NATURE

SATURDAY, MAY 17, 1924.

CONTENTS.

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

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

NO. 2846, VOL. 113]

The Quantum Theory.

THE jurisprudence of scientific law is a matter for the consideration of the philosopher, but the simple scientific worker can often form a fair idea of the condition of a science by examining what is the constitution of the legislature which is making its laws. In some sciences the government is parliamentary; in others, it is more like the rule of a supreme court of justice. In biology, for example, consider the subject of organic evolution. Here government has been nearly always parliamentary, and among the leading authorities there has usually been a very wide divergence of opinion. Sometimes the conservatives have been in power, sometimes the radicals, and it is sad to record that, as in other spheres of activity, it has often been the chief object of either party to "dish the Whigs" or to keep the Tories out, rather than to attempt to perfect the system of law. With this type of legislature progress is certainly made, but is only made by a succession of rather violent reactions; the Natural Selection Act is passed in spite of the bitter opposition of the conservatives, and for many years is regarded as a panacea for all ills, but, in spite of Mendel's Law (carried without a division), the present seems to be a time of reaction, and the conservatives are having another innings because of certain evilly-disposed creatures which persist in making variations without any eye to their own interests.

In the inorganic sciences, on the other hand, law has more usually been made by processes that may be likened to the rulings of a court of justice, so that they command immediate and universal acceptance—this may be only the naive estimate of a layman as to judicial infallibility. Newton propounds the law of gravitation, and there is no appeal; Kelvin and Clausius put forward the second law of thermodynamics, and they are quoted in all subsequent cases. But at times questions have arisen on which the bench has been divided, and then recourse must be had to the other type of legislation. Such a case has been radiation. If we may misapply our metaphor still further, all through the eighteenth century "members might vote as they pleased" as to the nature of light; but in the nineteenth century Fresnel's ruling took the matter out of the hands of parliament. At the beginning of the twentieth century, Planck's study of the question revealed a flaw in the decision, and again

the matter came before parliament under the new name of the Quantum Theory.

In 1914, Mr. Jeans wrote the first edition of the report now before us.[1] At that time the matter was very definitely under the control of the parliamentary type of government. There were the die-hards, especially strong in Great Britain, who would not abandon the logical perfection of the classical theory of Maxwell in spite of its proved inadequacy and of the sterility from which it had long suffered. There were the moderate men who were reduced to a state of almost complete agnosticism, and there were the Bolsheviks, ready to multiply any ν by h and face the consequences, however absurd—may we suggest quantising the eight-hour day so as to determine the amount of work to be done by the proletariat? In this parliament, Mr. Jeans occupied a rather special position, for he had been one of the leading conservatives, but had recently been converted to liberalism, and the report was particularly addressed to the die-hard party. In the lapse of the last ten years there has been no clear-cut discovery which would remove the quantum theory from parliamentary control, but the steady evolution of the theory of spectra has led to a shifting of opinion towards the left; the die-hard is now an agnostic, and the moderate man is himself ready to undertake the respectable process of quantisation. In consequence of this trend, the new edition of the report is no longer a polemic, but an outline of what is now a generally accepted—if incomplete—body of doctrine.

The quantum theory is based on two classes of argument—the positive and the negative. On the positive side, it has already succeeded in classifying in main outline the whole system of line spectra, and this would alone have justified it; but it should never be forgotten that the really conclusive proof lies on the negative side. Without breaking absolutely with the classical theory, it is impossible to explain either the radiation formula or the vanishing of specific heats at low temperatures. This side of the subject depends on highly abstruse considerations of the partition of energy, and so is shirked in many writings; we may count it as a great merit of the present work, that it has retained and amplified the detailed discussion of radiation given in the first edition.

By far the greatest change in the report is, of course, in the spectrum theory. The first edition was written shortly after Bohr's original discovery, and so could only contain the combination principle and the barest outline of the simple hydrogen spectrum. Now we have Sommerfeld's quantisation, the relativity correction, the motion of the nucleus, and a short reference to the Zeeman and Stark effects. The treatment of the more complicated spectra is very slight; they are regarded mainly as depending on analogy with hydrogen, and no account is given of any of the exceedingly shaky mechanical models which have been invented. There is also a sketch of the developments in purely classical dynamics which have been found to apply in such a curious way to the theory, including the beautiful principle of adiabatic invariance. The account of Bohr's correspondence principle is rather brief; it contains the formal statement, but scarcely shows the wide field which it has influenced. In some ways this is a good thing, for the principle is quite clear-cut and precise, but there has been a tendency of late to use it to describe any analogy, however vague, between the classical and the quantum systems of mechanics. The last chapter contains a discussion, of necessity very indefinite, of the possibilities of reconciliation between the old and the new mechanics.

We may note a few omissions. There is no mention of the theory of the specific heats of gases, though this theory is now really as sound as that of solids, and is a good deal simpler. Taken in conjunction with infra-red band spectra (which also are not mentioned) it constitutes one of the strongest confirmations of the whole theory. There is also no mention of the wonderful experiment of Stern and Gerlach, which shows directly that atoms orientate themselves in space according to the dictates of the quantum theory. Nor is the anomalous Zeeman effect discussed—but this is perhaps right; for though this effect has been analysed by the help of quantum principles, yet it, and with it the gyromagnetic effects, would appear not to belong to that theory, but to indicate some other quite different type of departure from classical mechanics. As this question is still rather unsettled, and is treated fully in other works, we need not very much regret its absence. The whole report furnishes an admirable summary of those parts of the quantum theory which are now really well established. It is probable that the physical outlook on the whole system will be revolutionised, but it will be very surprising if the subject-matter of the report cannot be taken over, mathematics and all, in the new interpretation.

[1] The Physical Society of London. Report on Radiation and the Quantum Theory. By J. H. Jeans. Second edition. Pp. iv+86. (London: Fleetway Press, Ltd., 1924.) 7s. 6d. net.

Eclipses of the Sun.

Eclipses of the Sun. By Prof. S. A. Mitchell. Pp. xvii+425+59 plates. (New York: Columbia University Press; London: Oxford University Press, 1923.) 17*s.* net.

THE title chosen by Prof. Mitchell for this admirable volume does not prepare his readers for the very wide field of information which has been covered by its contents. It is interesting to find how, with so little straining of definition, he has been able to bring in almost a complete treatise on solar phenomena, linking up each feature with some phase of inquiry requiring an eclipse of the sun for its source of information.

The twenty-one chapters may be classified into seven main sections, dealing with (*a*) historical eclipses; (*b*) applications of the spectroscope; (*c*) modern eclipses; (*d*) details of eclipse spectra; (*e*) ionisation theory; (*f*) corona; (*g*) relativity problems.

In the first section an instructive summary is given of the earliest records of eclipses, commencing with that found in the Chinese classic "Book of Historical Documents," or "Shu Ching." According to Oppolzer, the date of this ancient eclipse would be October 22, 2137 B.C., more than 4000 years ago. Many years intervened, with records of some uncertainty, until the eclipse of September 6, 776 B.C., on which the first trustworthy date in the history of China appears to depend for its recognition. Thirteen years later there occurred the celebrated Nineveh eclipse, and all that is known of exact dates in Egyptian and Babylonian chronology apparently depends on the occurrence of this phenomenon in 763 B.C., and on the records furnished by Ptolemy in the "Almagest." It would be a matter of extreme interest if further information could be furnished of the reported discovery by Layard of a Babylonian lens showing evidence of having been turned on a lathe.

The birth of astronomy is usually ascribed to the study of the heavenly bodies by the priests, who introduced the worship of the sun, moon, and planets as symbols of law and order. The gradual recognition of the chief great laws is here described in detail, showing how they resulted in the acquisition of accurate knowledge of the sun-dial, water-clock, signs of the zodiac, the lunar Saros, and eventually the calendar. An instrument consisting of a plumb-bob and sighting vane, apparently used for determining meridian passages, and regarded as being the oldest astronomical instrument in the world, is stated to be now in the Berlin Museum. Remembering the great interest which has been taken in endeavouring to prove the astronomical association of the Pyramids and other Egyptian structures, temples, etc., it is important to note that while eclipses of the sun were frequently observed in Babylon, there does not appear to be a single reference in Egyptian antiquity to an eclipse, either of the sun or the moon.

The only definite allusion to an eclipse in the Bible is that of Nineveh, 763 B.C., which is thus recorded in Amos viii. 9: "I will cause the sun to go down at noon, and I will darken the earth in the clear day." If the date of this be accepted, that given in Amos has to be altered by twenty-four years, and we have thus an interesting application of retrospective eclipse calculations giving means for the correction of biblical and classical references. Various other eclipses described in classical literature are also considered, the most noted being the eclipse of Thales, of Miletus. Several dates for this occurrence have been computed, that of May 28, 585 B.C. being now selected as the most correct epoch. Another eclipse is described by Thucydides as taking place at Athens, August 3, 431 B.C., this being the first detailed observation giving particulars about the solar crescent and the visibility of certain stars.

Tracing next the development of the ability to predict celestial phenomena, the author relates how the Greeks had inherited from the Chaldeans the calendar founded on the lunar month, but found difficulties owing to the month being equal to 29·5 days. Meton (born 460 B.C.) recognised that 19 solar years were so nearly equal to 235 lunar months that after this interval new and full moon phenomena were repeated with such exactness that the period became established as the Metonic Cycle. It is important to note that whereas the Chaldeans were eminently observers, the Greeks neglected this branch of astronomy, and may be said to have specialised in the science of interpretation. The fact that Aristotle is credited with proving the sphericity of the heavenly bodies suggests the nearest approach to some interest in observation. Hipparchus appears to have been the outstanding figure, having invented trigonometry, produced the first catalogue of stars (to the number of 1080), and contributed to the theory of the motion of the sun and moon.

The geometrical conditions for determining the elements of eclipses are next described in detail, and the method by which the Saros, of 18 years 11 days, enables the observer to gain some idea of the localities of successions of eclipses, by comparison with others of known occurrence. Dates are given for 56 total solar eclipses occurring during the 100 years 1875–1974. The United States has been specially well favoured as regards facilities for home observations since 1878, but after 1925 there will be a blank period of 45 years.

The only eclipse easily accessible to European observers will be that of June 29, 1927, when stations may be occupied in Ireland, England, Scotland, and Scandinavia, but the totality phase will last less than one second.

A concise summary is given of the procedure employed in calculating an eclipse, with a useful discussion of the successive improvements of the ephemerides by Hansen (1857), Newcomb (1878), and Brown (1920), by which the prediction of eclipses has become capable of greater precision than in former times. Attention is also given to the determination of the secular acceleration of the moon from a study of the most trustworthy eclipses of historical times.

Two chapters are next devoted to a description of the development of spectroscopic analysis, of which the first mention appears to be due to observations on prismatic colours by Kepler. Then Newton in 1666 carried the matter further, and probably only missed discovering the dark absorption lines in the solar spectrum on account of the poor definition of his prism. Wollaston in 1802 found ill-defined dark markings in the solar spectrum, and also examined other light sources, such as the candle-flame and electric light, giving bright line spectra. To Fraunhofer in 1814 came the honour of detecting the dark absorption lines in the solar spectrum, to which his name has been deservedly given, and to him we owe the first accurate map showing their relative positions. He also detected the same lines in the spectrum of the planet Venus, and showed that the spectrum of Sirius exhibited structure of an entirely different type. This latter observation was made by allowing the light from the star to fall directly on the prism placed before the object-glass of the observing telescope; this apparatus, in the form of the objective-prism camera, is still of the utmost service to astrophysical research, especially for eclipse investigations. Of equal importance was his development of the diffraction-grating, first made as a rectangular framework of parallel, equidistant wires, and later as a plate of glass or metal ruled with fine lines by a pointed tool. Next followed Brewster's solar map of 1833, with his discovery of certain lines near the times of sunrise and sunset, now known as the telluric lines.

The annular eclipse of 1836, observed by Forbes at Edinburgh, appears to have been an important event in the development of astrophysics. Forbes showed that the Fraunhofer lines could not all be due to the terrestrial atmosphere, as they were not visible in many stellar spectra. On the other hand, he misinterpreted the results of his observation of the eclipse and concluded that the sun's atmosphere had nothing to do with the production of the dark lines. Although he had the idea of using a projected image of the sun on his spectroscope slit, he did not carry it out, and this most important advance in spectroscopic manipulation was not employed until 30 years later. In 1845 Miller observed the intensification of certain lines when solar light was passed through a sodium flame, without realising the importance of it. Foucault in 1849, Stokes in 1850, Ångström in 1855, and Balfour Stewart in 1859 made similar observations, but it was left to the immortal Kirchhoff, in 1859, to give the critical explanation of the dark lines being due to absorption by the solar atmosphere, from the photospheric continuous spectrum, of precisely those radiations which that atmosphere was capable of emitting as bright lines. This work was the foundation of our modern method of determining the composition of the sun's atmosphere, and the prismatic camera of Fraunhofer is one of the most important adjuncts for eclipse investigation.

In 1882 a new epoch was inaugurated by the perfecting of the concave diffraction-grating by Rowland; his magnificent map of the solar spectrum was produced with its aid in 1887. This is still the practical standard of most astrophysical and laboratory research, although steps have been taken to connect it with a laboratory metallic standard for intercomparison work.

The reader is next given an account of present knowledge of solar surface phenomena, dealing generally with photosphere, sun-spots, chromosphere, prominences, spectroheliograms in monochromatic light, prominences, etc., with a short discussion of the eleven-year periodicity.

Following come five chapters describing in much detail the chief eclipses of modern times, beginning with that visible at Copenhagen in 1560, which so fired the enthusiasm of Tycho Brahe, then a boy of fourteen. Baily's Beads, described by Francis Baily as seen at the eclipse of 1836, appear to have been first observed by Williams at the American eclipse of 1780. The solar prominences were first observed by Stannyan at the eclipse of 1706, and subsequently by Vassinius in 1733, and Admiral Ulloa in 1778. The first scientific reference to the corona appears to have been made by Kepler, observing at Naples in 1605. Systematic observation of solar eclipses were commenced in 1842 by Baily and Arago. Then came Schwabe's discovery of sun-spot periodicity in 1843, causing additional interest in solar inquiry. The preparations for observing the succeeding eclipse of 1851 may be regarded as the initiation of the procedure whereby special expeditions have been organised for the study of all later important eclipses. Photographic registration was first successfully applied to the 1851 eclipse by Busch, using the daguerreotype process. In 1860 the solar

origin of the prominences was proved from the photographic records, and this success, combined with the brilliant work of Kirchhoff which had then just been made known, enabled the observers to prepare a comprehensive programme for the next eclipse of 1868, which was to prove of such momentous import. Janssen, observing with a slit-spectroscope, found the emission spectrum of the prominences so brilliant that he was enabled to repeat the work in full sunlight after the eclipse. Lockyer, in England, also without eclipse, had made practically the same observation, and the two accounts were read before the Paris Academy of Sciences on the same day. The method used is identical in principle with that employed at the present day.

At the eclipse of August 7, 1869, in Carolina, we have observations showing that the corona exhibited a continuous spectrum, together with a specially strong green line. Then on December 22, 1870, Young observed the flash spectrum, which he ascribed to a comparatively shallow reversing layer overlying the photosphere. The value of the slitless spectroscope for eclipse work was first demonstrated in 1871, when the resulting photographs showed conclusively the existence of the bright emission all round the sun.

We are next introduced to the more modern eclipses from that of 1878, which was observed by some 100 astronomers, occupying about 12 stations. The distinctive type of minimum or wind-vane corona was identified, with its delicate polar ray tracery and equatorial streamers.

In 1882 the prismatic camera, or slitless spectroscope, was used photographically with success, the dry plate process being employed.

Succeeding eclipses up to 1893 are notable for the gradual confirmation of the variation of the form of the corona with the eleven-year period, and numerous unsuccessful attempts by Huggins and others to photograph the corona without an eclipse. In 1896 we have the first decisive record of the whole flash spectrum by Shackleton in Nova Zembla. For the rest of the nineteenth century we have records of continual increase of the power of the photographic apparatus, comprising coronagraphs up to 40, 60, and 78 feet focal length, and spectrographs of great dispersion, using prisms, and plane and concave gratings.

Detailed descriptions then follow of the author's personal experiences during the eclipses of 1900, 1901, and 1905. At the last, observed at Daroca, in Spain, with a large concave grating used at the principal focus, he obtained the beautiful chromospheric spectra which form the basis of his comprehensive tables of the constituent radiations. Here also the author lets himself go in a realistic description of a bull-fight at Valencia. Most of us who witnessed that spectacle about the same time will doubtless endorse the opinion of not wishing to see another. Thirteen years later brings the author to his fourth eclipse, that of 1918; here the photographic record was partly obstructed by thin cloud, leaving the 1905 results still holding the premier position.

The author now deals with the discussion of the results of the inquiries undertaken at various eclipses, special attention being devoted to the spectroscopic sections. The points chiefly considered refer to (*a*) the heights attained by the various vapours above the photosphere from measurement of the lengths of the arcs; (*b*) the intensities of the spectral lines; (*c*) the wave-lengths of the lines, and the recognition of the elements to which they are due. The best photographs have been those obtained with a four-inch concave diffraction-grating, used at the principal focus of five feet, without slit, although this gives some difficulty with respect to the places selected for measurements of fiducial position. In 1905 the author thus obtained the chromospheric spectrum from $\lambda 3318$ to $\lambda 5875(D_3)$, occupying 9·5 inches (23·5 cm.) on the film, the scale being about 1 mm. = 10·8 Å. From this beautiful spectrum 2841 lines were tabulated; of these, only 126 are included which have not been identified with lines in Rowland's list.

Into the old controversy as to whether the bright line spectrum is evidence of a reversing layer it is not necessary to go. Suffice to say that it is now admitted that the flash intensities differ in a marked degree from those of the ordinary spectrum. Indeed if it were possible for an observer, well experienced in all the details of the dark Fraunhofer spectrum, to see the flash spectrum without knowledge of its source, it might well not be taken as being in the main due to lines with similar wave-lengths. If the region of absorption were narrowly localised, there would not be expected to be such diversity of intensity as is observed. This leads to some doubt as to the correctness of the author's conclusion to combine wave-lengths of blended lines by weighting them according to their intensities in Rowland's list, *i.e.* in the Fraunhofer spectrum. Seeing that the strongest or most characteristic lines of the chromospheric spectrum are not the strongest of the dark-line spectrum, there is here opportunity for considerable error in identification. Once it is admitted that the chromospheric spectrum is *mainly of the enhanced metallic type*, it would seem that the better procedure would have been to take as a guide, in all cases of blended groups, the relative intensities of such lines in the enhanced laboratory spectra. These spectra are known to agree closely with the relative intensities of most of the chromospheric lines which are *free* from blends; the distinction

between the Fraunhofer and flash spectra would then be exhibited by systematic residuals from free and blended lines.

This work on identification with laboratory origins is difficult, and the author is to be congratulated on much of his tabulation. In one paragraph, however, he makes these two consecutive statements: "In this part of the work many differences were found from the identification given in Rowland's tables. . . . Where Rowland has given identifications, they were in most cases found correct."

A special chapter is devoted to the discussion of the heights of the various vapours in the solar atmosphere, with correlations according to the class of spectral line, position of element in periodic table, etc. There is good evidence showing that the average height of metallic *arc* lines is not much greater than 600 km., whereas that for *enhanced* lines varies from 500 to 7000 according to their intensity. With the author's extension of the solar evidence to assumptions concerning the earth's atmosphere it is more difficult to agree. After about a half century of speculation we should welcome any measure of practical evidence, however small, to indicate the presence or otherwise of *hydrogen* or *helium* as main constituents of the upper regions of the *terrestrial* atmosphere.

Various observational problems are next discussed; including the spectroscopic method of determining solar rotation, the application of the Zeeman effect to find the magnetic fields of sun-spots and the general magnetic field of the sun, and a comparison of the results of chromospheric records with and without an eclipse. About the solar rotation the author strikes a disconsolate note, even going to the extent of suggesting partial cessation of the inquiry. The problem has certainly become very complex since the days of visual determinations, but new discoveries are being made which may help to trace the irregularities to their source. Taking the equatorial velocities as first needing elucidation, much has been made of possible alterations of velocity at different periods of the solar cycle, but if the latest accepted values given at the International Astronomical Union, Rome, 1922, be examined, it will be seen that whatever evidence of change there may be is more of the nature of continued diminution of the recorded equatorial velocity from 1900 to 1918, throughout two minima and two maxima. This is shown in the accompanying diagram (Fig. 1). For the general question the conclusion of the Mount Wilson observers from their own results for eight years must be respected, namely, that they think there is no evidence of any observable change in the rotational velocity of the sun.

Regarding the relationship of solar and terrestrial phenomena we cannot agree with the statement "the display of a brilliant aurora is almost certain to be accompanied (and caused) by a spot central on the face of the sun." Surely, in a comparison of this kind, exceptions are more important than apparent coincidences of phenomena, which may, or may not, be cause and effect. There are numerous examples of great magnetic storms and related phenomena without any exceptional spot activity being visible on the sun, and in many cases when no spots are present.

The work in connexion with the determination of solar magnetic phenomena is clearly explained. The delicacy of this problem is shown by the statement that the examination for the detection of the sun's general magnetic field depends on the recognition of differences so small as 0·001Å. The anticipated reversal of sun-spot polarities has been confirmed by Prof. Hale, but he also reports that the Hα vortices have not shown any reversal in direction at either minimum, 1912–13 or 1923 (see NATURE, January 19).

A short chapter is devoted to a general description of the electron theory, and of the quantum theory

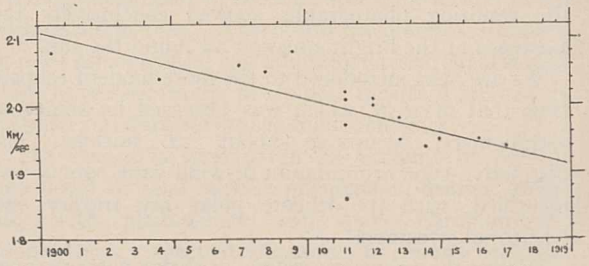

FIG. 1.—Equatorial solar rotation from observations at seven different stations, 1900–1918.

applied to spectral series by adoption of the Bohr modification of the Rutherford atom. The wide scope of astronomical research is well illustrated by the developments of atomic theory, which have been specially valuable during the last ten years. While the study of astronomical distances involves quantities of the order of 10^{21} metres, or 100,000 light years, the spectroscopist finds it necessary to investigate quantities dependent on the radius of the electron, computed to be about $1{\cdot}9 \times 10^{-15}$ metres. Moreover, the development of the theory of the Rutherford atom involves the idea of circulatory motions which are boldly assumed to be of somewhat similar nature to the planetary motions in the solar system.

Saha's theory of ionisation receives special attention, and is followed in its explanation of the main peculiarities of the flash spectrum. The notable differences between Fraunhofer, sun-spot, and chromospheric spectra are discussed in detail. The author, however, is mistaken in claiming that the diminution of intensity of low temperature lines in the chromospheric spectrum is here recognised for the first time. He has shown

such a methodical grasp of the available astrophysical literature that it is difficult to understand how the main contention of Lockyer's Kensington classification can have been thus lost sight of. The opposite behaviour of the two classes of lines has been repeatedly explained, in text and by diagram, in both solar and stellar spectra. The explanation may possibly be related to that involving the special note of prominent names connected with investigations in the laboratory being correlated to observations on the sun itself, without any reference to Lockyer and his staff at the institution usually regarded as the original home of the application of laboratory methods to astrophysical research.

