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The Protection of Wild Life by Law.[1]

THE protection of wild animals in general by legal enactment is a development of comparatively recent times, and is in a large degree still in the empirical stage. It is, therefore, with no ordinary interest that one watches the progress of such laws in countries which do not hesitate to extend or amend previous legislation whenever it is found to be either insufficient or superfluous, for the experience of these countries is likely to carry much weight in the development of legal protection in other lands.

The United States of America afford an outstanding example of progressive legislation in respect of wild life. During 1923 forty-four States held legislative sessions, and of these all but six made changes in their game laws—a striking contrast with the position in Great Britain, where the game laws may remain unaltered for generation after generation. But the contrast is scarcely a fair one, for "game" in the United States includes a very different assortment of creatures from the meagre list affected by the Game Laws of the United Kingdom. The contrast should rather be made with British legislation dealing with wild life in general, since *game* in the American sense, as indicated by the pamphlet of the Department of Agriculture, seems to be synonymous with *animals requiring protection*, and includes, as well as deer, hares, rabbits, partridges, quails, grouse, pheasants, and other "game birds," such creatures as black bears, and all the many birds comprised in the international Migratory Bird Treaty and the Federal and State laws protecting wild birds. Even so, it is evident that the laws protecting wild life in the United States are in a much more fluid condition than the corresponding laws of the United Kingdom.

It would be unprofitable to discuss all the changes which have taken place during the year in this vast body of legislation, particularly as many are influenced by local conditions, such as the arrival and departure of migratory birds; but it is important that the general trend of the changes should be understood. On the whole it would appear that the majority of the animals concerned are suffering in numbers from overshooting, and that in almost every case further protection is desirable. This is attained in a variety of ways.

Even in the case of common animals many States have decided to curtail the period of legal shooting: the hare and rabbit seasons have been shortened by periods varying from 10 days to two months in Illinois, Maine, and other States; the grouse, quail, prairie chicken, and squirrel seasons have been similarly

[1] U.S. Dept. of Agriculture. Farmers' Bulletin No. 1375. Game Laws for the Season 1923–24. A Summary of the Provisions of Federal, State, and Provincial Statutes. By Geo. A. Lawyer. (Washington: Government Printing Office, 1923.)

curtailed in various areas. Still other States have found it necessary to prohibit altogether the slaughter of certain creatures for definite periods of years: in Arkansas the season for prairie chickens and pheasants has been closed until 1928, in Connecticut quail and Hungarian partridge have been protected until 1925, in Colorado the close season for quails, pheasants, and doves has been extended until 1930, and so on. It is exceptional to find, even in the case of the smaller game, any relaxation of protection, but the rabbit season has been extended for 15 days in South Carolina and for a month in Michigan, and 5 days have been added to the quail season in Tennessee.

As regards big game, it is scarcely surprising to find that the protective laws as a rule require strengthening, for civilisation invariably marks the larger animals for destruction. Here we encounter a series of laws of a kind unknown to present-day legislation relating to Great Britain. We are familiar with the annual close season, which is extensively adopted also in the States, but the total prohibition of the shooting of true game animals for a series of years has perhaps not been exercised in Britain since moor-fowl or grouse were absolutely protected for a period of seven years in Scotland towards the close of the seventeenth century. Absolute protection of big game is a favourite device in the States, and one result of the notable tendency towards uniformity of legislation is that moose and antelope hunting is now prohibited everywhere in the United States, except in Alaska and in Wyoming, where special regulations are in force.

Another type of law, unknown in Britain, with which America has been experimenting, permits the slaughter of buck deer, while prohibiting the killing of does. It is interesting to note that while in some areas this method has proved effective and has been extended in its operation, in others it has been found to be a failure, and the noted deer country of Minnesota has repealed its buck law and replaced it by a fresh experiment, deer-hunting being totally prohibited in 1923 and in every odd year thereafter. There has also been a considerable extension of laws defining an age limit under which deer may not be shot.

Black bears appear to be the only predaceous animals in need of protection, and to them marked attention has been given by several States, three of which have in the past year added bears to their game lists, while others have for the first time afforded them an annual close season or total protection for several years.

Amongst other developments of protective law during 1923 the most striking is the very extensive creation of game refuges in Idaho, Nevada, and Tennessee. These areas, to be reserved for the undisturbed existence of the wild life of the country, run into hundreds of thousands of acres, and the expressed intention of the legislatures which have authorised their creation is to afford, as well as protection for the native animals, recreation grounds for the people—a far-sighted policy deserving more consideration than it has received from British law-makers.

The Foreign Student—in Italy and Elsewhere.

ITALIAN schools and universities (including schools of Fine Arts) are, the *Times* announces, to be open in future to foreign students without the imposition of fees of any kind. Foreign students are even to be encouraged by grants of money from a fund from which allowances will likewise be granted to Italians studying abroad. The *Times* infers that "it will now be possible for poor English students to reap some of the many advantages of technical and advanced study in Italian universities." Perhaps it will, but the administrators of the fund may, reasonably enough, consider that Rumanians, Croats, and other Balkan neighbours, and inhabitants of the Italian cantons of Switzerland, should be given a preference. Assuming that the decree in question has been correctly summarised, it should attract to Italy a considerable number of students who would otherwise have gone to study in other countries or stayed in their own. To some extent it will compete with the very substantial grants made by the French Government for the encouragement of students from Poland and other countries having inflated currencies, and with the vacation (and other) courses for foreigners provided by so many French and Swiss universities.

In England we have not hitherto adopted, in relation to the imponderable commodities produced in our seats of learning, any policy of bounties on export. Our universities have maintained the medieval tradition of recognising the existence of no national boundaries in the learned world. They have lately established a degree (Ph.D.) on lines supposed to be specially acceptable to foreign graduates, and there are the vacation courses for foreigners in London and, alternately, in Oxford or Cambridge. They make no other effort to attract foreign students. On the other hand, they offer numerous inducements to their own students to go abroad.

As for Germany, it will be difficult until she has stabilised her currency to estimate the pull her universities will exert beyond her frontiers. Berlin has already a fully organised Institut für Ausländer which helps foreign students not only in the formal study of the German language and "kultur," but also by placing them in German family homes, obtaining for

them other opportunities of social intercourse, and arranging excursions.

Turning to the United States, one finds a potent magnet in the Teachers' College of Columbia University, New York, where, last year, 250 foreign students and 100 Americans connected with foreign educational missions were being instructed in American educational methods and ideals and their adaptation to conditions in other lands, and in the study of foreign educational systems. The work of the College in this field is being largely developed owing to the receipt of a new appropriation for this purpose of 100,000 dollars a year for ten years. Another institution which will draw many foreign students to New York is the International House, now being constructed, with accommodation for 500. No European country has any agency for the expansion of its culture, its characteristic intellectual standards and ideals, which can be compared with these Napoleonic enterprises.

Centenary of the Royal Astronomical Society.

History of the Royal Astronomical Society, 1820–1920. Edited by Dr. J. L. E. Dreyer and Prof. H. H. Turner. With Chapters by them and by Dr. R. A. Sampson, the late Col. E. H. Grove-Hills, Prof. H. F. Newall, and H. P. Hollis. Pp. vii+258+12 plates. (London: Wheldon and Wesley, Ltd., 1923.) 20*s*.

MANY centenaries occur during the present decade 1920–30, and one of the most interesting is that of the Royal Astronomical Society. To celebrate the occasion a number of astronomers have collaborated in writing the history now before us. Such must be from one point of view an account of the work of the leading British astronomers of the period—the Herschels, Airy, Baily, Adams, De la Rue, Lockyer, Huggins, Gill . . . : from another it must necessarily be a story of the advances that have been won by means of the great progress that has been made in experimental and mathematical physics.

Prior to the advent of the nineteenth century, science, particularly in England, had lain dormant for many years. There had been no striking advance in general science, applicable to observational astronomy, since the invention of the telescope. The speeding up of interest was brought about, in the first instance, by Airy's appointments to the Cambridge Observatory as Plumian professor in 1828 and, a few years later, to Greenwich as Astronomer Royal. His great merit lay in the importance he gave to the reduction of observations and in his insistence upon increase of precision in observational work. We have to pass to a private observatory to reach the pre-eminent name of William Herschel, who, with much other work, had made the brilliant discovery of binary stars. As yet there was no spectroscopy, no solar physics, no photography. Variables, general photometry, meteors, parallaxes, systematic proper motions had barely come under consideration. The only branch that was in full vigour was geometrical and gravitational astronomy. Le Verrier and Adams both sought to explain the observed motion of Uranus by calculating the elements of an external planet that would produce the known perturbations, and the reader of this volume will find a carefully written statement of the facts concerning the contributions of each of these astronomers to the epoch-making discovery of the planet Neptune.

The year 1850 was of great moment in the history of astronomy for two reasons. It was at about this time that Kelvin, Stokes, and Clerk Maxwell, by their researches, placed applied mathematics and mathematical physics upon a distinctly higher plane; and this great event almost coincided with the advent of photography and spectrum analysis, inventions which were destined to have a great effect on the progress of astronomy. Sir David Brewster, in his presidential address to the British Association in 1851, spoke of photography, but he regarded it as having but a slight connexion with astronomy. Others with clearer prophetic instinct were at once convinced of the great possibilities of the invention, and as early as 1854 the council of the Royal Society decided that a photo-heliograph should be established at Kew for the purpose of making a daily record of the sun's surface. A satisfactory photograph of Donati's Comet of 1858 was not found to be practicable. A little later, as is well known, great progress was made, principally by De la Rue and Common in photography, and by Lockyer and Huggins in spectroscopy of the sun and stars.

It was in the fifties of last century that the relative position as regards publication of astronomical papers between the Royal Society and the special Society arose acutely. The birth of the Royal Astronomical Society had been opposed, and for a time frustrated, by Sir Joseph Banks, who held the view that a special society, publishing its own papers, would operate against the interests of the Royal Society by preventing the best papers in the special subject being submitted to that Society for publication. In the year 1820 the Royal Society might, conceivably, have been able to publish the epoch-making or important papers in all branches of science; but this ability has long since ceased to be even arguable, and it is still a very difficult matter to determine, as between the Royal and special societies, the principles which should guide the actions of societies and individuals. De Morgan, in his

"Budget of Paradoxes," states that in 1855 the late Lord Rosse, in a confidential memorandum to the council of the Royal Society, said, "In a council so small it is impossible to secure representation of the leading scientific societies, and it is scarcely to be expected that under such circumstances they will continue to publish inferior papers while they send the best to our Transactions."

It will be noticed that Lord Rosse speaks as if it were the custom of the special councils to send on, automatically or otherwise, their best papers for the Royal Society council to deal with as they saw fit. It is doubtful if this was ever anything more than an exceptional action of a council. It could only have taken place in conformity with the rules of the society, which are and were to the effect that no person, who is not a fellow, can have a paper considered for publication unless it be presented on his behalf by a fellow. The council of a special society has no *locus standi* which enables it to forward a paper to the Royal Society. On the other hand, it had been claimed, from time to time by certain persons, that the president and council of the Royal Society had an absolute right to the publication of scientific papers of the first importance. This claim could never have had any foundation.

As matters stand at present, a fellow brings a paper to the Royal Society on behalf either of himself or of a non-fellow, and such a paper, once submitted, can be retained as a right by the society. Hundreds of rejected papers have as a consequence been preserved in its archives. This possible fate of a paper has no doubt an effect in contributing something towards a solution of the difficulty. Moreover, nowadays the field of scientific activity is so extensive, the number of workers so large, and the cost of printing so high, that most men of science are satisfied to see their researches published almost anywhere, and an increasing responsibility rests upon councils and scientific editors in regard to the standard of merit that may justify acceptance for publication. On the whole, it seems that an attitude of *laissez-faire*, and trust that matters will settle down fairly satisfactorily if left to themselves, is the wisest course.

This co-operative history exhibits abundant evidence that the Royal Astronomical Society has justified its existence. It has, in fact, done more than that. It occupies a place in the front rank of the world's astronomical societies. It has done much to bring about an international organisation of research which is the envy and may well be the despair of some other branches of science. The annual reports of the secretaries (who appear to be invariably indefatigable) on the progress of astronomy are both comprehensive and valuable—comprehensive as including every observatory in the world, valuable because information is collected therein which is not otherwise accessible to astronomers. For many years successive presidents have been called upon to recite the achievements of the gold medallist of the year, on the occasion of its presentation. This practice has resulted in every branch of astronomy being brought under review and its solved and unsolved problems discussed. This has been satisfactory because it has not been the custom for the president to speak concerning his own speciality in any formal address; but, it may be stated, a president has had frequent opportunities of giving his views at the largely attended monthly meetings, and that a verbatim account of the proceedings is always published in the *Observatory*. It is a coincidence that the publication of the Society's history marks the resolve of the council to abolish the custom of a speech by the president devoted to the work of the medallist. In its place there will be addresses by leading astronomers.

The society has been conducted with enthusiasm from the time when Augustus de Morgan's personality was one of its chief assets, while of recent years evidence that there is no diminution in this respect is supplied by the numerous extra meetings that have been held for the purpose of promoting the study of geodesy and guiding research in seismology and other branches of earth-physics.

The collaborators in this history of a fine society may be congratulated on a successful issue from their labours. P. A. M.

A Bibliography of Fishes.

A Bibliography of Fishes. By Bashford Dean. Extended and edited by Eugene Willis Gudger; with the coöperation of Arthur Wilbur Henn. Vol. 3: Including Indices, General Bibliographies, Periodicals relating to Fishes, Early Works, Voyages and Expeditions, Addenda, and Errata of Volumes 1 and 2. Pp. xvi+707. (New York: American Museum of Natural History, 1923.) n.p.

THIS volume forms the final instalment of one of the most important contributions to zoological science which has been made in recent years. The science in question appears at the present time to be undergoing a slow but none the less effective process of asphyxiation: it is being gradually smothered under accumulated masses of detail. The researcher, finding himself more and more "unable to see the wood for the trees," tends in despair to desert his real task of helping to develop the general ideas of his subject, for the far easier one of the indiscriminate collection and publication of still additional detail. The more able type of potential recruit to the ranks of zoological

investigators is, on the other hand, apt to be held up on the threshold and to have his enthusiasm checked and chilled by his glimpses of the fact-collectors at work. The great Bashford Dean Bibliography will do a really important service to the section of zoology with which it deals by helping to counteract the harmful influences just indicated, inasmuch as it will form an admirable guide to the investigator and learner through the otherwise impenetrable labyrinth of detail.

The three imposing volumes that constitute the Bibliography have evolved out of a simple card index to the literature of fish made by Bashford Dean as an aid to his own early research work. By the year 1900 this had increased in size to about 20,000 cards, and by 1910 its continued growth had reached the limits of practical possibility for a " one man " affair. Fortunately its author was now able to call to his aid the powerful organisation of the American Museum of Natural History: additional secretarial and editorial assistance was provided, and the result is seen in the three stately volumes just completed.

The volumes deal with the literature relating to those vertebrates that are included under the ordinary English word " fish "—regrettably converted by many writers into a technical group named Pisces, which unavoidably produces the impression that they form a compact, precisely bounded natural group of vertebrates comparable with Amphibia or Reptilia or Aves, instead of being, as they are, a random collection of minor groups, each composed of more or less modified representatives of the primitive vertebrates but, as a rule, of only remote genetic affinity to its neighbours.

Whatever be the future developments of zoological science, it is quite certain that the study of human structure will remain free from neglect. Its future is safeguarded alike by our natural curiosity and by its intimate relationship to medicine and surgery. So long as the study of human anatomy persists, we may rest assured that the bigger minds engaged therein will refuse to be satisfied by the unmitigated facts of anthropotomy and will insist upon trying to grasp the evolutionary philosophy of which they are the symbols. They will realise that of all vertebrates there are none that throw such a flood of light upon the fundamental ground plan of human structure as these odds and ends of ancient vertebrates that we call " fish." It is from their study, for example, that we *know* that the teeth of man are the vestigial remnant of the scales which in the far back ancestor covered the whole body. It is from their study that we *know* that the weird course of development of the main arteries in the embryo of man is conditioned by the fact that the far back ancestor had gill-openings in the sides of its neck for breathing the watery medium in which it lived. It is, again, from their study that we get the reason for the otherwise incomprehensible manner in which the inferior vena cava arises in the embryo, and for the extraordinary fact that the complex muscular system of man, with its countless bundles of muscle-fibres running in all directions, is in the embryo foreshadowed by segmentally arranged blocks of fibres all arranged parallel to the long axis of the body. So it is with innumerable other puzzles in the structure of man: they first display their evolutionary meaning when illuminated by the bright light that emanates from the study of fish. The scientific study of fish will, then, persist and flourish if for no other reason than the light it casts upon structure, and indeed function too, in man.

The main section of the Bashford Dean Bibliography is constituted by about 1760 pages of titles of publications (about 50,000 in number) printed in double columns, arranged alphabetically according to names of authors. The Bibliography does not deal with purely species-work, but apart from this it forms an extraordinarily complete survey of the whole literature of fishes up to the period of the War. How varied are the aspects of the subject dealt with is seen even by a cursory glance over the Subject Index, when the eye is caught by such headings as abdominal pores, adhesive or cement organs, æstivation, air bladder, angling, aquaria, archæology, auditory organs, behaviour, electrical organs, evolution, fisheries-depletion, legislation and protection, determination of age, longevity, records of size, light production, pathology, urino-genital organs, and so on.

Less bulky than the " Authors " catalogue of papers, but constituting one of the most important parts of the work for the user, is the Subject Index. Here we have in a space of about 300 pages the science of ichthyology evaporated down to a minimum bulk. The subject-matter is divided into sections arranged alphabetically under headings such as have already been quoted, and each section contains a clear and succinct statement of the subject dealt with, such as cannot fail to be of the greatest use to students consulting the book. Although called a Subject Index, this part of the work constitutes in point of fact an admirable condensed text-book of ichthyology, differing pleasantly from the normal text-book in the complete absence of padding. Its perusal is a fascinating occupation to any one interested in the scientific study of fish. He may not always agree with the attitude taken towards a particular problem, but the statement is always up-to-date and clearly and forcibly worded, and with it is given an admirable guide to the special publications which must be consulted by those desiring to follow the matter further. The Subject Index is followed by its complement, an excellent " Finding

Index," to enable the reader with a minimum of expenditure of time to lay his finger on the particular item he is in search of. In the preface to the concluding volume there is given an interesting account of the technique of working up this Subject Index which will serve as a useful practical guide to those embarking upon similar bibliographical tasks in the future.

It is comforting to note that common sense has been allowed full sway in determining the system of classification to be used in the Bibliography. The author clearly realises—as some do not—that the animal kingdom was not created to fit a code of "laws" of taxonomy, but that the whole of animal taxonomy is simply a condensed statement of current views as to the genetic affinities of animals formulated in a particular manner for the convenience of workers. Instead, therefore, of trying to produce a system of classification absolutely up-to-date—which would necessarily soon be out-of-date again owing to the advancement of knowledge—Dr. Dean adopts the classificatory groups used in the Cambridge Natural History and therefore familiar to, or at least easily accessible by, every one.

The paper and typography and general get-up of the work are admirable. Errors in detail, both of omission and commission, are inevitable in a work of such magnitude, but they are remarkably few and unimportant—though we regret to see an eminent physiological colleague appear as Staring, E. H., and one of the islands adjacent to Great Britain as Little Cumbrœa.

The author of the Bibliography, in concluding his thirty-year task, pays generous tribute to the colleagues associated with him in his work—in particular the late Dr. C. R. Eastman, who took over the editorship in 1914, Dr. E. W. Gudger, who succeeded him in 1919 and is the contributor of important sections of the work, and Mr. Arthur W. Henn, who played a great part in preparing the admirable Subject Index.

Dr. Bashford Dean and his fellow-workers, and also the authorities of the American Museum of Natural History, who acted as sponsors to the undertaking, are indeed deserving of the warmest gratitude of all interested in the study of fish for their invaluable contribution to that study. J. GRAHAM KERR.

Early Scientific Instruments in Oxford.

Early Science in Oxford. By R. T. Gunther. Parts 3 and 4: Physics and Surveying. Pp. vi+195-408+21 plates. (Oxford: Printed for the Author at the Oxford University Press, 1923.) 21*s*.

IN this third instalment of Mr. Gunther's work the matter is arranged under the headings: the teaching of natural philosophy in the eighteenth century, mechanics, notes on miscellaneous machines in Oxford, clocks, hydrostatics, barometers, the study of gases, sound, heat, optics, microscopes, electricity and magnetism, meteorology, surveying instruments, appendixes. The frontispiece is from the fine portrait of Dr. Robert Recorde, lent by Mrs. Done Bushell last year for exhibition in the Bodleian Library with the Lewis Evans collection of instruments. There are many other interesting illustrations in the book, chiefly from photographs of the Oxford instruments, and from early books and manuscripts. Nearly two hundred instruments at Oxford and about a hundred others are listed or described. The latter group includes the instruments belonging to the Royal Society, but there is no indication given that most of these have been on exhibition in the Science Museum at South Kensington during the last twenty-five years.

In an introductory note the author states: "Of the work of the great Oxford inventors of the seventeenth and eighteenth centuries, of the air-pump, of the first microscope, balance spring and anchor escapement of timepieces, barometer, hygrometer, of the magnetic inventions of Gowin Knight, or of the first electric battery, neither in Oxford nor out of it, are there any examples to show." This is probably true so far as Oxford is concerned, but possibly a few examples may still be in existence outside Oxford. Gowin Knight's battery of magnets, for example, though not in its original form, is at any rate represented in the Science Museum, on loan from the Royal Society, and Mr. Gunther quotes (pp. 308-9) in full the description from the Museum catalogue (*Physics*, 1905).

In the same note he states: "Notwithstanding that Wren, Hooke, and Boyle seem to have had a hand in every scientific invention of their age, no scrap of their work is now extant. Is not this neglect the strongest of all arguments for the need of a *Museum for Scientific Instruments*?" The reference is, of course, to scientific instruments and apparatus, and not to architectural work, which in Wren's case is still gloriously extant. But the statement is probably true, in spite of the fact that Hooke, as first curator of the Royal Society's museum, devoted considerable time and thought to its arrangement and development, and that Boyle presented his air-pump to the Society.

Reference has already been made to the causes which lead to the dispersal or disappearance of valuable historical objects (NATURE, January 20, 1923, p. 76), and the above argument is perhaps strongest of all for a *national* Museum of Science, which has indeed been in existence at South Kensington for half a century.

In describing the "Sky Optick," or scioptric ball (p. 280), Mr. Gunther states that "after searching through many books in vain for an early account of this

instrument I found it described and figured in 1671 by Father Chérubin as an 'Oculaire dioptrique' to show sun-spots and eclipses of the sun on a screen in a darkened room, and again by Zahn in 1685 as an 'Instrumentum aptum pro speciebus clarius in chartam inducendis.'" He will find an earlier figure and description by Hevelius in "Selenographia" (1647).

A fine plate of the Marshall microscope (No. 8, Orrery Collection) is given at p. 286. In stating that "there are only one or two original Marshall Microscopes in existence," and that "there are none in the fine collection of Microscopes exhibited at South Kensington," Mr. Gunther is slightly in error. Though very scarce indeed, there are more than one or two examples in existence; the very fine example in Mr. Court's collection has been on exhibition during the last five years in the Science Museum at South Kensington. A footnote (p. 288) referring to an example in the Crisp collection states: "Since these lines were written, Sir Frank Crisp has died, and his magnificent collection of microscopes has been sold by auction and dispersed. Had Oxford had a Science Museum this collection, which he did not desire to see absorbed in the Royal Microscopical Society's series, might have been preserved among us, to the great gain of the history of British science." As a matter of fact, Sir Frank Crisp's wishes and intentions, repeatedly expressed, were that his collection should be presented to the Science Museum at South Kensington; but he evidently omitted to leave behind him the legal document necessary to give effect to his wishes.

