOMONS.

SIR D. GOLDSMID-STERN-SALOMONS, better known perhaps by his earlier name of Sir David Salomons, died at his residence at Broomhill, Tunbridge Wells, on April 19, at the age of seventy-three. He was educated at University College, London, and Gonville and Caius College, Cambridge, where he graduated in the Natural Science Tripos of 1873. His uncle was Sir David Salomons, who made a long fight for admission to the House of Commons and was the first of the Jewish faith to sit there. His uncle warmly encouraged Sir David's interest in physics and engineering. He equipped a physical laboratory for him, and a few years later a workshop and a small electric generating station were added to it. Sir David was undoubtedly one of the earliest pioneers of electric lighting for use indoors. He claimed that so far back as 1874 he used incandescent lamps for house lighting. He was a most enthusiastic inventor, making for himself all the electric switches and other devices which he required. He was one of the first to realise the difficulties in the way of heating and sparking that had to be overcome. No one outside the electrical profession realises the immense amount of research and ingenuity that has been

expended in developing the ordinary domestic electric switch.

Sir David took a great interest in the development of engineering in France. He was one of the eight founders of the Aero Club de France, and was a founder and an honorary member of the Automobile Club de France. In the early days, long before there seemed to be any commercial possibilities in automobiles, he had a motor car, and later on he helped the industry by assisting in the formation of the Royal Automobile Club, of which he was a vice-president. He was the author of several books, of which the best known is "Electric Light Installations and the Management of Accumulators," which is now in its eleventh edition. For many years this was practically the only book on the subject, and was in the library of almost every electrical engineer. He also carried out important researches, and made inventions in connexion with electric signalling apparatus, speed indicators and fire-proofing material.

As a member of council Salomons took a great interest in the management of the Institution of Electrical Engineers, with which he was closely connected almost from its inception. He was honorary treasurer for many years, and a vice-president for five years. In 1895 he would, in the ordinary course of affairs, have become president had not several members of council objected. They said that the president of a professional institution should only be a member who was in actual practice. He was president of the Electrical Trades Benevolent Institution, and took a great interest in its prosperity. He was also very interested in the training of young engineers, and founded several valuable scholarships. In his later years he devoted much time to photographic developments. His only son lost his life by drowning in 1915 when on active service.

Sir David was a good citizen and took a leading part in municipal, political and social affairs. He will be sadly missed by the older generation of electrical engineers, who will always remember his useful pioneering work. A. R.

WE regret to announce the following deaths:

Dr. V. Ebner, Ritter v. Rofenstein, professor (1888–1913), and emeritus professor of histology in the University of Vienna, and a member of the Vienna Academy of Sciences, distinguished for his contributions to embryology and histology, on March 21, aged eighty-three.

Dr. G. S. Fullerton, formerly professor of philosophy in the University of Pennsylvania and in Columbia University, and president in 1895 of the American Psychological Society, on March 23, aged sixty-five.

Dr. W. H. Julius, professor of experimental physics since 1896 in the University of Utrecht, and known for his work in astrophysics on anomalous dispersion, on April 15, aged sixty-four.

Dr. Frédéric Morin, president of the Station Climatérique de Leysin, Switzerland, and one of the founders and later a president of the International Union against Tuberculosis, aged seventy-two.

Mr. J. A. Parkhurst, for twenty-five years on the staff of the Yerkes Observatory, and associate professor of astronomy in the University of Chicago, who made contributions to our knowledge of photographic and visual stellar magnitudes, on March 1, aged sixty-three.

Prof. Eduard F. L. Mazelle, formerly Director of the Observatory, Trieste, a corresponding member of the Vienna Academy of Sciences, distinguished for his work on meteorology and seismology, on January 26, aged sixty-two.

Current Topics and Events.

MONDAY next, May 4, will be the centenary of the birth of Thomas Henry Huxley, and the event is one to be held in grateful recollection by all who esteem the pursuit of scientific truth or see the light to which it leads. As a tribute to the memory of this great naturalist and teacher, we are issuing with next week's NATURE a special Supplement containing a remarkable collection of articles surveying his scientific work from various aspects and relating the personal reminiscences of the few remaining people who were in close contact with him during his life. It is very rarely that a great man of science is also a great leader in social and intellectual development, but in Huxley these two qualities were brilliantly combined. The four volumes of his scientific memoirs establish his place in scientific history, and the papers in them display deep insight as well as extraordinary powers of generalisation. As examples of his scientific genius mention may be made of his recognition of the fundamental character of the endoderm and ectoderm, his demonstration of the close affinities between reptiles and birds, and of the ancestry of the horse, and his work "On Man's Place in Nature," in which he showed that the anatomical differences between man and the higher apes were no greater than those between the higher and lower apes, and thus provided substantial evidence of the extension of the evolutionary principle to man. The full significance of this work can be understood only in scientific circles, in which it has taken a permanent place. To the public he was a fearless champion of scientific thought and intellectual freedom, possessing exceptional gifts of lucid exposition in his literary style and lectures, and using them continuously in social service. The symposium which we shall publish in our next issue will, we hope, induce workers and thinkers of the present time to turn to Huxley's life and writings for the stimulus and guidance which are as much needed now as they were in his own days if science is to come into its kingdom.

THE Governors of the Imperial College of Science and Technology, South Kensington, have made special arrangements for the celebration of the centenary of Huxley's birth. During the afternoon of Monday next, May 4, there will be an exhibition in the Zoological Department of the College, followed after tea by an address to be given by Prof. E. B. Poulton on Huxley's zoological work, and in the evening at 8.30 a reception will be held by Lord Buckmaster (chairman of the Governing Body) in the

Royal School of Mines, Prince Consort Road. Huxley was professor of biology at South Kensington from 1854, and was Dean of the Royal College (then Normal School) of Science and the Royal School of Mines from 1881 until his death in 1895. He was also actively interested in the formation of the Central Technical College, which is now, under the name of City and Guilds (Engineering) College, one of the three institutions federated to form the Imperial College. It is thus appropriate that the chief memorial of Huxley's great work should be in some form at South Kensington, and the Governors of the Imperial College hope to raise sufficient funds for a suitable purpose. In moving to this end, the Governors are following the advice given them in 1923 by a meeting of the representatives of the principal institutions with which Huxley was actively connected, including the Royal, Linnean, Geological, and Zoological Societies, the British Association, the Board of Education, as the official successors of the old Science and Art Department, the Education Committee of the London County Council, as the successors of the London School Board, the Hydrographic Department of the Admiralty, the Royal College of Surgeons, the University of London, and the Natural History branch of the British Museum. For the future May 4 is to be recognised at the College as an annual holiday.

IN our issue of April 25, p. 613, reference was made to the fact that the American Museum of Natural History depends largely for financial support on a large body of regular subscribers, and it was suggested that it would be well if the British Museum (Natural History) could obtain similar assistance. That additional funds are needed for work of the first scientific importance is obvious from the letter appearing elsewhere in this issue (p. 638) from Sir Sidney Harmer, Director of the Museum. A modest expedition has been sent out to Tanganyika Territory by the Trustees of the British Museum to a locality which is known to be rich in dinosaur remains, and the funds in hand will allow of work during the present season on a limited scale. It would appear that the remains, including some of gigantic animals, are lying on the surface or close beneath it, and that a well-fitted expedition could obtain specimens which would be of inestimable value to science. However, as Mr. C. W. Hobley pointed out in NATURE of April 18, p. 573, in an article describing the region and its inhabitants, the conditions are such that the best results can only be obtained by a carefully organised expedition with full technical and transport staffs. Sir Sidney Harmer's letter should drive home the urgent needs of the expedition and will, we hope, produce the necessary and practical assistance which he asks. The American Museum of Natural History has been able to fit out an expedition to Central Asia which has been in the field for several years in succession, exploring and digging with striking results. It is surely not too much to expect that the appeal for the comparatively small fund necessary to work an area already known to be strewn with interesting animal remains will meet with ready response.

THE name of Prof. Bohuslav Brauner, Director of the Chemical Institute of the Charles University of Prague, is familiar to many men of science in Great Britain and elsewhere. It is therefore a pleasure to congratulate him on attaining his seventieth birthday on May 8. Prof. Brauner is a grandson of K. A. Neumann, the first professor of chemistry at the Polytechnic High School in Prague. He speaks and writes fluently in no less than six languages, namely, Czech, English, German, French, Russian, and Italian, in addition to a perfect knowledge of Latin and Greek. In chemical science he has acquired an international reputation. He was the first to liberate (in small amounts) the element fluorine from fluoplumbates, and established the complex nature of didymium, separating out the praseodymium. The well-known "critical discussions" of the atomic weight determinations which preface the accounts of each element in Abegg's "Handbuch" are his work. He was an early and vigorous supporter of Mendeléeff's periodic classification of the elements. Prof. Brauner established, but not without opposition, that beryllium is a divalent metal and has an atomic weight 9, thus heading the group of alkaline earth metals in Mendeléeff's system. He was also instrumental in securing the adoption of oxygen (16) as the basis of atomic weight determinations, a large number of which he carefully redetermined himself, devoting much effort to a valuable study of the rare-earth metals. In Bohemia he has done much to foster an interest in science, and through his efforts in 1903-4 the Chemical Institute was erected. In commemoration of his seventieth anniversary a "Jubilee volume" (mainly in English) is being published as a special number of the *Recueil des Travaux Chimiques des Pays-Bas* (price 12*s*. 6*d*. from Dr. W. P. Jorissen, 11 Hooge Rijndijk, Leiden, Holland). This volume will contain thirty-four communications from Prof. Brauner's friends in England and abroad, including prominent chemists, and describing original and recent researches, hitherto unpublished, in general, inorganic, analytical, organic, physical and electrochemistry. It will certainly be of interest to many chemists and physicists.

REFERRING to a point in our leading article on February 21, Mr. A. E. Bostwick, librarian of the St. Louis Public Library, Olive, 13th and 14th Streets, St. Louis, Missouri, writes stating that *aeroplane* is derived from *aero-* + *planet*, as is given by the American New Standard Dictionary (1914), of which Mr. Bostwick was an associate editor, and as is correctly illustrated in the title of the Norwegian publication the "Aeroplanet"—the air wanderer—(1918). It is difficult, however, to see how the final *t* of the Greek root can be dropped to form *aeroplane*. The New Dictionary of the English Language, Oxford, gives the usual derivation from *aero-* + *plane*, which is unassailable so far as Great Britain is concerned. The word *plane*, as denoting surfaces which are "substantially" flat, in patent law jargon, has been established by the custom of more than a century, while the evolution of *aeroplane* to denote first a lifting surface and afterwards a flying machine is

more than half a century old. Sir George Cayley introduced *plane* in this sense in his remarkable articles on "Aerial Navigation," in *Nicolson's Journal of Philosophy* (1809), and Thomas Walker uses *plane* for wings, shown as curved in sketches, in his "Treatise on Aerostation," 1831. F. H. Wenham introduced *aeroplane* to denote a lifting surface in the first report of the Aeronautical Society (1866), and D. S. Brown used *aeroplane* to denote a complete flying machine in the Society's eighth report (1873). Our correspondent further suggests, out of wide experience of American libraries, and of editorial work on encyclopedias and dictionaries, that in the United States *aeroplane* holds its own in technical discussions, and is used as frequently as *airplane*. The point made in our leading article was that the National Advisory Committee for Aeronautics had adopted *airplane* officially. It also appears in numerous aeronautical and engineering journals of standing, but this need not controvert Mr. Bostwick's estimate for the whole range of American publications.