The author's explanation of the weakness of λ4481, the prominent enhanced line of magnesium, in the chromospheric spectrum, does not agree with laboratory data. The writer's experience is that λ4481 is most difficult to suppress, being shown with the slightest capacity in the spark circuit.

The corona is treated in two chapters, very full details being given of the progress of study at various eclipses, dealing with the form, structure, spectrum, and various theories proposed for its explanation. The numerous references in this section are a welcome feature.

The book concludes with a discussion of the relativity theory, with special reference to its solar significance in the deflexion of starlight passing through the sun's gravitational field, and in the change of wave-length of the solar spectrum lines towards the red. The deflexion of starlight has received confirmation at the eclipses of 1919 and 1922, and the spectroscopic effect is now admitted to be shown by results obtained by St. John at Mount Wilson and Evershed at Kodaikanal.

In so large a work it is a pleasant experience to find so few misprints. Mention may be made of the misidentification on the lower chromospheric spectrum facing page 230, where the line λ4471 (He) is indicated as Hγ.

The volume is clearly printed, and the numerous illustrations very satisfactorily reproduced. A more detailed index would have made reference easier. It is a very welcome publication, and should prove a valuable help to teachers and students of astrophysics.

C. P. BUTLER.

A Handbook of Conifers.

A Handbook of Coniferæ: including Ginkgoaceæ. By W. Dallimore and A. Bruce Jackson. Pp. xi+570+32 plates. (London: E. Arnold and Co., 1923.) 42*s.* net.

THE authors of this textbook on conifers, who are in close touch with Kew Gardens and the Imperial Institute, have brought together into one handsome volume a copious mass of information about the 380 living species. Those cultivated in Great Britain, some three-fourths of the total number, are naturally treated more fully than the natives of subtropical regions, that have not been introduced. The botanical descriptions of the former are adequate and expressed in simple botanical language, while artificial keys are provided to render identification easy. The numerous sports which have arisen are clearly distinguished, and their cultural value is pointed out. Scarcely any mutation of a utilitarian character has occurred in this great class of plants, and coniferous sports are planted either as objects of ornament or of curiosity. The student is further helped by the admirable series of 120 drawings, made by Miss G. Lister from fresh material, which faithfully depict the branches, foliage, buds, cones, and seeds of the more important trees and shrubs. The æsthetic value of the book is also enhanced by 32 plates of forest scenes in America, plantations in Scotland, and well-grown trees on English lawns.

Mr. Dallimore, who has long been in charge of the Forest Museum at Kew, is responsible for the economic part of the book, and gives under each species the results of his own investigations on timbers and other forest products. He also frequently quotes from recent official and commercial reports, so that the information is brought up-to-date. The common fungus diseases and insect attacks are shortly described under the important silvicultural genera, like pine, spruce, larch, silver fir, and Douglas fir. Useful notes on cultivation and choice of soil are dispersed throughout the volume; and directions about propagation are given in the case of rare species and varieties, of which seed is not obtainable.

The genera and species are arranged alphabetically under the two families of Taxaceæ and Pinaceæ, into which conifers are divided; but one alphabetical arrangement would have been simpler. Easy reference would also have been facilitated if every right-hand page had been headed with the name of the genus and species treated in the text beneath. The introductory matter occupies only 17 pages, and could have been enlarged with advantage, as a difficult subject like conifers requires considerable preliminary study. The key to the genera given in the introduction also could be much improved.

The merits of this handbook outweigh any slight imperfections; and it will supersede most if not all of the English textbooks which have been published on similar lines. It satisfies the needs of gardeners, foresters and landowners, for whom it was primarily written, and will prove useful to out-of-door botanists.

The Origin of Vertebrates.

The Ancestry of Vertebrates as a Means of Understanding the Principal Features of their Structure and Development. By Dr. H. C. Delsman. (Published with support of the Koninklijke Natuurkundige Vereeniging, Batavia.) Pp. vii+236. (Weltevreden, Java: N. V. Boekh. Visser and Co.; Amersfoort, Holland: Valkhoff and Co., 1922.) n.p.

MORE than 100 years ago Geoffroy St. Hilaire compared a vertebrate to an anthropod turned upside down, and afterwards Semper and Dohrn developed on similar lines a theory of the derivation of the vertebrate from an annelid. These theories met with many serious difficulties, not the least of which is the position of the mouth, and in spite of many ingenious suggestions to account for the disappearance of the old and the formation of the new mouth, they have rightly never gained general acceptance.

Dr. H. C. Delsman again takes up the problem of the origin of vertebrates from annelids, bringing in new considerations which he believes not only smooth over old difficulties, but also help us to understand better many obscure points in their morphology. It may be said at once that we do not think he has proved his main contention, in spite of the courage and skill with which he defends the theory. To begin with, the argument (p. 4) that because the nephridia of Amphioxus with their numerous solenocytes closely resemble those of certain polychæte worms, therefore the vertebrates must have been derived from annelids, loses its point when we know that very similar nephridia occur in such diverse groups as the Phoronidea, Acanthocephala, and Nemertina, and even in the Rotifera, Platyhelmia, and larval Mollusca.

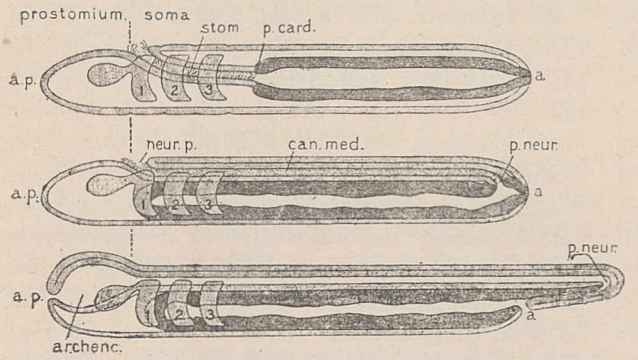

FIG. 1.—Diagrams of an annelid, an acraniate chordate before the formation of the tail has begun, and a craniate chordate with tail. *a*, anus; *a.p.*, animal pore; *archenc.*, archencephalon; *can. med.*, medullary tube; *neur. p.*, neuropore; *p. card.*, cardiac pore; *p. neur.*, neurenteric pore; *stom.*, stomodæum. From "The Ancestry of Vertebrates."

The nervous system, however, presents a more important problem, and it is in his treatment of this difficulty that Dr. Delsman differs most from his predecessors. The eminent Russian embryologist Kowalevsky once remarked that the tubular nervous system of the vertebrate, which opens behind into the gut by the neurenteric canal in the embryo, might represent a part of the alimentary canal of an early ancestor; but wisely he did not follow up the suggestion. Our less cautious author now puts forward the view that the dorsal neural tube of the vertebrate is homologous with the stomodœum or ectodermal lining of the pharynx of the annelid (see Fig. 1). The lengthening of this ectodermal ingrowth is supposed to have carried backwards the original blastoporal opening into the endodermal gut ("cardiac pore") to a position near the anus where it becomes the neurenteric canal of the vertebrate. On the other hand, the annelid mouth would remain as the embryonic neuropore in front; while the endodermal gut would be left as a sac ending blindly below it.

Such an interpretation seems to raise a multitude of difficulties which space will not allow us to discuss, nor indeed could justice be done to the ingenuity and learning with which Dr. Delsman attempts to dispose of them. In the course of a rather rambling discussion he ranges over almost the whole of vertebrate morphology; indeed, the bulk of the volume is devoted to such questions as the structure and segmentation of the head, the skull, the cranial nerves and the hypoglossus. It is often difficult to see what bearing some of these questions, however interesting and important in themselves, have on the theory of the origin of vertebrates from annelids. The fundamental difficulties with regard to the nervous system and mouth remain unsolved.

Dohrn and others, in their earlier speculations, at all events held that the chief organs fulfilling similar functions must correspond in the two groups. Dr. Delsman, however, not only turns his ancestor upside down, but, like Gaskell before him, assumes that a part of the alimentary canal destined by a long course of phylogenetic differentiation to perform functions connected with nutrition, has become incorporated into the nervous system, when a highly specialised nervous system had already been elsewhere developed having most complex connexions, also elaborated through a long course of histological and functional differentiation. Further, he seems to see no difficulty in supposing that a new mouth has arisen independently in Ascidians, Amphioxus, and the Craniates (p. 11).

We must confess that such speculations, founded for the most part on incompletely understood embryological observations capable of many interpretations, seem quite unconvincing and belong to a type of phylogenetic theory which we hoped was now extinct. If we must speculate as to the origin of vertebrates, let us not seek the ancestor among living specialised groups

already irretrievably committed to a certain type of differentiation, but let us build up a phylogenetic series every step of which shall be a "working" adult animal with a mouth and all necessary parts. In such a series there should be no violent revolutions either in structure or in function, no awkward intermediate stages in doubt whether to eat with the mouth or the neuropore, or whether to digest with the brain or think with the stomach.

It seems reasonable to suppose that the common ancestor must have been an elongated creeping animal with anterior mouth, posterior anus, excretory nephridia, paired cœlomic sacs from the walls of which developed the germ-cells to be carried to the exterior by paired genital funnels, and with a nervous system consisting of an anterior very rudimentary brain and a subepidermal plexus, possibly with ill-defined longitudinal dorsal and ventral cords. Such an undifferentiated form might diverge, on one hand into an annelid, and on the other into a vertebrate, without violating any physiological or structural principles.

The author is so sincerely persuaded of the value of his views, has put them forward with such care, and discussed them so fairly, that they fully deserve to be seriously considered, although we believe that he has failed to prove his case. Moreover, the book contains many interesting pages, among which may be mentioned those devoted to the relation of the blastopore to the anus in the last chapter. E. S. GOODRICH.

Our Bookshelf.

Les Confins de la science et de la foi. Par l'Abbé Th. Moreux. Tome premier. Pp. iv+299. (Paris: Gaston Doin, 1924.) 7 francs.

M. L'ABBÉ MOREUX is the director of the observatory at Bourges, and is well known as a writer of credit of popular books on science, especially on astronomy. In the realm of natural science we obtain our knowledge by observation, experiment, and measurement. Hence, employing the principles of sound philosophy and right reasoning, we formulate the so-called laws of Nature. These are necessarily but partial and inadequate expressions, which are continually being changed with the progress of scientific research. We may instance the effect of the principle of relativity on Newtonian mechanics, and of the theories of Mendel on evolutionary hypotheses.

In the things of the spirit, however, in supernatural science, we rely upon authority, upon God the Revealer. These supernatural truths are believed through the gift of faith. This body of doctrines is fixed and immutable. It admits of development in this sense, that we see ever more and more its implications, its mutual relations, and its consequences. Consequently, and it is this Catholic point of view which is expounded by the author, which too is embodied in the decrees of the Vatican Council, there cannot be any real dissension between faith and reason. Otherwise the God of revealed truth, the Creator of all the marvellous processes we study and codify in the laws of Nature, would contradict Himself, which is impossible. It is extraordinary how very few dogmas of revealed religion even apparently contravene some of the hypotheses of some scientific men. In the development of this thesis the author gives us in various chapters an interesting and adequate account of the progress and hypotheses of modern science, both in the physical and in the biological order. We shall await with interest the completion of the work in the second volume.

The present work has been passed by the ecclesiastical censor, and bears the "imprimatur" of the Archbishop of Bourges. This only means that there is no statement in the book which is contrary to faith or morals. It does not imply that the opinions of the author, theological, philosophical, or on matters of natural science, are thereby approved; for example, his system of cosmogony. A. L. C.

Elementary Experiments in Practical Mathematics. By R. C. Fawdry. Pp. 61. (London: G. Bell and Sons, Ltd., 1922.) 1*s.* 4*d.*

Practical Mathematics. By V. T. Saunders. Pp. 46. (London: G. Bell and Sons, Ltd., 1923.) 1*s.* 6*d.*

(1) MR. FAWDRY'S little book is essentially a collection of laboratory notes dealing with experiments on elementary mensuration, loci in two-dimensions, some field work on "heights and distances," experiments on the principle of Archimedes and specific gravities, the construction of graphs to represent experimental results, the derivation of equations to represent such graphs, and some experiments on the calculus. It is not a text-book, but a laboratory manual. It is interesting to note that nearly all the experiments on the calculus are taken from army examination papers—a testimonial to these excellently conducted examinations.

(2) Mr. Saunders's book is very similar in object and scope, but it is very irregular as regards difficulty: thus compare Expt. 27 with that preceding it. A further fault is that in trying to avoid the use of mathematical formulæ the author is reduced to asking the learner to *memorise* a rule like this: "The specific gravity of a substance is the number of times a certain volume of it is as heavy as an equal volume of water." We older people think that these horrors of our youth are no longer used to torture innocent children.

S. B.

The Human Side of Fabre. By Percy F. Bicknell. Pp. viii + 340 + 4 plates. (London: T. Fisher Unwin, Ltd., 1924.) 10*s.* 6*d.* net.

ALL readers of Fabre's works should find a place for this book on their shelves. Mr. Bicknell has here given us a vivid portrait of a very remarkable man whose talents and intellect appear to bear no relation to those of his peasant ancestors. Neither environment nor heredity afford any clue to the origin of this celebrated "mutation," on whom the red ribbon of the Legion of Honour was conferred by Louis Napoleon. It is frequently thought that Fabre's attainments were confined to entomology: this, however, is far from the case, for he was at home in nearly all branches of natural science, and was no mean mathematician. An excellent frontispiece portrait enables the reader to visualise the incidents so skilfully described by the author.

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 Encouragement of Medical Discovery.

IT is high time that this great subject should receive the fullest consideration from every point of view. By "discovery" I mean any advance, however small, in general knowledge; and by medical science I mean all those branches of science which help in preventing or curing human diseases. There is no science which is more germane to every living person than this. Advances in it have already been great and rapid; and I can see no reason why we may not expect some day to subjugate almost every malady, from cancer to coryza, which now persecutes us. But in the meantime we continue to suffer or we die by millions.

Men may adopt several attitudes towards discovery: (1) they may subsidise research in the hope that it will lead to discovery; (2) they may reward discoveries already achieved; (3) they may allow patent-rights to discovery as they now do to invention; or (4) they may leave it to look after itself as they now do with regard to philosophy, poetry, and other great adventures of the human spirit. The problem is, which is the best attitude to adopt?

With regard to the first policy, the Medical Research Council now distributes about 130,000*l.* a year for subsidised researches out of public funds. In addition to this, there are several special research laboratories such as those for cancer, and many medical research scholarships. There are also many municipal laboratories, hospital laboratories, and trade laboratories where much research is done in the intervals of clinical, chemical, therapeutical, and other tests. Then there are numerous university departments and laboratories with paid staffs, whose primary duty is teaching but who find time for research as well. It would be difficult, or impossible, to extricate the exact annual figure given in Great Britain for medical research in all these ways together; but if we put it at about 180,000*l.* a year it will work out to be a very generous contribution given by the 42,000,000 people of England, Scotland, and Wales for ascertaining how and why they die so frequently —namely, the sum of one penny a year each!

With regard to (2)—rewards for discoveries already achieved—we may remark that many of the most original and fundamental advances have been made by unsubsidised enthusiasts, generally private practitioners. Sometimes they gain professional reputation and practice by such work; but much more often, especially if that work is revolutionary (*e.g.* Harvey, Jenner, Thomas Young, Lister, Haffkine), they are met by jealousy and opposition and tend to lose practice or position for this cause, apart from the time they sacrifice over their researches. The only pecuniary reward ever given in Great Britain for medical discovery was that bestowed upon Edward Jenner (30,000*l.*) for his epoch-making invention of vaccination; but even he was so persecuted by enemies and pretenders that he said afterwards to the Tsar in London in 1814, "I have received the thanks and the applause, but not the gratitude, of the world" (Baron's Life, vol. ii. p. 207). The only other national monetary rewards for medical discoveries which I am aware of were those given by the Germans to Robert Koch, and, very recently and wisely, by the Canadians to Dr. F. G. Banting (see *Science Progress*, April 1924). Monetary prizes, usually small, are sometimes allotted by learned bodies for medical discoveries, the largest of these being, I think, the Nobel Prizes of 7000-8000*l.*, given wholly or in halves once a year. One of these does not equal the annual income of many medical consultants and legal or political functionaries, much less that of thousands of "business men," nor even, perhaps, the emoluments of some professorships during five years. As regards honours, successful medical consultants usually win higher state-dignities than do medical investigators; and university honours seem to go chiefly to politicians, generals, or local benefactors.

The subject of patent-rights for discovery as distinct from invention is now being discussed in NATURE. Some people are opposed to such rights being granted for medical discovery on the ground that, by an immemorial medical rule, medical discoveries must be immediately disclosed for the good of the public. This rule is quite sound; but the objectors referred to are ignorant of the fact that the act of patenting implies a simultaneous act of disclosure. In several cases recently, various therapeutic agents (for example, insulin) have been patented in order to prevent trade-exploitation; but to judge from certain inquiries of my own, I *doubt* whether valid legal protection of all discoveries as distinct from inventions can ever be obtained without wide changes in the law and without impeding research; but I am not *sure*.

With regard to the fourth policy, that of *laissez faire*, we need not consider it until the others have failed.

We are left then at present with the first two policies, namely, (1) *subsidies for research*—that is, *payment for expectations*; and (2) *rewards for discoveries*—that is, *payment for results*. These must be carefully compared.

Under (1), much of the considerable sums now being expended (say 180,000*l.* a year) must be lost owing to misdirected, mistaken, or incomplete work; and much good work may be wasted because necessary parallel knowledge has not yet been acquired. On the other hand, some work now negative may some day prove useful or even fundamental, if not forgotten in the immense mass of medical literature; while sometimes, but we must fear rarely, discoveries of second or even of first magnitude may be achieved. At the same time, certain definite secondary results are often or always obtained: some fields are worked out and proved to be barren; many young men are trained in scientific methods; additional payments for research attract more men to scientific careers; and fixed research-salaries keep others constantly at work—and so increase the chances of discoveries. But all this—like salmon fishing—costs money. It is a risky lottery, because for all we know there may be no prize at all in the bag; or when the prize is won it may be found to be not worth the cost of our tickets. On the other hand, it may be worth millions of lives.

Subsidised researches are mostly carried out in suitable institutions, often by young and newly-qualified persons, who may or may not work under the supervision of professors or directors—who also may or may not be subsidised. The subsidies are generally allotted for short periods "on programme" by committees which may not always contain many men who have themselves added much to knowledge. Of course, the most attractive programmes are those most likely to lead quickly to definite results and

therefore tend to be chiefly corroborative or complementary in nature. On the other hand the principle of "something to show for the money" is now rightly condemned.

The case in favour of (2), namely, rewards for discovery, is briefly as follows. Out of our 30,000 medical men, very few can be subsidised for research; but out of the thousands of papers which appear in the medical press, comparatively few give the results of subsidised research. In other words, most of the work actually done is voluntary and independent; but, as already noted, it may or may not recoup the worker by enhanced practice. Now it is important in the interests of suffering humanity that every possible worker should be enlisted in the army of investigation. The country cannot afford (even if this were desirable) to subsidise all these possible workers by payment whether they succeed or not; but it can greatly encourage enlistment by promising payment for important successes when obtained. The scheme of the British Science Guild formulated in 1920 was, if I remember right, that the State (or private benefactors) should be asked to distribute annually the sum of, say, 20,000*l.* in life-pensions of 1000*l.* a year and 500*l.* a year each for deserving discoveries when made and fully confirmed. This scheme would cost, say, a tenth of the money now spent in "payment for expectations." It is in fact nothing but an extension of that of the Nobel and other prizes now being awarded. The pensions, being for past work, should be given without future obligations; but in fact they would really amount to what are now being increasingly organised, namely, "research-professorships" for life, and may be called such. They would help to remove the popular (and true) conviction that "science does not pay"—and medical men have their families as well as their science to think of. But of course the prizes must be sufficiently numerous to allow hard work some reasonable chance of reward; and the allotting committees must consist of really competent and proved men.

The objections which have been raised may be analysed as follows: (1) It has been alleged that pecuniary rewards for success will not really ever stimulate investigation. What evidence is there for this statement? Pecuniary rewards, if large enough, will certainly stimulate the production of everything else, from a pair of boots to a professor, a bishop, or a lord chancellor. Even the production of great poetry, from Shakespeare to Kipling, has just possibly been somewhat stimulated by cash. What conceivable reason is there why discovery should be penalised so particularly? There is no reason, and never was. Then it is suggested (2) that men of science should be above rewards. Why so more than poets, professors, bishops, and lord chancellors? After all, they are mostly simple workaday people who have to make a living: they are not monks, anchorites, or prophets. Of course, any of them who are lofty enough can always refuse rewards for discovery if offered—one does not hear of this happening often, even in the form of professorships. The idea that a man of science should be a kind of Simeon Stylites is to me too grotesque for words. It has also been argued (3) that as every discovery depends on previous ones, none deserves any special reward. But rewards are given in order to encourage emulation—and victory. One might as well say that the winner of a race deserves no prize because the others are close behind him; or that all the competitors should be given the same prize before they start—surely very Bolshevistic notions. But *do* discoveries always follow others? I doubt it, and could mention several we expected twenty years ago which have not yet matured. How many centuries elapsed between the rectifications of Archimedes and the integrations of Newton? And I question whether smallpox vaccination would have been discovered even to-day but for Jenner. Lastly, it has been contended in the same sense (4) that it is difficult to ascertain who really made any given discovery. Perhaps it is—if we do not take the trouble. The same argument might be urged against giving any honours and rewards whatsoever from Victoria Crosses downwards.

Such counsels of academic prudery are of no consequence in comparison with the health and the lives of millions of human beings. The *first* duty of men to-day is to discover how their diseases, physical, mental, and moral, can be prevented or cured. For this purpose they should encourage not some but all efforts, and should employ not one but every means in their power, even if it cost them much more than one penny a year each.

RONALD ROSS.

Some Measurements of Gaseous Diffusion.

IN view of the theoretical significance of the diffusion through one another of monatomic gases and diatomic gases, particularly when the diffusing gas is greatly diluted, it seems desirable to develop experimental methods for the quantitative study of this subject. Convenient examples are afforded by mercury and iodine vapours in their diffusion through gases of the helium group and through nitrogen at ordinary temperatures.

The mercury and iodine are placed at the opposite ends of a straight, sealed glass tube containing the permanent gas. Their vapours then diffuse towards one another, and on mingling in an intermediate portion of the tube, combine chemically and deposit the solid and very slightly volatile iodides of mercury.

The deposit forms on the walls of the tube at a definite position relative to the vaporising elements, and contains the iodides in a definite proportion by weight. Between the iodide deposit and the iodine crystals on one side, a uniform gradient in the concentration of diffusing iodine vapour is supposedly established when the tube is of constant bore. There is likewise a steady flow of mercury vapour down a gradient on the other side.

Measurements of these gradients and of the mass of each vapour precipitated in unit time, together with the cross-section of the tube, give the values of the respective diffusion coefficients.

Since in a uniform tube the deposit is more distant from the iodine than from the mercury by a ratio greater than 120 : 1, it is evident that the length traversed by the mercury vapour is the less easily measured. But the column of mercury vapour may be conveniently lengthened by imposing a constriction in the iodine side of the tube. In tubes with such a constriction the gradient of iodine is not uniform, and no attempt is made to trace it.

As a rough indication of the magnitudes involved, it may be mentioned that in nitrogen at 10 mm. pressure and at 19·4° C. about $9{\cdot}1 \times 10^{-4}$ gram of iodine diffuse along a 3 mm. tube a distance of 1 metre per day. Under these conditions sufficient deposit for accurate weighing and analysis (say 20 mg. of Hg + I) is collected during a period of ten days. Under a pressure of 1 mm. one day would suffice, though time is saved somewhat at the expense of accuracy.