The chapter on sound consists chiefly of an extract (pp. 251-258) from Robert Plot's description (1677) of the echoes of the vicinity of Oxford. In the chapter on optics, Mr. Gunther quotes Roger Bacon's writings and states: "When we consider that a single lens or a single concave mirror, held at a distance from the eye, constitutes in reality a telescope, we can scarcely doubt that Bacon invented at least a telescope of this description. . . . The fame of Roger Bacon's lenses and mirrors lasted for centuries, and his writings were a source of inspiration to several Oxford men, one of whom must be regarded as the first contriver of a telescope. *See* vol. ii. p. 289." One cannot help thinking that Mr. Gunther's admirable enthusiasm for Oxford may occasionally affect his judgment in matters like the above. The mere statement of his father's accomplishments, even by a good son like Thomas Digges, unless supported by more definite information of the details of the optical devices employed than is at present available, cannot be accepted as evidence sufficient to justify the conclusion that Leonard Digges was the first contriver of a telescope.

In the very interesting chapter on surveying instruments, the invention of the back-staff is attributed to Captain John Davis of Limehouse, quite a different person from the real inventor and famous explorer, Captain John Davis of Sandridge; the date of the invention is by printer's error given as 1540.

An appendix (pp. 378-382) dealing with the Orrery collection at Christ Church gives in full the inventory of the collection as prepared by Thomas Wright in September 1731. It was the "chance finding of these instruments locked up in a dark cupboard in Christ Church, all smothered with the dust of ages that had crystallized upon them," that stimulated the author to his researches on early science in Oxford, some of the results of which are seen in the present volume,—a valuable and welcome contribution to the history of the subject. D. B.

Our Bookshelf.

Quantitative Agricultural Analysis. By Prof. E. G. Mahin and Prof. R. H. Carr. (International Chemical Series.) Pp. xiii+329. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 13*s.* 9*d.*

A TEXT-BOOK on the subject of agricultural analysis cannot confine itself to the purely analytical side of the subject, but must necessarily encroach to a certain extent on the field of general agricultural chemistry.

The book under notice preserves the balance fairly well between these two aspects, which is not surprising in view of the fact that its authors are professors of analytical and of agricultural chemistry respectively at the Purdue University.

The book is divided into three parts. Part I. deals with general analysis, and after treating of general principles of gravimetric and volumetric analysis, indicators, and general operations such as sampling (a particularly good section), filtration, weighing, and calibration, a series of determinations are discussed, so chosen as to illustrate the most important methods of quantitative inorganic analysis and their application to agricultural materials. Part II. is devoted to special measurements, the determination of density, heat of combustion, refractive index, optical rotation, and hydrogen-ion concentration. It is surprising, in view of the importance attained by the latter determination in recent years, to find only a scant two and a half pages devoted to that subject. Part III., more than half the book, deals with the analysis of agricultural materials, under the six headings of feeds; oils, fats, and waxes; dairy products; soils; fertilisers; insecticides and fungicides.

As the book is written by American authors for American students, the methods described, which are whenever possible the "official" methods of the United States, differ in several instances from those used in Great Britain. This somewhat lessens the value of the book to British students. There is, for example, no mention of the Neubauer method for the determination of phosphate and potash in the acid extract of soil, a method used largely on this side of the Atlantic. The American bias of the book is also

brought out by such statements as "the use of electric ovens having automatic temperature regulation is now almost universal" (p. 27), and the use of such words as "motivation" (p. vi.) and "humidified" (p. 27). Occasionally some rather curious information is met with; for example, "lignin is one of the most common of the pentosans" (p. 163); "certain soil bacteria cause the fixation of elementary nitrogen in the form of nitrates" (p. 235); phosphorus "occurs in the soil chiefly as apatite (calcium fluorophosphate)" (p. 241). These are, however, exceptional, and must not be taken as typical of the book, which is on the whole a most creditable production. H. J. P.

The Background of Economics. By Prof. Merlin H. Hunter and Prof. Gordon S. Watkins. Pp. x+514. (New York and London: McGraw-Hill Book Co. Inc., 1923.) 15*s.*

A GOOD text-book on descriptive economics, suitable for older students of schools and junior students at universities, has long been wanted; Messrs. Hunter and Watkins have supplied the need admirably. Of course, the conditions they write about regarding, for example, banking, currency, the department store, mail order business, and transport, refer principally to conditions in the United States. Yet there is sufficient in the book to make it useful also in Great Britain. Throughout, the authors have been eminently successful in making their meaning exceedingly clear; the law of diminishing returns (to take one illustration) is expressed in such a way that beginners cannot but grasp it in all its completeness.

The great value of the book lies in its treatment of agriculture and industry in their broadest aspects, and of particular industries in detail. The clothing industry, to which a chapter is devoted, may serve as an illustration. The authors begin with fibres, proceed to explain the process of weaving and finishing, describe the manufacturing centres and the history of the industry, consider its commercial importance, direct attention to specialisation, showing that there are no less than twenty-seven separate processes involved, and end with an account of working conditions. So they deal with other industries—lumber, leather and rubber, coal, iron and steel, and the manufacture of motor cars.

The attitude of the authors to labour may be gathered from their statement: "It is the major problem of industrial society to apply intelligence to the task of improving the status of the wage-earning classes and to eliminate the causes of industrial and social unrest." The common sense which marks this passage characterises the whole treatment of the subject, and the book deserves to find a large public. At the end of every chapter there are questions (most of them of a practical nature) and references usual in text-books published in the United States.

Gray's Spicilegia Zoologica. Conclusion. By O. E. Janson, J. R. le B. Tomlin, and F. A. Bather. Pp. 13-22+27 plates. (London: Janson and Sons, 1924.) 60*s.*

J. E. GRAY, former keeper of zoology in the British Museum, prepared about forty plates to illustrate novelties, in some cases described by him elsewhere, and began to issue these with brief explanations. Two parts, however, were all that achieved publication, namely, Part 1, pp. 1-8, pls. i-vi, July 1828, and Part 2, pp. 9-12, pls. vii-xi, August 1830. The remaining plates came into the hands of Mr. Janson, who has been able to make up an edition of some thirty copies of this Part 3. Eight pages descriptive of the plates are followed by an index and list of errata to the whole work. Mr. Janson himself, assisted by various naturalists employed or working at the Natural History Museum, deals with the mammals, birds, and chelonians; Mr. Tomlin determines the molluscs; and Dr. Bather discusses the few fossils, which are all represented on plate xii.

Most of the creatures figured, though they may have been new a hundred years ago, have long since been described. It is, as Mr. Tomlin says, curious that the well-known Philippine shell, *Helicostyla fischeri* (Hidalgo), should have had to wait for a name for fifty years after Gray's figure was drawn. There are two new names among the bats, but both are probably synonyms; and a *Podiceps affinis* (non Salvadori), which may be a young *P. dominicans*. A plate lettered *Actæus troglodytes* is thought by Mr. T. Iredale to represent a variety of *Gallirallus australis*, one of the wood-hens. The crinoid proves to be the holotype of *Millericrinus pratti*, the Lansdowne encrinite; and the drawing has at last rendered it possible to identify the specimen in the national collection. It will be seen from these few examples that Mr. Janson's production is something more than a bibliographic curiosity.

A Course of Laboratory Experiments on Physico-Chemical Principles. By Prof. Miles S. Sherrill. Pp. xi+125. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1923.) 9*s.* net.

THIS book covers part of the course of instruction given to students in chemistry and chemical engineering at the Massachusetts Institute of Technology. The author has in view the problem of dealing with large classes which have only a limited time for practical experimental work. The book consists essentially of descriptions of twenty-seven practical exercises in certain branches of physical chemistry, which are selected so that generally any exercise may be completed in less than three hours, using simple apparatus. To achieve this it would appear necessary to have a staff available to make thorough preliminary preparations for the fortunate student, to provide standard solutions, clean and arrange apparatus, start certain experiments, etc.

A reference to Noyes and Sherrill's "Chemical Principles" accompanies each experiment, and this is followed by a general outline of the work to be done and the apparatus necessary. A detailed description of the experiments and methods of manipulation follows, and finally, under the heading of "Discussion," calculations and deductions are considered.

The book is written essentially from the point of view of the American school, and without radical alteration of text it would, it is considered, be unsuitable for British students. It offers, however, some points of interest to the teacher in Great Britain with regard to the method of dealing with large practical science classes, and to the use of "data sheets" instead of the customary notebooks for finished reports.

JOS. REILLY.

Analytic Geometry. By L. P. Siceloff, G. Wentworth, and D. E. Smith. (Wentworth-Smith Mathematical Series.) Pp. vi+290. (Boston and London: Ginn and Co., 1922.) 11*s.* 6*d.* net.

THIS is an eminently useful book on the analytical geometry that is required by ordinary pupils in the higher classes of secondary schools. It is not intended for the exceptional pupil, who is tending towards becoming a mathematical specialist and can follow the condensed treatment of more classical treatises. It is a text-book for the average pupil, and as such is very well done. In addition to the usual course on the straight line, circle and conics, including the general conic and polar co-ordinates, we get a brief account of some "higher plane curves," as well as a short statement of the theory of three-dimensional Cartesian co-ordinates with applications to the easiest surfaces.

A possible fault is that chap. iii. is much too difficult for its position in the book, except for such pupils as have already done a large amount of graphical work and come to this book for their formal theory. The second circle in Ex. 44, p. 107, has an imaginary radius. As the authors deal so late in the book with the condition that the general equation of the second degree shall represent two straight lines, they surely do not need the rather uninspiring proof of mere algebraical elimination. The terms "spheric" and "cylindric" co-ordinates will sound peculiar to English ears.

S. B.

Determinations of Stellar Parallaxes from Photographs taken with the 24-inch Refractor of the Radcliffe Observatory, Oxford, under the direction of Dr. Arthur A. Rambaut. Vol. 53. Pp. xli+109. (London: Oxford University Press, 1923.) n.p.

A MELANCHOLY interest attaches to this work in that its publication coincided with Dr. Rambaut's death. It is an attempt to realise a portion of Prof. Kapteyn's scheme of a parallactic Durchmusterung.

It contains parallaxes of 2408 stars between north declination 25° and 52°, and of magnitudes mostly between 8 and 12. The chief difficulty in such work is well known to be the magnitude error. In determining individual parallaxes this is eliminated by reducing artificially the parallax star to the same magnitude as the comparison stars, but this is impossible in wholesale parallax determination. All that can be done is to investigate and remove the magnitude error peculiar to each separate plate. This has been done, both uncorrected and corrected parallaxes being printed. The probable errors printed range from 0·006″ to 0·06″. The smaller values are probably partly illusory, as in some cases fairly large negative parallaxes have small probable errors. However, the results can scarcely fail to be valuable for statistical purposes, though some of the individual values seem open to doubt.

A. C. D. C.

Appareils de mesures électriques. Par M. Chirol. (Bibliothèque professionnelle.) Pp. 332. (Paris: J.-B. Baillière et fils, 1923.) 12 francs net.

THE author's first object is to give to the workmen who construct measuring apparatus sufficient technical knowledge to enable them to understand better the principles underlying their work. By these means it is hoped to increase their output and improve its quality. The second object is to explain to all those who use the apparatus its method of working, the best conditions for measurements, the precautions to be taken and the care necessary to keep it in good working condition. The book is divided into three parts. The first gives a clear and very simple account of the theory and the fundamental laws on which the uses of measuring apparatus are based. In the second part, the measuring apparatus most commonly met with in practice is described, and the simplest and most rapid methods of determining the magnitudes of the electrical quantities to be determined are given. Finally, some useful advice is given as to the choice of the materials used in constructing electrical apparatus.

We noticed that the three voltmeter and the three ammeter methods of measuring power in alternating-current circuits are given without mentioning their limitations. Hence the reader may be misled. The book forms one of a "professional library" which will consist of 150 volumes.

Einführung in das Studium der veränderlichen Sterne. Von Dr. Karl Schiller. Pp. viii+383. (Leipzig: J. A. Barth, 1923.) Grundzahl: 14 marks.

DR. KARL SCHILLER of the Leipzig Observatory has produced a very complete handbook on variable stars. The work includes their spectra and colours, and describes the various methods of photometry—visual, photographic, and photo-electric. There are also a bibliography of the catalogues and charts available, and hints to observers on the methods of making and recording observations. The various hypotheses to explain the phenomena of Novæ, long-period variables, and Cepheids are discussed in full, but no attempt is made to decide finally between them.

The eclipsing variables are fully discussed, as regards period, eccentricity, ellipticity, and limb-darkening of the surfaces, also their distribution in galactic latitude. This chapter is followed by some useful tables. The diagrams include several interesting light curves and the shapes of the discs of some eclipsing variables, together with a few photographs of spectra and an illustration of the photo-electric cell.

Ocean Passages for the World: Winds and Currents. Compiled by Rear-Admiral Boyle T. Somerville. Pp. 585. (London: H.M. Stationery Office, 1923.) 18*s.* 6*d.* net.

THE original edition of this work, which appeared in 1896, was of meagre proportions compared with the present bulky volume. The book has been recast and amplified, and is now divided into three sections dealing respectively with oceanic winds and currents, steamship routes, and sailing-ship routes. Details of the winds of each part of the ocean are given fully in relation to the routes described, although, of course, in a work of this nature the information is descriptive rather than explanatory. For the navigator the volume needs no recommendation, but to the student and teacher it should prove valuable also, since much of the information is not readily accessible elsewhere. In an end-pcoket there are maps of seasonal winds, currents, and four charts of ocean trade routes. The only drawback to these is that their size and thin paper make them distressingly fragile in handling.

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 Radial Velocities of Globular Clusters, and de Sitter's Cosmology.

IF R be the curvature radius of the world, an invariant of the manifold, de Sitter's empty space-time is characterised, in the two-dimensional case which interests us here, by

$$ds^2 = \cos^2\sigma c^2 dt^2 - dr^2, \quad \sigma = r/R, \quad . \quad . \quad (1)$$

the corresponding elliptic space being covered by the interval $\sigma = 0$ to $\frac{1}{2}\pi$. With the observer's station O as origin, let a star be coerced to remain at a fixed distance r. Then, the permanence of atoms as natural clocks being granted, the observer should perceive a wave-length increment of a line of the stellar, as compared with his local spectrum,

$$\frac{\delta\lambda}{\lambda} = \sec\sigma - 1 \doteq \frac{1}{2}\frac{r^2}{R^2}, \quad . \quad . \quad (de\ S.)$$

the latter for small r/R. This is de Sitter's own result (1917), a second-order effect due to mere distance, based upon the artificial assumption that the light-source is at rest relatively to the observer. Its characteristic feature is that it gives always a *positive* or red-shift, as would be the common Doppler effect for a receding star. Since the B-stars were known to show a systematic displacement corresponding to about +4·5 km./sec., de Sitter welcomed them as so many supporters of his formula. Ascribing $\frac{1}{3}$ of the effect to their own gravitation, he represented the remaining $\frac{2}{3}$ by that formula, which, with $r = 3.10^7$ as the average distance of these stars,[1] gave him $R = 7.10^9$. This would, nowadays, seem rather too small, being just below Shapley's estimate, 9.10^9, of the semi-diameter of our galaxy. Such considerations, however, need not detain us.

What concerns us here is the actually interesting case of a star and an observer behaving as free particles, *i.e.* describing world-geodesics, when they *cannot be at rest* relatively to each other (unless one is at the polar of the other, when the case loses its interest). The distance-effect is then insolubly amalgamated with the velocity- or usual Doppler effect, and the total shift is essentially proportional to the first power of σ. The problem of determining this complete effect has been recently treated by Weyl, in the fifth edition of his book ("Anhang," iii. p. 322). It is Dr. Weyl's merit to have built up a general principle for deriving any such spectrum-shift formula intrinsically, that is, in terms of world-lines. But in applying it to the problem in hand (*Phys. Zeitschr.*, vol. xxiv., 1923, p. 230), Weyl, apart from a technical mistake, introduces as an apparently necessary feature a "universal scattering tendency of matter," which, however, is a perfectly arbitrary assumption, and by no means a desirable one. This claims the world-lines of the stars to belong to a pencil of geodesics diverging towards the future, which amounts to assuming that some time ago the stars were all crowded around O, and had, there and then, evanescent relative velocities, to grow later into huge and (apart from gravitation) ever-increasing positive radial motions. More details concerning this mythical scattering tendency will be found in a cosmological chapter of the writer's book ("Theory of Relativity," 2nd edn., now in the press). Here it will suffice to say that, due to the arbitrary limitation of the problem, Weyl's formula ultimately became

$$\delta\lambda/\lambda = \tan\sigma, \quad . \quad . \quad . \quad . \quad (W.)$$

with a unique, positive sign. According to this formula all stars should show *red*-shifts or positive "radial velocities." At first this would seem to be strongly supported by the spectroscopic findings on spiral nebulæ, inasmuch as Prof. Slipher's table, given in Eddington's "Mathematical Theory of Relativity," shows a marked preponderance of huge positive radial velocities. Yet, even in this table there are two or three, among which is the nebula in Andromeda, showing large negative velocities. Nor are negative velocities an exception among the globular clusters, some of which are, according to Shapley, about as distant as the spirals. Deploring these rebellious negative velocities, Eddington thinks (*l.c.*, p. 162) that in the equation for a free particle there are no terms to "encourage motion towards the origin." This, however, is a fallacy based upon a hasty analysis (p. 161). Negative as well as positive motions are compatible with de Sitter's cosmology and, at any distance, equally likely, as is shown in the writer's aforesaid chapter. Weyl's formula, then, is theoretically weak, since it is based upon a disguised gratuitous assumption, and, practically, untenable, as it is contradicted by the most remote celestial objects, and if it were a necessary consequence of de Sitter's theory it would certainly be fatal to the latter.

Fortunately, such is by no means the case. On the contrary, de Sitter's cosmology, when unsupplemented by superfluous mystical guesswork, seems to open up some very interesting astronomical possibilities.

The equation of radial motion of a free particle, readily derivable from (1), is

$$\frac{R}{c}\frac{d\sigma}{dt} = \pm\cos\sigma\sqrt{1 - \cos^2\sigma/k^2}, \quad . \quad . \quad (2)$$

where the upper and the lower signs correspond to a receding and an approaching particle respectively, and k is an integration constant. If $v_o = c\beta$ be the velocity which the particle had or will have at O, the meaning of this constant is $k = (1-\beta^2)^{-\frac{1}{2}}$. The integrated form of (2) is easily written down, but will not be required here. Such being the world-lines of the star and of the observer, and the minimal lines representing light-signals being of the form

$$\frac{c}{R}(t - t_o) = \int \sec\sigma d\sigma,$$

the required formula is arrived at without trouble by considering the intersections of these lines. In this way I find, for *the complete Doppler* effect,

$$\frac{\delta\lambda}{\lambda} = k[1 \pm \sqrt{1 - \cos^2\sigma/k^2}] - 1, \quad . \quad . \quad (3)$$

where $r = R\sigma$ is the star's distance at the moment of receiving its light. The upper sign holds for a receding, and the lower for an approaching star. This formula holds rigorously, for any value of the constant β entering through k, which, for all we know, may differ from star to star. If we were to judge from our nearest neighbours, β might be a very small fraction. But, no matter how small, it cannot be neglected unless σ is large enough to make the velocity (2) much larger than β. In fact, for comparatively near stars it is β which plays the chief part, while $\cos\sigma$ can be confounded with 1, thus leading to the formula

$$\frac{\delta\lambda}{\lambda} = \sqrt{\frac{1 \pm \beta}{1 \mp \beta}} - 1,$$

known from special relativity, which up to β^2 reduces

[1] If not otherwise stated, distances will be given in the usual astronomical units.

to the classical effect, $\pm v_0/c$. (For small σ, and short intervals of ct/R, the motion is quasi-uniform, with v_0 as velocity.) For somewhat remote objects both σ^2 and β may have to be retained, and I hope to give some applications of the complete formula (3) at a future opportunity. Meanwhile, aiming at the most distant celestial objects, let β be considered, tentatively, as negligible or $k \doteqdot 1$. Then, if D be written for the comparative Doppler effect $\delta\lambda/\lambda$,

$$D = \pm \sin \sigma = \pm \frac{v}{c} \sec \sigma,$$

the latter by (2). Since the largest effect ever observed (+1800 km./sec. shown by the spiral N.G.C. 584) still amounts to $D = 6.10^{-3}$ only, we may as well write

$$D = \pm \frac{r}{R}, \quad . \quad . \quad . \quad . \quad (3a)$$

the co-ordination of signs being as before. D-values, all large enough, are known for some forty spiral nebulæ. Unfortunately, however, no good distance estimates of these objects are as yet available. Even in the case of the great nebula in Andromeda, for which $D = -10^{-3}$, the distances quoted are so discrepant as 200,000 and 2800 parsecs, both estimates derived by Lundmark, and only 1700 according to Jeans. The radial velocities of *the globular clusters* are known only with a probable error which it is, according to a private letter of Prof. Shapley, a fair guess to put at 25 to 50 km. per sec. Yet, since their distances were fairly well estimated, we may pick out some examples from this class of celestial objects. Shapley has kindly referred me to his collection of ten globular clusters, with both r and D values. In view, however, of the said large P.E. of the latter, only those are worth considering the radial velocities of which are not much less than a hundred km./sec. We are then left, for the present, with seven globular clusters which yield the following results:

Cluster, N.G.C.	$r.10^{-8}$.	Rad. vel.	$D.10^5$.	$R = \lvert\frac{r}{D}\rvert$.
5024	38	−170 km./sec.	−57	$6{\cdot}7.10^{12}$
5272	28	−125	−42	6·7 ,,
6205	22	−300	−100	2·2 ,,
6333	50	+225	+75	6·7 ,,
6341	25	−160	−53	4·7 ,,
6934	67	−350	−117	5·7 ,,
7078	29	−95	−32	9·1 ,,

The agreement of the R-values in the last column, with a mean of $6{\cdot}0.10^{12}$, is, apart perhaps from the third item, surprisingly close, and, in view of the large margin of uncertainty of the measured D's, almost better than might have been expected. (No importance, of course, will be attached to the complete coincidence of three items, 6·7.) Many more data of a similar kind would, no doubt, be very desirable.[2] Yet, this little table, as it stands, seems to speak rather in favour of the last formula, and herewith also for de Sitter's cosmology. The same formula applied to the rough data of the Lesser Magellanic Cloud, $D = +5.10^{-4}$ at 10,000 parsecs, gives $R = 4.10^{12}$, not clashing with the cluster values.

It will be kept in mind that, by the very method of its deduction, this formula is, strictly, valid only when both the light-source and the observing station describe geodesics in de Sitter's *empty* world, *i.e.* in absence of gravitation. Our own station, being in the midst of a galaxy of millions of stars, and placed rather eccentrically, scarcely satisfies this condition. Still less the observed objects, especially those at or near the limits of our galaxy. In order, therefore, to be applied with some rigour to the vast majority of observable objects, the spectrum-shift formula (3) and even its sub-case (3*a*) would first have to be appropriately supplemented. An account of some results of such an investigation will be given at a later opportunity.

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[2] The writer would be particularly grateful to the readers of NATURE who can send him any indications as to the radial velocities of the clusters N.G.C. 6293, 6553, 6779, 6864, 6981, 7006, and 7492, for which distance estimates, due to Shapley, are available.

The Application of the Selenium Cell to Photometric Measurements.

IN view of the great disadvantage of the eye-strain involved in the use of visual photometers, many efforts have been made to utilise the photo-electric cell for photometric measurements, but its inconstant behaviour has until recently prevented its use in an instrument where great accuracy is required.