WE have received from the Science Society of China a pamphlet setting out, from a Chinese point of view, how best the Boxer Indemnity could be used. The Society is of opinion that a golden opportunity which occurs once in a thousand years would be lost, or indefinitely postponed, if the funds available either were divided among the Provinces or were devoted to river conservancy or railway construction, but that a maximum of usefulness might be attained if they were expended on pure research work. This is interpreted to mean the establishing of a model national research laboratory for physical, chemical, biological, and industrial work, the subsidising of laboratories of good repute, whether existing as independent institutions or as forming part of universities, and the founding of scholarships for research students. Besides this, the Society favours the establishing of libraries and museums and the endowing of Chinese chairs of literature and philosophy in foreign universities, but fears that the sums available —strangely understated, dollars being confused with pounds—will not cover so large a programme. The Society is strongly of opinion that general principles should be settled before individuals are appointed to allocate the funds. These should be, it is suggested, entrusted to a Board of Trustees under exact terms of reference, and the members, who should be scholars of repute and men of sterling character, should be appointed equally by both countries.

THIS scheme of the Science Society of China, which was published last August, was in September followed as to its general outlines in the scheme adopted by the United States. It doubtless sets out the results of the negotiations which actually took place between Peking and Washington. We note that the Society restricts its suggestions to the advancement of science, concerning itself with instruction rather than education, and limits co-operation between Chinese and foreigners to partnership on a Board concerned solely with the allocation of funds. To us this seems a somewhat barren use of the golden opportunity depicted. What China needs in its education, besides the addition of science to letters, is a system which aims at producing leaders and not merely students; and to promote this she needs in the educational field that kind of help from foreigners, which has brought stability and efficiency into the customs and the postal services by firmness of administration.

EVERY student of the natural sciences must be familiar with the name of Joseph Leidy, and yet each one may wonder at his fellow's familiarity. Few to-day can approach Nature from so many sides and to such good effect. Leidy was for thirty-eight years professor of human anatomy in the University of Pennsylvania; he was for forty-six years an officer of the Philadelphia Academy of Natural Sciences. As author of "A Flora and Fauna within Living Animals" (1851) and of sixty papers on the subject, he is rightly claimed as the father of American parasitology; and yet he has equal right to be styled father of American palæontology; his most perdurable, and probably his best-known, work is the beautiful monograph on "Fresh-water Rhizopods of North America." He was a mineralogist, well versed in gem-stones; his first collection was of flowers, and he was a competent botanist. His skill as a draughtsman and his love of natural objects made him primarily a descriptive naturalist, and as such pre-eminent: "he never," says Dr. H. F. Osborn, "made an incorrect observation or published an incorrect figure." But he was no mere accumulator of facts, for he was an evolutionist before Darwin, an experimental critic of spontaneous generation before Pasteur. It was, indeed, fitting that the centenary of his birth should have been commemorated on December 6, 1923, at Philadelphia, and that there should now have been issued a verbatim report of the many admirable addresses delivered on that occasion; but we regret that no indication is given of where or how the report can be obtained.

THE opening of the Lewis Evans' collection of historic scientific instruments in the Old Ashmolean Building at Oxford has been arranged for May 5. The ceremony will be preceded by the conferment of the degree of D.Sc. *Honoris causa* on Mr. Lewis Evans in the Convocation house. At 2.30 P.M. the Earl of Crawford and Balcarres will deliver an address in the Divinity School and will then pay a formal visit to the collection in the Old Ashmolean Building. The collection will be open to the general public on weekdays between the hours of 11 and 4. An illustration of the building appeared in NATURE for March 3, 1923, on the occasion of the Wren bicentenary celebrations, and Mr. R. Gunther informs us that he has since found additional evidence in support of his view that this building, with but small alterations, is the "College of Science" that was designed by Wren to be erected on the site in Arundel Gardens presented to the Royal Society by Henry Howard. Proving too costly, the building was not erected in London; but when a scientific institution was needed for the Oxford Philosophical Society and for Ashmole's "rarities," Wren's old plan was adapted and adopted.

THE annual congress of the South-Eastern Union of Scientific Societies to be held at Folkestone on June 3-6 should attract a large number of delegates and friends. The officers of the Union for the coming year are as follows: *President-elect*, Sir John Russell, Director of the Rothamsted Experimental Station; *Presidents of Sections*, Botanical, Mr. A. G. Tansley; Geological, Mr. A. L. Leach; Zoological, Mr. E. C. Stuart Baker; Regional Survey, Mr. Geo. L. Pepler. The presidential address to the congress will deal with the place of science in rural life, and is certain to be of much interest. Mr. Tansley, in his address to the section over which he presides, will deal with the vegetation of the English chalk, Mr. Leach with new road sections in north Kent, Mr. Baker with field naturalists and evolution, and Mr. Pepler with regional survey in east Kent. The evening lectures will be by Mr. D. Ward Cutler on "Life in a Garden Soil," Sir Arthur Smith Woodward on "The Evolution of Fishes," and Capt. J. J. Eckersley on "Broadcasting." The afternoon excursions include a novelty in the shape of a trip to Dungeness, that wild and remote shingle-tract which forms the seaward extension of Romney Marsh. Here both plant and animal life are unique and fascinating. Dover Castle, and the country behind Dover, will be visited, as also the recently excavated Roman remains at Folkestone, and several other places of interest. A Congress Museum, exhibiting current work by members of the Union, is in course of preparation, and should prove a most attractive adjunct to the gathering. A Handbook of Local Surveys is being prepared and will be published before the congress. The chapters—about twenty in number—will deal with local flora and fauna, geology, ecclesiastical architecture, Romano-British remains, and other subjects of interest. Copies of the book (price 2*s*.) may be ordered from the Secretary of the Folkestone Natural History Society, 16 Manor Road, Folkestone, who is also one of the local secretaries of the Congress.

THE first of the two annual conversaziones of the Royal Society is to be held on Wednesday, May 13, at 8.30.

SIR THOMAS H. HOLLAND, Rector of the Imperial College of Science and Technology, South Kensington, and formerly Director of the Geological Survey of India, has been elected president of the Institution of Mining and Metallurgy.

WE learn that it is intended to undertake the preparation of a biography of the late Dr. W. H. Maw, editor for many years of our esteemed contemporary, *Engineering*. Those of his personal friends, colleagues or correspondents who may have interesting material, especially in the shape of personal reminiscences or letters, to contribute, are requested to communicate with Mr. W. E. Simnett, c/o The Institution of Civil Engineers, Great George Street, London, S.W.1.

THE World List of Scientific Periodicals has now grown considerably beyond its original size, with the result that the next issue will be in two volumes, one to be issued this month, and the other by the end of the year. The List will be published by Mr. Humphrey Milford of the Oxford University Press. Subscriptions from Great Britain and Ireland will become due on May 15 and from other parts of the world at later dates: they should be addressed c/o Zoological Society, Regent's Park, London, N.W.8.

DURING the course of a recent lecture to the Society of Glass Technology on "Glass as an Instrument of Human Progress," Prof. W. E. S. Turner stated that he has had discussions very recently with manufacturers of optical instruments as to the best source of optical glass at the present time. It is very gratifying to learn that in the view of manufacturers whose reputation depends on their obtaining optical glass of the finest qualities, British optical glass is regarded as entirely superior to that of Continental or other makes. Two well-known instrument makers expressed the opinion that in view of the prejudices, both of the general public, and frequently, also, of scientific workers, in favour of instruments made from Jena optical glass, the present state of affairs ought to be widely advertised.

THE value of the intensive study of a small region as an introduction to wider geographical work is now recognised in most schools of geography and also in some secondary schools. A useful pamphlet, which claims to be no more than a guide to methods and sources of information, has been written by Mr. C. G. Beasley ("Local Geography." London: T. Murby and Co. Price, 1*s*. 6*d*.). The pamphlet begins with a scheme of regional survey in which Mr. Beasley shows how to link the human with the physical geography of a district, and discusses the preparation of a map or diagram to show types of land utilisation. The last section of the book is a useful but not exhaustive account of the sources of information. The pamphlet merits the attention of teachers who aspire to give a sound basis to their geographical work.

WE have received Heft 1 (for January) of a new German monthly periodical—the *Anzeiger für Schädlingskunde*. It is intended for the publication of short original articles and also as a medium for issuing notes and other announcements relating to the German Society of Applied Entomology, to the members of which it is supplied gratuitously. The editors are Dr. K. Escherich of Munich and Dr. F. Stellwaag of Neustadt a. H. The journal is published by the firm of Paul Parey of Berlin, and the present issue consists of twelve pages, but its size (28 cm. × 20·5 cm.), double columns and small type, allow of a larger amount of letterpress than might appear at first sight. It contains four short contributed articles and certain news items. The articles include one by Dr. Escherich, on the transference of wireworms through forest-litter (Waldstreu), and a longer contribution by Dr. H. Eidmann on the pyralid moth *Dioryctria splendidella* H.S. and its importance to forestry, both articles being illustrated by text-figures. The other contributors are Dr. A. Frhr. von Vietinghoff-Riesch, who writes on the pine moth and the bird world, and Herr Jac. Schlösser, who describes his experiences with arsenic "burning" in the control of fruit-tree pests.

SOME indication of the valuable work which is being done by the Canadian Government in investigating

the customs and beliefs of its Indian population, as well as in preserving a record of such of their traditional songs, legends, and ceremonies as have not already passed beyond recovery, is furnished by the Report of the Department of Mines for the period ending March 31, 1924, which has just been issued. The section dealing with the work of the Anthropological Section of the Victoria Memorial Museum shows that, in the course of the year, six scientific trips were undertaken which covered investigation among the Bella Coola, the Gitksan of Skeena River, British Columbia, the Carrier Indians of Bulkley River, B.C., and archæological excavations in Ontario. Some of the results of these expeditions were submitted to the British Association at the Toronto meeting last year. Perhaps the most noteworthy material obtained was that bearing upon the ceremonial dances of the Bella Coola by Mr. McIlwraith, which have thrown much light upon Indian psychology and afforded an opportunity for collecting valuable information on the chieftainship, government, magic, mythology, etc. More than one hundred songs were recorded by phonograph.

IN September of last year the Fuel Research Board of the Department of Scientific and Industrial Research issued a pamphlet which described the Arley Seam of the Lancashire Coalfield, and pointed out that this was to be the first of a series of similar pamphlets dealing in detail with the physical, chemical, and other characteristics of the individual coal seams of Great Britain. In pursuance of this scheme the Board has recently issued Part 1 of a report on the Ravine Seam of the same coalfield. (London : H.M. Stationery Office, 1925. 1*s.* 6*d.* net.) The seam is fully described in all its details, as it appears in different parts of the field, the variations which it undergoes being clearly indicated. There are numerous analyses, proximate and ultimate, together with a good study of the composition of the inorganic matter present. Washery tests and microscopical examination of the coal are also included. It is to be regretted that the more modern method of X-ray examination of the coal in order to determine the distribution of its inorganic contents has not been made use of. It is stated in the preface that "large scale experiments, including steam raising tests, the carbonisation of the coal at low and high temperatures, and the utilisation of the coke in a water gas plant, are in progress at H.M. Fuel Research Station, and the results will be published as Part 2 of this report."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned : an assistant lecturer in geography in the University of Manchester —The Internal Registrar (June 8); a probationer for the Indian Forest Service—The Secretary, Services and General Department, India Office, S.W.1 (July 1); principal of Agra College—The Commissioner of Agra, India (July 10); a reader in organic chemistry in the University of the Punjab, Lahore—The Joint Registrar (July 31); a physics laboratory attendant in the Science Department, University of Durham—Head of the Department, South Road, Durham.

Our Astronomical Column.

COMETS.—Mr. B. M. Peek of Boscombe and Mr. G. P. B. Hallowes of Wimborne have succeeded in obtaining a considerable number of observations of Reid's Comet though its meridian altitude was only 11°. Two of Mr. Peek's observations are given (referred to the equinox of 1925·0).