Agreement to 3 per cent. is obtained in the constants for iodine, while those for mercury are slightly less accurate.

Further, it is of interest that the deposit takes a

regular form. Spreading along the tube is slight and occurs to a distance comparable with the diameter of the tube, in bores of 1 or 3 mm., and under the conditions named. The deposit consists of dark greenish crystals on the side nearer the mercury, and of red crystals on that nearer the iodine. It forms two coloured bands which are contiguous, but, so it appears, sharply divided by a plane across the axis of the tube. Such regularities are of use in determining the location of the deposit.

The results of these measurements will be published in due course, together with observations on the production and character of the deposits.

J. M. MULLALY.

14 Bardwell Road, Oxford,
April 23.

Mendelism and Evolution.

MR. JULIAN HUXLEY'S choice of examples in his reply to Mr. Tate Regan, in NATURE of April 19, was no doubt made before the announcement of Dr. Annandale's death. In the circumstances I may be permitted to indicate the scope of Dr. Annandale's paper (Proc. Roy. Soc. B, 96, pp. 60-76) on evolution in the Viviparidæ, and to show that Mr. Huxley's criticism is not altogether relevant.

Dr. Annandale approached the subject from the viewpoint of an ecologist, and to criticise his neglect of "experimental" work is as unnecessary as it would be for any one to reproach Mr. Huxley for his own apparent neglect of ecology. Dr. Annandale advanced no theory—as Mr. Huxley supposes—of evolution, but merely attempted to confirm a hypothesis, which in view of the evidence he had accumulated is entirely justifiable. More than twenty years of first-hand experience of tropical biology led him to the conclusion that environment does affect certain forms of life, and that some inherited characters at least are persistent, an opinion strongly supported by Dr. Kammerer's recent experimental investigations. It is perhaps asking too much if we expect a man already immersed in diverse aspects of science to add Mendelian experiments to his activities.

I think Mr. Huxley will acknowledge this, and the utility of Dr. Annandale's ecological work, even if it does tend to show that the key to a satisfactory explanation of evolution does not lie solely in Mendelism. I would recommend to Mr. Huxley's notice his concluding remarks: "Mendelism is true in some cases; some species produce mutations, but gradual changes also take place under the influence of environment, and are perpetuated. . . . No one formula can express, much less explain, evolution."

A paragraph in Mr. Tate Regan's letter is strikingly applicable to Dr. Annandale's work: ". . . the evidence is clear as to what has happened, and when and where it has happened; there are even indications why; but the problem that remains to be solved is how!" And who can provide the solution?

CEDRIC DOVER.

London, April 20.

Condensation Bands formed during the Explosion of Hydrogen and Air.

WHEN a mixture of hydrogen and air is exploded in a tube open at one end "water rings" are sometimes formed on the sides of the tube. This phenomenon appears to be familiar to some people, but I have not been able to find any published account of it. The accompanying photograph (Fig. 1) shows the formation of these condensation bands during the explosion of a mixture of hydrogen and air in a test tube 6 inches long, the gases being ignited at the open end.

Prof. H. B. Dixon, in his work on the explosion of gases in long tubes closed at one end, has shown that, in the early stages of the explosion, vibrations are set up, and the flame moves with a jerky motion. A good photograph of such an oscillating flame is given in Prof. Dixon's paper (Phil. Trans., 1903, Fig. 68). The water condensation would appear to occur at the

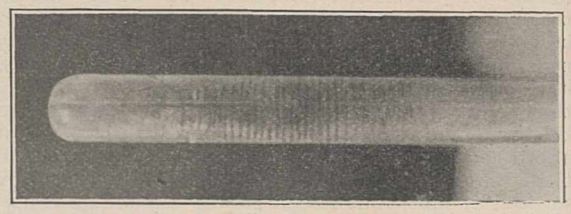

FIG. 1.

points of most rapid movement, the clear spaces indicating the halting points of the flame. The rings are a little more than 1 mm. apart at their closest, being wider apart near the open end of the tube. The photograph shows the beginning of the vibratory motion near the open end, the shortening of the swing, and its dying out as the flame approaches the closed end.

G. H. WEST.

Bedford Modern School, Bedford,
April 16.

"Systematic Organic Chemistry."

THE reviewer of our "Systematic Organic Chemistry" in NATURE of March 15 admits at the outset that the book is conceived on novel lines, and that the design is excellent, but in proceeding, he makes no attempt to bring either this design or the new text-book matter of the treatise to the notice of his readers; instead, he makes two orthographical corrections, calculates a joke through our omission of a decimal point (see yield of benzaldehyde), and includes other statements to complete what we think a very unfair review.

We believe that our concise account of the use of the library is sufficient to meet the needs of most students, who at any rate will not find the subject even mentioned in any other laboratory manual on the subject in English.

The relative drying power of various substances has been examined by Müller-Erzbach (*Ber.* 14, 1096), who found that concentrated sulphuric acid, phosphorus pentoxide, and solid potassium hydroxide were almost equal in drying power. It is surprising to us that our reviewer should be "surprised" to find us passing on this little information recorded at such an early date, and made widely known in Smith's translation of Lassar-Cohn's "Manual of Organic Chemistry." In this connexion, why did he omit to state that we quote this remark under the sub-heading—"Drying in Desiccators"?

The method given for the preparation of diazomethane is the standard method; while backed by the authority of Cain, we give *three* different methods for the sulphonation of benzene. Again, the reviewer does not mention that methyl iodide (and ethyl iodide) was given under "a general method for the preparation of alkyl iodides" and not as an isolated preparation.

We have the authority of Cohen and of Beckmann himself (*Ber.* 23, 1685) for stating that the yield of benzsynaldoxime is almost theoretical. We are well acquainted with the preparation of *p*-phenetidine, and hence have emphasised the importance of using

suitable mechanical apparatus. The method given for the preparation of acetamide from ethylacetate has long been used in this College without breakage.

The reviewer's statement anent the osazone method of distinguishing sugars is "not strictly accurate"—a phrase familiar to his pen but not to his judgment. As well as giving the melting points of osazones of the sugars mentioned, we give (on p. 283) the theory and method for their preparation, and emphasise the use of the microscope in their identification. Surely that is sufficient in a book of organic preparations.

WILLIAM M. CUMMING.
I. VANCE HOPPER.
T. S. WHEELER.
Royal Technical College, Glasgow,
and Research Department,
Royal Arsenal, Woolwich,
April 17.

I AM content to let those competent to judge decide whether my strictures on Messrs. Cumming, Hopper, and Wheeler's book were justified, and I do not think it would serve any useful purpose to deal with the authors' reply in detail in the columns of NATURE. My own view is that the work has not been compiled with sufficient care to be suitable for undergraduates' use, and I tried to express this opinion in my review. Apart from cardinal errors, statements are made which are incorrect without considerable qualification; such may not deceive the experienced, but are particularly dangerous to the beginner. I quoted some of the errors together with a few typographical mistakes; these were sufficient to justify my contention, though others could be cited.

THE WRITER OF THE REVIEW.

Geology of Ireland.

WHEN the writer of the obituary notice in NATURE of May 3 expressed regret that the late Prof. Grenville A. J. Cole was not spared to write a comprehensive work on the geology of Ireland, he seems to have overlooked the volume on the British Isles in the "Handbuch der Regionalen Geologie" Series, to which the late Prof. Cole contributed all the portions dealing with Ireland.

Before his death, Prof. Cole revised this matter with the assistance of Mr. Timothy Hallissy, of the Geological Survey of Ireland. This is now in the printers' hands, and will form a separate volume on the geology of Ireland which we shall publish shortly.

THOS. MURBY AND CO.
1 Fleet Lane,
Ludgate Circus, E.C.4.

The Theory of Hearing.

PROF. SCRIPTURE'S letter in NATURE of April 26 leaves me in great perplexity, for when I performed the experiment he suggested with a series of light pendulums of different length driven by resonance from a heavy pendulum of variable length, my findings did not at all tally with his description. According to Prof. Scripture, a variation in the rate of the driving pendulum should have been followed by irregular jangling of all the driven pendulums. But I did not observe this happening, if the change in length of the driving pendulum was carefully effected without interrupting its motion.

Suppose that the driving pendulum is set swinging and that a few minutes later the driven pendulums are examined. It will be seen that the swinging motion affects a group of the latter. In the centre of the group is the "in tune" pendulum, on either side are the slightly out of tune pendulums which are undergoing forced vibrations. Suppose now that the length of the driving pendulum is gradually increased, what I observe is that the swinging motion dies out on the side of the group occupied by the shorter pendulums at the same time that it is being initiated on the other side. This causes the swinging motion to transfer itself, as it were, towards longer pendulums. I observed no "irregular jangling."

Now if this experimental resonator system does not show any "irregular jangling" as the incoming oscillations are varied in rate, there does not seem to be any reason for supposing that the ear, if it contained resonators, should hear an "irregular jangle of tones" when sound waves of steadily rising and falling pitch are incident on it. Therefore the fact that we hear a single tone steadily changing in pitch (and Prof. Scripture agrees that he also hears this), far from affording grounds for criticism of the resonance theory, actually lends it support, for that is precisely what an inspection of the behaviour of the pendulum apparatus would lead us to suppose that we ought to hear, if the ear contained a system of resonators.

In the second part of Prof. Scripture's letter he says that since the vowel sounds cannot be resolved into constituent tones (not even inharmonic ones), it follows that the ear which perceives vowels cannot resolve them into constituent vibrations either, and therefore cannot act according to the resonance theory.

Prof. Scripture's argument to my mind contains two flaws:

(1) He states that vowel sounds cannot be resolved into constituent tones.

(2) He states that since the ear recognises vowels it appreciates the presence of these unresolvable components and therefore it cannot contain resonators.

Let us admit for one moment for the sake of argument that such unresolvable components are present in vowel sounds. Now we know that the ear is able to recognise one vowel from another. But we are not justified in concluding that the ear appreciates these unresolvable components unless we can prove—

(*a*) that the unresolvable components differ in different vowel sounds;

(*b*) that in all other respects the vowel sounds are identical.

I believe I am right in stating that Prof. Scripture has not proved either of these.

But have we any real evidence that such unresolvable components exist? I hold that we have not. Even if Prof. Scripture has been able to obtain records of vowel sounds, that can be shown by experiment to be precise records of the variations of pressure in the air, and even if he has failed to resolve these records into their component tones (be they harmonic or inharmonic) he has, to my mind, merely proved that he has not spent sufficient time in testing all the innumerable possible combinations of amplitude, phase, and pitch.

Turning now to Prof. Scripture's sound pattern theory, may I point out to him that besides Waller's theory, that of Ewald will require his consideration. This is a matter of importance because Ewald did much interesting experimental work in his search for evidence in favour of his theory. In fact, if the resonance theory at any time failed to justify its existence, and gave forecasts which were disproved by experiment, it would be to Ewald's theory that I should look for a possible successor, unless indeed meanwhile Prof. Scripture elaborates a better one.

Finally, may I add that, although I regard the resonance theory of hearing as satisfactory, I am not one of those people referred to by Prof. Scripture,

who believe that the vowels are composed of tones that are necessarily harmonic. Neither can I see any connexion whatever between the harmonic theory of the vowels and the resonance theory of hearing. The last sentence of Prof. Scripture's letter leads me to suppose that he does. It would very greatly interest me to know what he thinks the connexion is.

H. HARTRIDGE.

King's College, Cambridge,
April 29.

On Approximate Integration.

IN vol. 105 of NATURE, 1920, several very interesting letters were published concerning approximate integration. It is to be noted that all the formulæ alluded to in these letters are founded on the analytical method which consists in replacing the integrand by a polynomial. It appears that one very good formula based on geometrical reasoning and discovered by Poncelet is not so well known in Great Britain as it is in France. It may interest readers of NATURE, therefore, to try this formula. The general form is

$$\int_a^b y\,dx \approx h\left[2\mathrm{P}+\frac{\mathrm{E}_1-\mathrm{E}_2}{4}\right], \quad . \quad . \quad (1)$$

the interval (a, b) being divided into $2n$ sub-intervals each equal to h, P being the sum of those of the ordinates $y_1, \ldots y_{2n+1}$ the indices of which are even, E_1 being the sum of the extreme ordinates y_1+y_{2n+1}, and E_2 being the sum of the ordinates next to them, y_2+y_{2n}. The most remarkable feature of this formula is that, when the graph of y is everywhere concave to the x-axis (or everywhere convex), it gives an upper bound of the error, extremely simple and *not* necessitating the knowledge of the *derivatives* of y, namely: [1]

$$\left(\int_a^b y\,dx - h\left[2\mathrm{P}+\frac{\mathrm{E}_1-\mathrm{E}_2}{4}\right]\right) < h\left(\frac{\mathrm{E}_1-\mathrm{E}_2}{4}\right).$$

For the case where $h=\frac{1}{10}(b-a)$, $a=0$, $b=1$, Poncelet's formula reduces to

$$\int_0^1 y\,dx \approx \tfrac{1}{10}\left\{2[y(0{\cdot}1)+y(0{\cdot}3)+y(0{\cdot}5)+y(0{\cdot}7)+y(0{\cdot}9)] - \tfrac{1}{4}[\overline{y(0)-y(0{\cdot}1)}-\overline{y(0{\cdot}9)-y(1)}]\right\}.$$

This seven-ordinate formula may be compared with Simpson's seven-ordinate rule. Taking the numerical examples of Mr. Dufton, the errors of these two seven-ordinate rules are shown in the following table:

Errors on the value of $\int_0^1 f(x)dx$ computed by the seven-ordinate when $f(x)=$	Simpson's rule	0·0112	0·0079	0·011	0·0000	0·0000	0·0001	0·0000	0·0000	0·0045
	Poncelet's rule	0·0044	0·0032	0·004	0·0003	0·0010	0·0004	0·0001	0·0003	0·0037
		$\sqrt{x-x^2}$	$\sqrt{1-x^2}$	$\sqrt{4x-x^2}$	$\log(1+x)$	e^x	$1/(1+x)$	$1/(2+x)$	$\sin x$	$1/(1+25x^2)$

It will be noted that the abscissæ involved in the seven-ordinate Simpson's rule are 0, $\frac{1}{6}$, $\frac{2}{6}$, . . . and in the seven-ordinate Poncelet rule they are 0, 0·1, 0·3, 0·5, 0·7, 0·9, 1, so that the computation of the ordinates in Poncelet's rule will often be more easy.

On the other hand, it is important to note that *when the fourth derivative of y is known*, a very precise limitation of the error involved in Simpson's formula may be obtained, this error being $-h^4\frac{(b-a)}{180}y_c^{(\mathrm{IV})}$, with $a<c<b$, whatever be the number of ordinates.

Generally speaking, Simpson's rule is best adapted to the integration of mathematically defined functions; Poncelet's rule to empirically defined functions.

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[1] See de la Vallée-Poussin, "Cours d'analyse infinitésimale," t. i., third edition, 1914, p. 395.

The Migration of a Red Sea Crab through the Suez Canal.

THE Suez Canal was completed in 1869, and since that date it has been invaded from both ends by plants and animals. Some members of the Red Sea fauna have passed right through the Canal to spread into the Mediterranean, and some Mediterranean species have reached the Red Sea. Had periodic faunistic surveys of the Canal been made since the beginning, valuable information would have been obtained concerning the stages in the mixing of two entirely different faunas. Unfortunately this has not been done. To my knowledge there are only three published investigations of the Suez Canal fauna. The first, dated 1882 (C. Keller, "Die Fauna im Suez Kanal," Denkschriften der schweizerischen Gesellschaft für die gesamte Naturwissenschaften, Bd. 28), deals largely with the invertebrates; the second, in 1902 (J.-B. Tillier, "Le Canal de Suez et sa fauna ichthyologique," Mém. de la Soc. Zool. de France, t. 15, p. 279), concerns the fish alone; and the third, dated 1905 (L. Tillier et A. Bavay, "Les mollusques testacés du Canal de Suez," Bull. de la Soc. Zool. de France, t. 30, p. 170, and t. 32, p. 129), deals with the molluscs. It is proposed this year to repeat the earlier work in order to see what further immigration has taken place since then, and further to study the factors which permit and prevent migration.

I was last year able to fix the dates of the various stages in the migration northward through the Canal of a Red Sea crab, *Neptunus* (*Portunus*) *pelagicus*, and to trace the apparent limits of its present distribution along the Mediterranean coasts. This crab is fished for food in Egypt, so that when found in abundance at any place its presence is noted. My information regarding the dates of arrival of the crab from the south at various points along the Canal has been obtained from certain of the Canal Company's employés who happen to be keen fishermen. Naturally such evidence depends upon the memory of individuals, which might easily be mistaken, but I consider that all the dates recorded below are approximately accurate, since the evidence of more than one independent witness has agreed concerning them.

Neptunus pelagicus commenced to invade the Canal between 1889 and 1893 and reached Port Said in 1898. Keller (*loc. cit.*, p. 22) records that there was only one brachyuran in the Canal in 1882, "eine kleine Krabbe." This was evidently not Neptunus. Keller says that "kein einziger grösserer Kruster ist bisher auf der Wanderung beobachtet." In 1889 *Neptunus pelagicus* was unknown at the Signal Station at the southern end of the Little Bitter Lake, 29 kilometres from Suez, although to-day it is common there. In 1893, however, it had become numerous at Kabret, at the junction of the Little with the Great Bitter Lake, 42 km. from Suez. In the same year the crabs were observed for the first time at Toussoum, 75 km. from Suez. In 1898 they arrived at Port Said, 162 km. from Suez, and four years later were common in the port.

It is remarkable that the migration did not commence earlier than 1889, since anterior to that date *Neptunus pelagicus* was abundant in the Gulf of Suez. This late beginning of the invasion may be correlated with some physical change in the Canal, but the nature of this is at present unknown. The principal obstacle to crab migration may be the high salinity of the Bitter Lakes on the course of the Canal, but it is not known whether a change took place in this

salinity between 1889 and 1893 which would have then allowed the crabs to pass.

The migration over the 162 kilometres from Suez to Port Said took at least five years (1893–1898), not a rapid rate of travel, since the swimming powers of Neptunus are considerable. Dr. Borradaile informs me that he has seen numbers of the nearly related *Polybius henslowi* at the surface of the Atlantic, 200 km. from Brest. Even *Cancer pagurus*, which progresses much less rapidly than the swimming crab Neptunus, can move 160 kilometres in 100 days. A marked specimen has been found to travel thus along the East coast of England (W. B. Hardy, 12th Report of the Development Commissioners, 1922, p. 69).

Neptunus pelagicus has now spread along the Mediterranean coasts to right and left of the Port Said mouth of the Canal. To-day it is commonly fished at Alexandria, 260 kilometres to the west of Port Said, for sale on the market, and at Haifa, 315 km. to the north-east. The crab seems to be unknown at Beyrouth, so that Haifa is perhaps near the limit of its extension in this direction. The extreme point of its westward migration is unknown, but it has been reported from Mersa Matruh, 260 km. west of Alexandria. Dr. Calman has been kind enough to examine specimens from Alexandria and from Suez, and informs me that the Mediterranean specimens do not differ morphologically from those of the Red Sea.

H. MUNRO FOX.

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April 25.

The Brightness of Scintillations from H-particles and from α-particles.

IN a letter to NATURE (September 22, 1923, p. 435) Messrs. L. F. Bates and J. S. Rogers suggest that the particles found by G. Kirsch and H. Pettersson (NATURE, September 15, 1923, p. 394) to be expelled from lithium, magnesium, and silicon under bombardment with α-particles from radium C are really long-range α-particles from the source itself, which the authors first named claim to have found. In their reply (NATURE, November 10, 1923, p. 687) Kirsch and Pettersson point out that the very considerable difference in brightness between scintillations from H- and from α-particles make such a mistake improbable. This raises the question of the relative brightness of scintillations from particles of different kinds, which does not as yet seem to have been made the subject of direct measurements.

By means of a "Vergleichsokular" from Messrs. Reichert in Vienna (designed for comparing the images from two microscopes), in combination with two Watson holoscopic objectives, we have found a way of comparing the scintillations produced on two identical zinc-sulphide screens by, on one side, "natural" H-particles (from hydrogen gas or paraffin exposed to radium emanation), on the other side, α-particles from polonium. The ratio in brightness could be determined quantitatively by introducing light-absorbing screens of known absorption in the way of the light-rays from the α-scintillations until they and the H-scintillations appeared equally bright. The ratio in brightness, given by the absorbing power of the requisite light-filter, was found to be from 1 : 2·7 to 1 : 3·0. Similar measurements made with the particles expelled from quartz (as a quartz capillary charged with radium-emanation or as an extremely thin plate of ground quartz bombarded with the α-particles from a powerful preparation of radium C) gave the same ratio in brightness, referred to the α-scintillations from polonium. It appears therefore as highly probable, that the particles from quartz are really hydrogen nuclei expelled from the silicon atoms by the bombarding α-particles, a result which receives further confirmation from recent experiments by Sir E. Rutherford and Dr. J. Chadwick (NATURE, March 29, p. 457).

It may be added, that the ratio given refers to the surface-brightness ("Flächenhelligkeit") of the two kinds of scintillations. The ratio in integral light-emission is considerably greater, owing to the much greater surface which radiates with α-scintillations than with H-scintillations. The latter ratio has so far not been measured.

The same method is being used for studying the relationship between the velocity of the different particles and the brightness of their scintillations. It may also be of service as a simple means of identifying other unknown particles from the brightness of their scintillations, say the hypothetical X_3-particles, in case they are found to exist. It can also be used for distinguishing between the fragments from disintegrated atoms and the α-particles scattered through 90° by the new method for observing atomic fragments of very short range which has been developed in this Institute by Kirsch and Pettersson and described in a letter to NATURE of April 26, p. 603. The details of the experimental arrangement used by us are being published in the Sitzungsberichte of the Vienna Academy of Science.

ELISABETH KARA-MICHAILOVA.
HANS PETTERSSON.

Institut für Radiumforschung, Wien,
April 7.

The Cardio-Inhibitory Centre.

IN a recent article (*Journ. Physiol.*, vol. lviii. p. 168, 1923) on the localisation of the vaso-motor centre, J. M. D. Scott and Ff. Roberts refer to a paper by Bowman and myself (*Amer. Journ. Physiol.*, vol. xxxix. p. 149, 1915) on the cardio-inhibitory centre, and, by their remarks, indicate that they have not clearly understood our meaning. I desire to emphasise the fact that the other writers studied mainly vaso-motor effects, whereas we were concerned solely with cardio-inhibitory manifestations.

Bowman and I were the first to prove, by the method of unipolar faradisation, that the cardio-inhibitory centre is located in the dorsal vagus nucleus or *ala cinerea*. In a fresh specimen of the medulla oblongata of the dog, the dorsal vagus nucleus is easily recognisable as a translucent-looking ridge, forming the lateral margin of the calamus scriptorius. Its position and appearance, as shown in Fig. 1 of our paper, are identical with those indicated by Ellenberger and Baum in Fig. 165 in their "Anatomie des Hundes."

In localisation experiments, like those described in our paper, it is essential that the excitability of the medulla oblongata be carefully maintained and that the current applied by the stigmatic electrode be of threshold value. Such a current yields definite cardiac inhibition from the dorsal vagus nucleus, but fails to yield it from points 1 mm. or less mesially or laterally to the nucleus. Slightly stronger currents applied to the nucleus elicit complete inhibition (cf. Figs. 1, 2, 3, and 4 of our paper).