In a recent paper communicated to the Royal Society (Proc. Roy. Soc. 1923, 104 A, 248) G. M. Dobson overcomes this difficulty in a very ingenious way, and opens up a new field for the use of the photoelectric cell in precision measurements of light intensity. The principle he uses is this: The photo-electric cell is subjected alternately to two beams of light, one of which has passed through the medium the opacity of which is required, and the other through a standard optical wedge of known gradation. When the position of the wedge is so adjusted that the photoelectric current remains *unchanged* during the substitution of one beam for the other, then the intensity in each beam must be the same. The important point to notice is that the absolute value of the photoelectric current is immaterial; the essential condition is that it should remain constant while the comparison is being made. Thus any question of inconstancy of the cell over an appreciable time is eliminated.

At a meeting of the Royal Photographic Society held on February 12, a paper describing a new physical photometer, based on the principle developed by Dobson, was read by Messrs. F. C. Toy and S. O. Rawling of the British Photographic Research Association. The photoelectric cell is replaced by a selenium cell, which the authors consider has decided advantages in its favour. First, the current which can be used with the selenium is much larger, so that less delicate apparatus is required to record it; also, the selenium cell is more compact and convenient to handle than any form of photoelectric cell. Of course the latter is practically instantaneous in action, while the former shows considerable "lag," though this is no disadvantage in the instrument described. The arrangement of the optical system is different from that adopted by Dobson. Two opposite beams from a single source of light, after passing one through a standard wedge and the other through the medium the opacity of which is required, are converged so as to give two adjacent D-shaped discs of light which can be adjusted to meet accurately without overlap. The selenium cell is placed so that it can be moved quickly from one disc into the other without any discontinuity of illumination, and is connected with a moving coil galvanometer of low sensitivity but which is very quick in action and exceedingly dead beat, so that it responds almost at once to movements of the wedge. E.M.F. is provided by an ordinary

wireless dry battery. A single reading on the instrument is accurate to less than one per cent.

There seems to be no reason why the selenium cell could not be used in this way for measuring or comparing intensities in all cases where two-field instruments are employed, and where the wave-length of the light is within the region to which the cell is sensitive. It might also be useful for detecting positions of equal density on photographic plates, *e.g.* on spectral photographs such as are made in astronomical work. Possibly various problems in illuminating engineering might be more easily solved by its aid, and it is conceivable that it might be usefully employed for such purposes as measuring the opacity of liquid media. T. SLATER PRICE.

The Twinkling of the Stars in Relation to the Constitution of the Upper Strata of the Atmosphere.

IN an excellent paper published in the *Phil. Mag.* of October last, Prof. Vegard arrives at conclusions as to the constitution of the upper strata of the earth's atmosphere, from his photographs of the auroral spectrum. The observations show, independent of any hypothesis, "that nitrogen is a prominent component of the atmosphere to its very upper limits." Prof. Vegard is then led to the assumption that the nitrogen in the upper layer of the atmosphere is condensed into small particles, which constitute a stratum which surrounds the gas-atmosphere in the form of a dust-layer, about 100 km. above the surface of the earth. This assumption permits simple explanations of a few atmospheric phenomena.

The twinkling of the fixed stars may thus be given a new explanation based upon the nitrogen-dust-atmosphere, as follows: "The density of the dust-layer is very small and the average distance between the particles is comparatively large. If we draw a line through the dust atmosphere it might only cut a few particles and this number might undergo considerable and rapid changes. In this way the dust-layer gives a very simple explanation of the twinkling of the fixed stars. When we look upon a fixed star, with the eye, it is the average intensity through a cylinder with a cross-section equal to the pupil of the eye, which determines the observed light intensity. Inside such a narrow cylinder the number of scattering particles may undergo considerable variations, and these variations are seen as twinkling."

This explanation involves at least an intensity of scintillation constant for all altitudes of stars. We rather should expect a greater intensity near the zenith, because there the ray cylinder cuts the smallest volume out of the dust-layer. If, however, the scintillation of the fixed stars has its origin in the lower layers of the atmosphere, the maximum of intensity should occur at low altitudes of the stars. As a matter of fact, from the observations of Dufour (Pernter-Exner, "Meteorologische Optik," ii. ed., page 191), it appears that the minimum of intensity is situated at altitudes of 80°-90° (rel. size 0·30), and the maximum at 15° (7·89). Dörr (*Meteor. Ztschft.*, 1915, page 153), also, using the observations on Sonnwendstein (Austria), arrived at the conclusion that the intensity of twinkling diminishes with increasing altitude of the star. The results of these observations do not seem to be in favour of Prof. Vegard's hypothesis.

In his classical papers on scintillation, Karl Exner (f. i. Wiener Akad. Berichte, 84, p. 1038) points out that the effect is produced by atmospheric flaws ("Schlieren"). This explanation traces the origin of scintillation to the lowest layers of the atmosphere. Observations on high mountains cannot solve the problem, because the mountain ranges themselves deform the currents of the air and produce inequalities of density. Nevertheless, following Pernter-Exner, p. 239, we find several observations which confirm the view that the intensity of twinkling is less on high mountains than in the lowland. The close relation between scintillation and the meteorological elements observed near the earth's surface and at low heights suggests that the origin of scintillations lies in the lower layers of the atmosphere. Finally, it may be emphasised that Karl Exner's theory explains both the changes in intensity and those in *colour*, whereas the latter does not find any explanation in Prof. Vegard's hypothesis. V. CONRAD.

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Wien, XIX., January 30.

British Dyestuffs.

THE British national ensign, which figuratively was hoisted when the British Dyestuffs Corporation, Limited, was established with Government assistance, slipped some distance down the mast when in July last the directors announced the policy of reducing their expenditure on chemical research. The flag has now been lowered further to half-mast by the negotiations for an agreement between the British Dyestuffs Corporation and the great German combine, the Interessen Gemeinschaft; and if any agreement on the lines indicated is reached and finally sanctioned, it will inevitably, sooner or later, be replaced by the German flag.

The terms of the agreement which have been disclosed and have not been contradicted indicate that the Interessen Gemeinschaft is to receive half the profits of the British Dyestuffs Corporation in return for the granting (!) to the British Company of a monopoly of the British market and a share of the Colonial and foreign markets; the Interessen Gemeinschaft being also drawn upon by the British Dyestuffs Corporation for personnel and technical experience.

It is obvious that any such agreement takes no account whatever of several important interests. It may be considered that six British interests are concerned: (1) The British Dyestuffs Corporation; (2) the British dyemakers outside the British Dyestuffs Corporation; (3) the textile and other colour-using industries; (4) dyestuff merchants; (5) the State, which has invested 2,000,000*l.* in the British Dyestuffs Corporation; and (6) the general public.

The position can be considered from two points of view, the immediate interests of which appear to be opposed—the financial and the national. There is little doubt that the present financial interests of the British Dyestuffs Corporation, of the State as an investor, and possibly of the dye-user (though the latter is arguable), would be benefited by the conclusion of the agreement; but, on the other hand, the outside dye firms and the merchants would be greatly handicapped, though probably the former would ultimately benefit. The interests of the public in the matter may be considered to be purely national, as it is well known that the cost of the dye has a quite negligible influence on the cost of a suit of clothes or a dress. The national aspect of the matter is, however, of vital importance; and if this is to be the deciding factor, any agreement on the lines indicated should be vetoed by public opinion until international polity is such that another great war is for ever impossible.

From the general viewpoint of the advance of science and the development of industry, the curtail-

ment of the splendid training-ground for organic chemists afforded by colour factories would be a national disaster of the first magnitude. Such a training-ground is vital to us in peace as in war; and if German experience and personnel are to be imported, such curtailment must occur, and gradually the whole of our textile industries and all others dependent upon organic chemistry will come under foreign domination.

It is unlikely that the proposed agreement will be sanctioned by the shareholders of the British Dyestuffs Corporation, by the Board of Trade, and by Parliament; and the veto of public opinion is certain if all that is implicit in such an arrangement is understood. WALTER M. GARDNER.

The Transmission of Human Malaria.

IN NATURE of March 1, p. 304, Senatore Prof. Battista Grassi repeats the claims which he has been making for more than twenty years regarding the discovery of the relation between malaria and mosquitoes. They will be found already fully set forth in his "Studî di uno zoologo sulla malaria" (R. Accad. d. Lincei, 1900), in the *Policlinico* for 1900 and 1901, and in his "Documenti riguardanti la storia della scoperta del modo di transmissione della malaria umana" (Rancati, Milano, 1903). I have never been able to accept these claims in their entirety, although I recognise Prof. Grassi's good work and enthusiasm; and I have given the whole history of the subject with full references to all the pertinent literature in my recent Memoirs (John Murray, 1923).

Neither Prof. Grassi nor myself can be the ultimate judge in this controversy, which must now be left to the decision of competent men of science who have studied the matter. In my book I have quoted the opinions of Lord Lister, Sir Patrick Manson, Dr. Laveran, Prof. Robert Koch, Dr. J. Mannaberg, Dr. E. Ulmquist, and Prof. Dr. Galli-Valerio, some of whom were experts in connexion with malaria, while all had carefully examined the questions at issue. In the *Quarterly Journal of Microscopical Science*, No. 175, May 1901, Dr. G. H. F. Nuttall published a critical analysis of the question of priority; in 1902 the Nobel Committee of Stockholm decided in my favour; and in the last January number of *Discovery*, Sir Arthur Shipley has now summed up the position. I have therefore nothing further to add on the matter, and regret that I cannot afford to spend any more time on discussing it. RONALD ROSS.

The French Physical Society's Exhibition.

IL m'est signalé que, dans le numéro du 5 janvier 1924 de NATURE, l'exposition du Bureau international des Poids et Mesures et celle du Conservatoire national des Arts et Métiers, à la Société française de Physique "were somewhat disappointing."

Le savant Directeur du Bureau international des Poids et Mesures, M. Ch. Ed. Guillaume, vous a adressé à ce sujet une note explicative concernant son Établissement, note, que vous avez publiée dans le numéro de NATURE du 26 janvier, et dans laquelle il signale qu' "il ne pouvait être question de transporter nos instruments très délicats, lourds et volumineux, qui, malgré toutes les précautions qu'on aurait pu prendre, étaient susceptibles de subir des avaries irrémédiables."

Pour ce qui concerne le Conservatoire national des Arts et Métiers, qui possède des instruments scientifiques non seulement des plus modernes, mais également des plus remarquables de l'histoire de la science, des raisons analogues nous ont conduit à ne pas transporter dans une grande Exposition ouverte à tout venant, des appareils vraiment précieux. Ces appareils sont d'ailleurs utilisés chaque jour par notre Laboratoire d'Essais pour les expériences nécessaires aux essais mécaniques, physiques, chimiques et de machines demandés par les industriels.

C'est dans ces conditions que le Laboratoire d'Essais du Conservatoire national des Arts et Métiers a participé à l'Exposition en y faisant effectivement figurer des objets transportables, tels que : Collections d'étalons de masse et de longueur; un accéléromètre Boyer-Guillon et Auclair pour l'étude des vibrations des machines; un appareil interférentiel Cellerier-Jobin pour l'étude des déformations élastiques; un dispositif spécial d'étalonnage des chronomètres utilisant la transmission par T.S.F. de l'heure astronomique; divers succédanés du platine pour les usages médicaux, pour la joaillerie, pour les essais chimiques, pour les têtes de vis de rupteurs de magnétos, etc. . . .; des collections complètes d'éprouvettes pour les essais de métaux, d'alliages, de chaux et ciments, de produits réfractaires, de peintures, de câbles, de bois, etc.

Les appareils concernant notre Département de la Physique ont fait l'objet d'une très importante collection de photographies, le tout constituant un stand qui a été très visité pendant toute la durée de l'Exposition, et où se tenait en permanence un personnel instruit, pour fournir des explications utiles, lesquelles étaient complétées, au besoin, par des visites à notre Laboratoire.

Nous avons ainsi tenu à honneur, malgré les difficultés de l'heure actuelle, à contribuer pour notre part au mouvement scientifique de notre pays, et au développement de la science universelle.

T. CELLERIER,
Directeur.

Laboratoire d'Essais,
Conservatoire national des Arts et Métiers,
Paris, 21 février.

Insect Parasite of the Pea-Weevil.

A PAPER "On the Bionomics of *Perilitus rutilus*, Nees; a Braconid Parasite of the Pea-Weevil (*Sitona lineata* L.)" was prepared for presentation to Section D of the British Association last September, but, owing to the illness of the writer, it was withdrawn. The research on which it is based was commenced in 1919, but, on account of various difficulties connected with the breeding of the parasite and its host, no definite results were obtained until the spring of last year. The general points of the life-history are now known, but some details require further investigation, and it is hoped to clear these up in the course of the following season. When completed the work will be offered for publication to one of the zoological journals. Meanwhile it has been suggested to me that a short statement of my observations could appear appropriately in the columns of NATURE.

Perilitus rutilus, Nees, was bred by the writer from imagines of *Sitona lineata* L. and from other species of that genus. Its host and life-history had not previously been known. Oviposition is effected in the apex of the abdomen of the weevil. The egg, after oviposition, increases greatly in size, the chorion becoming stretched to cover an area four and a half times longer and twelve times broader than that of the mature ovarian egg. At an early stage in development, a cellular membrane may be observed which lies immediately beneath the chorion and completely encircles the developing embryo, but is

separated from it by a clear space. The cells of this membrane increase in size, and, when the larva is ready to emerge from its protecting envelope, they measure about 60μ by 25μ.

Emergence is effected by the larva rupturing the chorion. It is still often surrounded more or less completely by the cellular membrane, but at this stage the cells of the latter commence to dissociate and become free in the body cavity of the beetle. Here each cell assumes a spherical shape, and continues to increase in size, measuring eventually about 220μ by 160μ. They appear as opaque white spheres, and are a sure indication that a weevil is parasitised. When the parasite larva is young, as many as 600 of these cells have been counted in the body of the host, but as the larva increases in size the number of the cells decreases, and few or none are left when the larva is mature and ready to leave the host.

These cells react strongly to the usual fat tests, and when the Perilitus larva is approaching maturity they show signs of disintegration, being very readily crushed, with the result that their fatty contents ooze out. It is possible that the ultimate disappearance of these cells is brought about merely by their friction against the larva, which is by this time very large and almost completely fills the abdomen of the beetle. It is thought that the function of these cells is to absorb fat-constituents from the "blood" of the host for the ultimate nourishment of the larva, and it is interesting to note that the most rapid growth of the larva commences at the time when these cells have attained their greatest size and are commencing to disintegrate.

Henneguy in his paper on Smicra (*Comptes rendus*, tome cxiv. No. 3, pp. 133-136, 1892) and Marchal in his work on the development of certain Platygasters (*Arch. Zool.* IV.^{e} série, tome iv. pp. 485-640, 1906) describe a similar dissociation of the embryonic membrane, but the former makes no mention of the subsequent growth of the cells, and the latter shows that the dissociated amnion forms multi-nucleated balls, "pseudogermes," and not single cells with one nucleus as is the case with Perilitus. Marchal observed that these "pseudogermes" increased in size and multiplied by division, but the latter point has not been established in regard to the dissociated cells of the embryonic membrane of Perilitus.

There are at least three larval instars, and it is possible that the larva may undergo an additional ecdysis between the second and the final stadium. The first instar larva is characterised by a strongly chitinised head capsule and the possession of a caudal appendage. The second instar is represented by a soft and flabby larva in which the mouth parts are not strongly chitinised and the caudal appendage is absent. The final instar is achieved just before the larva emerges from the host. In this stage the larva is very active, yellowish in colour and with mouth parts very distinct. It forces its way out through the apex of the beetle's abdomen and immediately seeks for a place in which to spin its white silken cocoon. The host dies a few days later. Its body is almost devoid of fat tissue, and the reproductive organs have a much shrunken appearance. Investigation has shown that the ovaries are rendered functionless by parasitism. Thus, when a female weevil is infected with an egg of Perilitus before its ovaries are mature, they never attain normal development, and if parasitism occurs when the host is already laying eggs, oviposition ceases soon after and the eggs already present in the ovarian tubules undergo degeneration. Only one larva attains maturity in each weevil. When several eggs are laid in one host all commence development, but, in some, growth is arrested early and the embryo dies within the chorion. Other larvæ succeed in emerging from the chorion, but only one, the successful competitor, reaches the second instar, and the remainder gradually die off.

DOROTHY J. JACKSON.

Swordale, Evanton, Ross-shire,
February 6.

Problems of River Pollution.

I HAVE read with interest the letters upon this subject by Prof. Meek and by Dr. J. H. Orton and Prof. W. H. Lewis, in NATURE of November 17 and February 16 respectively. The subject of river pollution, notwithstanding the very large amount of work which has been done, is still very much in the stage where opinion is relied on rather than knowledge. That which is a necessity imposed by consideration of public health or industry in one riparian district is, from the point of view of that district, flagrant pollution when practised higher up the river. Sewage authorities, when their attention is directed to the effects of pollution, talk of factory discharges and vice versa. As the writers of the letter of February 16 say, "pollution . . . has to be allowed in some form." Public opinion in urban districts will insist on a sewerage system, but not necessarily on sewage treatment. Factories situated on or near rivers must, from economic reasons, discharge their waste liquors into the streams. The question which should be decided in each case, by somebody having no local interests, is what sort of pollution, continuous or intermittent, can properly be allowed as having no ill-effect on the amenities of a river or its value as a fishery. I do not refer to water supply as the requirements here are fairly well defined.

Dr. Orton and his colleague write as biologists. I can only base my remarks on a long experience of the chemical and physical aspects of river pollution, but I agree that a careful examination, extending over at least a year, of an unpolluted tidal river would be of the greatest value as showing what are the normal seasonal variations of such rivers. Does, for example, the retardation of photosynthesis and the accession of much-decaying matter in the autumn cause a fall in the dissolved oxygen before the winter rains bring down large volumes of well-aerated water? Is the foul mud of sewage-polluted streams materially different from the marsh-gas yielding mud of unpolluted swamps? Does sewage, as Miss Meek's work tends to show, act as a specific poison for fish? If so, why is it that on a certain eyot in the Thames one nearly always sees an angler sitting over the sewage outfall? The many biological problems arising out of river pollution no doubt call urgently for examination.

If any work is done on a large scale, it is important that it should be undertaken solely in the interests of truth, and not, as so much of the work of last century, from an *ex parte* point of view.

J. H. COSTE.

Teddington.

Origin of Atmospheric Electricity in Thunderstorms.

PROF. ARMSTRONG holds that Simpson's theory of the thunderstorm is invalid because its physical basis is unsound. He believes that it is not possible for water-drops to become electrically charged by simple rupture in air. If Simpson's paper (Phil. Trans., A, vol. 209, p. 379, 1909) is consulted, it will be found that the author of the theory has established quite definitely that when water-drops in contact with air only are broken by an air-current, the resulting smaller drops are positively charged, the corresponding negative charge going to the air as an excess of

negative ions. The present writer is all the more confident of the reality of this effect, as in subsequent experiments (Proc. Roy. Soc., A, vol. 90, p. 531, 1914), with a form of apparatus quite different from that used by Simpson, he obtained the same results. Thus, whatever be the grounds on which Prof. Armstrong declines to believe in the possibility of an electrical separation as the result of a "mere division of water-drops against an air-current," there is no doubt that such a separation does occur : εὑρήκαμεν !

J. J. NOLAN.

University College, Dublin,
February 4.

Forced Vibrations produced by Tuning Forks.

ABOUT two and a half years ago I noticed that if an ordinary small tuning fork (having prongs 6 to 8 cm. in length) held in the hand were sounded by a smart blow on a moderately hard cushion, then on applying its end to a wooden board, it is not only possible to obtain forced vibrations of the board of the same frequency as the fork, but also of an octave lower. This lower note is obtained by holding the fork so that it rests only lightly on the board. The powerful excitation of the fork and the manner in which the fork is held are important. But almost any board, such as a table or shelf, may be used ; even metal or brick may give the result required, though the ease of obtaining the note varies somewhat with the material used. This lower note has been obtained with all the forks tried (having frequencies from 270 to 550), and it could probably be obtained for frequencies outside this range.

It is suggested that when the board receives a normal impulse from the fork a wave on the surface of the board travels outwards, causing a momentary depression of the board at the point. Owing to the fork being pressed only lightly towards the board, the fork is thus separated by a small space from the board, for a short time. It would then be possible for the fork to make a small number of vibrations before it is again in contact with the board, the number depending on the force used to press the fork towards the board. If this represents what occurs, it should be possible to produce forced oscillations of the board of frequencies equal to once, a half, a third, and so on, of that of the fork's fundamental.

To test this further, the experiment was recently repeated, and it was found that, by sounding the fork loudly, and by holding it so as to press even less on the board, a note of a third of the frequency of the fork could be obtained. Occasionally a note of a fourth the frequency of the fork could be heard faintly. In place of the small forks that had so far been used, a medium-sized unmounted fork of frequency 288 was next used (each prong being $0{\cdot}7 \times 1{\cdot}4 \times 14$ cm.). The fork was bowed and the half frequency note obtained, and the third frequency with more care. The notes were naturally considerably louder than with the small forks, and could be heard several yards away. It was also found that, by touching the board with the side of the stem of the fork under either prong (so that the line of contact was in the plane in which the prongs were vibrating), the third and fourth frequency notes were more easily obtained than by using the end of the stem of the fork.

A sonometer was then tuned to have a frequency of 96, and divided by a bridge into two segments having frequencies 144 and 288. The end of the fork's stem was brought into contact with the frame of the sonometer board, and it was found that when it was applied with ordinary pressure a paper rider was thrown off the 288 part but not off the 144 part. When the pressure used was less and the half frequency note was heard, the 144 rider was thrown off, but not the 288 rider. When the whole wire, of frequency 96, was used, the rider placed a third of the way from an end vibrated most when the third frequency note was heard ; and on occasions the rider was actually thrown off by the third frequency note.

The production of the half frequency easily, of the third frequency with care, and of the fourth frequency faintly, together with the absence of any intermediate notes, leaves little doubt that the frequencies obtainable are all sub-multiples of the fundamental applied frequency, as would be expected by the theory suggested. There is further evidence from the fact that the lower frequencies are obtained in order by progressive decrease of the applied force ; and that if a sheet of paper or cloth be placed between the fork and the board, usually the primary note only can be obtained. These forced vibrations might be described as sub-harmonics. W. N. BOND.

University College, Reading,
February 7.

Apia Observatory, Samoa.

IT would seem by an article over the signature A. C. D. R. in NATURE of October 27, dealing with the Geophysics Section at the recent Pan-Pacific Conference at Melbourne and Sydney, that the existence and the scope of work of the Geophysical Observatory at Apia, Samoa, was not fully realised by some members of the Pan-Pacific Conference. Unfortunately, neither the Director nor any member of the Hon. Board of Advice in New Zealand received *ipso facto* an invitation to be present.

The Observatory is actively engaged in an extensive programme of meteorology, seismology, terrestrial magnetism, upper air observations, and atmospheric electricity, and acts as the co-ordinating centre for six wireless reporting stations in the south-west Pacific. These stations are Tahiti, Vila, Norfolk Island, Rarotonga, Nukualofa, and Suva, which extend over a range of 45 degrees in longitude and about 15 degrees in latitude. Since June of this year 80 pilot balloon flights have been made, the highest recorded flight being 21,000 metres. Continuous records of potential gradient are obtained at two stations. Continuous magnetic and seismological records have been taken here for 18 years.

The Observatory has been supported for the past two years by grants from the British Admiralty, the New Zealand Government, and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. After 1914, publication of results got into arrears, but these are being worked up by Dr. Angenheister, the former Director, through an arrangement with the New Zealand Hon. Board of Advice. The closest connexion is maintained between this body and the Observatory.

The Observatory during the period of the War went through many vicissitudes, but it is hoped that with the establishment of the New Zealand mandate over Western Samoa, and the kindly interest of scientific bodies throughout the world, sufficient funds will be forthcoming to maintain the institution in a manner capable of taking advantage of the opportunities for geophysical research that its isolated and insular position in the south-west Pacific affords.