	G.M.T.		R.A.		S. Decl.
Apr.	15^d 22^h 54·5^m		13^h 3^m 39·68^s		25° 59′ 37·3″
	24 22 13·4		12 50 1·36		28 12 48·0

They are corrected for differential refraction, but not for aberration or parallax. Taken in conjunction with the early observations given a few weeks ago, they will permit the deduction of improved elements.

A new orbit of Orkisz's comet has been computed at Copenhagen ; but it differs so slightly from Mr. Merton's orbit (NATURE, April 25, p. 616) that it is unnecessary to give it. Prof. Banachiewicz of Cracow has directed attention to the resemblance of the orbit of the comet of 1500, for which Dr. Hind found the following elements from Chinese observations : T 1500 May 17, ω 20°, Ω 310°, i 105°, log q 0·146. It is desirable to observe the comet as long as possible in order to decide the question of identity. Since it is travelling into high north declination, it is well placed for this purpose.

The following orbit of Schain's Comet has been deduced by Dr. A. C. D. Crommelin from observations on March 23 at Bergedorf, April 2 and 14, by Dr. W. H. Steavenson at Norwood.

T	= 1925 Aug. 6·918 G.M.T. (new)
ω	200° 31′ 10″
Ω	357 29 12
i	146 55 47
log q	0·629662

T is not likely to be more than a few days in error. Unfortunately, the comet will be hidden in the sun's rays at the time of perihelion, but it will be observable again from November onwards.

It should be noted that this comet was independently discovered by Señor Comas Solà at Barcelona a day after Mr. Schain detected it : custom therefore allows the coupling of the two names as joint discoverers, as the second detection took place before the news of the discovery had been distributed. Both discoverers found the comet in the course of their regular photographic search for new minor planets.

PROPOSED NEW ASTRONOMICAL CO-ORDINATES.—In the *C.R. Acad. Sci.*, Paris, March 2, M. C. Solà points out that, in order to study the sun's motion, a system of co-ordinates is required which does not rotate. A uniform rectilinear motion of translation of the origin need not be considered, since in infinite space such a motion has no real meaning. Since the position of the centre of gravity of the Milky Way is not known, it cannot be employed as the origin, and a system of axes based on the stars, particularly the brighter ones, most of which have definite proper motions, cannot be regarded as necessarily free from rotation. Under these conditions, it is better to take the centre of the sun as origin, and to measure the position of the stars in the different streams which form the Milky Way with respect to axes passing through it, and fixed with respect to the most distant objects visible, such as the globular star clusters, or, possibly better still, the spiral nebulæ. As these can be regarded as being practically at an infinite distance with respect to the bright stars, the axes so defined could be regarded as practically free from rotation. It is pointed out that modern astronomical knowledge demands the degree of exactitude which could be obtained in this way.

Research Items.

THE GOD SETEKH.—Some interesting deductions bearing upon the development of religious beliefs in ancient Egypt are made by Mr. R. O. Faulkner in the March number of *Ancient Egypt* from references to the god Setekh in the Pyramid Texts. The centre of the worship of this little-known deity appears to have been Ombos in Upper Egypt, and he appears to have been to some extent the embodiment of the destructive powers of Nature. In the Osiris and Horus myths of the later texts stress is laid upon his malevolent activities; but the Pyramid Texts, the oldest beliefs concerning him which have come down to us, present contradictory ideas which probably represent different stages in his history. Originally he ranked as equal with the other gods. Thus his relations with Horus and Osiris vary in three ways: (1) Setekh is without either friendliness or hostility, but stands over against them as representing a different tract of the country; (2) Horus and Setekh co-operate for the benefit of the deceased; (3) Setekh is the mortal foe of Horus. As the Osiris cult gained ground Setekh became hostile to him also. It is not always clear whether Horus is the old tribal Horus or the son of Isis. Probably the tribal myth was transferred bodily into the Osirian legend, the original cause of hostility being the feud for the supremacy of Egypt settled in the lawsuit which was brought before the court of the gods at Heliopolis. The reversal which converted Setekh from one of the principal gods of the Egyptian pantheon to an outcast was no doubt due to political causes, and the frequency with which he appears as the enemy of Osiris is to be attributed to the comparatively late rise of the cult of that deity when the evil character of Setekh had been fully established.

IRISH SEA HERRING.—The report for 1923 on the Lancashire Sea-Fisheries Laboratory contains three papers dealing with investigations into the life-history and fishery of the herring in the Irish Sea. Mr. A. Scott, from the results of his examination of stomach contents, concludes that the movements of both herring and mackerel are influenced to a very considerable extent by the presence or absence of plankton organisms, and believes that it should be possible to predict with a fair amount of accuracy whether these fishes will arrive earlier or later than usual, by making adequate observations on the plankton. The food of the herring during the fishery in June, July and August 1923 consisted of the few months' old stages of fishes such as rockling, sand-eels, clupeoids, gurnard and long rough dab, along with the crustaceans Meganyctiphanes, zoea and megalopa stages of crabs, larval pagurids, Pandalus, and various Copepoda. Mr. W. C. Smith, in a study of the composition of the Manx herring shoals, states that young fish approach the coast in May and remain close to the land for about three months, increasing in abundance during June and July, and moving to the deeper water off the Calf of Man in August. Older fish come in later, appearing on the Irish side of the Channel in July, and gradually working across to the "Calf" waters to meet the other shoals in August. Mr. W. Birtwistle and Miss H. M. Lewis made an extensive examination of Irish Sea herrings in 1923 with regard to age, growth, and maturity, and now put forward two interesting hypotheses: (1) Irish Sea herrings are all autumn spawned; (2) herrings spawned in the very early autumn will show a greater mean length and a more advanced mean stage of maturity than herrings spawned in the late autumn.

SEX DIFFERENTIATION IN THE CHICK.—In a paper published in 1921 (*Jour. Exp. Zool.*, v. 33), Minoura put forward the claim that he was able to produce in the developing chick embryo intersexual forms due to the action of the sex-hormones secreted by a gonad of the opposite sex grafted on to the chorio-allantoic membrane. His work was of fundamental importance, since it provided the only experimental support of Lillie's theory of the causation of free-martin in cattle. Minoura's experiments were recently repeated by A. W. Greenwood (*Brit. Jour. Exp. Biol.*, 2, No. 2, 1925). The technique has been greatly improved and a sex-linked cross was used, making it possible to identify the sex of the chicks at an early stage in development. Although the author obtained many successful grafts, he has entirely failed to confirm Minoura's results. He shows that Minoura cannot be said to have demonstrated conclusively that the differentiation of the sexual apparatus of the host embryo can be modified towards an intersexual condition through the action of a gonad graft of the opposite sex. Further, he shows that the conditions obtaining in the bovine free-martin are not reproduced in these experiments, in that in the latter the embryo is exposed to the specific action of the grafted gonad alone, whereas in the former the female co-twin is exposed to the action of all the internal secretions from the male.

A MULTIPLE TEMPERATURE INCUBATOR.—C. B. Williams and T. W. Kirkpatrick describe (Ministry of Agric., Egypt, Technical and Sci. Service, Bull. No. 38, 1924) useful forms of this apparatus designed to enable them to study the behaviour of cotton pests at a number of different temperatures in order to find their death-point, the points of greatest and least activity, and their rates of development at temperatures close together and approximately constant. A copper or aluminium bar, tube, or trough is inserted at one end into a hot tank and at the other end into an ice-box—all suitably insulated so as to minimise changes of temperature. In the first apparatus a copper bar was employed, and in this 71 holes were bored at intervals; each provided a place where a tube could be maintained at a different temperature the daily variation of which was found in any one case to be less than half a degree. The authors suggest that bacteriologists and mycologists may find the apparatus useful.

A NEOTENOUS SALAMANDER FROM JAPAN.—M. Sasaki (Jour. Coll. Agric., Hokkaido Imp. Univ., Japan, vol. 15, pt. i., 1924) gives an account of the bionomics of a salamander, *Hynobius lichenatus*, which, in Lake Kuttarush, occurs as a typical neotenous form, regularly breeding in that phase. While the phenomenon of neoteny is not rare, particularly among the Urodela, reproduction in the neotenous condition has hitherto only been known in the Axolotl. The larvae of neotenous parents underwent normal metamorphosis under laboratory conditions. From experiments the author concludes that the main factor which brings about neoteny is low temperature, to which, however, must be coupled a rich food supply. The temperature must not be so low as to impair the vitality of the animals and inhibit feeding, since starvation, even under otherwise good conditions, stops both growth and metamorphosis. Conditions suitable to neoteny, a permanent temperature of from 4°-10° C. and a rich food supply, were found to exist in the Nitella zone of Lake Kuttarush, where neotenous forms of *Hynobius lichenatus* were found by the author in abundance and regularly reproducing.

EMULSIFIED OIL-SPRAYS FOR LEMON CULTURE.—A large number of the lemon groves of Florida are

located in artesian well districts, and the water from these wells is utilised in spraying the trees for white flies and scale insects. Unfortunately this water is particularly hard, and great difficulty is met with in mixing unstabilised oil-emulsions with it. Accordingly the water was treated with caustic potash fish-oil soap prior to adding the emulsion, but the method involved trial and error; caustic soda and fish-oil soap, used separately, were found more economical. Where the rust mite prevails, as in the United States and the West Indies, other measures have to be taken. Messrs. W. W. Yothers and J. R. Winston give details of the use of combination sprays both for rust mite and for other insects, in Bulletin 1217 of the United States Department of Agriculture (1924). These sprays concern the use of soda-sulphur or potash-sulphur solutions mixed with unstabilised oil-emulsions, but they are not always so effective as they might be, and a lime-sulphur solution has been employed to greater advantage as an insecticide. Unfortunately there is again a difficulty in getting the lime-sulphur solution to mix with unstabilised oil-emulsion. Experiments in the direction of stabilising oil-emulsions have shown that the use of colloidal substances such as glue, skimmed-milk powder, casein, wheat flour, corn-starch and laundry starch produces the desired effect. The combination spray is made by filling a spray tank full of water, to which is added the requisite amount of lime-sulphur solution; then the stabilised oil-emulsion is added, consisting, for example, of paraffin or lubricating oil, water, caustic soda, fish-oil soap, and glue. After agitation the spray is ready for use, and it can be applied to foliage, branches, or fruit without injury, providing that the whole process of mixing has been carefully carried out and the correct proportions of each ingredient employed.

UPPER AIR CIRCULATION OF THE ATLANTIC.—The upper air circulation of the Atlantic Ocean is dealt with by Mr. E. W. Barlow of the Meteorological Office, Air Ministry, in Professional Notes, vol. 3, No 39. An historical account is given of upper wind currents and temperatures over the Atlantic obtained chiefly from kites and pilot balloons, and our present knowledge of air circulation in relation to trades and counter trades is indicated. The meteorological aspects of Atlantic flying are dealt with; these include sea-fog and conditions which create "bumpiness," and advice is given as to the most favourable heights for flights to North and South America. The work is of considerable interest, and the author has brought together a good deal of useful information. Some early discussions by the Meteorological Office, and especially those carried out under the supervision of Capt. Toynbee on the Atlantic equatorial regions, scarcely receive the attention they deserve. These earlier discussions show that in the region of the Doldrums, with north-east winds at the surface, the direction of upper clouds is generally from south-east, and with surface winds from south-east the upper clouds are about equally from south-east and north-east. To the north of the Doldrums and to 20° N., with wind north-east there is a high percentage of the upper clouds from south-west. To the south of the Doldrums and to 10° S., with wind south-east, there is a high percentage of upper clouds from south-west and a fairly high percentage from north-east. These results are obtainable for each month. Table IV., by the author, gives the times in hours required for flight between Newfoundland and Ireland under best, ordinary, and worst conditions. The Meteorological Office "Synchronous Weather Charts of the North Atlantic Ocean, 1882–3," have been used for these calculations. These charts represent the weather conditions for a single year, and the weather in any other year would in all probability be very different, a fact which should be emphasised.