The view expressed above, that the dorsal vagus nucleus is the source of the cardio-inhibitory fibres, is held by the following authorities: Kohnstamm, van Gehuchten and Molhant, Herrick, Ranson and Tigerstedt (the latter in "Physiologie der Kreislaufes," vol. 2, p. 424, 1921).

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The Auroral Spectrum and the Upper Atmosphere.

By Prof. L. VEGARD, University of Christiania.

THE aurora borealis is produced by the action of electric radiation from outer space upon the upper atmosphere. Height measurements have shown that such radiation usually penetrates to a height of 100-105 km. Most auroral forms have their maximum light intensity at a height of 10-20 km. from the bottom edge, and by far the greater part of the light emitted from the aurora comes from a height interval of 100-130 km. The upper limit varies very much. Usually we can only follow an aurora up to an altitude of 130-150 km., but the ray-forms may be seen much higher. The greatest altitude at which isolated auroral "rays" may appear seems to increase towards lower latitudes. Near the auroral zone no rays are observed higher than 300-350 km. At Christiania, however, Störmer finds that isolated rays may reach altitudes of 750 km.

Practically all auroral light is emitted from the matter present in the atmosphere, and not from the carriers of the cosmic rays; for none of the principal lines in the auroral spectrum shows any Doppler effect. The character of the light must be a function of the properties of the electric radiation and the constitution of the upper strata of the atmosphere.

The auroral spectrum has attracted much attention from many observers; but when, in 1910, in connexion with investigations of the properties of the cosmic electric rays, I sought for information on this point from the auroral spectrum, I found that practically all measurements were too inaccurate for identification of the lines, and there were as many—or even more—interpretations of the spectrum as there were observers. The analysis and interpretation of the auroral spectrum at that time was, therefore, an open problem.

In 1912–13 I commenced observations at Bossekop in Finmarken on the auroral spectrum. On this first expedition I used a spectrograph which combined a fairly high light power with a considerable dispersion, and I had also a spectroscope at my disposal. With the spectroscope I observed the prominent green line, and the best series of observations gave $\lambda = 5577$. With the spectrograph I obtained the green line and six lines in the blue and violet; and the latter were found to be identical with prominent lines in the negative band spectrum of nitrogen. This result has recently been confirmed by Lord Rayleigh. As the different determinations of the green line showed some variations, I undertook new measurements at Christiania with a spectroscope of greater dispersion. The first series gave $\lambda = 5578{\cdot}4$ Å, and the second and most extensive series $\lambda = 5577{\cdot}6$ Å. These values are in good agreement with those obtained from the night sky by Slipher, and recently by Babcock, at the Mount Wilson Observatory.

Although, however, the wave-length of the green line was found with great accuracy, its origin seemed as mysterious as ever. In order to get on the track of the origin of the green line, I determined to commence more systematic investigations on the auroral spectrum. Suitable spectrographs were constructed and mounted on the roof of the Geophysical Institute at Tromsö. Observations were carried on during the winter 1922–23, and also during last winter.

The first winter's work gave a number of good spectrograms, and 35 lines and bands were measured in the visible and ultraviolet parts of the spectrum. With the exception of the green line and three faint lines or bands, the lines were identified with known nitrogen lines. The auroral spectrum is not merely remarkable on account of the green line, but the other part is also of a most singular type. Out of the enormous number of lines and bands in the nitrogen spectrum, only some very few lines or band-heads are separated out in the auroral spectrum.

Although the stronger lines in the auroral spectrum were greatly over-exposed, *no trace of hydrogen or helium was found.* The view previously current that the atmosphere above 100 km. should mainly consist of light gases had, therefore, to be abandoned. It might be suggested that hydrogen, helium, or the hypothetical "geocoronium" produced the green line; but it is then curious that hydrogen and helium did not show any of their ordinary lines. By comparing the intensity of the green line with that of the known nitrogen lines of the auroral spectrum on spectrograms corresponding to the lower and upper limit of radiant aurora, *it was shown that the green line could not originate from any of these light gases*; for instead of increasing upwards, the intensity of the green line was found to be somewhat greater at the lower limit.

This fact, in connexion with the other fact that nearly the whole spectrum consisted of nitrogen lines, gave a strong argument in favour of the view, which I expressed so long ago as 1910, that the green line also belongs to nitrogen, and is emitted under the special physical conditions existing in the auroral region.

Independent of the view which might be taken with regard to the origin of the green line, we had to assume nitrogen to be a prominent component of the atmosphere to its very upper limit. To explain this we could assume either an increasing temperature upwards, or that the nitrogen must be electrically charged and be driven upwards by electric forces. The character of the spectrum and other reasons made me give up the first assumption, and following up the second I found that an electrified atmosphere in a highly ionised state could not exist in the form of ordinary gas, and so I was led to assume that the nitrogen at a very *low temperature was condensed into clusters or small crystals.*

This hypothesis, which at first might seem somewhat startling and contrary to previous conceptions, proved to be a most fertile one. First of all it gave for the auroral region a physical state which would explain why the auroral spectrum had not yet been reproduced in laboratory experiments; it gave possibilities for explaining the conspicuous colour changes of the aurora; and also simple explanations of other cosmic phenomena such as the twinkling of stars, the blue sky, and the zodiacal light.

As a consequence of this hypothesis it would follow that the auroral spectrum should be produced when this atmosphere of crystalline nitrogen dust was bombarded with electric rays. These conditions, which are very difficult to reproduce exactly, might be at any

rate approximately reproduced by bombarding solid nitrogen with such electric rays as can be produced in the laboratory. Through the generosity of Prof. Kamerlingh Onnes I was able to take up experiments of this kind at the Cryogenic Laboratory of Leyden. I have thus been able to make a first series of experiments on the light produced when *solid nitrogen is bombarded with cathode rays*, and these experiments gave, indeed, the very light effect which I expected.[1]

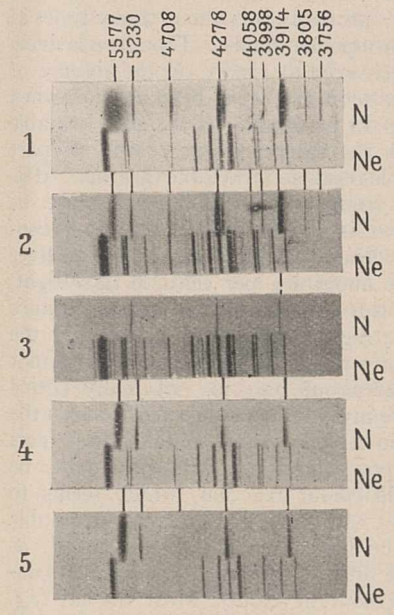

FIG. 1.

Rays from a Wehnelt cathode were made to fall on a layer of solid nitrogen formed on a copper surface cooled with liquid hydrogen. I took five spectra (Fig. 1) corresponding to various velocities of the rays. At a tension of 75 volts, only the strongest heads of the negative band spectrum were observed. At 200 volts (Fig. 1, No. 1) there appeared also a green line near the blue part (N_2) and a diffuse band near the yellow part.

When the potential was raised to 500 volts, the layer of nitrogen became brilliantly luminous with green colour, and in addition to N_2, a broad line or narrow band (N_1) now appeared with great intensity (Fig. 1, No. 2). By lowering the potential to about 350 volts, N_1 disappeared (Fig. 1, No. 3), but by increasing it to 700 volts (Fig. 1, No. 4) and 750 volts (No. 5) the light intensity, and especially that of N_1, increased enormously. *The line N_1 now dominates the spectrum, just as the green line* (5577) *is predominant in the auroral spectrum.*

To get an impression of the relative light intensity at the different potentials it may be mentioned that in Fig. 1 the times of exposure of the spectra are 30, 15, 10, 5 and 5 minutes respectively.

When the cathode ray bombardment was stopped, the solid nitrogen layer remained luminous for more than five minutes, and it is in this connexion of interest to remember that *an afterglow of about the same duration is also observed for the aurora. Measurements showed that the green auroral line* (5577) *is situated in the broad line N_1. The line N_2, which was found to have a wavelength about* 5230 Å, *coincides with a second fairly conspicuous green line in the auroral spectrum.*

In Fig. 2 three auroral spectra (Nos. 1, 2, 3) and one spectrum from solid nitrogen (No. 4) are reproduced. No. 1 is taken with a large quartz spectrograph. The others are enlarged copies from spectrograms taken with the same small glass spectrograph. Nos. 1 and 2 are taken on Imperial Eclipse plates, No. 3 on panchromatic and No. 4 on orthochromatic plates.

The agreement between the auroral spectrum and that of solid nitrogen is not restricted to the green part; but we see that also in the blue and violet the crystalline nitrogen gives just the reduction in the number of lines which is so characteristic of the auroral spectrum.

The comparison shows that the typical auroral spectrum is emitted from solid nitrogen, and thus my hypothesis with regard to the constitution of the upper atmosphere has been confirmed.

The high velocity necessary for producing the lines N_1 and N_2, and the very great variability of their intensity, are most remarkable facts from a physical point of view, and this variability may help us to understand many of the colour changes of the aurora. The afterglow indicates that the new light effect is a kind of phosphorescence; but to make clear its physical nature more experimental material is needed.

The new effect opens out a new field of research equally interesting from a cosmical and from a purely physical point of view. A more detailed study of the light emitted from solid nitrogen at various temperatures down to that of liquid helium may enable us to determine more exactly the temperature interval of the auroral region, and it is possible that, at an extremely low temperature, the broad line N_1 will become sharp. Experiments with rays of different velocities and carriers may give us information about the velocities and physical nature of the cosmic rays producing the auroræ.

If also other gases, *e.g.* hydrogen, oxygen, argon, neon, ammonia, nitric oxide, carbon monoxide, cyanogen, etc., in the solidified state under the action of electric rays give similar light effects to those of nitrogen, we may hope in this way to explain the

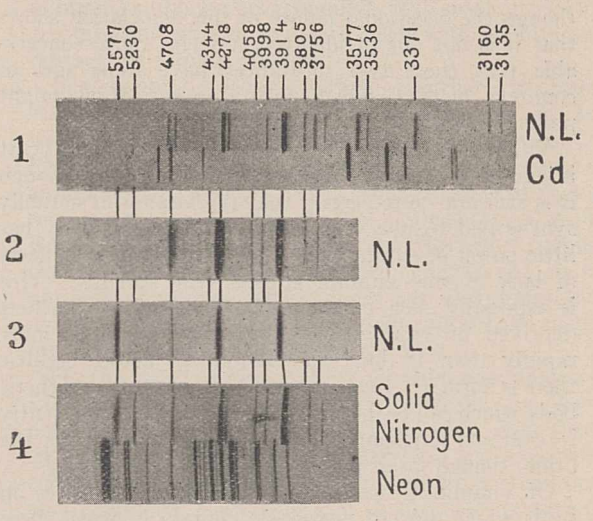

FIG. 2.

nebular lines and acquire a definite knowledge with regard to the constitution of nebulæ. Perhaps "nebulium" will then pass the same way as "geocoronium."

I am continuing experiments in the directions here indicated at the Kamerlingh Onnes Laboratory at Leyden.

[1] A more complete account will be found in the Proc. of the Roy. Acad. of Sciences, Amsterdam.

The Present State of Knowledge of the Vitamins.[1]

THE continued efforts of a large number of workers in many countries have resulted in definite advance in our knowledge of these dietary constituents, which have occupied first place in the attention of nutritional physiologists and biochemists for the past few years. We now know, thanks to their labours, much more of the origin and occurrence of the vitamins, and the vast sociological experiments in defective nutrition occasioned by the War have added considerable clinical experience to the exact but limited data yielded by the laboratory. Although we still remain in almost complete darkness regarding the chemical nature of the vitamins, there are not wanting indications that they are of relatively simple nature, and a study of their stability under various conditions serves not merely as a pointer for future work in the direction of unfolding their chemical identity, but also in the meantime places in our hands data of great practical value.

To deal first of all with the origin and distribution of the fat-soluble vitamin A, it seems now reasonably certain that this is synthesised by the plant, from which the animal obtains it, there being often a storage of the substance in the tissue fats. The vitamin cycle concerned in the origin of cod-liver oil is especially interesting. The marine diatom, *Nitzschia closterium*, forms large amounts of the vitamin by a synthetic process when exposed to light in sterilised sea-water, and many other marine algæ also contain the vitamin. These simple plants form the food of such small animals as copepods, to which their vitamins are transferred. Similarly the copepods are eaten by small fish, and these with their derived vitamin are finally devoured by the cod, which thus gets the fat-soluble vitamin at third-hand. Vitamin A is often associated with the yellow fatty pigments called lipochromes, and though the occasional failure of this association shows that it is not one of identity, it seems quite conceivable that these two substances have some sort of common history, which future investigation might perhaps reveal.

Vitamin B is also derived from plants, and yeast is one of the richest sources of this vitamin, though it is still not quite certain that the vitamin is actually synthesised by the yeast cells. The animal body has little power of storing vitamin B, and hence the effects of lack of this vitamin appear very speedily. This is especially seen in the milk produced by mothers deprived of vitamins, which loses vitamin B more rapidly than it does the fat-soluble factor, because there is normally some store of the latter in the mother's body which can be drawn upon. Vitamin B apparently is excreted unchanged or but little altered in the urine, though in all probability not quantitatively.

Of vitamin C we know even less: it arises in seeds which did not previously contain it, when these are germinated, and is not stored in the animal body to so great an extent as vitamin A, though present in some of the tissues.

[1] Medical Research Council. Report on the Present State of Knowledge of Accessory Food Factors (Vitamins). Compiled by a Committee appointed jointly by the Lister Institute and Medical Research Council. Second Edition, revised and enlarged. Pp. iv+171+9 plates. (London: H.M. Stationery Office, 1924.) 4s. 6d. net.

The properties of the fat-soluble vitamin A are of considerable interest. As its name indicates, it is much more soluble in fats and in fat solvents than in water, but since it is still present in whey in amount equal to half that in milk, it must be by no means insoluble in water: probably it is about thirty times as soluble in fat as in aqueous fluids. Though relatively stable towards heat, even at 120° C. in the absence of air or oxygen, it is soon destroyed by oxidation when oxygen is admitted, or by ozone. It is similarly stable towards alkalies in the absence of air, and forms part of the unsaponifiable residue extractable by ether. The amounts of this vitamin essential to life must be extremely small, as is shown by the following considerations. The unsaponifiable matter of cod-liver oil represents only about 1-2 per cent. of its weight, and nearly all of this consists of the inert substance cholesterol. Yet 2 mg. of such an oil can supply the vitamin A needs of a rat; this quantity of oil cannot contain more than about 0·01 mg. of really active substance. Future investigations directed towards the isolation of vitamin A will be able to take these facts as their starting-point, and use will, no doubt, be made of a curious colour reaction, which seems to vary in intensity with the content of fat-soluble vitamin, and to be lost when this is destroyed, as after heating in the presence of air. This reaction consists of a purple colour developed when the fat (*e.g.* cod-liver oil) containing the vitamin is dissolved in an organic solvent, and a drop of sulphuric acid is added. This test is, however, not given by oils from certain low plants, although these are rich in vitamin A, so that it must be concluded that it is not a test for the substance itself, but for some accompanying, and possibly related, substance.

Vitamin B resists heat up to 100° C. and exposure to air very well, a fact which is of practical importance as indicating that there is no appreciable loss of this substance in the baking of bread. But in the manufacture of tinned foods, the temperature often rises considerably higher, so that they contain little water-soluble vitamin. This vitamin is also resistant to hydrolysis, both by acids and alkalies, is soluble in water and alcohol, but not in ether, is readily adsorbed from its solutions by animal charcoal, fuller's earth, etc., by which means it may be separated from vitamin C; in fractional precipitation by silver nitrate, a compound with silver is formed, which follows the histidine fraction.

Vitamin C is extremely sensitive to oxidation, and therefore, under ordinary conditions, to the action of heat, and to drying. This explains why dried vegetables are usually ineffective as a treatment for scurvy; the only exceptions to this are certain very acid dried fruits, and the explanation is that the oxidative changes associated with drying are retarded by acids. We have little indication of the chemical nature of the anti-scorbutic vitamin, but there seems to be a parallel chemical reaction given by some associated substance which recalls that mentioned above for the fat-soluble factor: in the present instance, the test takes the form of a blue colour given by phosphomolybdotungstic acid—a reaction also given by quinol;

but as with the sulphuric reaction of vitamin A fats, the reaction is one of frequent association rather than of identity.

The very complicated problems associated with the ætiology of rickets are still under investigation. Much of the older work was vitiated by failure to define exactly what changes were to be considered as rickets. Osteomalacia in adults and rickets in children appear to have a common cause, or at all events represent similar results, while osteoporosis is due to deficient new bone formation, or to resorption of old bone. Diagnosis should therefore be confirmed by X-ray and histological examination. In the production of rickets, the essential factor is a lack of a vitamin which is similar to or identical with vitamin A, and it is the young and growing individual who is especially sensitive to this deficiency. Given a restricted amount of this vitamin, the condition is greatly aggravated if there is a lack of calcium or phosphorus in the diet, or an improper balance between these two elements. The severest forms of rickets in man are often seen in the gloomy and smoke-enveloped industrial cities, and in this connexion it is especially interesting to learn that the onset of rickets is greatly retarded by exposure to sunlight or ultra-violet light of wave-length of 300 $\mu\mu$ or less. It has even been claimed that contact with air which has been exposed to ultra-violet light accelerates the growth of rats fed on diets deficient in vitamin A. Whether this be true or not, it appears that the favourable effects of ultra-violet radiation are due to a mobilising action which the light exerts on stores of fat-soluble vitamins in the body.

Whether the anti-rachitic vitamin is identical with vitamin A, appears somewhat doubtful. Though they exhibit certain similarities in their known properties, there are certain well-marked differences in distribution and in other of their properties. Sources of vitamin A which show an action in preventing rickets are not necessarily equally powerful in preventing xerophthalmia, which is regarded as a characteristic of this vitamin. This applies to such fats as butter and coco-nut oil, for example. As the technical difficulties in the way of quantitative determination of vitamin action are very considerable, it seems that no definite judgment on this point can as yet be given.

Chemistry at the British Empire Exhibition.

(2) HEAVY CHEMICALS.

IN our previous article dealing with the chemical exhibits at the British Empire Exhibition, we gave some account of the situation and general arrangement of the Chemical Section in the Palace of Industry, and dealt with the fine chemicals and the scientific group. In the present article it is proposed to give a brief description of what may be termed the heavy chemicals.

Messrs. Brunner, Mond and Co., Ltd., and their allied companies, the Castner-Kellner Alkali Co., Ltd., Electro Bleach and By-Products Ltd., Chance and Hunt Ltd., Buxton Lime Firms Co., Ltd., and Synthetic Ammonia and Nitrates Ltd., have a large and impressive stand occupying more than 3250 square feet. In addition to their well-known "crescent products," including soda ash made by the ammonia soda process, bicarbonate of soda and ammonium salts, Messrs. Brunner, Mond are showing silicate of soda, one of the most interesting heavy chemicals, now finding an extensive use. Particularly is this the case for hardening concrete, and the stand includes an abrasion machine demonstrating by means of blocks of concrete, one half of which are treated with silicate of soda, the remarkable improvement of the properties by this process. Interesting also is a new form of calcium chloride in the form of crystals with the composition $CaCl_2 . 2H_2O$. The Castner-Kellner Alkali Co., Ltd., is showing many products obtained in the electrolysis of salt, including pure caustic soda, bleaching powder, liquid chlorine, and sodium peroxide, whilst Electro Bleach and By-Products Ltd. also has bleaching powder, soda crystals, and other products obtained by the Hargreaves-Bird process. Messrs. Chance and Hunt Ltd. display heavy chemicals, including acids, sodium sulphide, saltcake, and iron pigments, whilst the Buxton lime firms show lime and limestones, but particularly "Limbux," pure mechanically slaked lime, practically 100 per cent. $Ca(OH)_2$. The exhibition of ammonia and ammonium salts by Synthetic Ammonia and Nitrates Ltd. shows that the synthetic ammonia works at Billingham-on-Tees is now in operation and is producing 100-120 tons of sulphate of ammonia per day.

The United Alkali Co., Ltd. is showing a whole range of products: bleaching powder, acids, and chemicals for all kinds of industries, particularly soap, paper, and glass manufacture, dyeing and calico-printing, aniline dyes, galvanising and agriculture; whilst Spencer Chapman and Messel Ltd. have an interesting exhibition of fuming sulphuric acid products, both sulphur trioxide crystals, and various standard acids with definite percentages of sulphur trioxide.

Coal tar and coal-tar products, together with intermediaries and the carbonisation of coal generally, are well represented. The South Metropolitan Gas Co. has an interesting stand, including acid-free sulphate of ammonia (25·7 per cent. NH_3), wood preservatives, and road tar to comply with the No. 1 specification of the Roads Department of the Ministry of Transport; whilst the Gas Light and Coke Co., founded 111 years ago, shows not only a range of tar products but also β-naphthol and other intermediates, now a valuable section of the firm's business developed since the War.

On the stand of Messrs. Burt, Boulton and Haywood Ltd. will be found particularly creosote for wood preservation, a business in which they have been engaged for sixty years, disinfectants, and especially colloidal sulphur, a valuable product for horticultural and veterinary work, and also in the manufacture of special soaps; whilst the Midland Tar Distillers Ltd. also displays a complete range of tar products.

As regards aniline dyes, British Dyes Ltd. has a very large stand, which gives satisfactory evidence of the great progress being made in the British dyestuff industry. This impression is confirmed also by the fine displays of various other companies not so well

known to the general public. Thus Scottish Dyes Ltd. shows a complete range of dyed and printed textiles, using their well-known anthraquinone vat colours for cotton and silk, and acid alizarine colours for wool, both of which are extremely fast to light; whilst Messrs. L. B. Halliday and Co., Ltd., have also devoted their space to proving conclusively that dyestuffs of their manufacture are equal to German and Swiss products, especially as regards fastness to light, many exposed dyeings being shown, prepared specially by the Huddersfield Chamber of Commerce.

Messrs. Hickson and Partners Ltd. indicate that they now manufacture an extensive list of dyestuffs and intermediate products, particularly such unusual products as ortho-anisidine and dichlor-aniline, together with sulphur colours, and roseine (magenta) with its allied products, such as soluble blues. Other British dyestuff firms exhibiting are the Ajax Aniline-Dye Manufacturing Co., Ltd., showing particularly specialties for the leather trade, Messrs. J. C. Bottomley and Emerson Ltd., the Clayton Aniline Co., Ltd., and Messrs. Williams Bros. and Co.

With regard to the application of dyestuffs, Messrs. B. Laporte Ltd. show all strengths of hydrogen peroxide, for both medicinal and toilet use, and for bleaching wool, silk, straw, and similar materials. Further, there is a range of barium compounds, sodium sulphide, sodium perborate, and laundry products.

Salt is well to the fore, particularly in relation to the Cheshire district, which has been the chief source of salt in Great Britain for the past two thousand years. Apart from the chemical industries, all varieties of table and ordinary salt used for the preparation of food, such as butter- and cheese-making, dairy work, baking and confectionery, and in the curing of fish, are shown. Much attention is given to the preparation of a "free-running" table salt for salt pourers. Prominent in this section are Murgatroyd's Salt Works, Chance and Hunt, and Electro Bleach and By-Products Ltd.