ANDREW THOMSON,
Acting Director.
C. COLERIDGE FARR,
Member Board of Advice.

Apia Observatory,
Apia, Western Samoa,
December 24.

The Present Outlook on Descent.[1]

By Prof. F. O. BOWER, F.R.S.

A ROUGH periodicity may sometimes be seen in the progress of science. After a stirring time of advance may come a period of lethargy, or even of negation, followed again by some fresh spurt of activity. At the present moment we seem to have reached a phase of negation in respect of the achievements of phyletic morphology, and in conclusions as to descent. This is suggested by the presidential address in Section K at the British Association at Liverpool. Already Prof. Seward in the Hooker Lecture, 1922, had said, "It may be that we shall never piece together the links of the chain of life, not because the missing parts elude our search, but because the unfolding in all its phases cannot be compared to a single chain. Continuity in some degree there must have been, but it is conceivable that plant life viewed as a whole may best be represented by separate and independent lines of evolution, or disconnected chains which were never united, each being initiated by some revolution in the organic world."

From this and like passages, Mr. A. G. Tansley in his address at Liverpool concludes that such a picture of the history of evolution makes the search for common ancestors literally a hopeless quest, the genealogical tree an illusory vision. As Prof. W. H. Lang once remarked, the most recent graphic representations of the interrelationships of plants look more like a bundle of sticks than a tree. Contemplating the hypothetical tree thus reduced to a bundle of sticks, Mr. Tansley is further impressed by the growing evidence of homoplasy. He remarks on the increasing doubt whether many organs formerly regarded as homogenetic are of common origin by descent, or really homologous in this sense at all, and he concludes that the more such suspicions effect permanent lodgment in our minds the more uncertain all wide positive phylogenetic conclusions must become. He then states that the whole of this branch of botany seems to leave the great majority of the younger botanists cold. Of course it does when so presented to them. There is nothing more repellent to the aspiring mind than sheer negation, especially if it follows on a period of hope, however ill-founded that hope may have been. This is the present position regarding morphology as sketched from the chair of the Botanical Section at Liverpool. I believe that a similar negative attitude is also to be found among those who pursue zoological science.

How, then, are we to proceed in the inquiry as to the origin of living things as we see them? My reply is, by the continued study of morphology. In Darwin's own words ("Origin," chap. xiv.) this is "the most interesting department of natural history, and it may be said to be its very soul." We must remember that behind the facts of homoplasy, which appear to frighten off the young aspirants, the causes are still to be found, just as much as behind true homologies. The point that they are probably different from what we had thought need not be any deterrent. It is a feeble mind that is daunted by the difficulty of the quest. But we are told nowadays that morphology itself is not one; that different parts or aspects of it exist; that certain aspects are outworn, others herald a golden age that is coming; that the day of the formal morphologist is already past; the day of the causal morphologist is with us. Is this a true antithesis? In the first place, what do we mean by formal morphology? I understand it to mean, in the broadest sense, the comparative study of form. There can be no argument for evolution at all without such formal morphology, for form is the visible record of what physiology does, and without that record, argument on evolution would be impossible. It is in the interpretation of that form in the light of function, and in relation to the conditions external and internal, that formal morphology—perhaps better designated organography—still has, and will always have, its real value. The day of the formal morphologist in this sense will never be past, and in present practice that is the scope which his cult actually possesses. In fact, those who pursue organography have been anticipating this golden age for years.

An example was recently submitted to the Royal Society of Edinburgh of the newer formal morphology, in certain contributions on size. It was shown that complexity of vascular structure is closely related to actual dimensions. In particular it was found that increase in size, whether of stems or of leaf-stalks, is followed by decentralisation, and often by disintegration of the vascular tracts. Such changes following on enlargement have appeared repeatedly in distinct types, and in different parts of the plant body. In fact, certain characteristic vascular structures appear to depend on actual dimensions rather than on affinity of the plants showing them. Accordingly they lose grade as a basis for phylesis. This argument, which follows directly from the facts of the formal morphology of internal tissues, may be held as falling under the name of causal morphology; for whatever the cause may be, it is certainly related to actual size, as is brought out by the measurements submitted. Accordingly, we learn from this illustration that in present-day practice the distinction between formal morphology and causal morphology is not valid. The modern study of form is in practice inseparable from the study of the causes which bring it into existence.

A close comparison of related genera and species, which would in its execution be ranked as dead formal morphology, is often found to spring into life as disclosing some clear evolutionary trend. In my view no one is properly fitted to investigate questions of evolution unless he should have acquired, by practical study of some natural group of organisms, sufficient experience of formal morphology to classify them himself, or to criticise the classification already advanced by others. I very much doubt whether all of those who write on cytological detail, and rush from extreme minutiæ to far-reaching evolutionary conclusions, have passed through any such school. In the discussion of the phyletic relations of classes, I know that generalisations are light-heartedly handled by those who have no detailed systematic experience. This is altogether unsound. An architect would never dare to build a cathedral, or an engineer a bridge, without adequate

[1] Opening address delivered before the Royal Society of Edinburgh on October 22, 1923.

knowledge of the strength of the materials he uses. But the collapse of an ill-constructed theory is a less imposing catastrophe than that of a bridge or a building; so the evolutionist who fails through ignorance or inexperience gets off scot-free. He is not taught in the severe school of public condemnation.

An example of the near relation of specific knowledge of form to moving evolutionary questions of the moment is seen in what have been styled "phyletic drifts." These, which give a fertile stimulus to the inquiry into causes, depend largely for their recognition upon comparison of generic and specific differences of related forms. By the term "phyletic drift" (which may be held to connote a special type of convergent evolution) it is meant to convey that along a plurality of nearly related evolutionary paths, parallel but independent, a similarity of structure has been reached. Phyletic drifts are particularly well illustrated in the ferns, and the similarity of the results in them is sometimes so great that systematists have placed plants now known to have had distinct phyletic origin in the same genus. In no feature is this more impressive than in the slide of the sorus from the margin of the leaf to the under surface. There is no doubt that the primitive position was marginal; but along many distinct phyletic lines it may be traced how the sorus has passed, sometimes early in descent, sometimes later, to a superficial position, and it may be firmly fixed there by inheritance. Another example is seen in the old genus Acrostichum, which included representatives of as many as six different phyletic sequences, these having been grouped together on the ground of similarity of soral character. Again, the mixed sorus, which is the prevalent type of modern times, has been acquired along not one line only, but a plurality of them. Another widespread example of a phyletic drift is seen in the diminishing output of spores in the more advanced ferns, and this has been carried out by parallel progression in many distinct lines of descent. But more remarkable still is the reduction in number of the spermatocytes in the antheridia of ferns, which proceeds along lines parallel to those of their reduced spore-production. Many examples of similar parallel progressions are to be found also in the vegetative organs.

Here is indeed ample material for causal inquiry, all brought to light by formal observation. What is it that has affected all of these separate phyletic lines in the same way? Have these striking results originated by inner impulse, or are they the consequence of impress of similar external conditions upon the plants in question? Are these phyletic drifts to be held as evidence of some occult form of inheritance of acquired characters? Such insistent questions of causality are the direct outcome of that purely formal comparison which has brought the phyletic drifts to light. Such results may be described as "homologies of organisation," and, as Prof. W. H. Lang has so well said, "the critical study of homologies of organisation over as wide an area as possible becomes of primary interest and importance" (Address, British Association, Section K, Manchester, 1915). Questions of this sort would never have been raised but for the detailed comparisons of form combined with phyletic argument. Any one who reads my recently published volume on the ferns with ordinary care and intelligence will see that all through the detailed descriptions the relation to function and to the problem of causation is kept constantly in view. This illustrates once more how the formal and causal aspects of plant organs are inextricably united in modern writing, and how erroneous it would be to regard such writing as a mere summing-up of a past period of formal observation. The facts disclosed have themselves already opened up new lines of causal inquiry.

Another phase of morphology that promises to bring interesting results is experiment, already made fruitful by Goebel ("Einleitung in die experimentelle Morphologie der Pflanzen," Leipzig, 1908). It was said a good many years ago that the future lies with experimental morphology. But those who take this hopeful view appear to forget that present-day experiment cannot possibly reconstruct history, for it is impossible to re-arrange all the conditions as they were in a previous evolutionary period; and even then, are we sure that the subjects of experiment are really the same as they were then? Moreover, those subjects must always react under the limitations of their present-day hereditary character. Hence it is highly improbable that any modern reaction under experiment can be the exact reaction of a former age. The results may be suggestive, but it must always be a question how far they throw real light upon earlier events.

Returning now to the president's address at Liverpool, Mr. Tansley advocates in place of the mere pursuit of phylesis the study of "process of development." But he recognises clearly how "process and structure continually act and interact," and, accordingly, he concedes that "there should be no division of elementary Botany into morphology and physiology." That is surely in essentials the position introduced by Sachs forty years ago under the title of organography. Many of us have thought we were pursuing this all the time, not only in elementary teaching, but also in our research. This study of process of development can only be carried out effectively where there is adequate knowledge of the details of the thing developed. You must visualise your problems before you can hope to solve them. Their complete visualisation in all aspects is what I understand as the scope of morphology; and so I find myself substantially at one with the president. But this is not yet the universal view.

Morphology suffers still under depreciation at the hands of some whose special interest lies in other directions: they would give it only a subordinate place; but it will command its sustained value in the eyes of all those who survey the whole area of biological science with well-balanced view. Its limitations must, however, be clearly recognised. Where genera and species are few and isolated, and the fossil record is scanty, comparative morphology becomes proportionately more speculative, and the opportunity for developing its causal aspect is limited. But where there is an ample present-day representation of allied genera, well filled with species, and where the fossil record is rich and continuous, the scope of comparative morphology expands: any conclusions derived from comparison of living forms will acquire added weight so far as they are found to accord with the fossil record of related types. The most trustworthy line of argument will be the reverse of the line which evolution is presumed to have taken. It will start from an adequate

knowledge of the living types by study of closely related genera and species. It will progress backwards to earlier geological horizons. Frequently the line of affinity may be found to be more or less seriously interrupted, and gaps may have to be bridged by hypothesis rather than filled in by demonstration. But in favourable instances, and probably the ferns are more favourable than any other phylum of plants, the lines can be traced back with reasonable assurance of affinity of the plants compared to the fossils of the Primary Rocks.

Comparative morphology as applied to the Filicales may be held to have amply justified itself, and to have presented in a coherent and natural phylum a convincing evolutionary picture. Much of the detail may be wanting, and it may be far from being worked out satisfactorily into all its modern ramifications. But the main outline is becoming clear, so that working back comparatively we can build up from the converging downward lines a picture of an archetypic fern. It comes out as a type of vegetation not very different from those plants that constituted the vegetation of the Rhynie Chert. We need not assume that these plants were actual fern-ancestors, but it is not difficult to imagine how from such a type of vegetation as they present a plant might have been derived which would rank as an early Cœnopterid.

The Filicales are, however, an exceptionally favourable instance. From what has been said, it will be seen that even this phylum vanishes downwards into uncertainty, and other lines are still less clear. We arrive finally at that *terra incognita* of the early Palæozoic Period sketched by Seward. In this I see nothing that is deplorable and little that need be held as depressing. Why should we pledge our sense of satisfaction in phyletic study to an evolutionary tree with a single trunk? Why should failure to find such a tree lead any one endowed with a spirit of adventure to sheer off from formal morphology? However many the starting-points of new phyla may have been, or the separate lines of origin of such parts as leaves, the general position of evolutionary theory remains as sound as before this wave of pessimistic negation struck it. Evolutionary history must depend as before primarily upon formal morphology: the study of the "process of development" cannot be held as satisfactory without the "record of development." I am glad to find a somewhat similar opinion expressed from the chair of the Zoological Section at Liverpool in the words that "Morphology must be the forerunner of Physiology."

These two aspects of the study of organic nature should be held to be more than ever inseparable and co-ordinate in the modern developments of biological science. Though specialism may threaten divorce, this should be resisted by all who entertain broad views. A school based primarily on the study of "process of development," and with the "record of development" relegated to the background, might turn out good statisticians, but it would probably fail in converting them into historians. This is what we have been threatened with in recent years. But the president of the Botanical Section of the British Association gives his adhesion to the only sound line when he advocates the co-ordination of physiology and morphology—that is, of the studies respectively of "process" and of "record."

Oysters and their Nutritive Value.

By J. R. NICHOLLS.

THE natural oyster beds of England are a valuable part of British fisheries, and English oysters have been held in high repute from time immemorial. It is interesting, therefore, to find that scientific attention has been directed towards the oyster and its problems. Dr. E. S. Russell has produced an interesting paper based on an elaborate series of analyses carried out by the Government Chemist's Department, whose report is included in the publication.[1]

As a rule, monthly samples were examined from Burnham, Ipswich, Mersea and Whitstable during a period of a year. In all, 49 complete analyses are recorded. The average weight of meat per oyster was found to be greatest in the autumn or early winter, and the heaviest meats came from Whitstable, the order of the other districts being Ipswich, Mersea, Burnham. The proportion of water was practically constant. No clearly marked seasonal variation was observed in the percentage of fat, although it appeared to fall off in the autumn and winter. Proteins showed a well-marked change, being highest in the spring months and lowest in the second half of the year, but the total quantity of protein per oyster showed an increase during the growth period and remained nearly constant thereafter.

[1] Report on Seasonal Variation in the Chemical Composition of Oysters. By Dr. E. S. Russell (Ministry of Agriculture and Fisheries, Fishery Investigations, series 2, vol. 6, 1923, No. 1). H.M.S.O. 3s. net.

The most prominent feature was the change in glycogen, which showed a fall in the spring and a rise in the autumn. A general correspondence was observed between the variations in dry weight and variations in glycogen, indicating that the fattening of oysters in the autumn was due to accumulation of this carbohydrate. Glycogen occurs mainly and perhaps exclusively in the large vesicular cells of the connective tissue, and is the main, if not the sole, carbohydrate. As emphasised in the Government Chemist's report, it was found necessary to analyse a special portion of each sample for glycogen immediately after opening the oysters, as glycogen rapidly alters during the preparation of samples for analysis. It seems clear that surplus food material is stored mainly in the form of glycogen, and that this reserve is utilised certainly for the development of the sexual products, and probably also to maintain metabolism during periods of scarcity of food. The part played by glycogen in oysters is therefore similar to that played by fat in vertebrates.

The nutritive value is greatest in the autumn and early winter, hence oysters are then best as an energy-producing food. This period roughly corresponds with "the months with an *r*" in accordance with the popular idea.

Dr. J. H. Orton investigated the mortality among English oysters during 1920–21, and he has issued a summary [2] compiled from chemical, bacteriological and biological reports, part of which are to be published in *Fishery Investigations*, series 2, vol. 6, No. 3, and part later. During the winter of 1919–20 unusual mortality was reported in the oyster beds of Italy, and in the summer of 1920 similar conditions had spread to the beds of Western France and the Thames estuary. The epidemic died down during the winter of 1920–21, but reappeared in the summer of 1921 in the beds of the Thames estuary, English Channel, and North and Western France. The abnormalities of 1920–21 in the Thames estuary were investigated, particular attention being paid to (*a*) physical conditions, (*b*) oyster pests, (*c*) parasites, (*d*) observations on sound and weak oysters, and (*e*) possible direct poisoning from dumped munitions.

There is a lack of trustworthy information regarding the normal mortality of oysters, but English oyster planters estimate it at 10 per cent. in locally grown and at a higher proportion in relaid oysters. The loss occurs mainly in the summer months, and there is no one assigned cause. Variations in the temperature and salinity of the sea affect oysters, especially at the spawning period, and the effects of predatory enemies are of course evident, but parasites are normally absent. None of these factors accounted for the abnormalities under review.

Little has been recorded of the pathology, physiology, or even the histology of oysters. Various hitherto undescribed symptoms observed in weak or dying oysters were found to be probably normal. The most constant abnormal symptom, now observed for the first time, was the occurrence throughout the tissues of microscopic muscle spindles, which appear to be due to muscular degeneration. They can be produced if the tissues are bruised or if the oyster is starved, but poisons appear to have little effect. The phenomenon may be normal, but the condition of excessive myolysis is pathological, and requires further study.

It is known that munitions were dumped in the Thames estuary and elsewhere prior to 1920, and this might have caused local poisoning. A saturated solution of T.N.T. (1 in 10,000) kills oysters in a few days, but no appreciable or significant amount was present in the water of the Thames estuary after November 1920, either in solution or as floating particles. The conclusion is reached that the unusual mortality was not due to T.N.T., although a negligible amount of death may have occurred by ingestion of grains of T.N.T. by the oyster. Nitrites, oil and sodium picrate are not regarded as even probable causes of mortality.

From a large number of analyses of both healthy and sick oysters made at the Government Laboratory, it appears that oysters normally accumulate traces of metals such as copper, zinc, tin, iron, arsenic, etc. There is no uniformity in the proportions of metals present, nor do the quantities seem to be harmful to the oyster. It is suggested that the medicinal properties of oysters may depend upon these traces of metals. The metals are concentrated in the blood cells, and particular oysters may contain a far greater proportion of metals than the soil upon which the oysters rest. Mercury, barium and lead were not found either in oysters, soils or tow-nettings. Traces of arsenic are present in both sound and sick oysters, with, apparently, an accumulation in weak ones up to about five parts per million on the fresh meat. Of sound oysters yielding the maximum amount found it would be necessary, however, to eat more than two dozen to take the minimum medicinal dose of the British Pharmacopœia, and to eat about three thousand to take the minimum recorded fatal dose.

Varying quantities of arsenic from small to suspiciously large were found in soils, silts and tow-nettings; but some interesting experiments are recorded in which oysters have been kept in sea water containing white arsenic for many months without suffering harm. Under such conditions they easily absorb arsenic and easily lose it again, giving off continuously an arsenicated gas, probably arsine. The gas produced daily is minute in quantity, but can be easily recognised by the strong characteristic odour. The mode of absorption and retention of arsenic is not known, but it appears to be held differently from copper, zinc, etc. Arsenic, as well as most of the other metals, is present in sea water in very minute quantities.

No single cause or group of causes was found singly or collectively to account for the heavy and unusual mortality of 1920, but the investigation would appear to be of great interest and value to an industry to which very little scientific attention has been paid in the past.

[2] Summary of an Account of Investigations into the Cause or Causes of the Unusual Mortality among Oysters in English Oyster Beds during 1920 and 1921. By Dr. J. H. Orton (Journal of the Marine Biological Association, vol. 13, 1923, No. 1).

Obituary.

PROF. ROBERT TIGERSTEDT.

ROBERT TIGERSTEDT, professor of physiology at Helsingfors, died on December 2, 1923. Born in that city on February 28, 1853, he was the son of the well-known historian Prof. K. K. Tigerstedt and Evelina Degerman. Educated in Helsingfors, he took his degree in 1869, and at the age of twenty-three was appointed assistant in the Physiological Institute of the University. Ten years later he became professor of physiology at Stockholm, which post he resigned to return to Finland in 1900, at the time when that country was almost crushed out of existence by Russia. Appointed professor of physiology in the University of Helsingfors he remained there until his death.

Tigerstedt devoted a long life to physiology, and this science has lost a most distinguished teacher, as well as one whose personality and wide knowledge rendered it easy for his contemporaries in other countries to give him a foremost place among those who have contributed to the establishment of physiology as an experimental science.

Though the names of famous physiologists from Harvey onwards are familiar to many, it should be recognised that physiology as it exists to-day has

grown with exceptional vigour during the last fifty years. If we could speak of a renaissance of science, as we can of art and literature, then the re-creation of physiology might be considered to date from about 1850, and in English-speaking countries is chiefly associated with the names of Burdon-Sanderson and Michael Foster.

In this development of physiology the work of Tigerstedt played a large part. He was among those who early came under Carl Ludwig's influence at Leipzig, about the time when Bohr, Gaskell, v. Kries and a number of others were working in his laboratory. This was the period when a large amount of experimental work on the behaviour of the objectively excitable tissues, muscle and nerve, was in progress, and electro-physiology possessed a powerful attraction for those engaged in research. Tigerstedt's early papers, which extend between 1880–1884, were concerned with a study of the excitation processes in nerve. These were communicated to the Royal Academy of Sciences in Stockholm, and subsequently translated into English in the Biological Memoirs edited by Burdon-Sanderson in 1887. A later paper on the duration of the latent period in muscle appeared in 1885.

It was during his professorship at Stockholm that Tigerstedt became well known by the publication of two books. His "Lehrbuch der Physiologie des Kreislaufs" appeared in 1895 and was at once recognised as a work which presented a complete historical retrospect of the subject together with much original material. It is among the comparatively few volumes in physiological literature which stand out conspicuously as a permanent source of special information. The "Lehrbuch der Physiologie des Menschens" appeared in 1897, and an eleventh edition in 1923. An English translation of the third edition by Prof. J. R. Murlin, of New York, was published in 1906. This text-book shows distinctly the original bent of Tigerstedt's mind. Regarded by himself as a book designed primarily for medical students, special stress is laid upon the normal functions of the human body. But in the arrangement of material, the extended treatment of the general physiology of the cell, together with a general account of metabolism, Tigerstedt's text-book, which is a standard one among German students, preserves a marked individuality. His chapter on metabolism is probably the most complete general account given in any text-book, and many of the results of the metabolic experiments on man carried out with Sondén are to be found in this book.

Shortly before leaving Stockholm, Tigerstedt, in 1898, succeeded Holmgren as editor of the *Skandinavisches Archiv für Physiologie*. Following a custom not uncommon on the Continent, on the anniversary of his seventieth birthday the forty-third volume of this publication was dedicated to him by his friends and pupils. Several monographs were contributed by Tigerstedt to the "Ergebnisse der Physiologie," Nagel's "Handbuch der Physiologie," Oppenheimer's "Handbuch der Biochemie," and Winterstein's "Handbuch der vergleichender Physiologie." The publication of the "Handbuch der physiologischen Methodik" extended from 1908–1914. Among the contributors to this were Pavlov, Bohr, Gullstrand, Ewald, and v. Frey. The editing of this encyclopedic work was undertaken by Tigerstedt, and it is at the present time indispensable in any working physiological laboratory.

Tigerstedt, like most educated Scandinavians, was an excellent linguist. I met him not infrequently at various congresses, and at times in London and Vienna. He possessed a strongly developed patriotism, and took an active interest in whatever tended towards the preservation of the nationality of the Finnish people. His sympathies also spread to the Bulgars, who are ethnologically of the same stock. He was an able and successful exponent of his science, and published a number of popular works and pamphlets on hygiene. He also took a great part in the modern temperance movement, and must be ranked as one of the foremost scientific advocates of this cause. In several widely circulated publications he exposed the injurious effect of alcohol on the human body, but he was in no sense an ally of those who would enforce total abstinence by legislation.

The strong personality of Robert Tigerstedt made itself prominent even in private life. By his idealism, rich humour, and warm heart, he made lasting friends even among those who did not in all respects agree with his conceptions of life. From youth to death he maintained an optimistic trust in the future of his own nation. This trust it was that enabled him to bear the adversities and burdens which life also gave him in no small degree. Among these may be mentioned the loss of the greater part of his valuable library by fire. His relation to physiology in some respects resembled that of Bunsen to chemistry. The minds of both were alike in their singleness of purpose and the devotion of a long life to science, in the same sense that a life may be given to art or literature. Both men were endowed with the gift of making and preserving friendships, and the personality of each was, in a marked degree, shown by their power of attracting students of other countries to their laboratories. It is in these that the real progress of knowledge takes place, and where those intimate relationships between the teacher and the students are established which tend to the advancement of science. Robert Tigerstedt possessed a generous nature, a comprehensive capacity of critical judgment, a persistent industry, and a heart which sympathised with all truly human interests. Those were the qualities that marked his scientific, literary and social work, and won him a place in the foremost ranks of those who have striven for the advancement of Finland.