CLIMATE OF THE NETHERLAND INDIES.—The Royal Magnetic and Meteorological Observatory of Batavia, in Verh. No. 8, vol. 1, part 7, gives a discussion of the weather by Dr. C. Braak. In addition to the Dutch text English summaries are given. Favourable conditions for lightning and thunder appear to be calm air and an unstable vertical temperature distribution, extending to a great height. The bulk of tropical thunderstorms are heat thunderstorms, short-lived, and of relatively small extension. Fewer persons seem to be struck by lightning in the East Indies than in Europe, and fires caused by lightning are very rare. Special kinds of trees are struck fairly frequently, in particular the coco-nut palms. Hail is said to be a rare phenomenon in the tropics, but instances are given of the occurrence of hailstorms; they are most frequent in the monsoon changes, as is the case with thunderstorms. No marked connexion is shown between pressure and sunshine or pressure and temperature, but there appears to be a pronounced relationship between sunshine and temperature. A comparison is made between the climate of the Netherland Indies and that of other regions. With regard to temperatures of the wet bulb thermometer, it is noted that whilst at Batavia the maximum heat, although disagreeable, can be endured without too much discomfort, the same cannot be said of many other places in neighbouring countries. Destructive cyclones are rare. A comparison is made of the climates of those regions in the Archipelago and outside of it where the best results are obtained with different crops.

THE JAPANESE EARTHQUAKE OF SEPTEMBER 1, 1923.—Several papers have recently been published on the great Japanese earthquake of 1923, one of unusual interest being that by Mr. K. Shiratori (*Japanese Journ. of Astr. and Geoph.*, vol. 2, 1925, pp. 173-192). From the seismographic records at Sendai, he locates the epicentre in Sagami Bay off the southern end of the Miura peninsula, and the focus at a depth of 44 km. From September 1 until the end of the year, 652 after-shocks were recorded at Sendai, of which 80 were comparatively strong. The epicentres of the latter are distributed in three zones, together in the form of the letter N. The first zone is parallel to the Fuji volcanic zone and traverses the Idzu islands. The second, branching from the first near Tanzawa Mountain, runs along the Miura peninsula, crosses the Uraga channel, and meets the third zone, which follows the line of the Yamiso Mountains, off the east coast of the Boso peninsula. These zones are so intimately connected that, when one is active the others also come into action. Mr. Shiratori remarks that observations of the earth-potential at Sendai show abnormally large variations during near earthquakes, those at the time of the great earthquake being very marked.

VOLCANIC ACTIVITY IN KILAUEA.—In his interesting account of the recent eruption of Kilauea, Dr. T. A. Jaggar remarks on the periodicity of the great eruptions of that volcano (Hawaiian Volcano Obs., Mon. Bull. for April and May 1924). These have occurred in the years 1790, 1823, 1855, 1887, and 1920 (the culminating year of the present cycle), the mean interval between successive eruptions being thus 32·5 years. For Vesuvius, about 33 years is a common interval, the last two eruptions having occurred in 1872 and 1906. "It would appear, and this agrees

with Omori's work in Japan, that 130, 65, and 32·5 years are intervals significant in volcanism." In the *Volcano Letter* for February 19, Dr. Jaggar uses the percentage of dead cones in a district as an index of comparative volcanic activity in different Pacific regions (Sumatra, South Japan, the Fuji cross-zone in Japan, the Kurile Islands, the Tonga Islands, and the Hawaii Islands). He concludes that the extinction becomes less and the activity greater as we advance from the continental to the oceanic districts.

OIL AND GAS POSSIBILITIES IN MONTANA.—In a recent publication of the Department of the Interior, United States of America, we have a striking example of the value to a nation of highly organised geological survey, one that exists not only to amass and co-ordinate data of regional geology, but also to disseminate results and conclusions of contemporary economic import. In an area lying to the south of the Bearpaw Mountains, Montana, some little oilfield development had already been in progress, but had met with indifferent success; the United States Geological Survey accordingly sent Mr. Frank Reeves to investigate the geology and petroleum possibilities here, and the results of his survey are now available to the public in an excellent bulletin (751-C), one of high technical and literary merit. The author concludes that an area is favourable from a commercial point of view because the strata (*i.e.* Cretaceous) contain abundant organic material "of the proper kind to yield oil"; further, that there has been sufficient, but not too much, regional alteration of the sediments to influence oil formation from this organic material; that there are suitable reservoirs of porous strata; that structures favourable to oil accumulation are present; that there has been no escape of oil by faults or as a result of flushing by circulating ground-water; that the character of the water found in one oil well sunk is favourable to the existence of oil, and that gas in commercial quantity has been located within the area. If geological advice can be of positive value in minimising risk of failure, here is a clear case where the chance is worth taking, though, as the author conscientiously remarks, "no one should invest money in the drilling of wells here unless he can afford to lose it." For the rest, the survey of this area shows it to be geologically typical of much of the north-central Montana country, characterised especially by its full Cretaceous development, its complexities of folding and faulting—the last factor of a somewhat unique kind in this area—and its abundant evidence (though not always on a commercial scale) of bitumen in one form or another.

MINERALOGY OF FOSSIL BONE.—The common belief that fossil bones are generally silicified is completely disproved by A. F. Rogers, who has thoroughly investigated a collection of 300 different examples ranging from the Ordovician to recent times, and gathered from widely separated countries in every continent. The evidence, which is convincingly set forth with numerous excellent photomicrographs in the Bull. Geol. Soc. America, vol. 35, pp. 535-56, 1924, shows that fossil bone consists almost entirely of the amorphous mineral collophane, which is also the principal constituent of phosphate rock. Collophane is not a definite chemical compound, but seems to be a hydrous solid solution of calcium carbonate (with smaller amounts of the fluoride and sulphate) in calcium phosphate. Corresponding to this the refractive index of fossil bone ranges from 1·573 to 1·621, though the smaller range, 1·595 to 1·615, includes the great majority of the specimens. The values show no regular relation to geological age. Bones seem to become fossilised in a comparatively short time, and after that no further changes of importance take place. The collophane of fossil bone exhibits a feeble double refraction due to strain, and a thin section of the spine of a Permian reptile even displayed a distinct pleochroism from pale to deep yellow. This is probably the first record of pleochroism in an amorphous substance. Of all the specimens examined only three were found to be silicified. Various forms of silica, together with calcite, are commonly associated with collophane, but whereas the latter fills up the pores left by the removal of organic matter, and so preserves the structure of the bone, the associated minerals are usually merely the infillings of cavities. Thus it is found that the well-known opalised bones from White Cliffs in New South Wales are internal casts showing no organic structure.

DEFINING IRON AND STEEL.—The definitions of steel and cast iron as given by various authorities may be divided into two classes: (1) those based on the principal properties and methods of production of these materials; and (2) those based on the constituents present, *i.e.* on the carbon content. For example, steel is defined as an iron alloy which can be hardened by quenching or results from melting and is very tough, or is an iron alloy containing a certain quantity of carbon which when quenched is hard and elastic, etc. A definition based on the method of production is not really appropriate, for when a new method has been discovered, the definition has to be altered. The definition based upon properties is also inadequate, for the words "hard," "tough," and "elastic" are all relative. In a recent issue, Vol. 13, No. 2, of the Science Reports of the Tohoku Imperial University, Prof. Honda discusses this question and concludes that the only satisfactory definition is on the basis of composition. He defines steel as an iron carbon alloy with a content of carbon lying between 0·035 and 1·7 per cent. Cast iron is defined as an iron carbon alloy the carbon percentage of which lies between 1·7 and 6·7. The lower limit of 0·035 in the case of steel is chosen because, up to this amount, the carbon is retained in solid solution in the iron. These definitions take no account of the other constituents ordinarily present in steel and cast iron. While these may be regarded as immaterial in the case of steel, such is not the case for cast iron. However, Prof. Honda's contribution to the question is a step in the right direction.

UNITED STATES ORDNANCE.—The issue of the Journal of the Franklin Institute for March contains the address on modern ordnance delivered in September 1924 at the centenary celebrations of the Institute by Major-General C. C. Williams, of the United States War Department. It is devoted chiefly to the improvements which have been effected in the six years since the War, and shows that in almost every type of gun the range has been increased by about 50 per cent. at the expense of a small increase in weight. For sea-coast protection the guns are sixteen-inch and throw a projectile weighing more than a ton a distance of 27 miles. It has been decided that the long-range guns of the "Big Bertha" type are of doubtful value, as their work can be much more cheaply done by bombing aeroplanes. The demolition type of bomb has been considerably developed, and although a 4000 lb. bomb is under trial, it is believed that a 2000 lb. bomb will be the largest size needed. These bombs are timed so as to penetrate to the lowest story of a building or 40 to 60 ft. below the surface of the water before exploding. In this way the maximum effect is produced, and in the case of a ship greater damage is done by a near hit than by a direct one.

Royal Meteorological Society.

THE Royal Meteorological Society was founded under the name of "The British Meteorological Society" on April 3, 1850, and the occasion of its seventy-fifth anniversary was celebrated in London on April 21 and 22. The following brief account of the history of the Society and of its predecessors may therefore be of interest.

The first English Meteorological Society was inaugurated so long ago as 1823. Luke Howard, Thomas Forster, and Dr. Birkbeck were among its founders, while Prof. Daniell was one of its members. The Society became dormant shortly afterwards, when Luke Howard moved away from London, and in 1836 a new Society was formed, which was generally known as the Meteorological Society of London. One of its members was John Ruskin, who in 1839 contributed to the Society's Transactions a paper from which the following extract is taken:

"A Galileo, or a Newton, by the unassisted workings of his solitary mind, may discover the secrets of the heavens, and form a new system of astronomy. . . . But the meteorologist is impotent if alone; his observations are useless, for they are made upon a point, while the speculations to be derived from them must be on space." The truth of these words is realised more forcibly to-day than ever before, and it is remarkable that they should have been written so long ago.

The 1836 Society developed pronounced astrological tendencies as time went on, and this fact appears to have led to the foundation of the present Society in 1850. Mr. J. Glaisher, F.R.S., was secretary of the Society from 1850 until 1873, except during 1867–68, when he was president, and apparently his was the guiding spirit in the earlier years of the Society. The distinguished engineer Robert Stephenson, F.R.S., was president in 1857–58. Until 1866 the Society was a voluntary association of members, but in that year a Royal Charter of incorporation was obtained whereby members of the British Meteorological Society became fellows of the Meteorological Society. In 1882 permission was obtained from Queen Victoria to change the name of the Society to that at present in use, namely, the Royal Meteorological Society.

In conformity with the ideas expressed by Ruskin, the Society at first devoted itself to the expensive task of the collection and publication of meteorological observations from a number of stations, chiefly in England and Wales, as well as to the reading, discussion, and publication of original papers. For it will be recalled that in 1850 there was no State provision for meteorology in Great Britain. The results of this work are printed in the "Meteorological Record," which was published annually from 1881 until 1910. In 1911 the work was transferred to the State service, the Meteorological Office. Many investigations were undertaken by the Society in its corporate capacity, and brought to a successful conclusion; among these may be mentioned the collection of phenological observations from the area of the British Isles, and the annual publication of a phenological report in the Quarterly Journal of the Society. This enterprise is still vigorously pursued, the whole of the work of observation and compilation being voluntarily given. In 1919 the Scottish Meteorological Society, which had been founded in Edinburgh in 1855, was dissolved, and as many members of that Society as so desired were received as fellows of the Royal Meteorological Society.

The celebrations on April 21 and 22 took the form of (1) a visit to Kew Observatory, by invitation of the Director of the Meteorological Office; (2) a conversazione in the rooms of the Society at 49 Cromwell Road, South Kensington; (3) an anniversary meeting, when a lecture on "Clouds and Forecasting Weather" was delivered by Prof. E. van Everdingen, president of the International Meteorological Committee and Director of the Royal Netherlands Meteorological Institute; and (4) a dinner at the Hotel Rembrandt. About 75 persons attended the various functions, and the guests included members of the International Commission for the Exploration of the Upper Air, who had previously held meetings at the Meteorological Office under the presidency of Sir Napier Shaw.