As regards soap, the Erasmic Co., Ltd., have a very distinctive exhibit, especially toilet and shaving soaps, together with many toilet specialties; whilst Messrs. D. and W. Gibbs Ltd. show the manufacture with actual works plant of toilet soap, and Messrs. Joseph Watson Ltd. display their well-known products, especially "Matchless Cleanser," "Nubolic" disinfectant soap, together with the products of the firm's seed-crushing mills. Messrs. Lever Bros. Ltd. have a most extensive and interesting exhibit, including such well-known soaps as "Sunlight," "Lifebuoy," "Lux," and "Hudson's," together with "Twink" dyes and all kinds of toilet, shaving, and cleansing soaps, with many photographic illustrations of the famous Port Sunlight factory. Also to be noted are the products of the Ofome Company and Messrs. J. J. Rigby Ltd.

Candles are well represented, and Messrs. Price's Patent Candle Company, Ltd., are showing particularly the new "Trylite" triangular section candle, which is smokeless and does not gutter.

In the field of disinfectants we have Messrs. Newton, Chambers and Co., Ltd., with "Izal," Messrs. Jeyes Sanitary Compounds Ltd., "Jeyes fluid," the Midland Tar Distillers Ltd., and the South Metropolitan Gas Co.; and as regards matches, Messrs. Bryant and May Ltd., who, with their associated companies in the overseas Dominions, are stated to turn out 1,000,000 boxes of matches per 24 hours, have a particularly interesting exhibition, including not only every variety of their products and a model of their Fairfield Works at Bow, but also a unique collection from their private museum of "fire-striking" appliances.

Messrs. Peter Spence and Co., Ltd., have certainly one of the most beautiful stands of all, including a marvellous display of clear alum crystals of almost incredible perfection, including two pyramidal columns over 5 feet high, containing more than 130 perfect octahedral crystals of various sizes, the largest of which has taken two years to grow, whilst there is also a crystal more than 200 lb. in weight, the largest ever produced, the result of four years' growth. Very interesting also are the titanium specialties produced by this firm, which are largely used for stripping dyestuffs, and also in the leather industry.

Messrs. J. and J. White Ltd., the oldest and largest manufacturers of chrome salts in the world, have also a striking exhibit of their products, especially bichromates of potash and soda and various less-known salts, such as the trichromates, strontium chromate, and sesquioxide of chromium.

Finally, the Washington Chemical Co., Ltd., displays its well-known pure magnesia, of which it is the largest manufacturer in Europe. This product finds all kinds of uses, particularly in the form of 85 per cent. magnesia (mixed with 15 per cent. asbestos) as a high-grade non-conductive covering for steam-pipes and boilers, and for medicinal purposes.

Obituary.

MAJOR F. W. CRAGG, M.D., D.Sc.

THE death of Major Francis William Cragg, from typhus, at Lahore, on April 23, came as a shock to his many friends and admirers. He was only forty-two years of age. Medical entomology has lost in him one of its ablest workers and the Indian Medical Service a distinguished officer.

Cragg graduated M.B., Ch.B. in 1905 at Edinburgh, and then entered the Indian Medical Service. In 1910 he came to Edinburgh on leave and attended Prof. Ashworth's class of medical entomology and parasitology, and under Prof. Ashworth's direction took up the study of insect morphology, paying particular attention to zoological technique. He graduated M.D. in 1911, and his thesis on "The Structure of *Hæmatopota pluvialis*" was highly commended. This piece of research and the thorough grounding in technique was the foundation of Cragg's future work on medical entomology.

It was not long after his return to India before Cragg was drafted into the Bacteriological Department. The writer first made his acquaintance at the King Institute of Preventive Medicine, Guindy, Madras, where Cragg was sent to begin his scientific career, which was to prove so fruitful in so short a time. At Guindy, with much spare time and unlimited material, Cragg

soon began his studies of the mouth parts and the sucking apparatus of the blood-sucking Diptera. His numerous papers published in the Scientific Memoirs and the *Indian Journal of Medical Research* represent the best modern work on this subject. Apart from their intrinsic value as models of this kind of research, they are full of suggestive ideas for future work.

It was at Guindy that the writer conceived the idea of the joint work on "Medical Entomology" published in 1913, which was planned and carried out in less than two years. Cragg's sections dealing with insect anatomy, and his clear and accurate drawings, have been of the greatest use to teachers and students alike.

After Cragg's transfer to the Central Research Institute, Kasauli, in 1912, he became more deeply interested in insects in relation to disease-causing organisms. It is possible here to refer to only a few of his many papers published in the *Indian Journal of Medical Research*. His work on the geographical distribution of the Indian rat fleas as a factor in the epidemiology of plague, and his work on the bionomics of *Xenopsylla astia*, will be of the utmost value to the sanitary authorities of India if this flea proves to be of little or no importance in the transmission of the plague bacillus. Relapsing fever also attracted his attention, and it was while investigating its etiology at Agra in 1920–21 that he became infected, and came to Edinburgh on leave in 1921 with his health seriously undermined. He worked for some time in the Zoological Department at several problems, and obtained the degree of D.Sc. in 1922. On his return to India, he at once took up important problems connected with the bionomics of rat fleas, lice, and the bed bug. He hoped to return later to the study of the part played by *X. astia* in the transmission of the bacillus of plague.

Cragg was deputed early in 1924 to investigate the etiology of typhus, that fell disease which has only recently claimed another distinguished medical entomologist, Mr. A. W. Bacot. Like Bacot, Cragg was a fearless investigator, never hesitating to expose himself to infection. We mourn his loss; it is irreparable, as there are so few workers in this branch of zoology who may be considered such all-round experts as Cragg.

W. S. P.

DR. F. H. BIGELOW.

THE death of Dr. F. H. Bigelow, until recently professor of meteorology at the Oficina Meteorologica, Cordoba, Argentina, is reported from Vienna. Frank Hagar Bigelow was born in 1851 at Concord, Mass., and was educated at Harvard, afterwards becoming an astronomer at the Cordoba Observatory, where he took part in Gould's survey of the southern heavens. From 1884 to 1889 he was professor of mathematics at Racine College. Then, after two years at the Nautical Almanac Office, he was in 1891 appointed professor of meteorology at the United States Weather Bureau, Washington. With the duties of professor of meteorology he combined those of Chief of the Climatology Division of the Weather Bureau and (from 1894) of professor of solar physics at the George Washington University. Bigelow left Washington in 1910 to take up the post of professor of meteorology at the Oficina Meteorologica, Cordoba, and from 1915 until his retirement in 1921 he was also Director of the Solar Physics and Magnetic Observatory, Cordoba. In addition to his official posts, Bigelow was a member of a number of international commissions. After his retirement from official duties, he lived for some time in Rome, and at the time of his death was living in Vienna.

With the study of physical science Dr. Bigelow combined the study of divinity, and he was a B.D. of his University. He was chaplain of Racine College, and while at the Weather Bureau, Washington, he acted as assistant minister of St. John's Church, Washington.

Bigelow was a voluminous writer on meteorological and allied subjects. He contributed a large number of papers and reports to the Bulletin of the Weather Bureau, the *Monthly Weather Review*, and the official publications of the Argentine Service. Among his best known investigations are those on evaporation from the surfaces of lakes and reservoirs, and a very full discussion of the barometry of the United States, Canada, and the West Indies. His discussion of the distribution of cloud types forms a valuable contribution to the subject. From his studies of the storms of the United States, Bigelow concluded that extra-tropical storms do not have well-defined warm or cold centres, but that their centres are to be found at the line of separation of adjacent warm and cold masses of air, vertical convection produced thermally being of little or no importance. Many of the views expressed by Bigelow have become familiar to English readers through the writings of Bjerknes.

Bigelow's writings ranged over almost the whole field of meteorology. He devoted a considerable amount of time to the discussion of the relations of solar to terrestrial phenomena. Among his recent work will be found a treatise on circulation and radiation in the atmospheres of the sun and the earth, followed by a treatise on the sun's radiation. These two works may be regarded as an attempt to develop a new physics for the atmospheres of the earth and sun. They are by no means easy reading, and their failure to attain general acceptance may in part be due to this fact. Bigelow's writings were marked by originality, at times marred by a too-ready acceptance of new ideas without sufficient proof, but it cannot be questioned that he brought many new ideas into meteorology.

D. B.

WE regret to announce the following deaths:

Mr. T. Jamieson, formerly lecturer in agricultural chemistry in the University of Aberdeen and one of the original fellows of the Institute of Chemistry, on May 3.

Dr. E. F. Nichols, director of research, Nela Research Laboratories, Cleveland, and formerly president of Dartmouth College, Hanover, N.H., who was known for his work on infra-red radiation, on April 29, aged fifty-four.

Prof. S. G. Shattock, F.R.S., professor of morbid anatomy, University of London, and pathological curator, Royal College of Surgeons, on May 11, aged seventy-one.

Dr. H. Walsham, consulting radiologist to St. Bartholomew's Hospital and a fellow of the Royal Astronomical Society, on April 13, aged sixty-eight.

Current Topics and Events.

THE new president of the Iron and Steel Institute, Sir William Ellis, is an engineer by training, but has been identified with the great steelworks of Browns in Sheffield for more than forty years. His address delivered on May 8 consisted of a comparison of the practice of such a firm forty years ago with that of to-day, and a consideration of the circumstances which have enabled the very great change and development to take place. In the early 'eighties, the management was in the hands of men whose chief qualifications were common sense and great power of application. Apart from the training given at the Royal School of Mines under Dr. Percy, metallurgy as a science could scarcely be said to exist, and technical institutions for the training of students in engineering and metallurgy were only beginning to come into existence. The various departments were run by separate engines with long steam mains, very often ill protected against condensation, so that efficiency was very low. Steam hammers up to fifty tons were largely in use, and the overhead crane was only beginning to be adopted. The Bessemer process was supreme, although the open-hearth furnace was being rapidly developed. To-day, in contrast to this, the Bessemer process, although it still continues to be worked, has been superseded in importance by the open-hearth process. Electrothermic processes of steel manufacture have been introduced and in time will probably displace fuel-fired furnaces altogether. Forging plant has developed to a very great extent, and quick-acting forging presses have been universally adopted. Pumping engines for these have given place to the use of intensifiers. Ingots of more than one hundred tons in weight are required for forgings and large marine shafting. Only the introduction of hydraulic presses has rendered this class of production possible. In Sir William Ellis's opinion, three elements are mainly responsible for the great change: improved education, electric driving, and high-pressure steam. In the second part of his address, the president dealt with certain manufacturing difficulties in the heavy steel industry which still remain to be solved. His plea for a close understanding between the manufacturing engineer and the metallurgist is one which will be heartily endorsed by all those conversant with manufacturing difficulties.

ON May 10 a large party of the Gilbert White Fellowship proceeded from London to meet at Selborne for the unveiling of a seat dedicated to the memory of the author of "The Natural History and Antiquities of Selborne." They found the memorial seat placed in a commanding position upon the elevated Selborne Common and close to the "Wishing-stone" at the top of the zigzag, a pathway cut by Gilbert White and his brothers in the side of the beech-clad Hanger to provide an easy ascent to the summit of the hill. The seat is provided at each end with commodious elbows, appropriately terminated by a full-sized carving of "Timothy," the tortoise which White removed from Ringmer at the death of its owner, Mrs. Rebecca Snooke. It was designed and executed in teak by Messrs. Daymond and Son, Ltd., Westminster, and is inscribed "Gilbert White, 1720–1793. Erected by the Gilbert White Fellowship, 1924." The unveiling was performed by Lady Prain, the ceremony being preceded by an address delivered by Dr. William Martin, an ex-president of the Fellowship. Dr. Martin alluded to the simplicity of the memorial as being fully in accord with the unpretentious life of the great naturalist and befitting the character of one careless of fame and renown. The memorial was as simple as was the dwarf headstone in the churchyard with its brief inscription: "G. W. 26 June 1793." To know England, a German historian has remarked, compelled a reading of the Natural History of Selborne, a work in which is reflected the Englishman's inherited love of the countryside. But Gilbert White as antiquary was not to be forgotten in the plenitude of his researches and recordings of natural phenomena. There was indeed much in the Antiquities of Selborne which deserved attention, while the "Advertisement" to his great work showed that Gilbert White had within him the instincts of the historian. After the unveiling of the memorial seat, addresses were delivered by Sir David Prain and by Mr. Rashleigh Holt-White, the great grand-nephew of the naturalist, and author of the "Life and Letters of Gilbert White."

ON April 5 a second reading was given in the House of Commons to a short Bill for the Protection of Birds, presented by Sir Harry Brittain. This Bill seeks to prohibit the use of birdlime or of tethered, maimed, or blinded decoys, and also the confinement of birds in cages of insufficient size: its primary object is therefore the prevention of cruelty rather than the preservation of avifauna. It will certainly have the support of bird-lovers. One may also hope that progress will soon be made with the more comprehensive measure, reforming the present inadequate legislation on the subject of bird protection, which was introduced in the House of Lords by Viscount Grey of Fallodon last summer (see NATURE, August 25, 1923, p. 269), but failed to become law before the dissolution.

RECENT publicity in connexion with the United States naval oil reserves has served to focus attention on the serious question of conservation of oil for national requirements, and it is therefore significant to note that President Coolidge has appointed a special commission to review the situation in each of the existing reserves, to inquire into the possibility of creating new and larger reserves, to take stock of present tankage above ground, and finally to consider the problem of helium in relation to its production, storage, and use for inflating airships. The commission consists of Dr. George Otis Smith, Director of the Geological Survey, Rear-Admiral Hilary P. Jones, Commander-in-Chief of the United States fleet, and R. D. Bush, of the Californian Bureau of Mineralogy.

The official statement of reasons for appointing the commission includes an estimate of only twenty years' supply of oil within the United States at the present rate of production, and points out that national security, in the event of war, will be seriously endangered if adequate sources of fuel are not set aside for use in times of emergency. It foreshadows the possibility of increasing naval oil reserves " by assignment of additional public lands, transfers, trades, purchasers or otherwise," and, in fact, is so worded as to prepare the public for drastic developments in this connexion, both in the United States and in Alaska. Finally, President Coolidge has, by executive order, created the first national helium reserve in Utah, whereby some 7000 acres of land are withdrawn " from all forms of settlement, location, sale or entry," the mineral title being vested in the United States; previous tests by an independent oil company on this land showed that while petroleum was apparently absent, helium bearing natural gas was discovered in quantity.

THE memorial oration delivered by Prof. Adolf von Harnack at the dedication of the monument erected to Immanuel Kant in the cathedral of Königsberg by the university and the city, on the occasion of the bicentenary of his birth, has been published in *Die Naturwissenschaften* of April 25. " So far as our knowledge of history reaches," he says, " we can discover no third name to set beside Aristotle and Kant in respect to the manner in which they identified themselves exclusively with the problem of knowledge and devoted their lives to the single purpose of its elucidation." The same number contains an able article by Prof. von Kries of Freiburg-im-Breisgau on Kant's doctrine of space and time in its relation to modern physics. The article is part of a larger work to be entitled " Immanuel Kant und seine Bedeutung für die Naturforschung der Gegenwart." It is a singular fact that though Kant was directly led by his studies of astronomy, and of mathematical physics generally, to devote attention to the problem of knowledge, and though his theories were mainly determined by the necessity of finding a basis for science and answering the sceptical inquiry, How is physical science possible? yet science has gone its way, heedless of Kant and indifferent to him. The change which has come over the whole aspect of physical science with the coming of the principle of relativity has also altered the spirit in which scientific studies are being pursued. Scientific research workers are no longer indifferent to Kant's problem.

WE have received from the Wistar Institute of Philadelphia a statement of the method which has been developed since 1917 of publishing and indexing some of the leading American biological journals. This method has led to certain new departures which might well be adopted with advantage elsewhere. The Wistar Institute directs the publication of six journals devoted to zoology and anatomy, including the *Journal of Morphology*, the *Anatomical Record*, and the *Journal of Experimental Zoology*. It has also established a bibliographic service in connexion with these journals, which extends also to the *Biological Bulletin* and the *Journal of Physical Anthropology*. Each manuscript received from the editors for publication is accompanied by an author's abstract not exceeding 225 words. Every ten days, advance sheets containing a number of such abstracts are issued to zoologists, who may then order reprints of any papers desired, instead of subscribing for the complete journal. Eventually it is proposed to publish each paper as a separate issue of a journal. The authors' abstracts are printed on the reverse of standard library cards which have complete bibliographic references on the obverse. The cards for the eight journals are sent for a sum of 5 dollars a year, in advance of publication in the journals. The abstracts are also issued in book form exhaustively indexed, at the close of each year. This method of advance publication and subsequent indexing of abstracts has many advantages, including early acquaintance with the general results of a piece of investigation, and an indexing of the papers which makes their contents easily available for reference.

THE fourth annual report of the British Non-ferrous Metals Research Association records remarkable progress in the work undertaken by the Association. The membership has increased, and the income, which is almost entirely devoted to actual research work, now amounts to 10,766*l*. An extensive investigation is in hand on the influence of impurities in copper. The effect of oxygen, iron, and arsenic has been studied fully and work on other elements is in progress. The Atmospheric Corrosion Committee has published its first report in the form of a paper read before the Faraday Society, and this work is leading to interesting results. The Association has undertaken a very extensive programme of research on alloys used for die casting, three separate sections being studied, dealing with low melting alloys, light aluminium alloys, and bronzes and brasses respectively. A new programme of work has also been adopted, covering the determination of the mechanical properties of some of the more important non-ferrous metals and alloys up to temperatures of 700° C. In close connexion with this is a research which will be carried out in co-operation with the railway companies on the failure by scaling or erosion of copper stay rods. Altogether twenty different researches are in hand. The policy adopted by the Association of making its scientific results available to the public as well as to its members is a most enlightened one, for metallurgical science in general is benefiting as well as the industries specially concerned.

THE discussion before the Illuminating Engineering Society on April 28 on the lighting of textile mills raised several interesting points, though it seems evident that a great deal remains to be learned, in regard to both natural and artificial lighting in this industry. Mr. P. J. Waldram's paper on daylight illumination emphasised the continual difficulty of maintaining the even temperature essential to the processes, and at the same time providing window-

space which will ensure access of light into rooms filled with bulky machinery. In spinning mills the high temperature and humidity would be impossible with top-lighting, yet side-lighting is scarcely fully adequate. Coupled with the sensitiveness of the yarn to atmospheric conditions, there is the question of the effect of the temperature and humid conditions on the health of workers. Incidentally the paper mentioned one vital point—the determination whether illumination should be measured in a vertical or horizontal plane. The values of 2½ per cent. for the daylight factor given in the Home Office Committee's report were apparently based on horizontal measurements, whereas the illumination of a vertical plane is often more important on a spinning floor. The other paper, by Mr. E. L. Oughton, dealt with gas lighting. One point clearly brought out was the relation between coefficient of reflection of material and necessary illumination; in practice the maintenance of a specified *brightness* seems the essential thing.

MEMBERS of the Government are taking an active interest in the Conference on Science and Labour in the Modern State, to be held at the British Empire Exhibition on Friday and Saturday, May 30 and 31. The Prime Minister is to open the Conference, and the principal speaker at the first meeting will be the President of the Board of Trade (Mr. Sidney Webb). Sir Richard Gregory will preside at this meeting, and the general subject of discussion will be the place of science in government. Miss Margaret Bondfield, M.P., will preside at the meeting on Saturday morning, at which science and the human factor will be discussed, and Mr. Arthur Greenwood, M.P., at the Saturday afternoon meeting, when the subject will be science in educational organisation. The chairmen for the other meetings are Lord Askwith, president of the British Science Guild (scientific research in relation to industry), and Mr. C. T. Cramp (co-operation of science and labour in production); and among the other speakers whose names are announced are Lord Ashfield, Sir Hugh Bell, Major A. G. Church, M.P., Mr. A. P. M. Fleming, Sir Richard Glazebrook, Mr. Hugo Hirst, Sir Thomas Holland, Sir Oliver Lodge, Dr. C. S. Myers, Sir Arthur Newsholme, Dr. R. P. Scott, and Mr. R. H. Tawney. Copies of the programme may be obtained from the Conference Secretary, 15 Gower Street, W.C.1.

PROF. HANS OSCAR JUEL (Uppsala), Dr. Hans Spemann (Freiburg), and Dr. Johannes Schmidt (Copenhagen) have been elected foreign members of the Linnean Society of London.

MR. HAROLD KNOX SHAW, Director of the Observatory at Helwan, Egypt, has been appointed Radcliffe Observer at Oxford in succession to the late Dr. A. A. Rambaut.

PROF. D. M. S. WATSON will deliver the Croonian Lecture of the Royal Society on Thursday, May 29, at 4.30 P.M., taking as his subject "The Structure, Evolution, and Origin of the Amphibia."

AN assistant chemist is required by the British Research Association for the Woollen and Worsted Industries, Torridon, Headingley, Leeds. Applicants should, if possible, have some special knowledge of physical and colloid chemistry, and must be painstaking experimentalists.

THE Council of the Institution of Civil Engineers has made the following awards in respect of papers read and discussed at the ordinary meetings during the session 1923–1924: A Telford Gold Medal to Prof. C. E. Inglis (Cambridge); Watt Gold Medals to Mr. H. N. Allott (Manchester), and Mr. S. L. Pearce (Manchester); Telford Premiums to Mr. A. J. Martin (London), Dr. H. E. Hurst (Cairo), and Mr. D. A. F. Watt (Cairo), Mr. D. H. Remfrey (Calcutta), and Mr. William Burnside (Glasgow); a Crampton Prize to Mr. T. R. Nolan (Chittagong); and a Manby Premium to Mr. H. T. Tudsbery (London), and Mr. A. R. Gibbs (London).

AN assistant naturalist is required in the fisheries department of the Ministry of Agriculture and Fisheries. Candidates must have studied science at an institution of university rank, and have qualified for a degree or diploma. Preference will be given to candidates with experience of work at sea and a knowledge of modern languages and of statistical methods. Forms of application, etc., may be obtained from the Secretary of the Ministry, 10 Whitehall Place, S.W.1. They must be returned not later than May 24.

THE Sudan Government invites applications for the appointment of assistant Government chemists from candidates possessing a good degree in chemistry and experience in research work. For one of the appointments special qualifications in physical chemistry are desired. Applications, giving particulars of education, scientific training and experience, should be sent by, at latest, June 25, to Dr. A. F. Joseph, 51 Kings Avenue, Muswell Hill, N. Particulars of the appointments can be obtained from the Registrar, Institute of Chemistry, 30 Russell Square, W.C.1.

A CONFERENCE on Living Religions of the Empire has been organised by a joint committee of the School of Oriental Studies and the Sociological Society, to be held at Wembley on September 22-October 3. An account of the inception and scope of this Conference is given by Sir E. Denison Ross in the April number of the *Sociological Review*. The aim will be to spread information rather than arouse discussion. Among the religions to be considered are Hinduism, Buddhism, Islam, Taoism, and Confucianism, the religions of the Sikhs, Jains, and Parsis, and some modern movements and primitive religion. So far as possible, each religion will be expounded by someone by whom it is professed.

THE anniversary dinner of the Royal Geographical Society will be held on the evening of May 26 at the Connaught Rooms, Great Queen Street, Kingsway, at 7.45 P.M. Prince and Princess Arthur of Connaught will honour the Society with their presence, and among the guests who have accepted invitations are the Spanish Ambassador and Madame Merry del Val, the Czecho-Slovak Minister and Madame

Mastny, the Egyptian Minister, the Secretary of State for India and Lady Olivier, the Lord Chief Justice of England and Lady Hewart, Air Chief Marshal Sir Hugh and Lady Trenchard, Vice-Admiral Sir Roger and Lady Keyes, the High Commissioner for New Zealand and Lady Allen, and the High Commissioner for India.