G. A. BUCKMASTER.

WE regret to announce the following deaths:

Dr. W. Hatchett Jackson, sub-warden and tutor of Keble College, Oxford, and Radcliffe librarian, Oxford, on February 21, aged seventy-five.

Mr. A. H. Jones, formerly treasurer and vice-president of the Entomological Society, London, on February 24, aged eighty-four.

Prof. A. C. O'Sullivan, professor of pathology in the University of Dublin, on February 18, aged sixty-six.

Prof. J. Symington, F.R.S., emeritus professor of anatomy, Queen's University, Belfast, on February 24, aged seventy-two.

Dr. B. H. Wedd, who, with his sister, Miss A. F. Wedd, translated Duclaux's "Pasteur and his Work," formerly bacteriologist to the London School of Tropical Medicine, on January 28, aged forty-seven.

Current Topics and Events.

THE Imperial Wireless Telegraphy Committee recently appointed by the Postmaster-General has issued its report with commendable promptitude. The problem set to the Committee was the difficult one of State ownership and private enterprise, and was almost hopelessly complicated by the apparently haphazard action of successive governments in apportioning the continental traffic between the Post Office and the Marconi Company. No guiding principle was used, and their policy seems to have continually varied. The Marconi Company possesses nearly all the radio patents, and its engineers have an international reputation. The Post Office has of late years established a research station for radio work, and has made valuable advances. It has also had two years' experience of long-distance radio communication, and is building a station at Rugby which will be one of the largest in the world. Without entering into the merits of the disputes between the Post Office and the Marconi Company, which have led to a deadlock, the Committee feels justified, alike on the merits of the case and for reasons of expediency, in recommending that the Post Office should erect, own, and operate the Empire radio stations in England. In the case of Canada, however, it makes an exception. It is right and equitable that consideration should be given to the Marconi Company, which has carried on service to Canada for fifteen years and has consequently created a goodwill in the business. It is therefore recommended that the present competitive service to Canada be continued. In conclusion, the Committee states that the Post Office is capable of operating all the stations in Great Britain without a partnership, which, it is considered, would not work harmoniously. It is admitted that the constructional, engineering, scientific, technical, and organising work will be on a large scale, and that improved organisation will be needed to put the business on an equality with a private organisation. It will be interesting to see what action, if any, will be taken on this report. Improvements on methods of radio communication are being made so rapidly that a State-operated system will have difficulty in keeping pace with them.

THE Trustees of the British Museum have arranged to explore the deposits of bones of deinosaurs in Tanganyika Territory, from which large collections were made shortly before the War by the Germans when they were in possession of that part of East Africa. Mr. W. E. Cutler, of the University of Manitoba, who has already obtained important specimens of deinosaurs for the British Museum from Western Canada, is in charge of the work; and he will be assisted by Mr. L. S. B. Leakey, of St. John's College, Cambridge, who was born in Kenya Colony and is well acquainted with the natives and their languages. The weather is favourable from the middle of May to the end of December, and it is hoped to spend two seasons in collecting. The bone beds, which were first discovered by the late Dr. Eberhard Fraas, of Stuttgart, in 1907, occur round the hill of Tendaguru, which rises from the plateau about 50 miles inland from the little port of Lindi. They are shown, by the fossils in the rocks above and below, to date back to the early part of the Cretaceous period. The deinosaurs represented are therefore of great interest as being among the latest members of the group. The specimens now in Berlin are of various genera, both armoured and unarmoured, but perhaps the most striking form is Gigantosaurus, which is related to the familiar American Diplodocus, but has more slender limbs and is much larger, probably 20 feet high at the shoulder and 120 feet in length. The British Museum possesses a plaster cast of the humerus of this reptile, just over seven feet in length, which was made in Berlin to illustrate a lecture given by Dr. Smith Woodward to the London branch of the German Colonial Society in 1912.

DR. H. R. HALL has been appointed to succeed Sir Ernest Wallis Budge on his retirement as keeper of the Department of Egyptian and Assyrian Antiquities in the British Museum. Dr. Hall, the son of the late Mr. Sydney Hall, the artist, was born in 1873, and was educated at Merchant Taylors' School, and St. John's College, Oxford. As a boy he was interested in Egyptian antiquities, and after he came down from Oxford he was appointed assistant in his department in 1896. Since that time, following the tradition of his department, he has both written many books on Egyptian and Mediterranean archæology, and has travelled and carried on excavations in the Near East. His best-known book is his "Ancient History of the Near East," which has run into five editions, and is well known to candidates for Greats: he has also produced works on Coptic Ostraka, on the ancient civilisations of the Ægean, and on his excavations. He has dug at Deir-el-Bahari in Egypt, and in 1919 in Mesopotamia he made very interesting finds at the mound of El-Obeid, not far from Ur of the Chaldees, the results, including copper lions and other artistic work which date back to a very early period, being now exhibited in the British Museum. During the early part of the War he was on the Press Bureau, and afterwards was gazetted as a Lieutenant (later Captain) for Intelligence. His all-round knowledge of the archæology of the Near East makes him admirably fitted for his well-deserved promotion from deputy-keeper to keeper, and, if we may be allowed the more intimate touch, his genial personality, far removed from that conventional dry-as-dustness which tradition, quite erroneously, associates with those who spend their lives amid the dead surroundings of Egypt and Assyria, will be a great asset to the Museum in binding the loyalty of his juniors to him.

THE announcement of the appointment of Dr. F. A. Bather to succeed the present keeper of the Geological Department in the British Museum (Natural History) will be hailed with satisfaction by all who have at heart the welfare of that institution. A great exponent of vertebrate palæontology, who has upheld and extended the fame of his department, will be followed by one whose knowledge of the

invertebrate fossils has already given him a position of world-wide authority. Dr. Bather left Oxford in 1887 to take up his duties at South Kensington, and began, very shortly after, the special study of echinoderms, upon which he has since been continuously engaged. Of his very numerous writings dealing with that group the more important are: "The Crinoidea of Gotland, Pt. I. The Crinoidea Inadunata," published in 1893 under the auspices of the Swedish Academy of Science; "The Echinoderma," being Part III. of Sir E. Ray Lankester's "Treatise on Zoology," 1900; and the magnificent monograph, "Triassic Echinoderms of Bakony," in the "Resultate der wissenschaftlichen Erforschung des Balatonsees," which is indeed a model of what such a work should be. Palæontological nomenclature has given rise to many papers from Dr. Bather's pen—"Pentacrinus: a name and its history," *Natural Science*, 1898; "Eocidaris and some species referred to it," *Ann. Mag. Nat. Hist.*, 1907; "Some common Crinoid Names and the fixation of Nomenclature," *loc. cit.*, 1909; while his views upon the broader principles of the science are to be found in his presidential address to Section C (Geology) of the British Association at Cardiff in 1920. With a wide experience of foreign museums, Dr. Bather has long been a most active supporter of all branches of museum development at home, and has contributed many helpful and critical articles to the *Museums Journal* and elsewhere on organisation, aims, and arrangement. Though much of Dr. Bather's work has been for the specialist, the "Guide to the Exhibition Galleries of Geology and Palæontology," issued last year, is a sufficient indication—superfluous to those familiar with his broad outlook—that the claims of the ordinary visitor to the department under his charge will receive the sympathetic recognition on which the public utility of the exhibition galleries so much depends.

In the second of a course of Cantor lectures delivered by Mr. E. V. Evans, chief chemist of the South Metropolitan Gas Company, at the Royal Society of Arts on March 3, a striking innovation was made by the introduction of a cinematograph film to depict some of the chemical changes which take place when coal is heated in a closed gas retort. The film, which had been prepared by Mr. E. Anson Dyer, the well-known film cartoonist, showed in a remarkable way some typical chemical changes by means of the structural formulæ which are so familiar to chemists, but are viewed with awe by most other people. These intricate formulæ, when presented by the cinema, lost their complexity, and it seems that the schoolboy of the future will be able to supplement the practical knowledge gained in the laboratory by this entrancing and simple method of approaching a somewhat difficult subject.

Dr. Charles S. Myers, director of the National Institute of Industrial Psychology, read an important paper on "The Use of Vocational Tests in the Selection of a Vocation" before the Royal Society of Arts on February 27. He drew a distinction between "vocational guidance," meaning advice to the worker as to his best occupation, and "vocational selection," meaning the selection of the best qualified worker for a particular job; and described with illustrations the various tests employed and apparatus used. Some interesting information was given as to the position of industrial psychology in other countries. Germany, the lecturer said, "makes no secret of her aspirations, that by concentrating on the *human* problems of industry and commerce she may attain that success in the present century which she won in the past century by devotion to the *mechanical* aspects of the subject." There is need for further research of the relative values of the various methods of procedure in vocational testing.

On February 18 the Rev. H. G. O. Kendall delivered a lecture on "Chipped Flints" at the Cheltenham Public Library, in which he dealt in a comprehensive manner with the cultures of the Old and New Stone Ages in Great Britain, from their earliest beginnings. In describing the various types of flint implements and the methods of manufacture, he referred to the flint industry at Brandon, where flint chipping is believed to have been continuous from the palæolithic age to the present day. In that neighbourhood the remains of a peculiar language survive among flint-diggers, and are thought to be a relic of neolithic times. As an example he quoted "bubber hutching on the sosh," the term used for the process of heaving up the flint from stage to stage in a shaft. In regard to "eoliths" he held the view that they do not represent the earliest implements but are the less highly wrought tools of palæolithic man, implements for everyday use.

Prof. A. Fowler, Yarrow research professor of the Royal Society, will deliver the Bakerian lecture on May 15. The subject of the lecture will be "The Spectra of Silicon at successive Stages of Ionisation."

A conversazione of the Gilbert White Fellowship will be held at the Art-Workers' Guild Hall, 6 Queen Square, Bloomsbury, W.C.1, on Saturday, March 8, 3 to 6.30 p.m. A reception will be held by the president, Sir David Prain, and Lady Prain, and a number of demonstrations and exhibits have been arranged.

On Thursday, March 13, at 11.30 a.m., a memorial to Lord Lister will be unveiled in Portland Place by Sir Charles Sherrington, president of the Royal Society.

The annual conference of the Royal Institute of British Architects and its allied societies in the United Kingdom and in the Overseas Dominions will be held at Oxford on July 9-12.

A research physicist is required in the Research Laboratories of the General Electric Co., Ltd., Wembley. Applications for the post should be made, in writing, to the director.

The Munich astronomer, Dr. H. von Seeliger, has resigned the presidency of the Bavarian Academy of Science. Dr. M. von Gruber, professor of hygiene

and bacteriology at the University of Munich, has been appointed president for a period of three years.

AN assistant in animal nutrition under the head of the Chemical Research Division of the Ministry of Agriculture for Northern Ireland is required. Applications for the post should be addressed to the Secretary of the Ministry, Wellington Place, Belfast. The latest date for their receipt is March 22.

THE January number of the *Gazzetta Chimica Italiana* contains an interesting lecture on Giacomo Ciamician delivered at Rome by Prof. Giuseppe Plancher, of the University of Bologna. Prof. Plancher gave an account of the life and work of the distinguished Italian chemist, who died in 1922.

A NEW Geological Museum is being built at the Academy of Science in Petrograd, and the section already completed includes a special gallery for the display of the unique collection of skeletons of Permian reptiles discovered by the late Prof. W. Amalitzky in the region of the northern Dwina.

THE Meldola medal for the year 1923, instituted by the Maccabæans in memory of Prof. Raphael Meldola, and administered by the Institute of Chemistry, has been awarded to Mr. C. N. Hinshelwood, of Trinity College, Oxford, and was presented to him at the annual general meeting of the Institute held on March 3.

PROF. W. H. PERKIN, Waynflete professor of chemistry at the University of Oxford, has been elected to the board of the British Dyestuffs Corporation, Ltd. Prof. Perkin recently undertook the supervision of the Research Department of the Corporation, a duty which he will continue to perform in addition to serving as a director.

THE Toronto correspondent of the *Times* states that an aeroplane fleet consisting of thirteen machines is to be purchased by the Ontario Government to survey the forest wealth of the Province and to protect the lumber and paper industry, which represents an investment of about 15,000,000*l*. It is expected that the proposed aeroplane service, which will make a daily patrol of the timber tracts, will result in saving 50,000*l*. annually.

THE Department of Scientific and Industrial Research invites applications for the post of an assistant engineer at the Fuel Research Station, East Greenwich. Candidates should be fully qualified engineers with electric power station and, if possible, research experience. The latest date for the receipt of applications (addressed to the secretary of the department, 16 Old Queen Street, S.W.1) is March 17.

THE building of the Field Museum of Natural History in Grant Park, Chicago, was completed in January, at a total cost slightly exceeding seven million dollars, which is about 700,000 dollars more than the sum arising from Marshall Field's original bequest. Towards this deficit Mr. Stanley Field has contributed 75,000 dollars. Captain Marshall Field is giving an annual sum of 100,000 dollars, and other large donations are announced.

APPLICATIONS are invited by the British Medical Association for the Middlemore prize for 1925, consisting of a certificate and 50*l*. The prize on this occasion will be awarded for the best contribution on any ophthalmological subject, whether previously published or not, provided that it shall not have been published or prepared more than three years prior to the date on which applications are receivable for the prize. Competitive papers must be received by the Medical Secretary of the Association, 429 Strand, by, at latest, February 2, 1925.

A MEETING of subscribers to the fund which has been raised in memory of the late Dr. W. H. R. Rivers is to be held at the rooms of the Royal Society, Burlington House, on Tuesday, March 25, at 4 P.M. In inviting contributions to the fund the organising committee stated that it would be devoted to the promotion of those branches of science in which Dr. Rivers was interested. At the forthcoming meeting, subscribers will be asked to decide upon the exact form the Rivers Memorial should take to attain this object. Should any of the friends or admirers of Dr. Rivers not yet have subscribed, they are asked to communicate with the Treasurer, Dr. L. E. Shore, St. John's College, Cambridge.

AT the annual general meeting of the Optical Society held at the Imperial College on February 14, the following officers and members of council were elected: *President*, Prof. Archibald Barr; *Vice-Presidents*, Sir Frank Dyson, Mr. T. Smith, and Inst.-Commdr. T. Y. Baker; *Hon. Treasurer*, Major E. O. Henrici; *Hon. Secretaries*, Prof. Alan Pollard and Mr. F. F. S. Bryson; *Hon. Librarian*, Mr. J. H. Sutcliffe; *Editor of Transactions*, Dr. J. S. Anderson; *Council*, Dr. J. S. Anderson, Mr. W. M. Brett, Prof. F. J. Cheshire, Mr. R. W. Cheshire, Mr. W. B. Coutts, Mr. A. H. Emerson, Mr. H. H. Emsley, Mr. P. F. Everitt, Dr. J. W. French, Miss L. M. Gillman, Mr. J. Guild, Inst.-Lt.-Commdr. N. Langlands, Dr. L. C. Martin, Mr. F. C. Watts, and Mr. A. Whitwell.

THE following have been elected as fellows of the Royal Society of Edinburgh: Dr. A. Bowman, Scientific Superintendent, Fishery Board for Scotland; Prof. T. A. Brown, professor of mathematics in University College, Exeter; Mr. G. G. Chisholm, emeritus reader in geography in the University of Edinburgh; Mr. E. T. Copson, lecturer in mathematics in the University of Edinburgh; Prof. C. G. Darwin, Tait professor of natural philosophy in the University of Edinburgh; Mr. C. H. Dinham of the Geological Survey of Great Britain (Scotland); Dr. W. E. Elliot; Dr. A. H. Evans, lecturer in English history (under Special Board), Cambridge; Mr. W. E. Evans, assistant in charge of Herbarium, Royal Botanic Garden, Edinburgh; Dr. R. J. D. Graham, lecturer in plant physiology in the University of Edinburgh; Mr. D. T. Jones, chairman of H.M. Fishery Board for Scotland; Dr. D. M. Lyon, lecturer in Clinical Medicine in the University of Edinburgh; Mr. H. Macpherson; Mr. J. R. Matthews, lecturer in botany in the University of Edinburgh; Dr. P. Nelson, past reader in numismatics in the University of

Liverpool; Dr. J. B. Orr, Director of Rowett Research Institute for Research in Animal Nutrition, and research lecturer in physiology of nutrition in the University of Aberdeen; Mr. J. Parker, principal of the Fife Mining School, Cowdenbeath; Mr. E. Ponder, lecturer in physiology and biochemistry in the University of Edinburgh; Prof. J. Read, professor of chemistry in the University of St. Andrews; Mr. W. C. Reid; Mr. A. A. Scot Skirving, senior lecturer in clinical surgery in the University of Edinburgh; Sir Harold J. Stiles, professor of clinical surgery in the University of Edinburgh; Mr. R. Turner; Mr. Ramaswamy S. Vaidyanathaswami, University of St. Andrews; Mr. W. A. Williams; and Prof. W. Wilson, Secretary to the University of Edinburgh, and Regius professor of public law.

Two sets of six well-produced picture post-cards, at ninepence the set, have recently been issued by the Hull Municipal Museums. Series A gives some views of the general museum in Albion Street and the fisheries and shipping museum in Pickering Park; they include a good photograph of the great prehistoric dug-out from Brigg, Lincolnshire, which is in the former museum. Series B deals with the Wilberforce Museum—a truly delightful institution, which gives point to Mr. T. Sheppard's recent presidential address to the Museums Association on "The Small Museum," now re-issued as a Hull Museum Publication.

DR. A. L. J. SUNIER, of the Laboratory for Marine Investigations at Batavia, gives an account (in *Treubia*, vol. iii., 1923, pp. 127-148) of this new marine station which was completed about a year ago. As was mentioned in our issue of February 9, p. 203, the Station possesses a small but seaworthy motor boat and a research steamer (320 tons) about 40 metres long, suitable for more extensive work at sea. The author reminds zoologists that the many coral reefs in the Bay of Batavia represent in themselves a rich field for study, and that comfortable quarters are available at reasonable prices in Batavia. The interest of the coral reefs is emphasised by a memoir (with 13 plates) in the same journal, by Dr. H. Boschma, on budding and allied phenomena in Fungia, based on material collected on the reef in the northern part of the Bay of Batavia.

THE Report of the Manchester Museum for 1922–23 records the gift by Mr. Charles Heape, of Rochdale, of his rich ethnographical collection, which includes many objects now unprocurable, all properly labelled and in excellent preservation. The accession of Dr. G. H. Carpenter to the keepership is marked by increased activity on the entomological side in both its economic and its scientific aspects. This museum, as Sir William Boyd Dawkins recently reminded readers of the *Times*, is noteworthy for its instruction of elementary-school children. The five teachers engaged in the work deal with twenty classes each every week, which means 2500 children a week. The important feature of the teaching is that it follows a systematic plan correlated with the regular school work. There are also visits under guidance from secondary schools, social clubs, and the like, the value of which lies in quite a different direction—inspiration rather than instruction. This distinction is not always realised by those who write to the public press on this subject.

WE were interested in a catalogue, recently issued, of the Exhibition of Radio Apparatus which was held in Sydney last December. There are many experts in radio-telephony in Australia, and it offers such an excellent field for radio broadcasting that it is rather surprising that advantage of the art has only now begun to be taken. They have had, however, the advantage of watching the schemes devised by other nations develop. Broadcasting regulations have now been made and an Association for the Development of Wireless has been formed. A broadcasting license is issued to any person who desires to listen-in to the programme of a broadcasting station on payment of a subscription of 10*s*. per annum, though the broadcasting station has the power to make an extra charge if necessary. Radio dealers have books of license forms, so that the purchaser can buy his receiving apparatus and his license at the same time. The receiver is sealed and responds only to the wavelength of the broadcasting station with a ten per cent. tolerance. If the listener wants to listen to two stations special sealed apparatus is purchased, but he has to pay one pound and the charges, if any, of the two stations. The regulations with regard to experimental licenses are definite and stringent.

THE Section of Terrestrial Magnetism and Electricity (a branch of the International Geodetic and Geophysical Union) has now issued a report on the Transactions of the Rome Meeting, May 1922; the volume, of 182 pages, is edited by Dr. L. A. Bauer. It is chiefly devoted to questions of magnetism, though brief accounts of work on atmospheric electricity and earth currents are also included; in this sphere it is of interest to know that Prof. R. A. Millikan is taking up the study of atmospheric electricity and penetrating radiation at high altitudes. The discussions and written comments on the questions on the agenda referred (in the main) to matters of technical practice, concerning which there is but slow progress towards agreement. Of more immediate interest are the accounts, from many countries, as to the status of magnetic surveys, observatory work, instruments, and methods. These would be still more valuable if the ex-enemy countries and Russia were also included in the Union. Poland and Finland are among the States which have become active in the field of terrestrial magnetism since the War, and the geographical positions of the new observatories at Sodankyla (Finland) and Toolangi (Australia) render their institution particularly valuable.

WE have received an interesting pamphlet by Dr. E. F. Smith, of the University of Pennsylvania, on Jacob Green (1790–1841), an American chemist who was elected first professor of chemistry at Princeton in 1818, a position he resigned in 1822, apparently owing to lack of funds on the part of the governing body. In 1825 he filled the first chair of chemistry in

the newly founded Jefferson Medical College, which he occupied until his death. Prof. Green contributed to other sciences as well as chemistry: he was interested in electricity, botany, geology, and astronomy; in fact, as Dr. Smith says, "science in any form fascinated Green," and he was an enthusiastic teacher, known to his students as "old Jakey Green." In 1828 he visited Europe, and recorded his impressions in a diary which was published in 1830 in New York, and from which Dr. Smith gives some interesting extracts. He visited Dalton, who, "when I handed him my letter of introduction, was absorbed in a long arithmetical calculation [on the composition of the atmosphere], and he begged of me a few minutes to finish this operation," but afterwards entertained his guest with great kindness. In another book Green records his conviction that Dalton was not acquainted with the work of Higgins when he put forward the atomic theory. Davy was not in London when Green passed through, but he met Faraday and saw "the original instrument with which Cavendish ascertained the composition of water." In Paris, among others, Green saw Thenard, who was "something of the *beau* in his dress . . . fluent and animated in his style of speaking." It will be seen that Green's "Notes of a Traveller" must be an interesting book.

L'INSTITUT du Radium and La Fondation Curie, which represent the growth of the study of radio-activity from its physical and chemical aspects, together with that of the action of the rays from these bodies on living structures, form the subject of a well-illustrated article in *La Nature* for January 12. The article gives a very good account of the many sides of experimental and clinical work which is carried on at this, the chief centre of its kind in France, if not indeed in the world. Experimental laboratories on the physical side are presided over by Mme. Curie, who, it will be remembered, was recently given a pension of 40,000 francs a year by the French Government in recognition of her scientific work, on the occasion of the twenty-fifth anniversary of the discovery by M. and Mme. Curie of radium. Dr. Regaud is in charge of the laboratories concerned with the biological side, and the way in which the work of an experimental nature is co-ordinated to the mutual advantage of either science is at once evident. Not only so, but the inclusion of two pavilions, one for radium and the other for X-ray therapy, contiguous to the experimental laboratories, ensures the application of scientific methods so far as they are available, in such a difficult subject as the treatment of disease. The disease which is the main clinical study is cancer, and it is a noticeable feature of such treatment that radiation, whether from radium or X-rays, is looked upon as a scientific weapon which has to be wielded with extreme care, not only that dangers may be avoided, but also that the best clinical results may be obtained. It is a fact, patent from reports which issue from different radiological centres, that the application of quantitative methods has led step by step to improvement in results, and in no case is this better exemplified than in the Institution in question. The Institution can scarcely fail to be a source of national pride, which finds this practical expression of the capital importance attached to the discovery of radio-activity.