The visit to Kew Observatory during the afternoon of April 21 was much enjoyed, fine weather favouring the event. The visitors were shown over the observatory, and had the experience of witnessing the release of a registering balloon.

The conversazione on the evening of April 21 was held in the rooms of the Society and the visitors were received by Mr. C. J. P. Cave, president of the Society, and by Mrs. Cave. A number of exhibits, many of which had been lent for the occasion by fellows of the Society, were arranged, and Mr. F. J. W. Whipple showed a number of experiments, including the formation of halos, coronæ, and the green ray.

The anniversary meeting on the afternoon of April 22 was the principal event in connexion with the celebrations. The president welcomed the four honorary members who were present, namely, Prof. W. van Bemmelen, lately Director of the Batavia Observatory; Prof. E. van Everdingen; Prof. H. Hergesell, Director of the aerological observatory at Lindenberg; and Prof. Th. Hesselberg, Director of the Norwegian Meteorological Service and secretary of the International Meteorological Committee. The president then read a telegram which had been sent to His Majesty the King, patron of the Society, and the reply from His Majesty, which concludes: "The King rejoices in the thought that recent years have seen important advances in the science, and he earnestly trusts that the Society will be able to record still further developments in their valuable and interesting labours." Afterwards a number of addresses of congratulation were read from foreign meteorological institutes and other scientific bodies, and from a number of private persons, including a letter from the venerable Prof. H. Hildebrandsson of Upsala, foreign member.

Prof. E. van Everdingen then delivered his lecture on "Clouds and Forecasting Weather." He said that failure to forecast the weather 24 or 36 hours ahead can be ascribed to lack of suitable observations, among which are those of the motion of high and medium clouds. He showed an example of the improvement in the forecasts which would have been produced had cloud observations been available, and put forward a strong plea for the regular observation and transmission of information regarding cloud motion. The methods of the "weather-wise," who use only local observations to foretell coming weather, are ill-defined, but it is not difficult to account for many of their maxims in the light of modern knowledge, as derived from aerological research and the observation of clouds from aircraft. The main object of cloud-observation for the professional forecaster ought to be to tell him something definite of the atmospheric conditions in the upper air over the whole area of his map. Inversions of temperature usually occur over cloud-sheets, and if the latter are identified at a number of stations, the horizontal

extent of the inversion is defined. Such inversions tend to prevent upward convection and the formation of rain is hindered. Complete observations of halo would be of material assistance. At de Bilt in 1922, rain followed halo in 70 per cent. of cases of halo observations, and only 70 out of 200 rain-days were not preceded by halo observations somewhere in Holland.

The anniversary dinner was held on the evening of April 22. After the toast of the King, patron of the Society, had been enthusiastically honoured, Mr. H. Mellish proposed the toast of The Services, and Capt. H. P. Douglas, Hydrographer of the Navy, responded. He spoke of the work which is now being done in the Navy in the investigation of the upper air by pilot balloons and registering balloons. Sir Philip Sassoon, M.P., Under-Secretary of State for Air, proposed the toast of the Royal Meteorological Society. He referred to some of the events in the history of the Society, and paid a tribute to the aid which meteorologists had been able to send to the Airship R33, in the shape of weather reports and directions for the best course to be taken, on the occasion of its recent break-away in a gale from its mooring-mast at Pulham. The president responded to this toast. Sir Napier Shaw proposed the toast of International Meteorology, and Prof. E. van Everdingen responded.

R. C.

The British Science Guild.

THE annual meeting of the British Science Guild was held in the Salters' Hall on Tuesday, April 21, the chair being taken by the Right Hon. Lord Askwith, president of the Guild.

Reviewing the work of the Guild, the chairman directed attention particularly to its co-ordinative functions, linking together the operations of many different bodies, and to its efforts to bridge the gulf between men of science and the general public. Reference was made to the issue of the revised edition of the Catalogue of British Scientific and Technical Books, which now contains more than 9500 titles of books, and should prove most valuable to students, libraries, and manufacturers. Methods of obtaining "Science Publicity" are being considered, but this demands the co-operation of leading scientific and technical societies. A new feature has been the formation of six standing committees (National Security, Parliamentary, Health, Research and Industry, Finance, and General Purposes).

An address emphasising the need of increasing knowledge of science among the public, and the application of scientific method to public affairs, was delivered by Sir William Bragg, who pointed out the contrast between the marvellously rapid development of scientific data, and the meagre facilities for letting the public know what was being done on their behalf. The forty millions of people in the British Isles are living on the direct application of science, and they should know what science has done, and what it might do in the future. It is unfortunate that scientific men, who spend their days in wresting information from Nature in the laboratory, have not as a rule the supplementary gift of conveying scientific information in a popular form. Publicity for science is needed. If, as it is hoped, a proper organisation for publicity in scientific matters could be created, there should be at its head a scientific literary man, and behind it funds sufficient to tide over the first period of its existence.

Sir Arthur Newsholme, speaking as chairman of the Health Committee, said that the average life of a child born to-day is some 10 to 12 years longer than it was 30 to 40 years ago. This is due to a better knowledge of the laws of health. What should be investigated are the causes of evils rather than their alleviation—as illustrated by the millions of headache powders and similar nostrums sold. Attention has been directed by the Health Committee to two defects in the Births and Deaths Registration Bill now before Parliament. There is no valid verification of the fact of death, and the certificate of death should be regarded as confidential and lodged with the registrar and not handed to the nearest relative.

Major the Hon. H. Fletcher Moulton (chairman of the Research and Invention Committee) pointed out that in regard to industry there is a gap similar to that remarked on by Sir William Bragg in connexion with publicity. Manufacturers of Great Britain are sometimes blamed for not availing themselves more freely of the results of scientific researches. There is, however, a gulf between the man working in the laboratory and the business man. An intermediary, who could demonstrate to the latter how he would benefit from the application of science, is needed. It is in this intermediate stage that Germany has made such rapid progress.

Excavations at Cresswell Crags, Derbyshire.

AT a meeting of the Royal Anthropological Institute held on April 21, Mr. A. Leslie Armstrong read a paper entitled "Recent Excavations on Palæolithic Sites at Cresswell Crags, Derbyshire," describing excavations which had been carried out by him under a Joint Committee of the British Association and the Royal Anthropological Institute. The two important sites of Upper Palæolithic date under investigation consist of a rock shelter and a cave respectively. The former, excavated between June and October 1924, is situated in front of Mother Grundy's Parlour, the last cave of the Cresswell group excavated by Sir William Boyd Dawkins and the late Rev. J. M. Mills in 1879. This proved to be an undisturbed stratified deposit with a Palæolithic relic bed 2 feet 6 inches thick. The lowest stratum yielded implements of quartzite which, from evidence afterwards obtained in the cave site, are probably referable to Mousterian times. Overlying this was a rich deposit from which flint implements, bone tools, and three pieces of engraved bone were recovered. The latter are believed to represent bison, reindeer, and rhinoceros, but all are fragmentary. At the lowest level of this layer was a hearth formed in a hollow scooped out in the basement bed and ringed around with flat stones, on edge, just as Boy Scouts build a fireplace to-day. The area around the fire proved the most prolific in antiquities. The flint implements from that level are late Aurignacian in general character, those from the top of the deposit are early Tardenoisian, and those from the intervening layer reveal a gradual development in style and technique from one culture to the other.

The second site dealt with was the cave known locally as the Pin Hole. Excavations in September last revealed that the examination made by Mills fifty years ago had extended to the first seven yards only, and that the remainder of the cave was practically undisturbed. Through the generosity of the Percy Sladen Memorial Fund Trustees and the kindness of

His Grace the Duke of Portland, it has been made possible to undertake a thorough examination of the cave, and work is now in progress there. The results already achieved include the discovery of a lance point in mammoth ivory, engraved with a conventional pattern, which is assigned by the Abbé Breuil to the Middle Magdalenian period, and is identical with one found in the cave of La Madeleine itself. This implement and others associated are considered to provide the most definite evidence so far discovered at Cresswell for the precise dating of the culture and its correlation in point of time, if not in development, with the classic cave sites of France. Considerable data have also been obtained in proof of occupation in Upper Mousterian times and at a still earlier period.

At the conclusion of the paper a letter was read from Sir William Boyd Dawkins, chairman of the Committee, in which he entered a *caveat* against acceptance of the engravings on bone from Mother Grundy's Parlour as of human origin. In his opinion, they were due to the action of roots. In the discussion, Prof. W. J. Sollas said that he had no doubt that they were of human origin, while Miss Garrod stated that she was authorised to say that the Abbé Breuil, who had examined the fragments that day, was convinced that the reindeer, and some at least of the lines forming the figure which was thought to be a rhinoceros, had undoubtedly been engraved by man. The bison, however, was more doubtful and might possibly be due to root action.

The Natural History of Disease in Baltimore, Maryland.[1]

THE publication before us forms one of the admirable reports issued by the Carnegie Institution of Washington, and therefore calls for attention. It purports to trace the development of public health in one of the oldest cities in the States, and to correlate, so far as practicable, the ascertainable factors bearing on the natural history of disease in that city during a span of more than a century. The attempt is made in nearly 600 pages, beset with elaborate statistical tables and a number of graphs, which have been reduced to an extent which makes them partially illegible.

The valuable portion of the work deals with the actual topography of Baltimore and with the details of the gradual development of its public health administration. In 1820 an ordinance was passed making it the duty of all practising physicians to report cases of malignant or contagious fevers to the mayor or Board of Health; and although this and subsequent but very early further ordinances of similar nature were not enforced, they are interesting as preceding by many years similar ordinances (which were enforced) in Great Britain. Similarly, health commissioners, corresponding to our medical officers of health, were appointed, antedating the appointment of the similar earliest appointed officers in London and in Liverpool. But although these appointments were made, the rapid growth of Baltimore, its increasing heterogeneity of population, and other factors, have left it far behind in subsequent sanitary practice. The reader will find, in comparing the Baltimore enactments with those in Great Britain, much of interest and of practical value; and the balance to the good does not always rest with English legislation. Perhaps, however, we may agree with Solon in his advice to the Athenians; let us have the best law we can keep, not the best laws that can be made.

For epidemiologists and students of natural history generally, however, one looks chiefly to the history of disease prevalence as here presented. A vast amount of material has been compiled, Teutonic in bulk, and Teutonic likewise in the failure to sift out what is trustworthy and to save the student unnecessary and wearisome detail. Thus deaths and death-rates are given for all causes in the aggregate and for some single diseases from 1812 onwards; although prior to 1875, when death-certificates were first required by law, the only information available was that obtained from the sextons of the cemeteries. What proportion of deaths were buried "extra-murally" we can only guess; but the large extent to which deaths of inhabitants in institutions outside the city —which are not recorded in the city statistics— vitiate the statistics given throughout the report, may be gathered from data emerging here and there in the volumes.