THE meeting of the International Refrigeration Congress will be held in London on June 16-21. The scientific side of the work is under the direction of Prof. Kamerlingh Onnes, of the University of Leyden, who is coming over to London for the meeting. As this is the first visit to England of this distinguished investigator, and as he will be accompanied by Profs. Keesom, Verschaffelt, and Mathias, it is very much to be hoped that English physicists and men of science will give them a very hearty welcome. They intend to communicate a large amount of original work, and are anxious to meet their English colleagues during the Congress.

THE British Museum (Natural History) has published (N.H.M. Form 170A) a revised list of the picture postcards now being issued in monochrome and colour to illustrate the institution and its varied collections. Fifty-one series are already comprised in the list and, with each series, an explanatory leaflet is issued. The cost is very low, ten monochrome or five coloured cards, with leaflet, for 1*s*. Coloured cards are, so far, only available for the birds, insects, and amphibia. They are exceedingly well-reproduced illustrations of some of the more remarkably coloured members of their respective series. These cards deserve to be more widely known, and they should prove of great service for use in museums and schools, to which end special terms to such institutions are offered. The series of cards is being extended as occasion arises, and it is to be hoped that the demand will warrant a rapid increase in their numbers.

FROM the Report of the Rugby School Natural History Society for 1923 we learn that the Society's museum is to go and, owing to the prohibitive cost of a new building, the contents must be removed and housed elsewhere. This is surely a unique opportunity for some old boy of the school, whose interest in natural history is as keen as ever, to come forward and replace the old building by a new one, and so preserve intact a splendid monument to the interest and industry of many generations of boys, masters, and benefactors. Lists of the more important plants, lepidoptera, and birds observed during the year are included, and testify to the vigour and enthusiasm of the sections concerned. The biological section, however, has been wound up. It seems a pity that biological observations should be confined to plants, butterflies and moths, and birds. There is surely room and a need for observations on and an interest in the many other branches of biological study.

THE Report of the chairman of the National Illumination Commission for the year 1923 announces the decision of the British Engineering Standards Association to form a Committee in order to accelerate standardisation in matters connected with illumination. Of this Committee, the National Illumination Committee will form the nucleus. The Sub-Committee on Headlights has been engaged in comparing British and American requirements, the former based on candle-power, the latter on the use of the R.A.C. disc. By the aid of the National Physical Laboratory the relation between the visibility of the disc at different distances and the illumination necessary to produce that visibility has now been established with fair certainty. Thus it is now, for the first time, possible to compare the proposals on a common basis. It is hoped shortly to make comparisons between headlights constructed to meet each proposal. Reference is also made to the death, on September 12, 1923, of M. J. Violle, whose name is associated with research on the platinum standard of light. The next meeting of the International Illumination Commission is to be held in Geneva on July 21-25.

PART 1 of the first volume of a new quarterly, the *Australian Journal of Experimental Biology and Medical Science*, published at the University of Adelaide for the Medical Sciences Club of South Australia (price 21*s*. per annum), has just reached us. The periodical is edited by a board of nineteen editors, with Profs. J. B. Cleland and T. Brailsford Robertson as managing editors. The first number consists of thirty-seven well-printed pages, with a number of equally well-reproduced illustrations, and contains four papers. A. B. Anderson writes on "The Effect of Phloridzin on the Mortality from Insulin Hypoglycæmia in Mice"; M. L. Mitchell on "The Substitution of Taurine for Cystine in the Diet of Mice"; O. W. Tiegs on "The Mechanism of Muscular Action," and T. Brailsford Robertson on "The Influence of Hydrolysis upon the Capacity of Proteins to bind Acids and Bases." All the papers are of good standard, though the third is largely of a theoretical nature. While deploring the tax which yet another scientific periodical will put on our library resources, we welcome this Journal, which will at all events have the advantage of giving to Australian workers the opportunity for prompt publication of the results of their work.

FEW of those who consult catalogues of scientific apparatus and materials, whether from business or pleasure, can have any knowledge of the immense amount of work which such compilations entail, and of the great expense involved in printing them: the production of a large illustrated catalogue, similar to those issued by the leading instrument makers, runs into thousands of pounds. The latest catalogue of this kind which we have seen is the twenty-third edition of the chemical catalogue issued by Messrs. F. E. Becker and Co. (W. and J. George (London) Ltd., Proprietors), "Nivoc" House, 17-29 Hatton Wall, London, E.C.1. This volume contains 366 pp. (11 × 8½ in.) and no fewer than 1790 illustrations. It is so clearly arranged and so well got up that even an unemotional chemist will find some satisfaction in searching its pages when he has to replenish his stocks of apparatus and chemicals. He

will also be pleased to find that the tendency of prices is distinctly downwards. Taking a few items at random, he will note that the 50 c.c. burettes, graduated in 0·1 c.c. and provided with a glass tap, cost very little more than they did in 1913; that the price of the 6-inch Schiebler desiccator has fallen 30 per cent. since 1918; and that even the indispensable test-tube ($5 \times \frac{5}{8}$ in.), which was dumped upon us before the War in untold millions at 3*s.* 6*d.* per gross (retail), may now be purchased at 7*s.* per gross (compared with 14*s.* in 1918). If extrapolation on the time-cost curve were legitimate, he might anticipate that the pre-War level of prices was not far distant; but he would remember the factor of increased labour costs and conclude that the curve would now probably become horizontal, for makers and purveyors would not now be sinking large sums of money in new catalogues if they thought that prices would alter to an extent that would necessitate the early issue of amended editions.

THE *Brooklyn Museum Quarterly* for January 1924 reproduces photographs of three natural history groups recently added to the exhibits: the wandering albatross (*Diomedea exulans*), the gopher tortoise (*Gopherus polyphemus*), and the abundant marine life assembled on and around a submerged boulder in Long Island Sound. This last seems to be a notable example of a kind of group much attempted of late in American museums, but scarcely at all in Great Britain. The value of such submarine faunistic groups will ultimately be assessed according to the clearness with which they bring out the relations between the animals and plants composing them, and their adaptation to the physical environment.

THE Report of the Director-General of Public Health, New South Wales, for the year 1922 has just reached us. These annual Reports are of considerable interest, and it is regrettable that publication is so long delayed. The present issue contains valuable epidemiological data on the tenth outbreak of plague at Sydney, 1922. A report on the routine examination of rodents and of their ectoparasites since 1900 and a summary of the flea fauna of Australia are contributed by Dr. E. W. Ferguson. Anthrax cases in connexion with infected shaving-brushes and results of the bacteriological examination of the Sydney milk supply are other interesting features contained in this Report.

Our Astronomical Column.

THE MOUNT WILSON WORK ON SOLAR MAGNETISM.—*Scribner's Magazine* for May contains an interesting article on this subject by Prof. G. E. Hale. After a brief résumé of our previous knowledge of solar physics, he describes the discovery of solar vortices by photographs with the spectroheliograph, and the discoveries of Faraday and Zeeman on the effect of a magnetic field on the spectral lines are explained. The vortices were tested in this manner and showed the Zeeman effect, indicating that the whirling electrons produced a magnetic field. The recent discovery that the law of magnetic polarities is reversed in alternate sun-spot cycles is then explained and illustrated by several diagrams (*v.* also NATURE, January 19, p. 105). Dealing with the northern solar hemisphere in 1903, preceding components of pairs showed S-polarity, following components N-polarity. This persisted until 1912; it was then found that the spots of the new cycle showed reversed polarity. Still another reversal has now taken place, the first spot to show it being seen on June 24, 1922, in N. lat. 31°. Several further groups have confirmed the change, so that it now appears that the full solar cycle is 22 years. It is noted that the high level vortices in the hydrogen atmosphere do not share in the reversal, which is assumed to depend on some change of circulation of matter in the sun's interior.

PROPER MOTIONS WITH THE BLINK MICROSCOPE.—Union Observatory Circular 59 contains a discussion by Dr. Innes of proper motions in three regions (1) near η Argus, (2) near the globular cluster ω Centauri, (3) round the point R.A. $18^h\ 8^m$, S. Decl. 23° 40′. Regions (1), (3) are galactic, (2) is 15° from the galaxy. The plates, on the large scale of 30″ to 1 mm., were taken with the 24-inch M'Clean telescope; they cover an interval of some 20 years. In region (1) 4 stars were found with centennial motion exceeding 10″; the largest is 35″, magnitude 9·3; 24 had motions between 5″ and 10″. The centennial motion of the 18 bright stars in the region was investigated from meridian catalogues; excluding two exceptional ones, the mean was 2·57″, nearly towards the solar antapex; this gives an average distance of 400 light-years.

Two interesting points about region (2) were: first, that no shift of the cluster with reference to the general stellar background was detected; second, that no proper-motion stars were detected in the cluster area, although 50 were found in the region covered by the plates (1½ square degrees); 16 of these appear to belong to Drift II., 25 to Drift I. There is a discussion about a star for which the meridian catalogues indicate a centennial motion of 10″, while that found by the blink method is much smaller.

Region (3), in which the star density is 8000 to the square degree, has only 15 cases of detected proper motion in that area.

Seventeen paper reproductions of Franklin Adams plates of the southern heavens (each about $6\frac{1}{2}° \times 5°$) accompany the circular.

THE NORTH AND SOUTH CURRENTS IN THE SUN'S REVERSING LAYER.—Mr. R. Sekiguchi, who recently visited the Solar Physics Observatory at Cambridge, writes on this subject in vol. i., No. 3, of the Memoirs of Kobe Observatory. He quotes previous attempts to study north and south currents by the drifts of sun-spots, and also by spectroscopic measures of radial velocity. He has himself made an investigation by the latter method, using 17 lines of iron, manganese, titanium, etc., between 4219 and 4283. Exposures were made at three points on the disc at equal distances from the centre, the conditions being assumed symmetrical in the northern and southern hemispheres. He finds evidence of the existence of a current towards the equator in each hemisphere, the speed of which in latitude 65° is 0·347 km./sec. It is suspected that the speed is greater for the upper layers. Arrangements are now being made to extend the research to other solar latitudes. It may be mentioned that these Memoirs are in English.

Research Items.

GYPSY BURIAL CUSTOMS.—A detailed account of burial customs of the English gypsies is given by Mr. T. W. Thompson in the Journal of the Gypsy Lore Society, N.S. vol. iii. pt. 1. These show marked signs of a fear of pollution. It is, for example, very unusual for a gypsy to take part in laying out a corpse, and any food in a tent when a death takes place is buried. A fast follows until the burial, and, with the Boswells, this takes the form of a red-meat tabu. The coffin is made specially large to hold a great part of the deceased's personal possessions. Anything not so included is burned. Among the objects usually placed in the coffin, in addition to clothes, are the watch and other jewellery, a knife, fork, and plate, a hammer, and sometimes grain and bread, the latter a potent influence against evil. Clothes are turned inside out. Some gypsies place a tuft of grass or sod on the breast, and in Scotland at one time a knot of red and blue ribbons was used. Annual gatherings at the grave were in some cases made the occasion of offerings, such as beer, poured on the soil, tobacco, sugar, and even, in one instance, a Christmas pudding.

STONE IMPLEMENTS AT SUSA.—M. R. de Mecquenem, director of French archæological investigations in Persia, has published in *L'Anthropologie*, xxxiii. pt. 5-6, a review of the evidence relating to the implements of stone found on a necropolis site at Susa north of the acropolis excavated by M. de Morgan. Of two pits dug, one reached the original surface soil at a depth of 18 m., and produced from the deposit immediately above that level tablets of unbaked clay inscribed in cuneiform and dating from at least 2000 B.C. The second cutting reached the surface soil at 11·90 m. below the foundations of the Achæmenid palace, for the building of which the mound was partially razed. In the lowest stratum were found fragments of painted pottery and painted figurines of animals belonging to the prehistoric period. Above was a stratum with coarse undecorated pottery, and above this again an uninterrupted series of interments to Achæmenid times. The evidence from these excavations goes to show that stone implements were in general use until the twelfth century B.C., when they were superseded owing to a freer use of bronze; flint sickles and polished axes endured until the common use of iron in the eighth century B.C.; flint arrow-heads were employed by the Achæmenid archers; and the stone mace-head was in use almost to the present epoch.

THE ATLAS OF SARGON OF AKKAD.—The important bearing upon the early history of bronze of the geographical tablet of Sargon of Akkad (2750 B.C.) found at Assur has led Prof. Sayce to publish a translation for the use of non-Assyriological students in *Ancient Egypt*, 1924, pt. i. This tablet, which was first published in 1920, being No. 92 in *Keilschrifttexte aus Assur, Verschiedenen Inhalts*, is a late Assyrian copy of a Babylonian official description of seventeen high roads of Sargon's kingdom, giving their length in *béri*. The obverse only is preserved, and is much injured, in particular at the point at which it runs "to the tin-land (Kuga-ki) (and) Kaptara (Caphtor, Krete) countries beyond the Upper Sea (The Mediterranean)." A suggested identification of the tin-land here mentioned is Spain. The position assigned to the land of the Amorites also suggests an identification with the land of the Mitanni, which would support the views previously put forward by Prof. Sayce, but contested by German scholars, that the Hittites called the Mitannians "Murri." Mirrekh-nas occurs in the Syrian geographical list of Tothmes III., and Morrheus was the title of Sandes-Tarkus in Cilicia. Prof. Sayce points out that on Egyptian monuments the Amorites are blonde with blue eyes. In a supplementary note, Sir Flinders Petrie points out the difficulty in identifying the "Tin-land" with Spain, as tin was not known as a separate metal in the West so early as the reign of Sargon. He suggests for the unit of measurement, the *béri*, a length of 4·09 miles.

THE GROWTH AND FEEDING OF HONEY-BEE LARVÆ.—Bulletin 1222 (March 14, 1924) of the United States Department of Agriculture is devoted to the above subject. Part I., by Messrs. James A. Nelson and Arnold P. Sturtevaret, is devoted to the problem of growth. Larval development, up to the time of the sealing of the cell, lasts $4\frac{1}{2}$ to $5\frac{1}{2}$ days. From various observations it was found that the change in the composition of the larval food from one of high nitrogenous content to one of high sugar content takes place as early as the third day after hatching from the egg—this differs from the well-known statement of Von Planta in which the change is mentioned as occurring on the fourth day. There has been much controversy as to whether the food of the young larva is a secretion from glands or a regurgitation from the ventriculus. Its consistent lack of pollen grains and uniform appearance suggest secretion rather than regurgitation. The growth of the worker larva is remarkably rapid, and within $4\frac{1}{2}$ to 5 days it increases its initial weight by more than 1500 times, the most rapid increase taking place during the period when it receives the nitrogenous diet. Part II. of the Bulletin, by Mr. Bruce Lineburg, deals with the feeding of the larvæ. He finds that the elaborated food upon which the larvæ feed during about the first two days of their life is practically all placed with the newly hatched larva soon after hatching. Soon after the second day, food containing undigested pollen is given at about the same rate as it can be consumed. It is suggested that, owing to the fact that the nurses devote an excessive amount of time to the older larvæ as compared with the younger, possibly reciprocal feeding or trophallaxis is involved. This latter phenomenon is very evident among ants and wasps, but has not so far been observed among bees.

VITAMINS, SUCCULENCE, AND PRICKLY PEAR.—In a vigorously written Bulletin, Reprint 43, 1923, of the South African Department of Agriculture, Mr. A. Stead, senior chemist, Division of Chemistry, connects the above three factors, on grounds rather of interpretation of the community's experience than of experiment. Pointing out the value of succulent fodder to cattle, he concludes that this is due to its content of vitamin A, and then deduces from the healthy cattle (and human population) carried by the Karroo, in spite of the absence of grass, that such plants as prickly pear and the American aloe, *Agava Americana*, must be storehouses of vitamin A. Hence follows a vigorous plea to regard the prickly pear in another light than as South Africa's widespread pest, and the experience of representative farmers is cited for its value as cattle food when pulped, whilst where brushwood abounds, the spines can be dealt with by singeing over a brushwood fire.

OXIDATION PROCESSES IN TISSUES.—Oxidation processes of normal and cancer tissue are discussed by Alfred Fleisch in the *Biochemical Journal*, vol. 18, No. 2, 1924. It is shown that glutathione produces the same effect on the thermostable sarcoma residue as was found by Hopkins with the thermostable

muscle residue, but there are, nevertheless, points of difference between the oxidative processes which take place in cancer tissue as compared with normal muscle. One striking difference is as regards the oxidation of citric acid; this accelerates the methylene blue reduction of washed muscle, but not of the washed sarcoma, yet both tissues oxidise citric acid when oxygen is supplied. Succinic acid is much more actively oxidised by muscle than by sarcoma; at the end-point, it is found that one molecule of succinic acid uses one atom of oxygen. This oxidation, when effected in the presence of methylene blue, is not inhibited by hydrocyanic acid, but when effected by molecular oxygen there is marked inhibition by hydrocyanic acid. There is evidence that a "hydrogen transport factor" distinct from the specific "succinoxydase" is present in tissues, and that it is more abundant in muscle than in sarcoma tissue. For the oxidation of succinic acid as an aerobic process, it would appear that an activation of both hydrogen and oxygen is essential. Another paper which bears somewhat closely on the subject is by Dorothy Mary Moyle, and deals with a quantitative study of succinic acid in muscle. After anaerobic incubation, the content of this substance in muscle is increased; it is also increased by adding glutaminic or aspartic acid, but not by sugar, while addition of pancreatic preparations diminishes it. There is much more succinic acid in the red than in the white muscles.

BEHAVIOUR AND STRUCTURE OF HYDRA.—Miss Sheina Marshall (*Quart. Journ. Micro. Sci.*, vol. 67, pp. 593-616, 1923) gives an interesting account of her observations on Hydra. The digestive juices of Hydra are alkaline. Miss Marshall records that one specimen was ingested by another and remained in the coelenteron for more than twelve hours and was then expelled "none the worse." Observations on the origin of the egg are in accordance with the view that the egg arises by the coalescence of a group of primitive ova derived from interstitial cells. The different types of nematocysts—penetrant, volvent, and glutinant—were carefully examined. The thread of the penetrant has apparently rows of pores or permeable areas through which the fluid within can escape as well as through the terminal opening, and similar observations were made on the threads of glutinants. The nervous cells are divisible into two types—ganglion cells, and cells which are intermediate between ganglion and epithelial. The former are of various shapes according to the number of processes they possess. Their processes, which are often branching, can be seen to unite with those of another nerve cell, though many end freely—sometimes in a small knob, and others may be traced to the muscle-fibres of the myo-epithelial cells. The second type of cell is long and narrow and has a nervous process (fibril) at one end which may branch and come into connexion with another nerve cell. The opposite end of the cell is flattened or knob-like, and rarely bears a sense-hair.

NEW OR RARE SPECIES OF INSECTS FROM GREAT BRITAIN.—A significant fact is the frequent discovery in Great Britain of species of insects new to science, notwithstanding the large number of amateurs and others who are engaged in entomology. In the March number of the *Entomologist's Monthly Magazine* are records of two new species. Mr. J. V. Pearman describes a Psocopteron—*Cæcilius corticis* sp. nov.—from trunks of trees in the Bristol district. Both sexes and the nymphs of the insects were met with, but the eggs were not discovered. A curious feature is the wide range of trees upon which it was found, including beech, sycamore, hawthorn, and horse-chestnut; also sparingly on birch and conifers. Miss F. M. Wimshurst brings to notice a new aphid which she names *Macrosiphum galiophagum*. It was found on *Galium aparine* at Brenchly in Kent. The rare and curious sawfly *Xyela julii* Breb. is recorded by Mr. G. B. Walsh from near Scarborough, where it was taken off spruce on May 5 last year.

PHENOLOGY IN SWEDEN.—In 1873, Prof. H. H. Hildebrandsson of Uppsala organised a series of phenological observations in Sweden, with instructions specially adapted to that country. That series has continued to the present time. At first directed by the Meteorological Observatory in Uppsala, it was taken over in 1882 by the Meteorological Central Institute in Stockholm, and later on by the State Institute for Meteorology and Hydrography. Towards the end of 1923, this last body published a digest of these observations, so far as they refer to Svealand (that is, the provinces of Uppland, Södermanland, Nerike, Västmanland, Värmland, and Dalecarlia), from the pen of Dr. H. Wilhelm Arnell, who adds many observations of his own in order to complete the picture. Among the contents of this laborious work are: a comparison of the seasonal times in the various parts of Svealand; a comparison of the course of development in various years; a flower calendar for Uppland; dominant flowering-periods in Svealand, dealing with those plants which at the height of their blossoming chiefly characterise and give colour to the landscape in that part of Sweden.

CANADIAN PLACE NAMES.—In the seventeenth Report of the Geographic Board of Canada there are several papers on the meaning of Canadian place names. Mr. R. Douglas's contribution on city names gives the history of the titles of the chief cities of Canada. These researches in certain instances reveal interesting chapters in the history of the country, and although in many cases the derivation is obvious, it is well that it should be recorded before erroneous explanations, due to more recent events, creep into existence. In a paper on the names of Anticosti Island, which is accompanied by a useful map, Col. W. P. Anderson shows how the mingling of English and French speaking people has resulted in some curious forms, and in some cases in alternative names for the same feature, but what is most striking is the lack of originality and imagination exhibited in the choice of designations. The names which are not obviously descriptive are generally derived from vessels wrecked in the vicinity. The same peculiarities apply to the names of the Magdalen Islands, near the mouth of the Gulf of St. Lawrence, on which Mr. R. Douglas contributes a paper.

GLYCYMERIS IN THE TERTIARY OF NEW ZEALAND.—A valuable little monograph on the pelecypod shells of the genus Glycymeris (better known to a past generation of conchologists under the name of Pectunculus) from the Tertiary of New Zealand has recently been written by Mr. J. Marwick, of the New Zealand Geological Survey (Trans. New Zealand Inst., liv.). Eighteen species are described, of which eleven are new, while in one of the others the name has had to be changed. They are divided by the author into three groups: the *laticosta* group; the *huttoni* group; and the Axinea group. Since this last name, however, is one of Poli's, and he was not a binominal author, a different designation will have to be chosen when it comes to the stage of erecting subgenera. One or two of the *huttoni* group, especially *Glycymeris hurupiensis*, n. sp., are remarkable in showing an approach in hinge aspect towards Arca. The characteristic features of the several species are well brought out in the plates.