LOCAL Natural History Societies fulfil a most useful function in maintaining records of the fauna, flora, meteorology and other subjects of scientific interest. Amongst the numbers scattered over the country the Hastings and St. Leonards Natural History Society holds a high place. In volume iii. of its journal, the *Hastings and East Sussex Naturalist*, the six parts of which cover the period 1918–1923, are many admirable articles and lists of occurrences. It is refreshing to find that groups of animals that too often are neglected, *e.g.* myriapods, land isopods, Diplura (Campodeidæ), claim ardent devotees in this Society. This volume is, however, of unusual interest in that it contains a biographical sketch of William Markwick, with extracts from his Calendar 1768–1776, and notes on his natural history MSS. which are in the possession of the Hastings Museum. It is this William Markwick who is mentioned in the "advertisement" of the second (1802) edition of Gilbert White's "Natural History of Selborne," and whose calendar for Sussex is given in columns opposite to Gilbert White's for Hampshire. He was an all-round naturalist, and a fellow of the Linnean Society. He took the name of Eversfield under the will of an aunt; and by the generosity of a member of this family his MS. volumes have recently passed into the custody of the Museum.

THE Jubilee Volume (1923) of the Transactions of the Leeds Geological Association, and the Proceedings of the Liverpool Geological Society, recording its sixty-fourth session (1922–3), come together into our hands, and remind us of the constant additions to geological knowledge made in all parts of Britain by the followers of William Smith, A. Sedgwick, and H. C. Sorby. The latter publication contains an important presidential address by Prof. P. G. H. Boswell on the constituent minerals of sediments, with a closely printed bibliography extending over twenty-five pages (C. Tinling and Co., 53 Victoria Street, Liverpool, price 2*s.* 6*d.*).

THE announcement list of Messrs. Methuen and Co., Ltd., for the first half of the present year contains particulars of many science books. Among them are the following: "A Survey of Physics," by Prof. Max Planck, translated by R. Jones and D. H. Williams (it deals with general physics, traces the development of modern physical theories, and includes lectures and essays on the principle of least action, the nature of light and the quantum theory); a translation, by H. L. Brose, of Prof. Max Born's "Einstein's Theory of Relativity"; "Relativity for Physics Students," by Dr. G. B. Jeffery; "Crystals and the Fine-structure of Matter," by Prof. F. Rinne, translated by W. S. Stiles; and a translation, by J. G. A. Skerl, of the third German edition of Prof. A. Wegener's "The Origin of Continents and Oceans."

WE have received from Messrs. Watson and Sons (Electro-Medical) Ltd., an exposure table intended for

radiographic work upon the human body, working with a Coolidge tube at an alternative spark-gap of 5 inches, and at a focal distance of 20 inches. The times necessary for the different parts of the body are tabulated for three different currents through the tube, namely, 5, 10, and 30 milliamperes. The exposures are approximately proportional to the current passing through the tube, but not exactly so. The information is very neatly printed, and is reproduced on a card intended for the coat pocket of the user. From Bulletin 58 S. we learn that Messrs. Watson are now able to supply waterproof surfaces to the Sunic Intensifying Screens which do not materially add to the time of exposure. This should be very useful in preserving the screens and giving them a much longer life.

THE new announcement list of the Oxford University Press contains many books of scientific interest. Among them we notice an enlarged and illustrated edition of "Living Organisms: An Account of their Origin and Evolution," by Prof. E. S. Goodrich; the Index of Subjects and Index of Persons and Places to the translation of Suess's "The Face of the Earth"; "Timbers: their Structure and Identification," by W. S. Jones. The latter is a micrographic study of timbers, with special reference to the principal European, Indian, and American species. There are also a translation, revised and brought up-to-date, of Obermaier's "Fossil Man in Spain," with an introduction by Prof. H. F. Osborn; "Folklore of the Bombay Presidency," by R. E. Enthoven, dealing with the primitive practices and beliefs of the Bombay Presidency, excluding Sind; and "The Home of an Eastern Clan: a Study of the Palaungs of the Shan States," by Mrs. Leslie Milne, being an account of the life and customs of a little-known tribe of North-Eastern Burma.

Our Astronomical Column.

MARS.—Mars now rises at about 3 A.M., and is gradually becoming better situated for observation as well as increasing in apparent brilliancy. It is slowly moving to the north-east amongst the stars of Sagittarius. The planet will arrive at opposition on August 23 next, and will be very brilliant at that time though the position will be low in the firmament, its altitude at southing being only about 20°.

The apparent brightness and diameter of the planet will vary as follows in future months:

1924.	Stellar Magnitude.	Semi-diameter.
		"
March 15 . . .	+0·9	3·43
April 15 . . .	+0·4	4·30
May 15 . . .	−0·2	5·52
June 15 . . .	−1·0	7·44
July 15 . . .	−1·8	10·05
Aug. 15 . . .	−2·6	12·40
Sept. 15 . . .	−2·2	11·37
Oct. 15 . . .	−1·3	8·53
Nov. 15 . . .	−0·5	6·19
Dec. 15 . . .	+0·2	4·69

Telescopic observations of the surface markings will be more successful if made in the southern hemisphere, where its height above the horizon will be much greater than in Europe. Good definition is necessary, and this will be far more often and more easily attained in the southern hemisphere than in the northern. Mars will be nearer to the earth (34,650,000 miles distant) on August 23 next than it has been for a long period of time.

ANOTHER HARVARD STATION IN SOUTH AMERICA.—Excellent work has been done at Arequipa, Peru, since its establishment some thirty years ago, more than a hundred thousand photographs having been taken. But the weather is often bad from December to March; also the station is not far enough south to reach the regions near the south pole. According to *Science* of February 1, a subsidiary station has now been opened at Chuquicamata, Chile, twenty miles from the Smithsonian station at Calama. Its altitude is more than 7000 feet; the region is practically rainless, and clouds are rare. The southern Milky Way and the Magellanic clouds are being searched for variable stars; a continuous photographic patrol of the southern heavens is maintained with a wide-angle lens.

ROTATION PERIOD OF NEPTUNE.—No markings of a sufficiently distinct character to determine the rotation period of Uranus and Neptune have yet been detected. That of Uranus is, however, now known within fairly narrow limits; V. M. Slipher obtained photographs of its spectrum at Flagstaff; the slope of the Fraunhofer lines due to the different radial velocities of opposite limbs give a period of $10\frac{3}{4}$ hours, uncertain by several minutes; Leon Campbell found a variation of light with a period of $10^h\ 50^m$, in good agreement with the Flagstaff result. L. Campbell's method has been applied to Neptune by Maxwell Hall and others; a very full investigation on these lines by E. Opik and R. Liviander at Tartu (Dorpat) has just been published; 145 extra focal photographic images of the planet and neighbouring stars were obtained on sixteen nights between December 16, 1922, and March 21, 1923. On six of the nights the series of exposures extended over some five hours, which is a large fraction of the rotation period. Use was also made of twenty-six exposures obtained on three nights in March 1922.

The densities of the images were measured with a microphotometer. Comparison plates were exposed on the north polar sequence under similar conditions.

They found a double periodicity in Neptune, the two periods being $7^h\ 42^m\ 24{\cdot}1^s$ and $7^h\ 50^m\ 10{\cdot}7^s$ (mean time). The latter is practically identical with $7^h\ 50^m\ 6^s$ found by Maxwell Hall in 1915. So long ago as 1883 he announced a period of $7^h\ 55^m\ 12^s$, with a light-range of a whole magnitude (Mon. Not. R.A.S., vol. 44). As the observations extended over little more than a fortnight, the agreement is quite satisfactory. The shorter period is presumed to be that of the equator, the longer that of the temperate zones. The difference between them is not much greater than the $5^m\ 11^s$ of Jupiter, and is much less than the 25^m of Saturn.

The following table shows the light-range in stellar magnitudes for the two periods at various epochs; it varies with the size and darkness of the spots on the surface:

Date.	Observer.	Range for Short Period Magnitude.	Range for Long Period Magnitude.
1883	Maxwell Hall	..	1·0
1884–5	G. Müller	0·12	0·18
1908	J. M. Baldwin	0·14	0·15
1915	Maxwell Hall	..	>0·4
1922–3	E. Opik, etc.	0·14	0·13

These accordances seem sufficient to give very high probability to the result, according to which Neptune spins much the fastest of all the planets, and has no doubt great polar flattening. The effect of this is seen in the shift of the plane of Triton's orbit.

Research Items.

PREHISTORIC POTTERY FROM THE MIMBRES VALLEY, NEW MEXICO.—Dr. J. Walter Fewkes, Chief of the Bureau of American Ethnology, has just issued in the Smithsonian Miscellaneous Collections an illustrated description of one hundred designs on pottery from the Mimbres Valley. The designs are painted on the inside of food bowls and the exterior of vases which had been buried with the dead. The bowls were usually placed at the side of the body in the grave, but occasionally one is found placed over the head like a cap. They were nearly always "killed" or perforated before being buried with the dead, to allow the spirit to escape and accompany the spirit of the former owner to the land of the shades. The decorations fall into three classes: realistic, conventional, and geometric. The realistic designs, greatly in the majority, are of animals, and occasionally of human figures. Certain of the designs, especially the wings and tails of birds, have become more or less conventionalised, forming the second group, while the third, geometric figures, either form a marginal decoration or cover the entire inside surface of the bowl, often with most elaborate designs.

THE MOA AND MAN IN NEW ZEALAND.—Mr. H. D. Skinner has subjected to re-examination the material found in the Moa-bone Point Cave, Canterbury, N.Z., by Sir J. von Haast in 1872. The results are published in the "Records of the Canterbury Museum," vol. ii. No. 3. Three series of strata containing artefacts were originally differentiated. The first, said to be of marine sand, the second the "Moa-hunter" beds, and the uppermost the Maori beds. If the lowest beds were correctly described as of marine sand, it would afford evidence for a considerable antiquity of man in New Zealand, but there is ground for doubting the accuracy of the description. The culture of the "Moa-hunter" beds, which must be attributed to the Ngati-Mamoe, an ancient tribe of Canterbury, does not differ in any important respect from the culture of the tribes preceding or following; nor does it support the view that the Ngati-Mamoe were descended from the traditional Maruiwi whom some would affiliate with the Melanesians; and finally, as Moa bones were collected by the Maoris even in the early European period for manufacturing fish-hooks, etc., the occurrence of Moa bones in these beds does not necessarily support the view put forward by F. W. Hutton that some species of Moa were contemporaneous with man.

CHINESE PHYSICAL TYPES.—Our limited knowledge of the physical measurements of the Chinese adds materially to the value of an important study of this subject by Dr. S. M. Shirokogoroff which appears as an extra volume of the Journal of the North China Branch of the Royal Asiatic Society under the title "Anthropology of Northern China." The data upon which it is based were collected by the author at intervals between 1912 and 1918, and form part of a larger investigation in North-eastern Asia covering Chinese, Manchus, Koreans and Tungus. The Chinese figures are derived from men from Shantung (185), Chihli (114), and Manchuria (96). The author's conclusion is that the Chinese are a complex of anthropological types of which he distinguishes four. These are: Type A: Stature 1750, cephalic index 75, nasal index 100; Type Δ: Stature 1690, cephalic index 85, nasal index 75; Type Γ: Stature 1590, cephalic index 76, nasal index 75; Type B: Stature 1600, cephalic index 90, nasal index 110. Of these types, A is Chinese, Δ Mongol, Γ Tungus, comparable with the Tungus of Barguzin but of greater stature, and B is palæoasiatic, comparable with the Gilyaks, a comparison borne out by its frequency among the Chinese of Manchuria, as might be expected from their geographical situation.

THE MOULTING OF THE LOBSTER.—Mr. R. Elmhirst contributes notes (Proc. R. Phys. Soc. Edin., xx., 1923, pp. 271-276) on the moulting of lobsters observed at the Millport Station. The imbibition of water into the blood system is well under way before the moulting, and the lobster straightens the walking legs, therefore standing somewhat higher than usual, and partially flexes the abdomen. The arthrodial membrane at the junction of thorax and abdomen bulges, gradually stretches, and eventually ruptures, and the old carapace is forced upwards finally to the extent of two inches. Meantime the legs and more anterior appendages are gradually withdrawn from their old coverings. Part of the swelling of the body appears to be due to the blood supply of the chelæ being retained in the body, the chelæ when finally withdrawn being much shrunken. The withdrawal of the chitinous lining of the stomach next occurs, and then follows a series of strong erections of the abdomen and repeated jerking of this region, each jerk freeing one segment of the abdomen from the old shell, so that finally the animal frees itself completely and with two violent flaps of the tail shoots away from the old shell. During moulting the respiratory beat of the scaphognathite was slow but became rapid immediately after the moult.

INDO-PACIFIC BOPYRIDÆ.—The Bopyrid isopods of Indian Seas have been little investigated, but a beautifully illustrated memoir by B. Chopra (Records Ind. Mus., xxv., 1923, pp. 411-550, 11 plates) provides an excellent account of these parasites, which are comparatively common in Indian waters, the majority of the species of Caridean prawns in the Calcutta markets being infected. At least thirty-three species of bopyrids belonging to thirteen genera are represented in the collection studied by the author; twenty-five found in the Indian waters represent species hitherto unknown and two new genera have been instituted. The presence of the parasite inhibits the sexual activity of the host, preventing full manifestation of secondary sexual characters and sometimes rendering difficult the identification of the host—chiefly species of Palæmon, Alpheus, and Synalpheus. More than fifty per cent. of the prawns (Palæmon) in some of the collections made in the streams of the Gangetic Delta are infected. The author points out that Giard and Bonnier's hypothesis of one host species for one species of parasite, though not of universal application, has a practical value especially among certain of the genera. The author gives a key to the genera of Bopyridæ, followed by a systematic description of the genera and species.

A NEW ANÆSTHETIC.—Much discussion has taken place in the medical press recently regarding the extent to which cocaine can be replaced as a local anæsthetic by one or other of the numerous synthetic substitutes which have been discovered and marketed by manufacturers. A considerable number of these have survived the test of use in surgical practice and now have a recognised place in at least minor operations, but the discussion shows that cocaine cannot yet be completely replaced by any of them. A recent addition to the list, "butyn" (*p*-amino-

benzoyl-γ-di-*n*-butylaminopropanol sulphate), made in the United States, has received a good deal of attention, chiefly because of the stress laid on its rapidity and potency as an anæsthetic and its low toxicity. It has been found useful by some surgeons, though complaint has been made of its high cost, but others have found it unsatisfactory at least for certain branches of surgery. Sir St. Clair Thomson, who tried the new drug at the invitation of the Ministry of Health, records in the *British Medical Journal* of February 9 his experience of "butyn" in four cases of tubercle of the lungs and larynx. In two of these it failed to produce anæsthesia, though cocaine acted satisfactorily. In a third case it did act, but less completely than cocaine, whilst in the fourth case it gave rise to severe toxic symptoms. In all four cases the drug caused excessive secretion of mucus, which was troublesome in carrying out the operation. The author points out that during the last twenty years, though making free use of cocaine, the latter has not given him cause for anxiety in a single case.

EGGS OF EXTINCT REPTILES.—The discovery of deinosaurian eggs in Mongolia adds new importance to the investigation by V. van Straelen and M.-E. Denaeyer, of Brussels, of the optical and other mineral characters of the fragmentary shells of the eggs described by Ph. Matheron in 1896 from Upper Cretaceous lacustrine strata at Rognac in Provence. Matheron, with reserve, regarded these as possibly representing the eggs of his *Hypselosaurus priscus* (*Rhabdodon priscum*), which occurs in the same beds (see NATURE, vol. 112, p. 910), or else of some Mesozoic bird. P. Gervais, noticing a spherulitic structure in the calcium carbonate of the shells, as revealed between crossed nicols with the polariscope, and knowing the same structure in chelonian eggs, referred the fragments to the eggs of turtles. The present authors, however (Acad. royale de Belgique, Bull. classe des sciences, Jan. 6, 1923), show that spherulitic structure in egg-shells is not peculiar to chelonians. Their detailed study of material furnished to them by M. Derognat, of Marseilles, shows that the substance is calcite. While the shell closely resembles that of birds' eggs, there is nothing to oppose Matheron's suggestion that the eggs are those of Rhabdodon, an ally of Iguanodon that is actually associated with them.

BIBLIOGRAPHY OF GEOLOGY.—Geologists will find No. 36 (vol. 6, pt. 5) of the Bulletin of the National Research Council, Washington, D.C., of great value as a work of reference. It consists of a list of geological bibliographies published from 1896 to 1920, and has been compiled by Dr. E. B. Mathews, with the aid of Miss Grace E. Reed, who modestly declined to let her name appear as joint author. The work involved, with the view of saving others from much laborious searching, will be appreciated when we note that the list arranged under subjects, such as "Earthquakes" and "New York State," occupies 162 pages with two columns on each page. There is also a list of personal bibliographies, so that the work of geologists who have passed away in recent years, as well as of some happily still amongst us, can be discovered through reference to a wide field of accessible journals or professional publications. There are thus three references to James Geikie, covering 100 papers, and two to H. F. Osborn, the list by H. E. Ripley including 514 entries.

MAGNETISATION BY ROTATION.—Langevin has shown that, on the electron theory of matter, a rotation will produce a definite magnetic polarisation; however, for speeds of rotation which it is possible to obtain in practice, it is so small that it is almost impossible to prove its existence by a direct experiment. In the *Comptes rendus* of the Paris Academy of Sciences, Nov. 12, 1923, M. R. Lucas directs attention to the fact that, even at ordinary temperatures, the thermal agitation of the molecules produces very large velocities of molecular rotation, a molecule of HCl gas having a mean angular velocity of the order 10^{13}. If, then, the molecules are in a magnetic field, the couples due to the action of the field on the magnetic moments caused by rotation will, in general, be greater than those due merely to the polarisation produced by the field. M. Lucas has studied this effect from the point of view of the classical statistical theory, and the results obtained are summarised in his paper as follows. The magnetic orientation depends both on the magnetic anisotropy and the inertial anisotropy; a number of magnetically isotropic molecules can show the phenomena of molecular orientation, if they are inertially anisotropic. The study of this orientation in a particular case does not modify the relation to temperature and to field established by Langevin.

THE COLORATION OF CRYSTALS BY THE ACTION OF RADIUM.—In order to study the relation between the coloration of crystals and the amount and nature of the radiations falling upon them, Messrs. P. Ludewig and F. Reuther have produced a simple apparatus, consisting of a small thick-walled lead cylindrical box, with a heavy lead lid which protects the crystals from the action of all external sources of radiation (*Zeitschrift für Physik*, vol. 18, 3-4, 1923). The radium preparation is fixed in the axis of the cylinder, while round it are placed holders for the crystal plates investigated, which are all at the same distance from the radium preparation. A cylindrical screen of brass may be placed between the preparation and the crystals, to cut off all except the hard γ-radiation. The effect produced was measured with an Ostwald chrometer; and, in order to determine accurately the amount of white and of "black" in the transmitted light, a half-shade photometer was added to the apparatus. Rock salt proved to be the most suitable substance for study; in all cases the tint corresponded to numbers 7 and 8 of Ostwald's scale (amber yellow); the amount of white diminished with the time of exposure, very rapidly at first, and afterwards more slowly, though a limiting value was not reached after 56 days' exposure; the amount of black remained nearly constant, only falling a little below the original value before treatment. The amount of the pure tint varies in the inverse direction to that of the white, increasing quickly at first, and then more slowly, without reaching a limiting value. The effect of the full radiation with β- and γ-rays, and that obtained with the screen (hard γ-rays only), was qualitatively the same, though the rate of action was diminished in the second case.

CINEMATOGRAPHY IN NATURAL COLOURS.—It is about fifteen years since Mr. G. Albert Smith introduced the "Kinemacolor" process. In this the two coloured pictures alternate on the film, and although the process met with a large measure of success, it suffers from the disadvantages that the film must be moved at twice the usual rate in both taking and projecting, and that rapidly moving objects show colour fringes at their outlines. A few weeks ago Mr. G. Albert Brown described at the Royal Society of Arts (the Society's Journal, February 15) a method obviating these defects, which is called "Cinechrome." It is the method used by Mr. Brown to illustrate the recent tour of

H.R.H. the Prince of Wales in India. This also is a two-colour process, but the red and green pictures are taken simultaneously on a double-width film. The light that comes from the subject falls upon a silver ruled grating which allows the part that falls on the spaces to pass through, and reflects sideways the part that falls on the silver lines on to a mirror, so that the two images formed by separate lenses and colour filters are received side by side on the film. The optical paths of the transmitted and reflected rays are equalised by suitable glass prisms. The machine used does not differ from the machines in use at the regular cinemas, a simple adjustment enabling it to take the double width film and effectively to superimpose the two pictures. The films shown by Mr. Smith at his lecture were very successful.

THE SENSITIVENESS OF SILVER IODIDE TO LIGHT.—It is well known that silver bromide is more sensitive to light than silver chloride for practical photographic purposes, but that silver iodide is so little sensitive that it is commonly stated to be unaffected by exposure to light. This exceptional behaviour of the iodide has been investigated by Messrs. F. E. E. Germann and M. C. Hylan, who have published their results in the Journal of the American Chemical Society (reprinted in the *British Journal of Photography* for February 15). The authors find a "non-sensitive" iodide of silver emulsion is really sensitive if a sufficiently strong alkaline developer is employed. The lack of sensitiveness is due primarily to adsorbed potassium iodide, and secondarily to the absence of a sensitiser, as gelatin is not a sensitiser to silver iodide, though it is very effective with the bromide. Several substances that sensitise the iodide were experimented with.

THERMIONIC CURRENTS IN HYDROGEN.—As a preliminary to a study of the ionisation potential of hydrogen, M. Laporte, of the Radium Institute, Paris, has studied the effect of the pressure of the gas on the thermionic current emitted by a heated tungsten filament stretched along the axis of a surrounding molybdenum cylinder. His results are given in the October issue of the *Journal de Physique*. For a given filament current and a given difference of potential between filament and cylinder the thermionic current does not remain constant, while the pressure invariably increases owing to the liberation of occluded gas. This increase can be more conveniently obtained by introducing more gas, and it is found in either case that if the difference of potential of filament and cylinder is less than the ionisation potential of the gas, the thermionic current decreases as the pressure increases. If, however, the potential applied exceeds the ionisation potential, the thermionic current increases slowly with the pressure up to a certain pressure at which it increases suddenly to a maximum and then decreases. In all cases the variations of thermionic current due to variations of pressure are of the same order as those brought about by variations of the potential difference between cylinder and filament.

THE QUANTUM THEORY.—The Bulletin of the National Research Council of America for November 1923 contains the second edition of a report on the quantum theory by Prof. E. P. Adams, which in its revised and enlarged form gives a more consistent and comprehensive account of the theory and its applications to physical phenomena. The procedure here adopted differs from that usually followed, inasmuch as the historical development of the theory is treated as of subsidiary importance compared with the orderly presentation of the fundamental dynamical principles and the special quantum hypotheses. These additional hypotheses have had to be made to bring about co-ordination of the various phenomena. The treatment is largely mathematical, as the phenomena can be described with the aid of models that form periodic, or conditionally periodic, dynamical systems. In the last two chapters of the Bulletin certain phenomena are discussed which, though undoubtedly governed by quantum principles, have not, as yet, been brought under any general hypotheses supplementary to dynamical principles. Phenomena analogous to the photoelectric effect are first considered, and it is pointed out that for these the simple model in which the atom is regarded as composed of electrically charged particles of definite mass may be wholly inadequate. It may be necessary to postulate a more complicated mechanism within the atom, as in the model devised by Whittaker, to do away with any necessity of postulating a discontinuous distribution of radiant energy. The final chapter of the report contains an account of what Prof. Adams terms the magnetic interpretation of the quantum theory, which he considers may indicate a possible direction for future development.