When we pass to causes of death, difficulties in accepting the data laboriously collected begin to multiply. Thus on p. 193 is given a list of the causes of deaths named among the burials in the year 1819. "Consumption" is the only item of likely tuberculous nature which appears. On p. 383 the death-rate from pulmonary tuberculosis for the same year appears as 492 and from other forms of tuberculosis as nil. In 1920 the corresponding rates were 128 and 23! On such data, of which an extreme example has been given, are based discussions as to the upward and downward course of the tuberculosis death-rate, which possess very slight value. The problem in Baltimore, as in many other American cities, has been complicated by large immigration of Irish, of Greeks, of Russians and Poles, and by a large negro population. The statistics deal with these heterogeneous groups as if they formed a homogeneous whole; and on such data, extremely imperfect in other respects, we are asked to accept sweeping conclusions, as for example that the course of the death-rate from tuberculosis in Baltimore has been determined above all other factors by natural selection. On similarly imperfect data, to give one further illustration, is based the unlikely inference that although an increasing ratio of the population now attain middle life, these individuals on the whole prove to be poorer risks and less capable of survival to old age than were the proportionally smaller numbers who reached the age of 40 "when natural selection was more searching in its action." To base such a sweeping conclusion on the imperfect statistics of a heterogeneous population, affected by immigration, composed of blacks and whites, of persons of eastern and southern European as well as of British and Irish origin, is extremely indiscreet; and study of the English Registrar-General's figures would have shown its error for a country in which more stable conditions exist, and for which official mortality statistics can be regarded as trustworthy.

[1] Public Health Administration and the Natural History of Disease in Baltimore, Maryland, 1797–1920, by Dr. W. T. Howard, jun.

University and Educational Intelligence.

CAMBRIDGE.—Mr. H. Gilbert-Carter, Trinity College, has been reappointed as curator of the Herbarium. Sir John Russell and members of the staff of the Rothamsted Experimental Station are giving this term a special course of lectures on "The Chemistry, Physics and Biology of the Soil." The Linacre Lecture will be delivered on May 6 by Lt.-Gen. Sir William B. Leishman, Director-General, Army Medical

Services, on "Health in the Tropics: the Present and the Future."

An appointment is to be made in July of the Busk Studentship for research in aeronautics, and specially in those subjects such as stability problems, meteorological questions bearing on flight, or the investigation of gusts, treated either experimentally or mathematically, in which Edward Busk was specially interested. The Studentship is of the value of about 150*l.*, tenable for one year from October 1, and is open to any man or woman being a British subject and of British descent who had not attained the age of twenty-five years on October 1, 1924. Application forms, to be returned not later than May 12, can be obtained from Prof. B. M. Jones, Engineering Laboratory, Cambridge.

GLASGOW.—The degree of Doctor of Science (D.Sc.) has been conferred on Mr. F. Y. Henderson for a thesis entitled "An Apparatus for the Study of Transpiration under Controlled Conditions."

THE Yorkshire Summer School of Geography will be held at Redcar during the fortnight August 8-22, providing the number of entries is sufficient. The School is intended to provide a "refresher" course for teachers of geography which will help them to keep in touch with recent developments, and will include lectures, practical work, discussions, and excursions. Lectures will be given on the principles of human geography, economic and regional geography, the teaching of geography, and on climate. Practical work will include the analysis and study of topographic maps and the elements of survey. Applications for tickets should be made, not later than May 11, to the Secretary of the Yorkshire Summer School of Geography, the University of Leeds.

THE "Spirit of Modern Science Instruction" is discussed in a thoughtful article by Director O. W. Caldwell of Lincoln School Teachers' College, New York City, in the January number of *School Life*, the organ of the United States Bureau of Education. During the past fifteen years dissatisfaction with excessive specialisation in secondary schools has led to the development, after much careful study and experiment, of a type of "general science" course which has been widely adopted. Returns for 1921–22 show that in 13,700 public high schools there was an enrolment of approximately 400,000 students in general science. The success of this type of course has been achieved in many schools without any diminution of the numbers enrolled in the physics, chemistry, zoology, botany, and physiology classes, and has changed beneficially the character of the work done in these sciences. The point, however, to which the article chiefly directs attention is not so much the importance of science teaching being efficient as the importance of cultivating in the young an appreciation of the proper use of science in modern life, and a determination to make it subservient to the general welfare. "Until people do not wish to destroy their enemies or their competitors they must not possess the means or knowledge for doing so. Science courses for all the people must help all the people to interpret science for service, not science for power." To considerations such as these are partially attributable, no doubt, the remarkable efforts that are being now made in the United States in connexion with the "Education Week," and otherwise to promote instruction and training in good citizenship.

Early Science at Oxford.

May 3, 1687. An account of ye Solar eclips, May ye 1st 1687, was communicated by Mr. Caswell. The Dublin Minutes from Nov. 15 to April ye 7th were read, speaking of a new Engin invented by Mr. Ash to raise water with an inconsiderable Power. They communicated a farther account of ye petrifieing of Lough Neagh;—that a toad was kept for eight mounths in Dublin, notwithstanding ye Opinion that noe venemous creature would live there;—that hares and rabbits grow white by Snow;—that Partriges are generally white on ye Alpes.

A discourse was given in to the Society, being a confirmation of Dr. Moline's Observation of ye communication between ye ears of Birds, by Mr. Pit.

May 4, 1686. A Letter from Mr. Grail, Rector of Lassington near Glocester, was read, wherein he gave an account of the little stones called *Asteria*, found chiefly in his Parish, which being put in Vinegar, will move towards one another: if they lie long in vinegar they will wast away, but will keep their starre-like figures notwithstanding their diminution.

May 5, 1685. A Letter from Mr. Will. Molyneux gave an account of a new Hygroscope of his invention: it is made of common whip-cord fastened at ye upper end: the lower end hangs loose with a little weight annext, and turnes round according to ye degree of moisture in ye Air: the turning of ye lower end is mark'd by a tongue or index joyned to ye weight, and playing over a circle in paste-board or ye like, so as that ye weight hangs over ye centre of ye circle.

May 6, 1684. Dr. Plot was pleased to oblige us farther, with ye sight of a Glow-worm shining in ye middle of ye day. This gave occasion to some discourse concerning Lucid Animalls; in which Dr. Bathurst bore a considerable share, affirming, that, in some dissections of Glow-wormes, he had formerly observed, that as soon as ye Insect was cut in peices, ye lucidity disappeared; but it was asserted that even ye peices of a dissected Glow-worm have been known to shine; ye Doctor mentioned ye bones of a Thornback, as remarkable for lucidity.

The Mercury of ye Barometers, haveing been very low, all ye last weeke, and no rain near Oxon, gave suspition that there might be rain at some distance: ye like event haveing been certainly known about a month since. This discourse began on ye account of a scheme of ye weather ye last month, taken, and communicated, by Dr. Plot.

1690. A Project of making all ye high-ways and streets perfectly good and smooth at ye charge of what 3 years expence as ye present amounts to; after which they may be kept in repair for ever with very little charge or trouble by the use of rollers instead of wheels.

May 7, 1686. The Minutes of the Dublin Society from Feb. 22 to April 26 were read. They gave an account that encouragement being given by ye Lord Lieutenant for forming that Society into a body corporate by the procurement of a Charter, subscriptions for money towards it were made by several.

Mention being made in those minutes of a place between the Tropicks where the *Shadow* goes twise forward upon the dyal, and twise backward in a day, Mr. Caswell sayd that this thing happens some parts of the year in all places between the Tropicks (except under the Equinoctial) upon a horizontal dyal, and in other places that are not in the torrid zone, upon an inclining dyal.

Societies and Academies.

LONDON.

Association of Economic Biologists.—The following were among the papers presented at the Edinburgh meeting on February 26 and 27:—

February 26.—F. A. E. **Crew**: Intersexuality in fowls and pigs. The condition in fowls is classified as (*a*) those in which a functional ovary occurs on the left and an active testis on the right; (*b*) ovotestis on left and active testis or no gonad on the right. The first condition is due to lack of inhibiting power in the ovary, so that the other gonad develops. It is always male. In the second class, there is ovarian disease or some other cause for the change of tissue.—W. G. **Smith**: The relation between hill pasture and sheep grazing. Work carried out at Boghall Farm, lately acquired by the Edinburgh and East of Scotland College of Agriculture, has shown a definite relationship between herbage and the quality of sheep produced. The value of the herbage varies with the nature of water supply. When the water is entirely aerial, the soil is impoverished and acid, and grazing is limited mainly to young growth in early summer. When the herbage is flushed by springs, the soil is less acid, and grazing is continuous. The most constant grazing of sheep is in moist places responsive to phosphates, as shown by the increase of white clover and pluff grass.—W. **Robb**: Hybridisation of oats. Experiments conducted with the view of improving the technique of hand-pollination in oats. Oats are generally self-fertilised and natural hybrids are rare. In a number of pure line cultures of known varieties grown side by side for years, only one hybrid was secured. Oats do indeed flower freely, but apparently *after* self-pollination has taken place. A wide range of artificial hybrids has been secured, but none between *Avena strigosa* and any of the cultivated oats. A difference in the chromosome numbers may explain this failure.—J. W. **Gregor**: Observations on the physiology of reproduction in some agricultural grasses. The work was carried out by the use of paper bags in greenhouses and specially designed pollen-proof boxes in the field. More than 90 per cent. of plants in both Italian and perennial rye grass were found to be self-sterile, and the self-fertile fraction are probably not self-pollinated. A proportion of this self-sterility is due to lack of pollen, only the female organs being developed.—J. M. F. **Drummond** and F. W. **Sansome**: The improvement of swedes and turnips by breeding. Yield and quality are of primary importance, but keeping quality and resistance to finger and toe disease are also important. Problems of testing yield in small field plots and feeding value by chemical analysis have yet to be solved. The value of the "dry matter" percentage as a criterion of feeding value is being reinvestigated. The policy of the Scottish Plant Breeding Station has been that of line selection (pure line method). In beginning work, 1922, strains approximately homozygous in respect of important characters were selected. A number of characters in swedes and turnips proved to be inherited, and enough evidence is at hand to show the possibilities of line selection for the improvement of these roots.—J. **Ritchie**: The control of mussels in sea water-pipes. The method used to prevent the blocking of the pipes at Portobello Electric Station with mussels and other marine growths was described. The problem was serious, for during the five months of maximum growth a layer 2-3·5 inches thick formed inside the 5-foot feed pipe. The water taken in was used in the condensers, and it was found that by raising the temperature, in vacuo, of water that had just been used and returning it through the feed pipes, the growth could periodically be killed and prevented from assuming obstructive proportions.

February 27.—R. S. **MacDougall**: The ox warble flies and their control. Warble flies (Hypoderma spp.) are the cause of a great annual loss in Great Britain alone to farmers, butchers, and particularly hide and leather merchants. Great success has attended the attack on the larvæ in their last instar, when lying in a swelling on their victim's back. From 82 to 90 per cent. can then be killed by (1) tobacco powder and lime, (2) Derris, or (3) sulphate of nicotine, in various proportions.—P. H. **Grimshaw**: The occurrence in Britain of *Hydrellia griseola*. In Britain this fly does no damage though it is widespread, but round the Baltic it has been for a long time a serious pest of barley and oats.—Malcolm **Wilson**: (1) *Rhizosphæra Kalkhaffi* causing disease of spruce firs. The fungus is widespread in Central Europe and has lately been discovered frequently in Britain on the glaucous varieties of *Picea pungens*. Needles of the spruce become pale and purplish and fall off. Stem, etc., become blocked by spores. The disease also attacks Sitka spruce and (on the continent) the Norway spruce. It is spread by spores. (2) The occurrence of *Tuberculina maxima* in Scotland and its effect on the blister rust of the Weymouth pine. Blister rust is so serious a disease of the 5-needled pines in Britain that their planting has practically ceased. *T. maxima* is a parasite of the blister rust, and it has now been found for the first time in Britain. On the continent *T. maxima* does not apparently entirely kill out the rust, but there are indications that under the different weather conditions prevailing in Britain, the parasite may have greater value as a control.

Institute of Metals.—The following were among the papers presented at the annual general meeting held on March 11 and 12.