EXCITATION OF THE SPECTRA OF ARGON, KRYPTON, AND XENON.—M. G. Déjardin describes the results he has recently obtained by electron bombardment of the above gases, with gradually increasing electron velocity (*C.R.*, Acad. Sc., March 24). They confirm his conclusions from previous experiments, in which he studied the discharge in tubes without electrodes, using alternating currents. The following table gives the results: P_1 is the ionisation potential at and above which the first or arc spectrum is produced. This is emitted by the normal atom. There are two limits of excitation for the E_1 spectrum, the lower of which, P_2, is only observed when the pressure is relatively high and the bombardment intense. The difference between this and the higher excitation limit P_3 is equal, for each of the gases, to the ionisation potential. The spectrum is ascribed to singly ionised atoms. The lower threshold of excitation is, according to the author, the potential of further ionisation of the singly ionised atom, while the second corresponds to the simultaneous extraction of two electrons from the normal atom. The most intense lines of E_2 appear for an accelerating potential of the bombarding electrons P_4; other lines appear as the potential is raised, and have maximum intensity at about 15 volts above P_4. It is very probable that the E_2 spectrum is due to the excitation of doubly charged ions. Column A

Gas.	P_1.	P_2.	P_3.	P_4.	A.	B.
Ar .	15·2	19·0	34·0	70	2·24	4·61
Kr . .	12·7	15·5	28·25	59 ?	2·22	4·65
Xe . .	10·9	13·0	24·25	51	2·22	4·68
Limits of Error .	±0·2	±0·5	±0·5	±2		

gives the ratio of the double and single ionisation energies $= P_3/P_1$, while column B gives that between the excitation potential of spectrum E_2 and that of the arc spectrum; all the values in column A are nearly equal, and the same is true of column B. This shows the analogy between the structures of the electronic layers in which the spectra of successive orders originate, for these three gases. Only a few of the lines formerly ascribed to the E_3 spectrum were photographed by the bombardment method even at 100 volts, and they were very weak. They are probably due to the excitation of ions carrying at least three elementary charges.

THORIUM EMANATION IN THERMAL SPRINGS.—M. A. Lepape has recently investigated a number of thermal springs in France in order to find whether thoron is contained in the dissolved gases (*C.R.*, Acad. Sc., March 10). A funnel was placed over the mouth of the spring to collect the gases given off, which passed upwards into a large zinc cylinder in which was a smaller, aluminium, insulated cylinder, with a sheet of aluminium foil wrapped round it. This was kept at a potential of −300 to −350 volts, and the decay products of radon and thoron, if any, were collected on the aluminium foil. The radon products reached a maximum value in four or five hours, the thoron products in two or three days. The aluminium foil was taken out and placed in an ionisation chamber. If four hours after the removal an ionisation current was found, which diminished to one-half in about eleven hours, the presence of thoron in the spring gases was indicated. Five springs in the Pyrenees showed no thoron; but three out of four in the central French plateau showed a very small amount, most being found in a spring which gave off very little radon. All the other springs examined contained radon. The reason why such small quantities of thoron were found is that its life is very short, so that if more than ten minutes elapse before the water reaches the outlet all the thoron has disappeared.

ARE METALS DISINTEGRATED BY AN ELECTRIC DISCHARGE?—The Journal of the American Chemical Society for April contains a communication from Prof. Harkins and Mr. S. K. Allison on the examination of gases left after the passage of electrical discharges between fine wires of platinum or tungsten in a vacuous bulb, through hydrogen, and through mercury vapour. A condenser of 0·5 microfarad charged to 42,000 volts was used in the case of the metal wires; in the case of mercury vapour (0·1 mm. pressure) the voltage was 84,000 and the discharge passed between steel balls 3·2 cm. in diameter. In the case of hydrogen, the 84,000 volt condenser was discharged a hundred times through a 500 c.c. bulb containing very pure hydrogen at 40 mm. pressure. In all cases the gases left were examined for helium by the spectroscopic method of Soddy, but in no case was any helium found. The result may be compared with the announcement made by Wendt and Irion in 1922 that in the explosion of tungsten wires in vacuum, by a powerful discharge, the metal disappeared, and helium was produced (NATURE, 1922, vol. 110, p. 529).

REINFORCED CONCRETE CHIMNEYS.—A number of cases of failure of reinforced concrete chimneys is noted in Engineering Abstracts, No. 19, published by the Institution of Civil Engineers; the particulars of these failures were taken from the Copenhagen paper *Ingeniøren* 32. Many of the earlier chimneys developed cracks, and it was assumed that suitable reinforcement combined with firebrick linings would overcome this difficulty. Renewed investigation has become necessary owing to several important failures. A concrete chimney 213 feet high, discharging very hot gases, collapsed suddenly on a quiet day; there was a free lining of firebrick throughout. It was concluded that the lining collapsed first, owing to the high temperature, and damaged the lower part of the reinforcement, consisting of hoop iron spaced 8 inches apart. The fracture would probably have been avoided if round steel bars of substantial section had been employed. It would appear that the circumferential reinforcement should be of ample section, and that free firebrick linings exposed to high temperatures should be substantial and well built. In another case where the chimney was dismantled after four years' use, having become wholly unsafe, it was thought that the change between winter frosts and extreme heat may have caused the cracks. Neither cracking of the concrete nor corrosion of the reinforcement was found where the cover of the reinforcement was ¾ inch on the outer surface and 1½ inch on the inner surface. In another chimney, built in 1909 and dismantled in 1923, warm subsoil water was obviously the principal cause of decay. In the same number of *Ingeniøren* Mr. H. Kronkvist describes the failure of the top portion of a reinforced concrete chimney at Limhamn, Sweden, and states that his firm has abandoned the construction of such chimneys and has reverted to brickwork. Another chimney, 164 ft. high, used for discharging fumes from an ammonia-extraction plant, was built in 1915 and was in a dangerous condition in 1923. The external and internal layers of concrete had separated from the reinforcement to a height of 59 feet above ground-level, and there was much other damage. It is intended to replace this chimney with one constructed entirely of brickwork.

British Universities and Empire Development.

THE annual conference of the universities of Great Britain and Ireland took place at University College on May 10 under the presidency of Sir Donald MacAlister. The four subjects chosen for discussion were: (1) Directions in which universities might profitably develop, at the present time, were funds available; (2) the Ph.D. degree as an encouragement to higher study and research; (3) universities and research in relation to the development of the natural resources and the industries of the Empire; (4) interchange of university teachers and students.

In opening the discussion of the first subject, Sir Theodore Morison said that the task for which universities require funds most urgently at the present time is not an extension of the field of their activities, but the consolidation of ground already occupied. To discharge efficiently the functions they have already undertaken, resources which would have amply sufficed before the War are now totally inadequate. This is due not only to the large increase in the number of students, especially of students of science, but also, so far as the modern universities are concerned, to the fact that a very large proportion of them now come from humble homes and lack the traditions, standards, and the pocket-money which enabled the students of a bygone day to provide for themselves the essentials of a healthy social life. Under the new conditions, therefore, there rests upon the universities a much heavier responsibility than before in regard to such matters as the provision of hostels, club-rooms, libraries, and recreation grounds. The laboratory requirements of the science departments have grown year by year, and both staffs and equipment are much more costly than before the War.

The Vice-Chancellor of Oxford spoke of the needs of the Bodleian and the need of funds for endowing post-graduation studies, and Dr. R. S. Conway emphasised the value of scholarships for foreign travel both as correctives of provincialism and, particularly since the World War upheaval, on account of the direct and friendly personal relations with inhabitants of foreign countries which they lead to. Dr. E. Barker, Principal of King's College, suggested that the universities consider what preparations are necessary for the increase, which is almost certain to take place in the near future, in the number of students in their teacher-training departments, involving additional hostels, improved opportunities for research by teachers, and development of departments of psychology and fine art. Sir Alfred Ewing directed attention to the progressive character of old subjects and the necessity for continual adjustment of equipment to enable the teaching of the fundamental subjects to be maintained at university standard. In science, this involves from time to time very heavy outlays. He instanced the new chemical laboratories of Edinburgh, which have cost a quarter of a million pounds.

The second subject was introduced by the Master of Emmanuel. At Cambridge, candidates for the Ph.D. degree have during the past three years numbered 143, 179, and 209. Two-thirds of them come from other universities, hoping to find more facilities for research, better methods of training for research, and wider opportunities for association with other students, than their own universities afford. Dr. Giles quoted advice given by Sir Ernest Rutherford that research students should not lose sight of the importance of continuing their education, that occasional special lectures by great specialists are extremely valuable, and that the formation of students' discussion societies should be encouraged. Prof. A. N. Whitehead reminded the conference that the foundation of the Ph.D. degree marked the beginning of a new era of co-operation between British universities, promoting the unity of British civilisation. The number of candidates for this degree in London had exceeded all expectations notwithstanding that ample precautions are taken for maintaining a high standard of qualification for admission. The most important aspect of the work of these students, and the aspect which should be ever present to the minds of their supervisors and examiners, is the extent to which it favours the development of creative knowledge, of ability to render knowledge available and applicable to concrete problems. Sir Richard Lodge argued that a relaxation of requirements in regard to residence is needed in order that students may pursue elsewhere studies begun in the universities in which they first graduated. In particular he advocated the "federalisation" of the London Institute of Historical Research so that other universities may contribute to its support and acquire the right to send students to it without severing their connexion with their own universities. He announced that the Council of the Institute had agreed to this in principle.

The third subject, the relation of the universities to the development of the resources of the Empire, was dealt with first by Principal Grant Robertson of Birmingham, who directed attention to the fact that the supply of men, other than medical students, who have been trained broadly in the biological sciences is far short of the present demand, whereas chemists and physicists have difficulty in finding employment. He suggested that the universities should adopt an agreed policy with the view of remedying this unsatisfactory state of affairs. Sir Frank Heath said that industry recognises that for further progress in research it is largely dependent on the universities. At the same time, universities are subject in this connexion to certain limiting considerations. It is inappropriate for them to undertake certain kinds of research which, owing, for example, to their involving an excessive amount of patient repetition of experiment, have but little educational value, or involve enormous expense spread over a long period of years. There are many industrial problems the investigation of which involves wide-flung team work whether owing to the nature of the problem, as in atmospherics, or to other causes. For the due co-ordination of the available agencies for research throughout the Empire, there is needed a central staff in close touch with the universities, the industrial research laboratories, and the laboratories of individual workers.

Sir Walter Fletcher, confirming the somewhat unfavourable comments made recently by Dr. Abraham Flexner on the subject of medical research in Great Britain, stated that our progress during the past twenty years cannot justly be described as satisfactory. Americans believe that the Dutch are more progressive. They contrast their energetic measures for the extirpation of the hookworm begun twenty years ago and financed mainly by Mr. Rockefeller, with our supineness in regard to the same disease in India. We are lacking as a nation, said Sir Walter Fletcher, in scientific staff work, and a conspicuous example of this is to be seen in the lack of intercommunication between the men in the field and the men in the university laboratories. In this connexion Sir John Russell said that visitors from overseas are constantly invited to visit the Rothamsted Experimental Station, and endeavours are made

to keep in touch with them after they go back. He thought that it would be a good thing if universities were to endeavour to establish contact with men engaged in industrial and administrative work in the outlying parts of the Empire. Sir Theodore Morison thought the Colonial Office should remodel its antiquated system of recruiting for scientific services.

The discussion of the fourth subject, the interchange of university teachers and students, was opened by Sir Henry Miers. A mode of exchange which has recently been tried with success by Cambridge and Manchester is as follows: a professor of university A obtains leave to spend a term at university B, where he is received on the footing of supernumerary professor and obtains a thorough insight into the working of the department without undertaking responsibility for its administration. Afterwards a return visit is paid by a professor of the same department of university B to university A. Inter-university visits of junior teachers and graduate students have been successfully arranged, and nothing but the cost of crossing the Atlantic prevents the development of a very extensive interchange of such visits between Great Britain and America. It is desirable from an imperial and international point of view that interchange, especially of young teachers, both between the home universities and those in other parts of the Empire and between British and foreign universities, should be systematically encouraged, as it is by governments or associations in other countries. Sir Richard Lodge praised, in this connexion, the work of the Student Christian Movement. Dr. Hickson of Manchester thought it important also to encourage interchange of teachers between the home universities. Dr. Duniway, of the American University Union, remarked that American universities are eager to *provide facilities* in the form of part-time employment for visits by young British university teachers and other graduates, and that the administrators of American universities look upon the whole civilised world as their recruiting ground for their summer school staff. Two visitors from Australian universities recommended that steamship companies be approached with the view of obtaining concessions for graduates visiting Australian universities from Great Britain similar to those already in force for visits in the opposite direction.

A full report of the proceedings is in preparation and will be issued from the Universities Bureau of the British Empire, 50 Russell Square, W.C.1.

The Sir William Dunn Institute of Biochemistry, Cambridge.

ON Friday, May 9, the recently completed Sir William Dunn laboratories in which the Cambridge School of Biochemistry is now housed were officially opened by the Earl of Balfour, Chancellor of the University. Upwards of 400 guests, a gathering representative of all faculties of the University of Cambridge and of many outside academic and public bodies, were present when the Chancellor rose to call upon Sir Jeremiah Coleman, the chairman of the board of trustees of the late Sir William Dunn, to make his statement.

Sir Jeremiah Coleman explained the circumstances in which the trustees had allocated the money which Sir William Dunn had desired should be devoted to the alleviation of human suffering, to found this great institute in Cambridge, in the opinion that this was the most fruitful way in which the testator's wishes could be carried out. For the erection of the building and its endowment the sum of 210,000*l.* had been given. (In addition, Sir Jeremiah himself has made a generous private gift toward the endowment of the library of the School.)

The trustees' formal statement having been read by Sir Jeremiah Coleman and the building thus handed over to the University, the Chancellor gave his address. After thanking Sir Jeremiah and the board of trustees as the discerning agents of this great bequest, he recalled the earlier benefactions by which the beginnings of biochemistry in Cambridge had been made possible, and without which the present munificent gift could never have been made. The great object towards which the testator had desired that his estate should be applied could not have been better approached than in the direction which the body of trustees had chosen, that of the foundation of a great institute of research and teaching which should deal with the fundamental problems at the meeting-place of chemical and biological science, with the solution of which the well-being of the race, both now and in the future, was so intimately bound up. He instanced cancer, the scourge which had for many years defied the utmost clinical efforts, as being one of the urgent fields of work which might well yield up its secrets, to the immense benefit of humanity, in such a laboratory. The new foundation was particularly happy in having the genius of Prof. Gowland Hopkins to inspire and direct the endeavours of the devoted band of workers that was now gathered under his leadership.

The building was then declared open, and the guests were invited to visit the numerous demonstrations which had been arranged in the laboratory, illustrating the principal lines of research work which are being carried out at present in the School.

A three-storey edifice of dark red brick, the building was designed by Sir Edwin Cooper and built by Messrs. William Saint and Co., of Cambridge. It stands on land which was bought by the University from Downing College, has a frontage on Tennis-court Road, and overlooks part of the grounds of Pembroke College. Facing as it does somewhat south of west, every room in the building has the advantage of at least a portion of the day's sunlight. Behind, it shares with the School of Agriculture two sides of what will eventually become the second court of the group of natural science laboratories on the south side of Downing Street.

The library, the nucleus of which was built up in the vestry whilst the School of Biochemistry pursued its adolescent life in what had previously been a Dissenting Chapel, is now lodged, in the new building, in the more congenial oak of the southern ground-floor room, which contains four wood-carvings in relief, of Mayow, Liebig, Graham, and Pasteur. The library crosses the building from east to west, and is balanced by a lecture-room of similar dimensions at the northern end of the building, in which room may be found the earliest chemical lecture-room bench to be used in Cambridge, presented to the School by St. John's College. The offices and cloak-rooms are on this floor, together with six research and lecturers' rooms and another room where a not unimportant part of the day's routine is carried out from 4 to 4.30 P.M. On the first floor are Prof. Hopkins's private room and laboratory, another large room specially designed for bacteriological research, and eight research rooms. The second floor is taken up by one large laboratory for elementary, and a smaller one for advanced students, together with the necessary preparation rooms, and a lecturer's room. The basement contains service and store rooms, the workshop, engine-room, animal houses, and two research laboratories.

Although originally designed to hold what appeared to be the ample number of 20 to 24 research workers, the laboratory has already a population of no fewer than 38, of whom 11 are women. Included among these 38 are six members of the University staff, three Australians, a Canadian, a New Zealander, a citizen of the Irish Free State, an Indian, a Norwegian, and an American; whilst among the fellowships and exhibitions held are four Beit Memorial Fellowships for medical research, one Sir William Ramsay Memorial Fellowship, and two 1851 Exhibitions.

The following list of problems, among those with which this body of workers is engaged, indicates the extremely wide field with which modern biochemistry is dealing: cell oxidations both in the animal and the plant; the mechanism of the action of glutathione and other oxidising enzymes; the properties and mode of action of insulin and other hormones; bacterial metabolism; protective syntheses in the animal; inorganic metabolism; the constitution of casein, hæmatin, thyroxin; inositol metabolism; the rôle of phosphorus compounds in metabolism; vitamins; cancer; analytical methods; the colours of flowers; the pigments of insects; the optically active substances in blood.

Unless the promise of "Back to Methuselah" is fulfilled in this or some similar laboratory in the reasonably near future, the writer of these lines fears that he will not be able to be present at a ceremony which he would attend with the very greatest interest, namely, that of the centenary of the opening of the Sir William Dunn Institute of Biochemistry, when the magnificent possibilities of the new laboratories shall be in no small measure realised.

Problems of Muscular Receptivity.

SIR CHARLES SHERRINGTON, whose book "The Integrative Action of the Central Nervous System" has received world-wide attention, gave the Linacre Lecture in the Lecture Room of Anatomy and Physiology at Cambridge on May 6. He commenced by pointing out that Linacre (the founder of the Royal College of Physicians), who is claimed first by the Grammarians as one of themselves, also initiated medical teaching on the banks of the Cam and the Isis. Linacre was a researcher in science at a time when scientific research was practically in its infancy. It is therefore very fitting that the lectureship which he founded should be devoted to a consideration of the results of research in medicine.

The reactions of the central nervous system involve two kinds of receptors, those of the special sense organs and those of the proprioceptive organs. The former arouse conscious reaction: the latter seldom do. On the other hand, the latter initiate complex reflex actions: the former do not do so often, except with the intervention of consciousness.

The muscles which form the motor mechanisms of the body, whether it be to fell a forest or pronounce a syllable, are called into action not only by reflexes, but also by the initiation of the will directly or indirectly dependent on the receptors above mentioned. But these muscles themselves are known to possess receptors which respond to events taking place not only outside but also within themselves, thus the term used for such receptive organs found in muscles—the "proprioceptor organs."

For the experimental investigation of such proprioceptors the still surviving body of the recently killed animal has to be used. It lies motionless or stands motionless unless stimulated; it can initiate no movements since the cerebral hemispheres are destroyed. The muscles preserve their tonus, which may be better called "postural contraction." To preserve this tone, the receptors somewhere must be reacting to stimuli, since the tone disappears when the nerves connecting all the receptors with the central nervous system are cut. Among these receptors are the pads of the soles of the feet and the skin of the limbs. Experiment shows, however, that these take little or no part. The principal part is played by proprioceptors in the animal's own muscles—those which hold up the head, those which keep the jaw closed, and those which keep it in the erect position against the action of gravity.

Experiment shows that a muscle, such as the knee extensor, which is about 100 mm. long, will with nerves intact exert some 2 kilograms tension when stretched to 101 mm. With nerves cut, no such tension is exerted. The intact muscle will, moreover, preserve the contraction even if it be allowed to return to its previous length of 100 mm. If by means of appropriate electric stimulation we abolish the contraction, we find practically none of it was due to the passive stretching of the structure of the muscles. To this tension set up in a muscle as the result of stretching it the term "the stretch reflex" may be given.

Returning now to the whole animal and applying these experimental results, we find the active posture of standing is the summation of a large, highly organised number of stretch reflexes. Moreover, we observe a high degree of adaptability on the part of the animal. The feet may be planted in various positions and still the posture of standing is preserved.

Sir Charles explained in detail how this adaptability was brought about. He then enumerated the parts of the problem which have yet to be solved by further research, and concluded his lecture by saying that one of his hopes was that, as a result of the Linacre Lecture which he was delivering, more recruits would join the ranks of physiologists for the purpose of attacking some of these problems.

University and Educational Intelligence.

DURHAM.—Dr. A. K. MacBeth, lecturer in chemistry at the University of St. Andrews, has been appointed reader in chemistry in the Durham Colleges. Mr. H. J. E. Dobson, of University College, London, has been appointed lecturer in chemistry.

LEEDS.—Applications are invited for the open fellowship of 200*l.* per annum established by the Institution of Gas Engineers for the prosecution of post-graduate research in gas chemistry. The latest date for the receipt of applications by the Registrar of the University is June 2.

LONDON.—Miss M. Tildesley, Research Assistant, Royal College of Surgeons, will deliver a free public lecture at University College (Department of Applied Statistics and Eugenics) on Tuesday, May 20, on Sir Thomas Browne, author of "Religio Medici"—His Skull and Portraits. A free public lecture (in English) will be delivered at 5.15 on Wednesday, May 21, in the physics lecture theatre of the Imperial College, Royal College of Science, by Prof. P. Zeeman, on "The Optical Effects of Motion." No tickets will be required for either lecture.

Applications are invited for the university studentship in physiology, value 50*l.* It will be awarded to a student qualified to undertake research in physiology. The latest date for the receipt of applications is May 31. They should be sent to the Academic Registrar, University of London, South Kensington, S.W.7.

MANCHESTER.—The Sheridan Delépine research fellowship in preventive medicine, value 300*l.*, will shortly be awarded. The selected candidate will be required to register as a research student of the university and to devote his whole time to research in the department of bacteriology and preventive medicine. Applications, together with particulars of qualifications and the proposed subject of research, must reach the Internal Registrar of the University by June 20 at latest.

SHEFFIELD.—The Council has made the following appointments: Mr. W. F. Wyatt to be demonstrator in chemistry, and Mr. R. R. S. Cox, assistant lecturer and tutor in mathematics, to be curator of the University Observatory.

A COURSE of four free public lectures on "Astronomers of four Centuries" will be delivered by Mr. A. R. Hinks at Gresham College, Basinghall Street, E.C., on May 20 to 23, at 6 o'clock. The astronomers in question are Tycho Brahe, Edmund Halley, William Herschel, and Edward Emerson Barnard.

APPLICATIONS are invited by the Appointments Board, University Offices, Cambridge, for the chair of organic chemistry in the Indian Institute of Science, Bangalore. Particulars of the post may be obtained from the Secretary of the Board, to whom applications should be sent before June 30.

WE learn from the *Revue scientifique* that M. Léonard Rosenthal has given a sum of a million francs, the income of which is to be administered by a special committee, for the promotion of research in chemistry, physics, natural sciences, etc., and particularly the "borderland" sciences which have at present no recognised status. At least one-half of the income derived is to be used as a gift to enable a research worker to follow his investigations uninterruptedly, and the other portion is to be divided into two or three awards for young workers already engaged in scientific research.

APPLICATIONS are invited by the Middlesex Hospital Medical School for two part-time Cancer Research Scholarships (one being the Crausaz Memorial Scholarship), each of the annual value of 150*l.*, tenable at the school for three years upon yearly appointment. The Crausaz scholar must have medical qualification, and will be expected to undertake laboratory research on cancer. The holder of the second scholarship must have medical qualification, and will carry out clinical investigation in the radium treatment of cancer, under the direction of the Radium Committee. Applications, with testimonials not exceeding three in number, should reach the Secretary to the Council of the School by Monday, May 26.

THE World Federation of Education Associations is prepared to receive (at Augusta, Maine), up to July 1, suggestions for the "education of the children of all nations so as to bring about a better international understanding and to eliminate hatred both racial and national." For the best plan a prize of 25,000 dollars is offered. Foreign travel as an adjunct to foreign service training in colleges and universities is so highly esteemed in the United States that a National Council on Foreign Service Training, lately organised under the auspices of the Bureau of Education, is preparing a programme of co-ordinated effort to promote it, with special reference to foreign trade. On the other hand, British students of architecture are being encouraged to visit America by the offer by an American architect of a six-months scholarship.

Early Science at the Royal Society.