COLLOIDAL FERRIC HYDROXIDE.—In the *British Medical Journal* of February 9, Sir William Pope and Mr. R. T. M. Haines give the results of a comparison of various forms of colloidal ferric hydroxide. They show that a solution prepared in such a way that the ferric hydroxide particles have a negative charge and are "protected" to prevent immediate coagulation and ensure stability, differs considerably in behaviour with some chemical reagents and with body fluids from colloidal solutions of ferric hydroxide, in which the particles are positively charged as in the "dialysed iron" which at one time figured in the British Pharmacopœia.

THE STILL ENGINE.—A paper on the Still engine was read by its inventor, Mr. W. J. Still, before the North-east Coast Institution of Engineers and Shipbuilders on February 15. Mr. Still dealt at some length with the question of the flow of heat through the cylinder walls, and asked for the assistance of any who might have particulars of the heat flow through the walls of large combustion engine cylinders (using any fuel). The trend of development in oil engines is towards the use of larger units, and further information is required as to the flow of heat. It is Mr. Still's intention to publish complete results for the benefit of all oil-engine builders. Heat flow is the cause of heat stresses in the cylinder and other retaining walls of oil engines; these stresses are due to temperature differences and increase directly as the rate of flow. Heat stresses are proportional to the wall thickness, and for high rates of flow very thin walls should be employed. The walls, however, must stand the pressure stresses caused by the combustion of the oil and, in the Still engine, the necessary strength is obtained by using ribbed walls and hooping the ribs. The thin liner transmits the stresses to the steel hoops via the ribs, which thus become piers supporting a girder. By this means the liner thickness can be reduced to $\frac{5}{8}$ inch irrespective of the cylinder diameter, which might require an ordinary liner to be 2 inches thick. Mr. Still considers that he is not overstating the case by saying that the tension stresses in his liners have been reduced to one-third of what they would have been with ordinary construction at the same rate of heat flow and with other conditions constant.

The Imperial College of Tropical Agriculture.

ON January 14 the foundation stone of the new and permanent building of the recently established Imperial College of Tropical Agriculture in Trinidad was laid by His Excellency Sir Samuel Wilson in the presence of a large and distinguished gathering. His Excellency was attended on the platform by Sir Francis Watts, the Principal of the College, and the members of the professorial staff, as well as by Sir Arthur Shipley, chairman of the governing body, and the following members of the governing body—the Director of the Royal Botanic Gardens, Kew, who was present at the request of the Secretary of State for the Colonies; Mr. Moody Stuart, chairman of the Finance Committee; the Hon. Gervase Bushe, chairman of the Executive Committee; the Hon. W. G. Freeman, Director of Agriculture, Trinidad; Mr. de la Mothe, Mr. Robinson, and other Trinidad members, and Mr. Aspinall, secretary.

The proceedings opened with a speech by Sir Arthur Shipley, who gave a short account of the founding of the College, and referred to the generous help which had been forthcoming from the West Indian Colonies and especially from Trinidad, from the Rhodes Trustees, from the Sugar Manufacturers of Great Britain, and from private benefactions. He pointed out that, so far, British Guiana and Jamaica had felt unable to support the College, but expressed the hope that they also would help forward the aims and objects of the College by making contributions and so promote the truly Imperial work which the College is so well fitted to carry out.

Sir Francis Watts then followed with a brief history of the work that has already been accomplished at the College during the short time of some sixteen months that it has been in existence. He referred with justifiable pride to the excellence of the converted Hospital building at St. Augustine's, which has been restored and equipped, so that it is now as efficiently fitted up as are the best scientific establishments at home. The present building, which is close to the new one, is provided with well-furnished laboratories and class-rooms for botany and genetics, mycology, entomology, agriculture, chemistry, physics, and sugar technology, as well as accommodating the large and valuable college library. As Sir Francis indicated, it will still be used when the new building is completed, and will permit of the housing of the biological and chemical sciences in separate buildings.

Sir Francis Watts also referred to the research and diploma students, about 30 in number, who were or had been working at the College. Of the former, several were graduates either at Oxford, Cambridge, or London, and four were engaged on cotton research work, while some eighteen diploma students from Trinidad and elsewhere were attending the college courses.

His Excellency then rose to lay the foundation stone, and in a remarkable speech outlined the need of such a College, laying particular emphasis on its value, not as a local institution, but as "an Imperial institution which will be maintained from now onwards for the benefit of all parts of the British Empire, and not for the benefit of one portion more than another." He also paid a fitting tribute to the work of Sir Francis Watts, to whose ability and unremitting energy the existence of the College is so largely due.

The inscription on the foundation stone is as follows:

THIS FOUNDATION STONE
OF THE
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE
WAS LAID BY
SIR SAMUEL WILSON, K.C.M.G., K.B.E., C.B.,
Governor of Trinidad and Tobago,
ON JANUARY 14TH, 1924.
Via colendi haud facilis.

The proceedings terminated by the proposal of a vote of thanks to His Excellency by Dr. A. W. Hill.

The new building, which will be in the Spanish Colonial style with wide open galleries, is being constructed in ferro-concrete from the designs of Major Corlette, and is beautifully situated in the charming park-like grounds of St. Augustine's—the gift of the Government of Trinidad—which comprise some eighty-five acres. The College is about seven miles from Port of Spain and of very easy access both by road and railway from the city, and it is also close to the Government Experiment Farm at St. Augustine's.

Physiology of Vision.[1]

THE further advance of our knowledge of the physiology of vision is to a considerable extent wrapped up in the discovery and elaboration of fresh lines of experimental attack. The old methods, which enabled such far-reaching advances to be made by the hands of Helmholtz, Hermann, Abney, Maxwell, and others, have nearly completed their useful life. For further progress new methods are necessary. It is, therefore, with the greatest satisfaction that we learn of the discovery of a new method by Prof. Frank Allen. Briefly, this consists, first, of stimulating one eye with a bright monochromatic light of chosen wave-length and constant intensity, and secondly, of investigating the least rate of flicker, with a second monochromatic light, of independent wave-length from the first, either in the eye which is receiving the constant stimulus (monocular experiments) or in the other (binocular experiments).

Prof. Allen makes the justifiable assumption that an increase in the flicker rate demonstrates an increase in the sensitivity of the retinal area under investigation. On this basis the following brief statement of the main experimental results may be given.

With binocular experiments a coloured stimulus to one eye increases the sensitivity of the other eye to all colours except 0·653 μ and 0·500 μ. With monocular experiments (in which the uninvestigated eye is uniformly stimulated by means of white light) the sensitivity of the eye is diminished for rays of the same primary colour but increased for those of the two others, rays of 0·660 μ and 0·500 μ again being unaffected.

If in the monocular experiments the constant stimulus is yellow, then the retinal sensitiveness is found to be diminished for both the red-orange and the yellow-green regions of the spectrum, the retina on the other hand showing enhanced sensitiveness for the blue-violet region of the spectrum. A blue-green stimulus brings about corresponding changes.

Let us now consider how these results link up with those of previous investigators. Fechner showed that whereas the stimulation of both eyes at the same time by means of a bright light gives a more intense sensation than that perceived when one eye alone is used, on the contrary the stimulation of one eye with

[1] "Reflex Visual Sensations," by Prof. Frank Allen, *Journ. Opt. Soc. America*, August 1923.

a dull light and the other with a bright one gives a less intense sensation than that perceived when only the eye stimulated by the bright light is used. Sherrington elaborated Fechner's experiments and showed that this paradoxical effect is due to the fusing of the sensations of the two eyes, as distinct from the fusing of the stimuli or the fusing of the nerve impulses. Prof. Allen has now partly investigated the matter quantitatively for monochromatic lights. To complete the analysis it remains for him to show by experiment that all colours (except 0·66 and 0·50 μ) are less intensely perceived in one eye when the other is weakly stimulated with monochromatic rays; and that further there is a certain intensity of stimulation to one eye which leaves the sensitiveness of the other eye unaffected for rays of different wave-length. If these results are obtained they will provide a complete account of Fechner's paradox in terms of monochromatic light.

Taking now the monocular experiments, Prof. Allen has shown that a monochromatic stimulus if it corresponds to the red, green, or blue regions of the spectrum, depresses the activity of the neighbouring retina for the corresponding spectral region, but also enhances its sensitiveness for the other regions. If, however, the monochromatic stimulus corresponds to the yellow or blue-green regions, then in the first case both red and green are depressed while blue is enhanced, and in the latter case green and blue are depressed and red enhanced. Now these results fit in closely with the older experimental work on simultaneous contrast. They show, however, greater detail, because the underlying nature of the processes bringing the phenomenon about are now laid bare. For Prof. Allen's experiments make it clear that processes both of inhibition and facilitation are simultaneously at work.

The explanations which Prof. Allen advances are not so satisfactory as the experiments themselves, because, ignoring the theory which Sherrington and others have advanced for Fechner's paradox, contrast, etc. (namely, that they are manifestations of a central mechanism situated where the nerve impulses from the two retinæ are correlated), he advances the view that the phenomena which he has discovered are of peripheral origin, one retina modifying the reception of the other via the inter-retinal fibres. Thus the title of the paper is "Reflex Visual Sensations." To the present writer it seems that the older view is greatly to be preferred.

It remains to consider how this work affects the position of the rival theories of colour vision. It will be remembered that both in monocular and binocular experiments there were two invariable colours at 0·66 μ and 0·50 μ respectively. These divide the spectrum into three parts — red, green, and violet, which show appropriate changes of enhanced or diminished activity.

When in the monocular experiments the continuous stimulus corresponded to the yellow spectral region, the sensitiveness of the retina for this region was not found to alter. What did alter was its sensitiveness to red, to green, and to blue, the two former being diminished, the latter being increased. When the continuous stimulus was blue-green, corresponding changes were found to occur. The experiments strikingly support the three components theory of colour vision of Thomas Young. H. HARTRIDGE.

Silt and Current Velocity.

IN a paper read recently before the Institution of Civil Engineers, Mr. Arthur Burton Buckley, jun., directed attention to the influence of silt on the coefficient of friction in rivers and canals, and put forward the interesting and striking suggestion that the increase in velocity which has been observed in silt-laden rivers is due to the lubricating effect of the silt. Expressed in the terms of the paper:[1]

"A mass of water starting from rest—as, for instance, on issuing from a lake—if flowing down a channel of uniform slope and section, assumes a condition which, with sufficient accuracy for the present purpose, may be described as steady flow; and its behaviour in this respect differs from that of many other travelling masses whose motion is equally due to the influence of gravity and which undergo acceleration. The friction between the water and the periphery of the channel is the cause of retardation. Any one who has observed the behaviour of the very light particles of sand found sometimes at the bottom of clear streams will have remarked the eddies which exist. The retardation of the flow alluded to is brought about by the work expended in friction of the mass of water against the channel in passing from one level to another, and this work takes the form of eddies. When, therefore, a stream carrying solid matter in suspension has its velocity arrested, a precipitation of the solids occurs. The result is the interposition of a much heavier fluid, or slurry, between the principal mass of water and the periphery of the channel. The energy of the water, while sufficient to create eddies in the clearer water, now becomes insufficient to produce the same effect on the heavier liquid, with the result that the eddies, which before were communicated far towards the heart of the channel, now become damped; the retarding effect due to the friction with the periphery is therefore partially eliminated, and the water acquires a higher velocity."

Mr. Buckley supports his contention with data collected in connexion with the observations of discharges of the River Nile, and from these, Mr. Lelyavsky, one of Mr. Buckley's assistants in the Egyptian Ministry of Public Works, has devised a formula, termed the Beleida formula, which is as follows:

$$V = \{147 + 3{\cdot}92(Z - 10)^{0{\cdot}383}\} R^{0{\cdot}85} S^{0{\cdot}72},$$

where V is the mean velocity in the river in metres per second, Z is the average amount of silt in suspension, expressed in grams per cubic metre of water, R is the hydraulic radius in metres, S is the sine of the angle of slope of the water-surface, and 10 is the minimum silt-content during the low stage, in grams per cubic metre of water.

The fact of an increase in velocity under silt-bearing conditions in certain rivers has, of course, been known for some time, but no generally acceptable explanation has been put forward. Mr. Buckley's theory, ingenious and striking as it is, does not command unqualified approval, as is evident from the opinions expressed in the discussion following the reading of the paper. The alleged suppression of turbulence is a difficulty, and it is also suggested that some partial explanation of the variation in discharge may be due to changes in viscosity and density. Now that attention has been directed to a possible hypothesis, continued research should be able to do something to clear up what is, undoubtedly, a complex and obscure problem in hydraulics.

[1] The Influence of Silt on the Velocity of Water flowing in Open Channels. Min. Proc. Inst. C.E., vol. ccxvi.

University and Educational Intelligence.

ABERDEEN.—The Senatus has appointed Sir J. J. Thomson to deliver the University lecture in science for the current year.

The Senatus has agreed to confer the honorary degree of LL.D. on: Dr. Michael Comport Grabham, Sir Henry M. W. Gray (Montreal), Dr. J. J. R. Macleod (Toronto), and Mr. C. T. R. Wilson (Cambridge).

CAMBRIDGE.—Dr. C. F. Fox has been elected to a Bye fellowship at Magdalene College.

The Appointments Board has just issued its Annual Report. During the year 377 appointments have been made through the Board, including 20, mainly scientific, in Government departments, 77 administrative appointments in commerce and industry, 88 in manufacturing and technical appointments, 18 in agriculture and forestry, and 118 educational appointments. There has been a large demand for apprentices in electrical engineering, and it is noted that chemical engineering shows some signs of revival.

The governing body of Emmanuel College offers to a research student commencing residence at the University in October 1924, a studentship of the annual value of 150*l.*, which will be tenable at Emmanuel College for two years and renewable, but only in exceptional circumstances, for a third year. The studentship will be awarded early in August, and applications should be sent so as to reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than July 31.

LONDON.—The following doctorates have been conferred: *D.Sc.* (*Chemistry*), Mr. E. H. Farmer, of the Imperial College (Royal College of Science), for a thesis entitled "Some Aspects of Carbon Conjugation"; *D.Sc.* (*Geology*), Mr. W. A. Richardson, for a thesis entitled "A Micrometric Study of the St. Austell Granite," and other papers.

The following are among the newly-appointed fellows of University College: Prof. T. Hudson Beare, professor of mechanical engineering at the College, 1889–1901, and since 1901 Regius professor of engineering in the University of Edinburgh; Dr. Edwin Deller, academic registrar in the University; Dr. Elizabeth A. Fraser, senior assistant in the Department of Zoology and Comparative Anatomy; Mr. Leonard E. Hill, Director of the Department of Applied Physiology, National Institute of Medical Research, Mount Vernon, Hampstead; Dr. B. A. Keen, Assistant Director of the Rothamsted Experimental Station; Dr. Irvine Masson, reader in organic chemistry.

The following are among those appointed fellows of King's College: Prof. T. H. Pear, professor of psychology in the University of Manchester; and Prof. A. H. Jameson, professor of civil engineering in the College since 1912.

OXFORD.—At the meeting of Congregation held on February 19, it was incidentally mentioned that an offer of 75,000*l.* had been made by the trustees of the Rockefeller Foundation for the development of the Department of Biochemistry. At a forthcoming meeting it will be proposed that the offer be accepted, with the condition made by the Rockefeller trustees that the University contributes an annual sum of not less than 1250*l.* to the same purpose. The money will be applied to the building of a laboratory and the equipment and staffing of the department. Room will be found in that portion of the University Park recently set apart for scientific purposes.

It will also be proposed that the valuable collection of scientific instruments and of books connected therewith, offered by Mr. Lewis Evans, be accepted and housed in the Ashmolean Building.

An important series of statutes will shortly be promulgated, establishing a superannuation scheme for members of the regular teaching and administrative staffs of the University. Some provisions will be included for regularising the status of demonstrators and other scientific assistants.

Applications are invited for the posts of advisory chemist and advisory mycologist at the School of Rural Economy. Application forms (returnable by, at latest, March 15) are obtainable from the Secretary to the Committee for Rural Economy.

By the death on February 21 of Dr. Hatchett Jackson, the University has lost the services of one of its oldest resident members, who as Radcliffe librarian was well known to many generations of teachers and students. His remarkably extensive knowledge of biological literature was always at the service of those who sought his aid; and during the forty-four years of his work as tutor at Keble College a long succession of pupils has had occasion to remember with gratitude his sympathetic supervision, and untiring exertions on their behalf.

THE London County Council Education Committee has agreed to recommend the Council to establish two Sir Robert Blair fellowships for applied science and technology, each of the value of 450*l.* for one year. These fellowships have been made possible by a balance of 20,000*l.*, available from work done on munitions, when Sir Robert Blair was in charge of the Council's organisation for training munition workers and for the manufacture of gauges. They are to be awarded to persons engaged in engineering work or those who have completed courses of study with distinction, preference being given to London candidates, and they will be tenable anywhere.

THE Khartum correspondent of the *Times* states that the Kitchener Memorial Medical School at Khartum was opened on February 29 by Sir Lee Stack, Governor-General of the Sudan. The school, which is intended for the training of native Sudanese doctors and for granting diplomas for practice in the Sudan, was a cherished project of Lord Kitchener's when he was High Commissioner, and it has been made possible by voluntary donations, largely subscribed by the natives of the Sudan. The school is vested in trustees and is under the management of a general board, an executive committee, and a school council, the last-named being responsible for the work of the students and the professional examinations. The cost is E26,000*l.*

THE announcement of the foundation of the Frances Riggs fellowships of 1200 dollars each, tenable by British graduates in the University of Michigan, follows so closely on the foundation on somewhat similar lines of other fellowships tenable by British students in America that it gives ground for a belief that the balance, over-weighted on the British side by the Rhodes scholarships, is in a fair way to be redressed as between Britain and America. The other fellowships referred to are the Clarence Graff, for advanced study by graduates of Oxford and Cambridge at institutions of learning in the American Middle West; the Henry P. Davidson, tenable by Oxford and Cambridge men at Harvard, Yale, and Princeton; and the Jane Eliza Procter, tenable by British scholars (nominated by the Universities of Oxford and Cambridge) in Princeton Graduate College. The Riggs foundation differs from the others in having no special connexion with Oxford and Cambridge; the first two fellows are Mr. R. I. Lovell of London and Miss M. Lindsey of Manchester.

Early Science at the Royal Society.

February 22, 1681. Collection of arrears.—ADDENDUM to entry in NATURE of March 1: Mr. Hill reported the answer of Mr. Edmund Waller [the Poet] as follows: Mr. Waller said, that the plague happening some time after the Society was established, and he being perpetually in parliament had never been able to attend the Society, either to serve them, or receive any advantage thereby: that he was now of a great age, had lost half his fortune for the king, and having a great charge of children, hoped, that he should be considered as others, who had not been able to wait on them as well as he: and he humbly took leave to consider how he might be able to serve them.

March 2, 1664. It was ordered, that all those of the society, who should print any books of a philosophical nature by order of the society, be desired to own themselves in the title page fellows of the society.

1670. Dr. Clarke proposed, that a man hanged might be begged of the King, to try to revive him; and that in case he were revived, he might have his life granted him.

1680. An experiment was made in Dr. Papin's engine, wherein were put pieces of ivory, horn, and tortoise-shell, all of which in the space of about half an hour, were reduced to softness.

1684. It was said that at Brocklesby in Lincolnshire there were sycamores planted in Henry VII.'s time, which are bigger than any trees in the lordship, though the leaves were as small as the common maple.

1686. Ordered, that the manner of finding the meridian by help of the small telescopical stars about the pole point be tried at night after the next meeting.

March 4, 1663. Mr. Aubrey presented the Society with the scheme of a cart, with legs instead of wheels, devised by Mr. Francis Potter; which was referred to the consideration of Mr. Hooke.

March 5, 1662. The account of the refining of gold was ordered to be brought in by Dr. Goddard, Dr. Whistler, and Mr. Winthrop.

1668. The wind-gathering vessel with some improvements was again exhibited, and appeared to be sensible of the least wind near it. It was ordered that a description should be made of it, together with a scheme, and registered.

1672. Mr. Hooke promised to give the society, at their next meeting, a lecture upon his weather-clock.

March 6, 1675. There was read a proposal for encouraging the press of Oxford, recommended by Sir Joseph Williamson, Secretary of State, viz., to fix upon some good book or books to be printed at a reasonable rate, at such time as five hundred subscribers should be obtained.

March 7, 1667. Dr. Wren intimated, that an exact plan was best made by motions in a strait line.

1671. An experiment was made of the method, proposed by Mr. Hooke, of conveying intelligence from place to place, which was performed from Arundel-house garden to a boat lying near the shore on the other side of the Thames, by letters of a foot long, and glasses of two feet long, the distance being about half a mile. The contrivance was applauded as very ingenious, and the author desired to make more tryals of it at greater distances.

March 8, 1664. Mr. Haak related that he had put some young live vipers into a bottle with Malaga wine, which, though not full at first, became full after a while; whereupon untying the string of the stopper, the cork burst out against the ceiling of the room, three of the vipers following after it; the rest he kept still in the bottle unconsumed.

Societies and Academies.

LONDON.

Royal Society, February 28.—O. W. **Richardson**: Thermodynamics of electron emission. The relations are discussed which hold, at a transition point between two condensed phases of any substance, between the various quantities which enter into the thermionic formulæ. If the universal constant which enters into the emission formula is exactly, and not merely approximately, constant, the thermo-electric powers of pairs of metals should vanish at the absolute zero, a conclusion which is almost certain on other grounds. Davisson and Germer's measurements require the kinetic energy of the electrons which carry the current inside the metal to be practically independent of temperature, and are definitely against the classical type of theory of metallic conduction. They are also in good agreement with the author's formula for the temperature coefficient of the internal latent heat of evaporation of electrons.—W. A. **Bone**, D. M. **Newitt**, and D. T. A. **Townend**: Gaseous combustion at high pressures. Pt. IV. Influence of varying initial pressures on rate of pressure developments, etc. The principal points established are as follows: That whereas in exploding such mixtures as normal hydrogen-air ($2H_2+O_2+4N_2$) or a $2CO+O_2$ "knall-gas," an increase in the initial pressure shortens the time required for the attainment of the maximum pressure, the reverse is the case with normal CO-air ($2CO+O_2+4N_2$) mixtures. There is appreciable "activation" of nitrogen in the explosion of a normal CO-air mixture after an initial pressure of 10 atmospheres is used. It increases with the initial pressure until at 50 atmospheres and higher it becomes a marked feature of the explosion phenomena. Such activation is a radiation effect, being probably due to the similar electronic configurations of N_2 and CO molecules. Generally, no appreciable "after-burning" occurs when these mixtures are exploded at initial pressures of 10 atmospheres or higher; nor is the maximum temperature in the explosion of an undiluted $2CO+O_2$ "knall-gas" at such initial pressures limited by the dissociation of carbon dioxide, although in certain cases it exceeds 5200° abs.—J. E. P. **Wagstaff**: An electrical method of determining the velocity of detonation of explosives. A method is developed for the measurement of time intervals of the order of 10^{-4} sec., depending on the rate at which a standard condenser discharges through a circuit of known resistance and self-inductance. This measurement of time intervals is applied to the determination of the velocities of detonation of explosives in a bomb. An electromotive force is established in a circuit passing through the explosive during detonation, the magnitude and direction of which is constant for a given metal. In general, it follows very closely the magnitude and direction of the Thomson effect; in lead wire it is negligible. The velocities of detonation measured vary from 200 to 7000 m./sec.