March 11.—H. T. **Angus** and P. F. **Summers**:—The effect of grain-size upon hardness and annealing temperature. Many heavily worked metals increase in hardness on annealing for a short time at relatively low temperatures, and this property depends, among other things, upon the grain-size that existed at the time of rolling. A coarse grain-size increases this rise in hardness and the range of temperature over which it extends, whereas with a fine grain-size, softening may commence at much lower temperatures. This effect was noted in both pure copper and bronze containing 4·5 per cent. of tin. The recrystallisation temperature of copper is higher in the coarse-grained metal than in the fine-grained. By calculating the area of grain boundary per cubic millimetre of metal from the grain-size, and plotting against hardness, a straight line was obtained, indicating that the hardness varies directly with the area of grain boundary per unit volume of metal.—S. L. **Archbutt**: A method of improving the properties of aluminium alloy castings. The process consists in allowing the molten alloy or metal to cool slowly in the crucible in the furnace until it has just completely solidified; it is then remelted, and may be carefully stirred, raised to the pouring temperature, and cast. Ingoting the metal is not satisfactory, as the ingots cool too quickly, and during remelting are too much exposed to the furnace gases. Passage of an inert gas through the melt during slow cooling and solidification improves still further the soundness of resulting sand-cast bars. The method eliminates a

considerable proportion of dissolved gas and thus reduces unsoundness, and to a considerable extent removes pin-holing.—Ulick R. **Evans**: Surface abrasion as a potential cause of localised corrosion. Previous work has indicated that most cases of serious corrosion are of an electrochemical character; it has been suggested that very severe corrosion may be occasioned by electric currents flowing between a bare abraded portion and the still encrusted area. An experimental investigation has been made regarding the existence of these currents. Sometimes they flow in such a direction as to localise corrosion on the small abraded portion, sometimes in the contrary direction. But they are generally transitors, dying away soon after abrasion ceases. Moreover, the abrasion required to produce them must, in most cases, be sufficient to damage the metal by mechanical erosion also. In the corrosion of zinc by hydrochloric acid, the wiping away of the black scum of residual impurities (lead, etc.) actually diminishes the rate of attack. Commercial (impure) zinc is attacked more slowly than some grades of much purer zinc. Probably "homophase" impurities (in solid solution) behave in the opposite mode to "heterophase" impurities (present as a separate phase).—J. Newton **Friend** and J. S. **Tidmus**: The influence of emulsoids upon the rate of dissolution of zinc in solutions of lead, nickel and copper salts. Emulsoids tend to retard the velocity of such reactions, whether chemical or physical, as involve a change of state from solid to liquid, or vice versa, in one or more of the components. This retardation is, in the main, due to adsorption; a thin layer of the emulsoid collects upon the surfaces of the solid reactants and impedes their chemical activity. The retarding action frequently falls off markedly with rise of temperature.—Denis **Bunting**: The influence of lead and tin on the brittle ranges of brass. The chief effect of lead is mechanical; the brittle range in itself is not affected, but masked owing to the embrittling effect at other temperatures of the lead which segregated as globules at the grain boundary. Tin in excess of the solubility limit produces extreme brittleness owing to the production of the brittle gamma or delta constituent. The effect of tin in solution appeared to be connected with an increase in crystal rigidity.

March 12.—G. L. **Bailey** and R. **Genders**: The density and constitution of the industrial brasses. A reduction of density, due to unsoundness accompanying constitutional change (β to α), occurs in the brasses over a considerable range of composition. The unsoundness is removable either by reversing the constitutional change (as by quenching) or by mechanical compression. Thus heat-treatments, involving quenching of the α β brasses and a small range of the α brasses, may give rise to internal stresses of considerable magnitude. The cracking of heat-treated articles which sometimes occurs appears to be attributable to constitutional volume change rather than to the difference between the expansivities of the different constituents.—A. L. **Norbury**: Note on the effects of certain elements on the electrical resistivity of copper. Values for the increase in the electrical resistivity of copper due to the presence in solid solution of 1·0 atomic per cent. added element are calculated for each of the added elements. The "atomic effects" are small for elements like silver and gold—which are in the same group as copper in the Periodic Table—and are progressively larger as the added elements are farther away from copper in the Table.—Sir Thomas Kirke **Rose**: On the density of rhodium. One specimen was forged up from sponge and annealed but not melted, and the other melted from sponge in the oxyhydrogen blowpipe and forged while hot. The rhodium sponge was chemically pure. The density of the melted specimen was 12·47 in vacuo at 0°/4°, but the other specimen was evidently not free from internal cavities, as its density was only 12·22. Previous determinations have given 12·1-12·6.—Kotaro **Honda** and Ryonosuke **Yamada**: Some experiments on the abrasion of metals. In soft metals and carbon steels the amount of wear is proportional to the frictional horse-power, provided that the coefficient of friction is constant. Under a constant frictional horse-power the amount of wear increases with the coefficient of friction. The effect of the velocity of abrasion on the amount of wear is negligibly small in the range of velocity investigated.

PARIS.

Academy of Sciences, March 23.—A. **Haller** and Salmon **Legagneur**: Diketones and mixed ketones derived from the *a*-mono-nitrile of camphoric acid and of methyl cyanocampholate.—A. **Desgrez** and R. **Vivario**: The estimation of carbon in organic substances. The wet combustion method (sulphuric acid and potassium bichromate) with addition of a short length of red-hot copper oxide is employed. Tubes of potassium ferrocyanide and borax are used to remove chlorine and hydrochloric acid. Test analyses are given.—G. **Claude**: The rectification of the light in neon tubes. If the Geissler tube is made up of a series of wide and narrow sections, the wide portions show the mercury spectrum only and the narrow the neon spectrum.—G. **Friedel**: Ethyl anisal—*p*-aminocinnamate.—Henry **Scott** was elected corresponding member for the section of botany.—Bertrand **Gambier**: Generalisation of the remainder theorem of Brill and Nœther. Application to groups of superabundant points.—Alexandre **Kovanko**: The necessary and sufficient conditions for the summability of some functions.—V. **Weniaminoff**: Some properties of the limit derivative.—P. **Clerget**: Reconstitution of the explosion motor of 1806 of the brothers Niepce. At the instance of the Service technique de l'Aéronautique, this early internal combustion motor has been reconstructed and found to work perfectly, using lycopodium powder as the combustible.— — **Rateau**: Remarks on the preceding communication.— — **Barrillon**: Resistance to the passage (through water) of cylinders of revolution turned in a sense perpendicular to their axis.— — **Lémeray**: Spherical clusters. The theorem of level surfaces.— — **La Rosa**: The relation between colour and amplitude of the variable stars and the ballistic theory. Reply to some criticisms by Ch. Nordmann and C. Le Morvan.—**Le Roux**: The determination of the viscosity coefficient of water in absolute value. The rotating cylinder method was adopted in preference to the capillary tube. Absolute viscosities are given for 5° C. intervals between 0° C. (0·0178) and 50° C. (0·057). The results are in good agreement with those of Thorpe and Rodger.—G. **Reboul**: Study, under reduced pressure, of the radiation emitted by highly resistant bodies traversed by an electric current.—G. **Foëx**: The various magnetic states of an ion. Two specimens of a pure salt (Mohr's salt), well defined from a chemical point of view and placed under identical conditions, may present very different magnetic properties, apparently corresponding to distinct structures of the paramagnetic ion.—E. **Darmois**: The action of boric acid on the rotatory power of malic acid and the malates. The existence of complex compounds of boric and malic acids is clearly

proved; some definite lævorotary compounds of ammonium, sodium, and aniline have been isolated, but the complex dextrorotary compounds are less stable, and, at present, have not been isolated.—P. **Lambert** and D. **Chalonge**: A self-recording micro-photometer with a photo-electric cell. The current from the photo-electric cell is amplified by a triode valve, under conditions securing stability and proportionality. As an example of its use, a negative of the ultra-violet spectrum of the sun is given.—A. **Couder**: The action of ammonia on cyanamide.—P. **Job**: The spectrographic study of the formation of complexes in solution and their stability.—L. **Hackspill** and R. **Grandadam**: The reduction of the metallic oxides by the alkaline cyanides. A repetition of Liebig's experiments (1842), using pure sodium cyanide (98·5 per cent.) and working in a vacuum. The oxides of lead, tin, copper, and iron give the metal, carbon, carbon monoxide, carbon dioxide, nitrogen, and metallic sodium, the weight of the sodium being practically equivalent to that of the reduced non-volatile metal. Strontium and barium are also reduced and combine with the metallic sodium to form a volatile alloy.—Mlle. Suzanne **Veil**: The decomposition of hydrogen peroxide in the presence of nickelous hydroxide. Nickel hydroxide decomposes hydrogen peroxide with evolution of oxygen, but no higher oxide of nickel is formed. The study of the changes in the coefficient of magnetisation shows that nickel hydroxide is not a true catalyst, if the latter be defined as a substance which remains unchanged throughout the reaction. Curves are given showing the changes in the magnetisation coefficient as a function of the time of exposure to the hydrogen peroxide solution.—— **Delbart**: Contribution to the study of cold-drawn steels.—Ch. **Jacquet**: The constancy of the yield of the cold spring Velléda of the Royat thermal establishment. The hourly yield of this spring (10,210 litres) has not changed since 1886, and is independent of external meteorological conditions.—Emm. de **Martonne** and L. **Aufrère**: Extension of the oceanic drainage.—F. **Lœwinson-Lessing** and V. **Mitkewitch**: The natural and artificial permanent magnetisation of rocks. A method is described capable of distinguishing between permanent magnetisation produced by lightning and that produced by the terrestrial magnetic field.—Henry **Hubert**: The quasi-permanence of the shape of the meteorological curves in Western Africa.—Pierre **Lesne**: The fauna of the peaty alluvium of the Seine valley to the south of Paris.—René **Souèges**: The embryogeny of the Hypericaceæ. The development of the embryo in *Hypericum perforatum*.—A. **Guilliermond**: New observations on the structure of the Cyanophyceæ.—J. **Nageotte**: The extreme contraction resulting from freezing striated muscle in the frog.—Ch. **Champy** and N. **Kritch**: Analogy of the hormone action of the male and female genital glands on the crest of the Gallinaceæ.—Marcel **Avel**: The vacuome and apparatus of Golgi in the vertebrates. The vacuoles, whether pre-existing or not, which take up neutral red and other stains are, at least in vertebrates, independent of the apparatus of Golgi.—René **Jeannel**: The morphology and origin of the claw of the tarsus of insects.—Jacques **Risler** and Paul **Mondain**: The limit of the antagonistic action of the spectrum and the application of radiations of great wave-length to the treatment of radiodermites and neoplasms.—René **Fabre**: A new method for the extraction of alkaloids or of various organic substances contained in the organs. The organ in a fine state of division is submitted to the digestive action of pancreatine for 12 hours at 50°-55° C. After filtration, the filtrate can be extracted with suitable solvents. Substances such as strychnine, narcotine, veronal, sulphonal, atropine, cocaine, and morphine are stable towards the ferment, but the possibility of the pancreatine acting on the substances sought for must not be forgotten. Compared with the classical Stass-Otto method the process suggested gives higher yields in less time.—A. **Goris** and M. **Métin**: The presence of two aklaloids in *Aconitum Anthora*.—N. **Bezssonoff**: Some data on the nature of the anti-scorbutic principle known as vitamin C. A new process for extracting vitamin C from cabbage juice is described. The crystalline product obtained was analysed (carbon, 45·6 per cent.; oxygen, 48·2 per cent.; hydrogen, 6·2 per cent.). Daily doses of less than 2 mgrm. of this product prevented scurvy in guinea-pigs.—C. **Gessard**: Pyocyanoid bacilli of the melanogen variety.—Léon **Blum**, Maurice **Delaville**, and van **Caulaert**: The relations between the physico-chemical state of the body fluids and the phenomena of ossification and decalcification.

ROME.

Royal Academy of the Lincei, February—G. Arturo **Crocco**: The degradation of wealth.—Secondo **Franchi**: Observations on the large overthrust Ausonio-Lepino.—Giulio **Supino**: Elastic systems in two dimensions and their relationships to spacial deformation.—Enrico **Fermi**: Intensity of multiple lines.—Francesco **Rizzi**: Rotatory power of fluorinated derivatives of benzene and its homologues as a function of the wave-length.—P. **Bertolo**: Action of iodine on desmotroposantonin; Artemisic acid.—Luigi **Sanzo**: Ova and larvæ of Alalonga (*Orcynus germo* Ltkn.).—Roberto **Savelli**: Transmission of mutations through interspecific hybridisations: Statistics of the first series of experiments.—Nazareno **Strampelli**: Acquisition of new characters in the glumes of blind and eared wheats (*Triticum folliculosum*).—S. **Mandelbrojt**: Generalisation of the calculus of variations.—F. **Sbrana**: An integral equation occurring in the statistical theory of the photo-electric effect.—A. **Carrelli**: Certain effects produced by rotatory motions.—Mentore **Maggini**: Aspect of the spots on Mars observed at Catania during 1924.—Francesco **Vercelli**: The results obtained during the cruise of the *Marsigli* in the Straits of Messina. The investigations on currents are described.—Washington Del **Regno**: Transformation or nickel in the neighbourhood of the Curie point. The temperature at which nickel begins to undergo transformation varies with the physical phenomenon considered. Apparently certain properties exhibit variation as soon as even a small part of the metal passes from one state to the other, whereas others vary only when an appreciable proportion of the material has suffered change.—Giuseppe **Stefanini**: First geological results of the mission of the Royal Italian Geographical Society to Somaliland, 1924.—G. **Rodio**: Pigments of the Florideæ.

Diary of Societies.

SATURDAY, MAY 2.

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting), at 10.30.—A. Cheatle: The Mastoid Emissary Vein and its Surgical Importance.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. P. Pycraft: Use and Disuse and their Effect on the Bodily Structure of Animals (II.).

MONDAY, MAY 4.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—R. H. Fowler: A Theoretical Study of the Stopping Power of Hydrogen Atoms for α-particles.—Dr. N. Bohr: On the Interaction of Atoms

during Impacts.—K. G. Emeléus: The Action of the Electrical Counter. —R. A. Fisher: Theory of Statistical Estimation.—W. Burnside: (*a*) On the Idea of Frequency; (*b*) On the Representation of the Modular Group of Order.—J. P. Gabbatt: On Pedal Quadrics in Non-Euclidean Hyperspace.—F. P. White: An Extension of Wallace's, Miguel's, and Clifford's Theorems on Circles.—Prof. H. F. Baker: (*a*) The Stability of Rotating Masses of Liquid; (*b*) Note on a Formula for Lamé Functions.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Prof. E. Naville: Paper.

ROYAL COLLEGE OF SCIENCE ASSOCIATION (at Royal College of Science), at 5.—Prof. E. B. Poulton: Thomas Henry Huxley (Huxley Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—R. C. S. Walters: Water Power Exhibits at the British Empire Exhibition, Wembley, 1924.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 6.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof. J. Laird: The Nature of Ideas.

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. S. S. Brame: Motor Fuels (Howard Lectures) (III.).

SURVEYORS' INSTITUTION, at 8.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.15.—J. E. Hackford: Gas Production from Heavy Oils by Partial Combustion.

ROYAL SOCIETY OF MEDICINE, at 9.30.—Dr. R. Hutchison: Dr. Samuel Johnson and Medicine.

TUESDAY, MAY 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. D. Adrian: The Interpretation of the Electromyogram (Oliver-Sharpey Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: Some Effects of Climate on the Circulation (III.).

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Annual General Meeting.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—F. G. Rappoport: Some Notes on Water Shut-off.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. C. F. Sonntag: Exhibition of Anthropoid Skulls presenting Features of Interest.—F. Martin Duncan: Exhibition of Cinematograph Films recently taken in the Society's Gardens.—Miss Joan B. Proctor: Notes on the Nests of some African Frogs.—Major S. S. Flower: Contributions to our Knowledge of the Duration of Life in Vertebrate Animals. III. Reptiles. —C. R. Narazana Rao and B. S. Ramanna: On a New Genus of the Family Engystomatidæ (Batrachia).

INSTITUTION OF CIVIL ENGINEERS, at 6.—Capt. H. Riall Sankey: Heavy-oil Engines: Some Outstanding Questions relating to Large Engines of the Self-ignition Type (James Forrest Lecture).

ROYAL PHOTOGRAPHIC SOCIETY, at 7.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.

RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—C. H. Holbeach: (*a*) Some further Aspects of the Theory and Operation of Potter-Bucky Diaphragms; (*b*) The Treatment of Coolidge Tubes.

WEDNESDAY, MAY 6.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—E. B. Bailey: The Tertiary Igneous Geology of the Island of Mull.

INSTITUTION OF CIVIL ENGINEERS (jointly with Institution of Mechanical Engineers, Institution of Electrical Engineers, Institution of Naval Architects, Institute of Marine Engineers, North-East Coast Institution of Engineers and Shipbuilders, Institution of Engineers and Shipbuilders in Scotland, Institute of Chemistry of Great Britain and Ireland, Institution of Gas Engineers, British Electrical and Allied Manufacturers' Association, British Engineers' Association, Admiralty, War Office, Air Ministry), at 6.—J. Carnaghan: A Standard Code for Tabulating the Results of a Heavy-oil Engine Trial.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Capt. H. J. Round, T. L. Eckersley, K. Tremellen, and F. C. Lunnon: Report on Measurements made on Signal Strength at Great Distances during 1922 and 1923 by an Expedition sent to Australia.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—J. King: The Adulteration of Conserves, with special reference to Pectin and Agar-agar.—J. S. Willcox and H. T. Cranfield: The Influence of Palm Kernel Meal on the Composition of Bacon Fat.—C. H. Ridsdale and N. D. Ridsdale: Points arising from the Analytical Standardisation of British Chemical Standards.—Dr. B. S. Evans; (*a*) A New Method for the Separation and Determination of Tin in Alloys; (*b*) A New Colorimetric Method for the Determination of Cobalt in the Presence of Nickel.—W. B. Walker: The Determination of Small Amounts of Iron by Colorimetric Methods.

ROYAL SOCIETY OF ARTS, at 8.—Air Vice-Marshal Sir William Sefton Brancker: Commercial Aviation.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8.—Prof. H. A. Lorentz: The Motion of Electricity in Metals (Annual May Lecture).

ROYAL SOCIETY OF MEDICINE (Surgery Section) (Annual General Meeting), at 8.30.—Informal Discussion on Acute Small Intestinal Obstruction.

THURSDAY, MAY 7.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10.—Presidential Address.—T. W. Hand: Progress in British Rolling-mill Practice.—A. Hultgren: "Flakes" or "Hair Cracks" in Chromium Steel, with a Discussion on "Shattered Zones" and "Transverse Fissures" in Rails.—At 2.30.—T. H. Turner and J. D. Jevons: The Detection of Strain in Mild Steels.—J. D. Jevons: Strain Detection in Mild Steel by Special Etching.—L. Aitchison and L. W. Johnson: The Effect of Grain upon the Fatigue Strength of Steels.—A. G. Lobley and C. L. Betts: The Influence of Gases at High Temperatures upon Iron, with special reference to the Formation of Blowholes.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Dr. W. Rosenhain and Miss J. McMinn: The Plastic Deformation of Iron and the Formation of Neumann Lines.—Dr. A. E. H. Tutton: (*a*) The Monoclinic Double Sulphates containing Thallium. Thallium Nickel and Thallium Cobalt Sulphates; (*b*) The Crystallographic and Optical Properties of Iodo-Succinimide.—Kathleen Yardley: An X-Ray Examination of Iodo-Succinimide.—*To be read in title only*:—B. Lambert and S. F. Gates: An Investigation of the Relationships existing between Hydrogen and Palladium.—C. G. T. Morison: The Effect of Light on the Settling of Suspensions.

LINNEAN SOCIETY OF LONDON, at 5.—G. C. Robson: Exhibition of the Rare Cephalopod, Spirula.—Sir Sidney F. Harmer: Exhibition of Specimens illustrating Old Age in Cetacea.—Dr. H. G. Cannon: Exhibition of Specimens showing Ectodermal Origin of Muscles in the Crustacean Cheirocephalus.—Miss Andersson: The Genetics of Ferns.—S. L. Moore: A Third Contribution to the Composite Flora of Africa.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. D. Adrian: The Interpretation of the Electromyogram (Oliver-Sharpey Lectures) (II.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. J. Fleure: Prehistoric Trade and Traders of the West Coasts of Europe (I.).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 6. —Annual General Meeting.

CHEMICAL SOCIETY, at 8.—E. H. Ingold: The Tautomerism of Dyads. Part III. The Effect of the Triple Linking on the Reactivity of Neighbouring Atoms.—J. O. Cutter, H. Burgess, and Prof. T. M. Lowry: The Rotatory Dispersive Power of Organic Compounds. Part XVI. Halogen-derivatives of Camphor.—S. Sugden, J. B. Read, and H. Wilkins: The Parachor and Chemical Constitution. Part I. Polar and Non-polar Valencies in Unsaturated Compounds.—J. P. Griffiths and C. K. Ingold: The Tautomerism of Dyads. Part IV. New Evidence of the Tautomeric Mobility of Oximes.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8. —Annual General Meeting.

FRIDAY, MAY 8.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10.—R. H. Greaves and J. A. Jones: Temper-brittleness of Steel; Susceptibility to Temper-brittleness in relation to Chemical Composition.—D. H. Ingall and H. Field: "Peeling" in White Heart Malleable.—R. L. Smith and G. E. Sandland: Some Notes on the Use of a Diamond Pyramid for Hardness Testing.—J. H. Whiteley: Observations on Martensite and Troostite.—B. D. Enlund: The Structure of Quenched Carbon Steels.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir Gilbert T. Walker: Indian Meteorology.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. N. Kriloff: On Sir Isaac Newton's Method of Determining the Parabolic Orbit of a Comet.—J. Evershed: On Some Measures of the Solar Rotation at Different Levels of the Chromosphere.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—E. Hughes: A Magnetic Bridge for Testing Straight Specimens and an Analysis of the Hysteresis Loop of Cobalt Chrome Steel.—M. C. Johnson: The Experimental Control of Electrically Broadened Spectral Lines.—M. K. Rao: On the Spectra of the Metals of the Aluminium Sub-group.—Prof. A. O. Rankine: Demonstration of the Diffraction of Light by a Spherical Obstacle.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Fourth Report of the Steam-Nozzles Research Committee.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—A. C. Wire: Five Weeks in the High Alps.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.15.

ROYAL SOCIETY OF MEDICINE (Ophthalmology and Comparative Medicine Sections), at 8.30.—Discussion on Diseases of the Eyes Common to Man and Animals.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. H. H. Dale: The Circulation of Blood in the Capillary Vessels.

SATURDAY, MAY 9.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—G. L. Bickersteth: Byron and Italian Literature (I.).

FREE PUBLIC LECTURES.

TUESDAY, MAY 5.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Prof. A. Van Gennep: Some New Methods in the Study of Primitive Man. (Succeeding Lectures on May 7, 8.)

THURSDAY, MAY 7.

GUY'S HOSPITAL MEDICAL SCHOOL, at 5.—Sir J. J. Thomson: The Structure of Light (Fison Memorial Lecture).

ST. MARY'S HOSPITAL (Institute of Pathology and Research), at 5.—Prof. W. E. Dixon: The Cerebro-spinal Fluid, with special reference to Pituitary Secretion.

KING'S COLLEGE, at 5.30.—Prof. A. Cabrera: Prehistoric Paintings in Spain. (Succeeding Lectures on May 14, 18, 21.)—At 6.30.—Dr. O. Vočadlo: The Czechoslovak Republic To-day: Population and Racial Problems.