Optical Society, February 14.—T. **Smith**: The addition of aberrations. General expressions are found which give quantitative measures of the aberrations of a complex optical instrument in terms of the corresponding measures of its component parts. The systems considered are symmetrical about an axis, but otherwise of a quite general character.—J. W. **Gifford**: The choice of wave-lengths for achromatism in telescopes. In correcting a combinating of two glasses for chromatism, focal lengths for two colours of the spectrum are made equal. The outstanding error for other such colours is called the secondary spectrum. The object of the paper is to

determine the effect on the secondary spectrum of varying the two colours chosen.—E. F. **Fincham**: A new form of corneal microscope with combined slit-lamp illuminating device. For the clinical examination of the cornea and anterior portions of the interior of the living eye, a specially mounted microscope, monocular or binocular, is used in conjunction with a so-called slit-lamp. In the apparatus as used at present two instruments are separately mounted and must be adjusted independently. A combined instrument is described in which the adjustment is common to both the microscope and the lamp, thus greatly facilitating the observation.—D. **Baxandall**: The Troughton dividing engine. Dividing engines were constructed by Henry Hindley of York (1740), the Duc de Chaulnes (1768), and Jesse Ramsden (1766). Ramsden's second engine (1775), for which he received the reward from the Commissioners of Longitude, is now preserved in the National Museum at Washington. Other dividing engines described were those of John Troughton (1778), Edward Troughton (1793), and William Simms (1843). The Troughton engine exhibited in the Science Museum, South Kensington, was the original engine of Edward Troughton, with the self-acting mechanism of William Simms added in order to make it automatic in action. The engine has been in use almost continuously from 1793 until a year or two ago, though superseded for more accurate division by better engines constructed by the owners at different periods.

Mineralogical Society, February 19.—Dr. A. E. H. Tutton, past-president, in the chair.—F. N. **Ashcroft**: Mineral localities in the Tavetschthal, Switzerland. An account of a number of localities in the Tavetschthal, *i.e.* the uppermost part of the valley of the Vorder Rhein, and in the neighbourhood of Disentis a little farther down the river, visited by the author in 1922 and 1923. The geological features and the mineral associations characteristic of each locality were described.—E. D. **Mountain**: Crystals of calcite from Holywell, Flintshire. A specimen of calcite from the Bryn-gwiog mine, collected by W. Campbell Smith in 1923, consists of crystals of two distinct habits. These are pyramidal, with the uncommon hexagonal bi-pyramid $L\,(8.8.\bar{1}6.3) = (91\bar{7})$ predominant, and prismatic, with acute rhombohedral termination; both habits are sometimes developed on the same crystal.

Zoological Society, February 19.—Prof. J. P. Hill, vice-president, in the chair.—R. I. **Pocock**: A new genus of monkeys. The new genus, Presbytiscus, is founded upon the species described by Dollman as *Rhinopithecus avunculus*. Presbytiscus resembles Rhinopithecus in cranial and facial characters, having a small upturned nose and a long upper lip, thus differing from Nasalis; but it differs from Rhinopithecus in the structure of the hands and feet, which have digits remarkably long, as in Nasalis, the tip of the hallux, when turned forwards, reaching to the distal end of the first phalange of the 2nd digit.—E. W. **Shann**: Further observations on the myology of the pectoral region in fishes.—H. C. **Chadwick**: On some abnormal and imperfectly developed specimens of the sea-urchin, *Echinus esculentus*.—P. R. **Lowe**: On the presence of broadbills (Eurylæmids) in Africa.—C. F. **Sonntag**: On the anatomy, physiology, and pathology of the orang-outan.

Royal Microscopical Society, February 20.—Mr. A. Chaston Chapman, president, in the chair.—William E. **Hall**: A simple apparatus for the extraction of micro-organisms from samples of water. The sample is collected in a small straining jar through which any quantity of water can be passed. From this concentrated sample the organisms can be extracted by passing it through a filter paper about $1\frac{3}{4}$-inch diameter placed over a small funnel attached to a vessel from which the air is extracted by means of an exhauster. The organisms are finally washed off the filter paper by means of a wash bottle with about 2 c.c. of water.

Linnean Society, February 21.—Dr. A. B. Rendle, president, in the chair.—G. C. **Robson**: A cephalopod (*Histioteuthis bonelliana*, Fér.) with abnormal reproductive system. A male specimen of this species obtained off the Natal coast had its reproductive system completely developed (including the spermatophores) with the exception of the testis, which is represented only by a minute piece of tissue. The question whether the testis is *undeveloped* or *atrophied*, and the significance of this condition in relation to the development of the rest of the generative system, was discussed.

PARIS.

Academy of Sciences, February 11.—M. Guillaume Bigourdan in the chair.—C. **Guichard**: A particular class of networks.—Henri **Villat**: Certain differential equations of the second order, with doubly periodic coefficients.—F. H. van den **Dungen**: Application of integral equations to a proposition of Lord Rayleigh.—J. **Priwaloff**: Certain metric properties of analytical functions.—Bertrand **Gambier**: Surfaces of revolution with entirely closed geodesics.—A. **Khintchine**: A general theorem relating to probabilities.—Carl A. **Garabedian**: Thick rectangular plates.—M. **Mesnager**: Remarks on the preceding communication.—L. **Leroy**: A registering chronograph, marking hundredths of a second.—Louis **Breguet**: The aerodynamical resultant of a glider submitted to vertical aerial pulsations.—Alfred **Muller**: The deformation which produces a tangential force in the surface of contact between two bodies.—P. **Lasareff**: The laws of the magnetic anomalies caused by electric currents, or by magnetic deposits. A criterion is developed which allows the magnetic anomalies developed by electric currents to be distinguished from those produced by the presence of magnetic deposits. The anomaly of Koursk, described in earlier communications, is produced by a magnetic deposit.—Mme. J. Samuel **Lattès** and Antoine **Lacassagne**: Chemico-physical technique and the detection of polonium injected into organs. Detailed description of the method of destroying organic matter and depositing the polonium on silver. Working with 10 to 15 grams of material, the method is susceptible of detecting quantities of the order 10^{-3} U.E.S. per gram of organ.—Edmond **Bayle** and René **Fabre**: Researches on the fluorescence of some organic compounds. Certain organic compounds, such as novocaine, sodium salicylate, and many others, exhibit intense fluorescence with ultra-violet light (mercury line, 3650), whilst in many other cases (cocaine, stovaine, acetylsalicylic acid) no fluorescence is observed. This property may be applied to the separation of crystals of novocaine in complex mixtures.—A. **Bouzat** and G. **Leluan**: The determination of the boiling-point of bromine. Bromine was purified by several methods. As a mean result, pure, dry bromine was found to boil at 58·80° (hydrogen scale) under normal atmospheric pressure. This is in good agreement with the 58·75° C. found by Ramsay and Young (1886).—Léon **Piaux**: The kinetics of the spontaneous oxidation of uric acid in alkaline solution.—Pierre **Bonnet**: The geosynclinal character of the Palæozoic of Southern Transcaucasia.—N. **Arabu**: Contributions to the study of the genus Arcestes: its representatives in the Trias of Bithynia (Asia Minor).—Raoul **Cerighelli**: The respiratory quotient of the root and its variations in the course of the develop-

ment of the plant. Using the manometric method of Maquenne and Demoussy, it is found that the respiratory coefficient of the root during development is always less than unity.—D. **Rosén**: Some remarks on the colour of the sepals in *Anemone hepatica*.—Henry **Cardot** and Henri **Laugier**: The illumination of vacuum electric lamps by friction.—Georges **Mouriquand** and Paul **Michel**: The relations between age, appearance, and evolution of the symptoms of C avitaminosis. Experiments on 317 guinea-pigs show that under the same food regime, deficient in anti-scorbutic substances, young animals are affected and die sooner than adults. There is no appreciable difference between the two sexes in susceptibility.—F. **Maignon**: The effects of electrolysis on tissue diastases of animal origin. The abundance of silica in the ash. The diastases extracted from various organs (liver, thyroid, pancreas, etc.) by Lebedeff's method contain a high proportion of mineral matter (19 to 46 per cent.), the silica being unexpectedly high. These diastases, subjected to electrolysis for five days, lose their therapeutic properties.—L. J. **Simon** and E. **Aubel**: Attempts to detect pyruvic acid in the muscle and liver.—Mlle. M. L. **Legueux**: Temporary sexual character in *Gammarus duebenii*, a crustacean amphipod.—Mme. Anna **Drzewina** and Georges **Bohn**: A new case of hermaphrodism in the sea urchin *Strongylocentrotus lividus*.—Raymond **Poisson**: Some parasitic microsporidia of arthropods.—R. **Argaud**: Remarks on polyadenoma of the stomach of the Brünner type.—C. **Levaditi**: Attempts at the treatment of the after effects of epidemic encephalitis by intra-rachidian injections of living encephalitic virus.—Georges **Blanc** and J. **Caminopetros**: Vaccine and mesoderm.—S. **Metalnikow**: The influence of the nervous system on immunisation.—Jean **Camus** and J. J. **Gournay**: The disappearance of an old genital atrophy after ingestion of large quantities of crude thymus gland.—Ernest **Fourneau**, Jacques **Tréfouël**, Mme. Jacques **Tréfouël**, and Jean **Vallée**: A new series of trypanocidal drugs. In 1920 a new drug of German origin, "Bayer 205," was introduced, possessing exceptional trypanocidal power. Its composition was kept secret. The authors have prepared a substance, which they call "No. 309," which from its physical properties and action on trypanosomes appears to be identical with "Bayer 205." It is a complicated substance, the symmetrical urea of *m*-amino-benzoyl-*m*-amino-*p*-methyl-benzoyl-1-naphthylamino-4-6-8-trisulphonate of sodium, and details are given of the method of synthesis. A mouse injected with nagana (*Tr. brucei*) is completely cured by $\frac{1}{16}$ milligram, and no toxic effects are produced by a dose of 10 to 12 milligrams, thus showing an unusually wide margin between the toxic and curative doses.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 9, No. 12, Dec.).—F. L. **Hitchcock**: Note on an experimental problem of the late A. G. Webster.—G. Y. **Rainich**: (1) A new kind of representation of surfaces. Generalised stereographic projection is employed. (2) The electromagnetic field and curvature.—J. W. **Alexander**: On the deformation of an *n*-cell.—R. G. **Harris**: Control of the appearance of pupa-larvæ in pædogenetic Diptera. Pupa-larvæ of Miastor appear to arise under crowded conditions and in old cultures presumably containing an unusually large amount of the by-products of metabolism; other factors, probably external, may exercise some influence. A medium of malt extract, agar-agar, and water gives the most satisfactory results for artificial cultures.—G. L. **Clark** and W. **Duane**: (1) The wave-lengths of secondary X-rays. Rays from a Coolidge tube with a tungsten target fall upon a secondary radiator and thence pass into an X-ray spectrometer. Curves are drawn showing the ionisation currents as functions of the positions of the spectrometer crystal using (*a*) barium chloride, (*b*) lanthanum oxide, (*c*) potassium iodide, (*d*) neodymium carbonate, and (*e*) praseodymium carbonate, as the secondary radiators. Wave-lengths corresponding to the peaks of the curves are calculated. Rays coming from the secondary radiators (fluorescent rays) do not differ in wave-length by more than 1 per cent. from those obtained when the same elements are used in a target. Peaks representing scattered X-rays from the K series lines of the tungsten target correspond to wave-lengths precisely equal to those in the primary radiation. The amount of secondary radiation having a wave-length shift of 0·024 Å.U., as indicated by Compton's theory of scattering, is considered to be inappreciable as compared with the amount having wave-lengths precisely equal to that of the primary radiation. (2) The above experiments were repeated using carbon, aluminum, sulphur, and copper as secondary radiators, with similar results. The curves obtained when copper is used have humps at a somewhat greater distance from the zero than is required by Compton's theory. It is suggested that the photo-electrons produced by the primary rays produce radiation (tertiary rays) when they strike neighbouring atoms. This tertiary radiation would be of lower frequency and longer wave-length than the primary and should have a short wave-length limit corresponding to the element used in the secondary radiator. This hypothesis appears to offer an explanation of the humps observed when the secondary radiator is copper, and also of Compton's effects obtained with a molybdenum target in the Coolidge tube.—L. R. **Cleveland**: Symbiosis between termites and their intestinal protozoa. Wood is the normal food of termites, but if the protozoa which fill their intestines are destroyed by incubation at 36° C. for 24 hours, they die in 3-4 weeks. The intestinal fungi and bacteria do not appear to digest cellulose or wood. Moreover, the protozoa generally contain wood-particles, and if wood is withheld, they die 10-20 days in advance of the termites. The wood-digesting protozoa contain quantities of glycogen. It appears that termites cannot digest wood or cellulose, and in return for the food and shelter they afford the protozoa, the latter provide them with material elaborated from wood.—R. **Pearl** and Agnes L. **Bacon**: The absolute weight of the heart and the spleen. The absolute weight of the heart is about 25 per cent. heavier in males than females from the age of 25 years onward, and reaches a maximum at about 35 years, after which it decreases in both sexes. Spleen weight has a similar maximum.—J. G. **Dickson**, Sophia H. **Eckerson**, and K. P. **Link**: The nature of resistance to seedling blight of cereals. Wheat seedlings at low soil temperatures have a high carbohydrate content resulting in thickened cell-walls resistant to fungus penetration. Maize seedlings at comparatively high soil temperatures are similarly protected. These conclusions are based on trials made at varying soil temperatures with seed infected with *Gibberella saubinettii*.

Official Publications Received.

Annals of the Cape Observatory. Vol. 10: Spectroscopic Researches. Part 7: On the Orbits of the Seven Spectroscopic-Binary Stars:—*l* Gruis, θ' Crucis, 28 Doradûs, α Phœnicis, β Doradûs, w Velorum, ρ Tucanæ. By Dr. Joseph Lunt. Pp. 42G. (London: H.M. Stationery Office.) 6s. net.

Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert and the Secretary, Sugar Bureau), 1922-23. Pp. iv+120. (Calcutta: Government Printing Office.) 1 rupee.

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Entomological Series, Bulletin No. 15: Studies in North American Delphacidæ. By F. Muir and W. M. Giffard. Pp. 53. (Honolulu, Hawaii.)

Proceedings of the Royal Society of Victoria. Vol. 36 (New Series), Part 1 (containing Papers read before the Society during the months of March to July, 1923). Pp. 81+6 plates. (Melbourne.)

Borough of Colchester Museum. Publication No. 1: Essex Bronze Implements and Weapons in the Colchester Museum. By Charles H. Butcher. Pp. 12+6 plates. (Colchester.) 1s.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 8: Het Klimaat van Nederlandsch-Indië (The Climate of the Nederlands Indies). Door Dr. C. Braak. Deel 1 (Vol. 1), Algemeene Hoofdstukken (General Chapters), Aflevering 4 (Part 4). (With English Summaries.) Pp. iv+223-278+91-122+8 plates. (Batavia: Javasche Boekhandel & Drukkerij.)

Proceedings of the Geologists' Association. Vol. 35, Part 1. Pp. 88. London: E. Stanford, Ltd.) 5s.

University College of North Wales, Bangor: Department of Agriculture, in Association with the County Councils of Anglesey, Carnarvonshire, Denbighshire and Flintshire. Preliminary Report on the Agricultural Zoology of North Wales. By C. L. Walton. Pp. 28. (Bangor.)

National Museum of Wales. Sixteenth Annual Report (1922-23) presented by the Council to the Court of Governors at a Meeting held in Cardiff on the 18th October 1923. Pp. 37+4 plates. (Cardiff.)

The Journal of the Institute of Metals. Vol. 30. Edited by G. Shaw Scott. Pp. xii+838+30 plates. (London: 36 Victoria Street, S.W.1.) 31s. 6d. net.

Diary of Societies.

SATURDAY, MARCH 8.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 A.M.—R. Lake: (*a*) Case of Vertigo, probably Central in Origin; (*b*) (with Dr. E. A. Peters) A Thick Flap for the Partial Lining and Diminution of too large Mastoid Cavities; (*c*) Forceps for use in Tonsillar Dissection.—Dr. Collier: (*a*) Abscess of Lateral Sinus; (*b*) Cerebral Abscess.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Properties of Gases in High and Low Vacua (1).

MONDAY, MARCH 10.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—D. W. Oates: The Nature and Validity of Subjective Estimates of Intelligence.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. Tribot Laspière and others: Discussion on the Work of the International Conference on E.H.T. Lines held in Paris, November 1923.

ROYAL SOCIETY OF ARTS, at 8.—E. V. Evans: A Study of the Destructive Distillation of Coal (Cantor Lectures) (3).

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—C. E. N. Bromehead: Natural Resources in relation to the Arts.

TUESDAY, MARCH 11.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Lt.-Col. G. Liston: The Plague (Milroy Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. R. W. Chambers: Civilisation and Literature of the Anglo-Saxon Period (1).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (Annual General Meeting) (at Royal Society of Arts), at 6.—H. Barringer: Presidential Address.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—Capt. P. T. Brown: A Note on the Air Supply to the Larger Type of the Motor Vessel.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual General Meeting.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at University College), at 8.30.—Dr. Morton Prince: "Meaning" and "Setting" in relation to Pathological States—a Theory of Progress, etc.

WEDNESDAY, MARCH 12.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M. to 5 P.M.—Prof. T. Turner: Presidential Address.—D. Bunting: The Brittle Ranges in Brass as shown by the Izod Impact Test.—Dr. J. Newton Friend and R. H. Vallance: Determination of the Thermal Coefficients of Expansion of some Commercial Metals and Alloys.—W. E. W. Millington and Prof. F. C. Thompson: The Investigation of a Fatigue Failure of Brass Tubes in a Feed Water Heater—with a Consideration of the Nature of Fatigue.—T. Martin: The Tensile Properties of Aluminium at High Temperatures.—W. E. Alkins: The Relation between the Tensile Strength and the Electrical Resistivity of Commercially Pure Copper.—S. H. J. Wilson: Note on the Effect of Cold-Drawing and Annealing on some Electrochemical Properties of a Low-Tin Bronze.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. H. H. Dale, Prof. W. E. Dixon, Prof. C. S. Gibson, Sir Maurice Craig, F. Moore, Dr. P. W. Williams, and others: Special Discussion on The Possible Substitutes for Cocaine.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Mrs. J. Longstaff: Ordovician and Lower Silurian Gasteropoda from Girvan.—A. Heard and R. Davies: The Old Red Sandstone of the Cardiff District.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 7.—C. E. Stromeyer and others: Discussion on CO_2 Recorders.—R. H. Parsons and others: Discussion on The Practical Testing of Steam Boilers.

ROYAL SOCIETY OF ARTS, at 8.—A. A. Campbell Swinton: Personal Recollections of some Notable Scientific Men.

THURSDAY, MARCH 13.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M. to 5 P.M.—Dr. J. Newton Friend and J. S. Tidmus: The Relative Corrosion of Zinc and Lead in Solutions of Inorganic Salts.—E. R. Jette, G. Phragmén, and Dr. A. F. Westgren: X-Ray Studies on the Copper-Aluminium Alloys.—F. W. Rowe: The Effect of Casting Temperature on the Physical Properties of a Sand-Cast Zinc-Bronze.—K. Iokibe: Copper-Zinc Alloys which expand on Solidification.—C. H. M. Jenkins and Dr. D. Hanson: The Constitution of the Alloys of Copper and Cadmium.—D. Stockdale: The Aluminium-Copper Alloys. Alloys of Intermediate Composition.—Dr. M. Cook: The Cadmium-Lead-Zinc System.—M. Isihara: The Equilibrium Diagram of the Copper-Tin System.

ROYAL SOCIETY, at 4.30.—Prof. A. Fowler: The Series Spectrum of Ionised Carbon (C II).—Dr. E. S. Bieler: The Large Angle Scattering of α-Particles by Light Nuclei.—Prof. W. L. Bragg: The Refractive Indices of Calcite and Aragonite.—Kathleen Yardley: The Crystalline Structure of Succinic Acid, Succinic Anhydride, and Succinimide.—L. F. Bates and J. S. Rogers: Particles of Long Range from Polonium.—A. Müller: The Determination of the Crystal-Axes in "Single-Crystal" Aluminium Bars by means of X-Rays.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Lt.-Col. G. Liston: The Plague (Milroy Lectures) (2).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. S. Flett: Types of Volcanic Structures (2).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.

OPTICAL SOCIETY (at Imperial College of Science and Technology), 6.30 to 7.30 and 8.30 to 10.—Demonstration of Optical Aberrations by Cooke, Troughton and Simm's "Pathological" Set of Object Glasses. Lens-testing bench designed for large "air photography" photographic lenses. Hartmann test applied to microscope objectives. Foco-collimators and various focometers. Projection of rock-sections in polarised light, and other polarisation experiments. Experiments in diffraction, interference, etc., with some practical applications. Sundry other experiments in Photometry, Refractometry, Polarimetry, etc. Experimental models of nephelometers. Accessory for squaring on and centring micro-objectives. The illusion of relief in low-powered microscopy by means of a rotating eccentric diaphragm. The Cambridge one-ton single-lever testing machine and the determination of Young's modulus. Improved Ewing's apparatus for experiments on the bending of bars. Wooden models of the generalised mechanism of Sarrut. The geometrically designed microscope of Keith Lucas. Experimental model of a sensitive gas balance. Wood's method of preparing reflecting collodion films. The remarkable crystals of the sulphate of iodo-quinine discovered by Dr. Herapath in 1851. The decimal classification of knowledge by the Institut International de Bibliographie and its application to the indexing of the papers contained in the Transactions of the Optical Society, now in progress.—At 7.30.—Miss H. G. Conrady: A Study of the Significance of the Focault Knife-edge Test when applied to Refracting Systems.—B. K. Johnson: A Reflecting Spherometer.—Dr. L. C. Martin: Note on a Convenient Bench for testing Telescope Object Glasses.—R. Kingslake and Dr. L. C. Martin: The Measurement of Chromatic Aberration on the Hilger Lens Testing Interferometer.

FRIDAY, MARCH 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. J. K. Fotheringham: The Meteoric and Callippic Cycles.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—J. H. Shaxby and A. E. Evans: Certain Properties of the Osglim Neon-filled Lamp.—U. A. Oschwald and A. G. Tarrant: (*a*) Ionisation and a New Photo-Electric Effect; (*b*) Notes on certain Electrical Properties of the Neon Lamp.—J. Taylor and W. Clarkson: The Critical Resistance for Flashing of the Low-Voltage Neon Lamp.

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

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. Martin-Duncan: A Criticism of the Prints in the Affiliation Print Competition, 1923.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—L. M. Jockel: Water-tube Boilers.

SATURDAY, MARCH 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Properties of Gases in High and Low Vacua (2).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—A. L. Leach: Paleolithic Man in the Caves and Rock Shelters of Dordogne.

PUBLIC LECTURES.

SATURDAY, MARCH 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. H. S. Harrison: Man's Early Discoveries and Inventions.

TUESDAY, MARCH 11.

UNIVERSITY COLLEGE, at 5.30.—Prof. J. W. van Wijhe: The Origin of the Vertebrate Skeleton. (Succeeding Lecture on March 13.)

WEDNESDAY, MARCH 12.

INSTITUTE OF HYGIENE (Devonshire Street), at 3.30.—Dr. Jane Walker: The Health of the Housewife.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. G. B. Dixon; Some Aspects of the Tuberculosis Problem in an Industrial City.

KING'S COLLEGE, at 5.30.—Prof. H. Driesch: The Possibility of Metaphysics. (Succeeding Lectures on March 14, 18, and 19.)

UNIVERSITY COLLEGE, at 6.—E. S. Pearson: Birth Intervals as a Factor in the Size of the Family.

BIRKBECK COLLEGE, at 8.—Dr. W. Bateson: Progress in Biological Science (Birkbeck College Centenary Orations) (5).

THURSDAY, MARCH 13.

UNIVERSITY COLLEGE, at 5.30.—Dr. C. Pellizzi: Galileo Galilei (in Italian).

FRIDAY, MARCH 14.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Dr. C. S. Myers: The Future of Psychology.

SATURDAY, MARCH 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. N. Bromehead: Links between Geology and Art.