May 11, 1664. A letter concerning the transplanting of the East-India spices in the West-Indies, was ordered to be communicated to Mr. Povey, in order to recommend that work to the council for foreign plantations; and Mr. Povey gave some account of what had been formerly in design concerning it, and promised to promote the same with all possible vigour and to report the progress.

1676. There was made by William Cole, M.D. an observation about the intestines of Animals, viz., that the structure of their fibres is not annular, as had been before generally received, but spiral. Because the meeting was very thin, and neither the president nor vice-president in the chair it was thought proper to discourse it at a fuller meeting.

May 12, 1686. Dr. Papin shewed the experiment of brewing in his new digester; and it was found, that there was a very strong tincture drawn from the malt in much less time than it could have been done in the ordinary way.

May 13, 1663. The experiments appointed for the next meeting were: That of descending bodies in a receiver emptied of air—That of putting water purged of air into the engine—Of condensing air in the new compressing engine—Of killing a mouse or frog in the said engine.

1675. Mr. Evelyn continued to read his *Discourse of Earth*, and explained what advancement of fertility might be expected from stercoration and manuring the ground by composts.

1680. Before the Society sat Mr. Mellin, who had long made it his pleasure and business to make small len's for microscopes, shewed several members some of his own making, which were extremely small and yet very good.

May 14, 1662. Dr. Wallis gave an account of a young man deaf and dumb, who, after three months' instruction by him, was brought to speak words very plainly. The doctor was desired to bring the young man to the next meeting of the society. (Wallis, writing to Oldenburg, says: "I am now employed upon another work, as hard almost as to make Mr. Hobbes understand mathematics. It is to teach a person dumb and deaf to speak, and to understand a language.")

1668. The rarefying engine being called for to try an experiment appointed, but found not to have been brought, the operator was strictly charged to bring it in at the next meeting; as also to provide a glow-worm or viper to make trial upon.

1684. A letter of Signor Malpighi to Mr. Aston was read, returning thanks for the books last sent him by the Society, and mentioning the burning of his house in the preceding month, whereby he had lost all his *adversaria* and microscopes.

May 15, 1672. Dr. Grew made some observations about the secundine or innermost cover of the seed in plants, of which he produced a description in writing; and gave in the heads of the most considerable particulars concerning vegetables—Mr. Hooke made some experiments relating to Mr. Newton's theory of light and colour which he was desired to bring in writing.

May 16, 1667. The great load-stone of sixty pounds weight was tried. It moved a needle at about seven feet and a half distance. Mr. Boyle moved that it might be tried somewhere in the ruins of London, what was the declination of the needle after the fire. It being inquired how the quick-silver stood about and during the time of the fire, Mr. Hooke affirmed that he had found it very high. Mr. Boyle had not found his tube so.

Societies and Academies.

LONDON.

Physical Society, April 11.—Mr. F. E. Smith in the chair.—C. R. **Darling** and R. H. **Rinaldi**: The thermo-electric properties of bismuth alloys, with special reference to the effect of fusion. With a note on thermo-electric inversion. A number of different alloys of bismuth with lead and tin respectively were prepared, some of which expanded on freezing, whilst others contracted. The E.M.F. given by these alloys against copper was observed up to 400° C. or over, and it was found that (1) the change in E.M.F. due to the addition of increasing portions of either lead or tin to bismuth reached a maximum value for certain compositions; and (2) that the alloys which expanded appreciably on freezing showed a change in thermo-electric power at the freezing point. The methods employed were not sufficiently sensitive to decide whether the point of disappearance of the thermo-electric change was reached in the case of alloys which were unaltered in volume on freezing. One of the alloys (60 bismuth, 40 tin), when coupled with iron, shows the unusual phenomenon of thermo-electric re-inversion. With a cold junction at 0°, this couple shows a zero E.M.F. at 0°, 200°, and again at 350°.—J. J. **Manley**: (1) Preliminary measurement of a primary gas-grown skin. An electrical method for detaching a gas-grown skin from a glass surface is described. Determined in this way, the massiveness of the skin per unit area is much larger than is generally supposed. (2) Removal of gas-grown skins from a Sprengel pump. The pump possesses two vacuum tubes which are interposed between the cistern and the fall-tube. The vacuum tubes have external electrodes. When the pump is in use the electrodes are activated; and the mercury, in falling through the glow discharges, is largely freed from condensed and adsorbed gases.—W. N. **Bond**: Sub-harmonics produced by a tuning-fork. An extension of experiments described in NATURE of March 8, p. 355.

Royal Microscopical Society, April 16.—Mr. A. Chaston Chapman, president, in the chair.—T. Howard **Rogers**: Electric method of staining radulæ. Radulæ, after removal from the animal, are boiled in a 10 per cent. solution of caustic soda to remove the connective tissue, etc. After thorough washing in 10 per cent. acetic acid, they are smoothed out between moistened filter paper and laid between two polished metal plates (zinc and copper) attached by flexible leads to a 2-volt accumulator. Protoplasmic stains alone are suitable. They are dissolved to saturation in 33 per cent. acetic acid, and the zinc positive plate with the radulæ upon it is placed in a dish and flooded with the stain. The process should continue until the tissues are somewhat over-stained. They are then washed with 25 per cent. HCl-alcohol solution until sufficiently decolorised, taken up the alcohol series and mounted in balsam.—T. **Goodey**: Recent work on nematode life-history. The following nematodes came under review: *Tylenchus dipsaci*, causing stem diseases in a number of plants of agricultural importance, *T. tritici* causing "cockles" in wheat, *Allantonema mirabile* from the body-cavity of a weevil, *Hæmonchus contortus*, the stomach worm of sheep, *Ancylostoma duodenale*, the human "hookworm," with special reference to skin penetration by the infective larvæ, *Syngamus trachealis*, causing "gapes" in chickens, *Ascaris* spp. of various animals, and *Habronema megastoma* from the stomach of the horse.

Royal Microscopical Society (Industrial Applications Section), April 23.—Sir Charles Parsons in the chair.—Annie D. **Betts**: The practical use of the microscope in the bee-keeping industry. The microscope is of assistance to the bee-keeper in disease diagnosis and in questions of colour inheritance and constancy to type (important to the queen-breeder). It also makes possible the determination of the country of origin, if not the floral source, of a sample of honey; and by the same means (identification of pollen) enables the bee-keeper to determine the times of flowering of the principal nectar plants of his district. —S. R. **Wycherley**: Fibres, analytical and economic. From the analytical point of view it is desirable to make standard sets of slides, from which materials to be tested can be judged. In examining products of various kinds the plant hairs, being difficult to destroy and in many cases quite characteristic in form, often prove a method of investigating the purity of a compound, and the amount, if any, of the adulteration. The study of fibres from the economic point of view is also of great value. For example, cotton fibres are characterised by a peculiar twist, and the regularity of that twist together with the thickness of the hair itself is one of the tests for the quality of the cotton fibre used. Animal fibres also form important lines of investigation. For example, the scale marks covering the outer cuticle of the surface of the wool are very constant in various qualities of wool and form an important point in testing for quality.

Royal Anthropological Institute, May 6.—Prof. C. G. Seligman in the chair.—Sir E. **Denison Ross**: The origin of the Turks. The word "Turk" is properly applied to all the peoples of Central Asia speaking a Turkish dialect, the oldest of these being the Turki of Eastern Turkestan, the most modern the Osmanli Turkish of Constantinople. The migrations of the Turks from the heart of Asia to the Ægean can best be traced by a study of these dialects in their three groups of Chagatai, Tartar, and Turkish. The oldest inscriptions are those of the Orkhon and are the work of the Northern Turks, or Tú-chüeh, as they were known to the Chinese, from whom we get most of their history. The Tú-chüeh under their great Khans Tuman and Mokan had a stirring history, conquering all Central Asia up to the Oxus, and combining with the Sassanides of Persia to overthrow the Ephthalites, or White Huns, while by 568 they had conquered the Sassanides also and received an embassy from Tiberius Cæsar. After this glorious epoch they declined through internal division, and the highly civilised Uighurs, whose official religion was Manichæism, became the leaders of the Turkish race. Their brief empire was from 750-850, when they were destroyed as a power by the Kirghiz, but ever after provided the brains and culture of the Mongol conquerors. Then the Turks declined again until Chingiz Khan brought their history to its glorious zenith by his conquests of the thirteenth century, starting a period of greatness which only ended with the fall of Constantinople in 1453, and included the conquests of Tamerlane in Central Asia, and the domination of the great Moghuls in India. In conclusion, a few words may be said on the confusion between the three words "Turk," "Tartar," and "Moghul." "Turk" is the name by which these peoples always speak of themselves throughout the sixth, seventh, and eighth centuries, and their language they called "Turkcha," as do the Osmanlis to-day. As for "Tartar," it is probably derived from the Chinese "Ta-ta," corresponding to the Greek "Barbaros" and applied to their savage neighbours generally. To-day it is confined to the Turks of the Volga and Caucasus. "Moghul" is the same as "Mongol," and the Mongols were the race of Chingiz Khan, and the Moghul Emperors, in reality Turks, used the corruption "Moghul" that they might be thought to have the blood of the Mongol Chingiz in their veins rather than that of the Turkish Tamerlane.

DUBLIN.

Royal Dublin Society, April 29.—Prof. E. A. Werner in the chair.—C. **Samman** and J. B. **Gatenby**. Notes on acarine or Isle of Wight bee disease. Numbers of experiments have shown that healthy bees may become infected in twenty-four hours. The most beneficial treatment found was to feed the bees during the winter on candy containing 15 per cent. of *Succus allii*.—F. E. **Hackett** and T. A. **Crowley**: A physical method of separating the constituents of butter-fat. Using the well-known property of the absorption of fats by paper, a fat has been separated from butter-fat which solidifies about 10° C. and liquifies about 20° C. The separation of this constituent has an important bearing on the theory of the physical constitution of butter.—H. H. **Poole**: A mechanical device for sealing off radium emanation tubes. The capillary tube, which it is desired to divide into short lengths, is inserted in an apparatus somewhat similar to a miniature lathe provided with two chucks which are rotated independently at the same speed by gearing. These chucks grip the tube which passes through them both. They are allowed some end play in their bearings, so that the distance apart of their nearest ends may vary from 7 to 13 mm., and may be pressed apart by means of a spring. Thus if the tube be rotated and a small gas flame, mounted on a hinged arm, be applied at a point between the chucks, the tube is sufficiently drawn out to ensure a satisfactory seal-off. Each chuck contains a small piece of cycle valve tubing through which the emanation tube passes. This rubber tube can be compressed longitudinally by means of a screw collar so as partially to close the central hole and thus grip the capillary. The emanation tubes can be readily inserted and withdrawn with the aid of forceps, so that handling is obviated.

PARIS.

Academy of Sciences, April 22.—M. Guillaume Bigourdan in the chair.—E. **Fournier**: Cyclonic vortices of cirrus which do not extend to the level of the ground. These disturbances at the ground level show only as a simple depression composed of sensibly concentric isobars, moving with a velocity equal to that of the central axis of the vortex from which it results. Rigid dirigible balloons, if at sufficient height, may be affected by these phenomena, and the catastrophe of the *Dixmude* was probably due to this cause. A formula is developed which will enable the commander of a dirigible to minimise the effect of contact with such a disturbance.—Jean **Perrin** and Mlle. **Choucroun**: Fluorescence, and the general laws relating to reaction velocities.—André **Blondel**: Vibration and resonance in axles carrying screw propellers.—J. B. **Senderens**: The catalytic preparation of benzyl ethers. Benzyl alcohol (108 gm.), heated in a flask fitted with a reflux condenser with 2 c.c. of $H_2SO_4 + 3H_2O$, between 130° and 140° C., is quantitatively converted into benzyl ether, $C_7H_7 . O . C_7H_7$, in about thirty minutes. The preparation of mixed ethers has been carried out by slight modifications of the same method: the properties of five mixed ethers thus prepared are given.—A. **Pellet**: A new theorem on equations.—M. **Manderbrojt**: Remarks on a note by M. Mordouhay-Boltovsky.—J. **Villey**, P. **Vernotte**, and F. **Fontenay**: The methods of study of the evolution of caoutchoucs. Damping of the torsional oscillations.—Charles **Lafon**: A calculating apparatus designed to supplement numerical calculation and the use of tables utilised in group navigation.—Raymond **Charonnat**: The stereochemistry of ruthenium.—J. **Seigle**: The composition of the gases from blast furnaces.—E. A. **Martel**: The largest cavern in Europe (Eis-Riesenwelt) and the circulations of subterranean waters in high mountains. This cavern is in the Tennen-Gebirge massif, at an altitude of 1641 metres, and is 36 kilometres S.S.E. of Salzburg. Labyrinths extending over 30 kilometres have been explored.—P. **Lasareff**: The general law of stimulation.—P. **Mazé**: The influence of the bactericidal power of raw milk on the lactic ferments grown in sterilised milk, and the empirical selection of lactic ferments.—G. **Raymon**: The anatoxins. The term diphtheric anatoxin is applied to a toxin which has been submitted to a high temperature for a prolonged period, with or without the addition of formaldehyde. A toxic plant albumen, abrine, and cobra poison have been submitted to the same treatment. These toxins not only become non-poisonous ("anatoxiques") but also confer immunity on animals (guinea-pigs).

ROME.

Royal Academy of the Lincei, January 13.—M. **La Rosa**: The constitution of variables such as Mira Ceti, according to the ballistic hypothesis of the speed of propagation of light. The hypothesis that the speed of light is dependent on that of the radiating source and that all variable stars are double or complex is applied to the case of Mira Ceti. The presence of a second star, revolving around this variable, besides the one recently observed by the Lick Observatory, is suggested.—L. **Sabbatani**: Pharmacological researches on iron: colloidal ferrous sulphide prepared in the presence of gelatin.—G. **Albanese**: Birational transformation of any algebraical curve into another without multiple points.—E. **Čech**: On projective geodetic lines.—S. **Aurino**: Photometric observations of R Leonis, RX Virginis, R Virginis.—A. **Carrelli**: On polarised fluorescent light. The influence of the solvent on the polarisation of fluorescent light issuing from a solution is examined. The emitted light consists of polarised light coming from particles and is not produced by dichroism or diffusion.—V. **Ronchi**: On testing optical surfaces and systems by fringes between uncentred gratings.—C. **Di Capua** and M. **Arnone**: The hardness of lead-bismuth and cadmium-bismuth alloys.—B. **Oddo** and G. B. **Crippa**: Discatole.—C. **Artom**: Tetraploidism of *Artemia salina* from Odessa in connexion with some general problems of genetics.—G. **Lambertini**: Histogenesis of formations and secondary organs in the human embryo. The fusion of the palate plates together and with the nasal partition, the development of the tooth tissue, of the nail and of the mammary gland, the production of skin and the origin of hair, are examined with the conclusion that these organs are formed by elementary morphogenetic processes (secretion, cell multiplication, etc.).

January 20.—V. Scialoja in the chair.—B. **Grassi** and M. **Topi**: Experiments on the supposed different races or species of vine Phylloxera.—S. **Pincherle**: Simple transcendental functions.—U. **Cisotto**: Kinetic energy of continuous fluid masses: various expressions for the kinetic energy.—S. **Tranchi**: The great "slide" of secondary calcareous masses of Mount Ausoni and Mount Lepini on to the Miocene deposits of the Valle del Liri and of the Valle Latina.—P. **Scatizzi**: Solution of a differential equation the unknown function of which is an index of derivation.—A. **Amerio**: Variability in the absorption of the sun's atmosphere. Differences occur in the transparency of the solar atmosphere from day to day, and in view of the fact that these do not exhibit any periodicity synchronising with the sun's rotation,

the suggestion is made that the cause lies in changes in the mass of the atmosphere of the sun.—G. **Grablovitz**: Harmonic law of teleseismic propagation. Formulæ are given which express the intervals between the epicentre and the first and second preliminary tremors respectively as functions of the angular distances of the epicentre. These formulæ are not empirical but are based on the principle of free propagation of the first seismic impulse by longitudinal and transverse waves through a sphere the density of which increases gradually from the surface to the centre. The values of the coefficients of the expressions given may require modification as further data become available.

Official Publications Received.

The Indian Forest Records. Vol. 10, Part 2: Oils and Fats from the Seeds of Indian Forest Plants. Part 6: The Oil from the Seeds of *Aleurites montana*, Wils. By Richard Neville Parker, Madyar Gopal Rau, Wheatley Alex. Robertson, and John Lionel Simonsen. Part 7: The Oil from the Seeds of *Salvia plebeia*, R. Br. By Madyar Gopal Rau and John Lionel Simonsen. Pp. 16. (Delhi: Government Central Press.) 9 annas.

Memoirs of the Department of Agriculture in India. Botanical Series, Vol. 12, No. 4: Studies in Indian Oil Seeds. No. 2: Linseed. By Gabrielle L. C. Howard and Abdur Rahman Khan. Pp. 135-183. 1.4 rupees; 2*s*. Botanical Series, Vol. 12, No. 5: Studies in Gujarat Cottons, Part 2. By Maganlal L. Patel. Pp. 185-262. 1.12 rupees; 3*s*. (Calcutta: Thacker, Spink and Co; London: W. Thacker and Co.)

Report of the Kodaikanal Observatory for the Year 1923. Pp. 5. (Madras: Government Press.) 2 annas.

Ministry of Agriculture, Egypt. Cotton Research Board: Third Annual Report, 1922. Pp. xii+111. (Cairo: Government Publications Office.) 15 P.T.

Rocznik Astronomiczny Obserwatorjum Krakowskiego. Supplemento Internationale, Nr. 2. Edito par T. Banachiewicz. Pp. iv+33. (Kraków.)

Rhodesia Museum, Bulawayo. Twenty-second Annual Report, 1923. Pp. 12. (Bulawayo.)

Department of Commerce: U.S. Coast and Geodetic Survey. Results of Observations made at the U.S. Coast and Geodetic Survey Magnetic Observatory near Tucson, Ariz., in 1919 and 1920. By Daniel L. Hazard. (Serial No. 248.) Pp. 98. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Education. Physical Education Series, No. 3: Suggestions for a Physical Education Program for small Secondary Schools; arranged with Special Consideration of the Problems in Physical Education which face the Local School Officials where there is no Director of Physical Education. By Walter F. Cobb and Dorothy Hutchinson. Pp. vi+79. (Washington: Government Printing Office.) 10 cents.

Sixty-first Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan, and Thirty-fifth Annual Report of the Experiment Station from July 1, 1921, to June 30, 1922. Pp. 672. (Lansing, Mich.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 498: The Lower Gila Region, Arizona; a Geographic, Geologic, and Hydrologic Reconnaissance, with a Guide to Desert Watering Places. By Clyde P. Ross. Pp. xiv+237+23 plates. 50 cents. Water-Supply Paper 511: Surface Water Supply of the United States, 1919 and 1920. Part 11: Pacific Slope Basins in California. Pp. vii+456+2 plates. 40 cents. (Washington: Government Printing Office.)

Proceedings of the Geologists' Association. Vol. 35, Part 2. Edited by G. M. Davies. Pp. 89-167. (London: E. Stanford, Ltd.) 5*s*.

Ministry of Public Works, Egypt. Report on Investigations into the Improvement of River Discharge Measurements. By E. B. H. Wade. Part 5. (Physical Department Paper No. 13.) Pp. 21+11 plates. (Cairo: Government Publications Office.) 10 P.T.

Board of Education. Vacation Courses in England and Wales for Instruction in Various Subjects, 1924. Pp. 17. (London: H.M. Stationery Office.) 6*d*. net.

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, corrected to 1st November 1923, with Supplementary Register to March 1924. Pp. 322. (London: Institute of Chemistry.)

Transactions and Proceedings of the Perthshire Society of Natural Science. Vol. 7, Part 5, 1922-23. Pp. 245-269+viii+lxxi-lxxxvi+8. (Perth: Perthshire Natural History Museum.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1923, presented to the Annual Meeting, February 11th, 1924. Pp. 55. (York.)

Diary of Societies.

MONDAY, MAY 19.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—S. Perks: London Town Planning Schemes—1666 and After.

ARISTOTELIAN SOCIETY (at University of London Club, Gower Street), at 8.—Prof. E. T. Campagnac: Make-Believe.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Ahmed Hassanein Bey: Through Kufra to Darfur.

TUESDAY, MAY 20.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: The Effect of Altitude on Man. IV. Acclimatisation to High Altitudes.

ROYAL STATISTICAL SOCIETY, at 5.15.—Dr. M. Greenwood: The Vital Statistics of Sweden and England and Wales: an Essay in International Comparison.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the month of April 1924.—Major S. S. Flower: Exhibition of a remarkable Tortoise of the genus Testudo.—Sir Sidney F. Harmer: Mesoplodon and other Beaked Whales.—R. I. Pocock: Some External Characters of *Orycteropus afer*.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Willford: Some Methods and Results in Nature Photography.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8.15.—Mrs. Scoresby Routledge: The Austral Islands and Mangareva, S.E. Pacific.

WEDNESDAY, MAY 21.

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. E. Clark, I. D. Margary, and R. Marshall: Report on the Phenological Observations in the British Isles from December 1922 to November 1923.—E. K. Robinson: Note on the Unusual Order of Flowering of the Hazel in 1924.—C. E. P. Brooks: The Distribution of Rainfall over Uganda, with a Note on Kenya Colony.—S. C. Russell: Exhibition of a Diagram showing Daily Records of Well Levels at Chilgrove, Sussex, and Detling, Kent, during 1923.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—C. A. Sussmilch: The Geological History of South-eastern Australia, with special reference to the Carboniferous and Permian Periods.

ROYAL MICROSCOPICAL SOCIETY, at 7.45.—Dr. E. W. Bowell: The Mounting and Photomicrography of Radulæ.—Dr. R. J. Ludford: Experiments on the Impregnation of the Golgi Apparatus by means of Osmium Tetroxide.

ROYAL SOCIETY OF ARTS, at 8.—Sir William J. Pope: The Outlook in Chemistry (Trueman Wood Lecture).

INSTITUTION OF WELDING ENGINEERS (at Institution of Electrical Engineers), at 8.—Dr. J. H. Patterson: Power Supply for Electric Welding Operations.

THURSDAY, MAY 22.

MEDICO-PSYCHOLOGICAL ASSOCIATION (at Royal Society of Medicine), at 3.—Dr. J. Carswell: Some Sociological Considerations bearing upon the Occurrence, Prevention, and Treatment of Mental Disorders (Maudsley Lecture).

ROYAL SOCIETY, at 4.30.—Prof. J. W. Gregory and C. J. Gregory: The Geology and Physical Geography of Chinese Tibet, and its Relations to the Mountain System of South-eastern Asia.—*To be read in title only*:—Madge Kaye and Dorothy Jordan Lloyd: A Histological and Chemical Investigation of the Swelling of a Fibrous Tissue.—C. H. Browning, Prof. J. B. Cohen, S. Ellingworth, and R. Gulbransen: The Antiseptic Action of Compounds of the Apocyanine, Carbocyanine, and Isocyanine Series.—H. J. Watt: Dimensions of the Labyrinth correlated.

LINNEAN SOCIETY OF LONDON (Anniversary Meeting), at 5.—Presidential Address—Presentation of the Linnean Gold Medal, etc.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. V. Appleton: Atmospheric Interference in Wireless Telegraphy (II.).

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—H. Graham Cannon: Reduction in Number of Offspring of Animals as they ascend the Ladder of Evolution.

FRIDAY, MAY 23.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Prof. S. W. J. Smith, A. A. Dee, and W. V. Mayneard: The Magnetism of Annealed Carbon Steels.—A. A. Dee: Some Thermo-magnetic Properties of Nearly Pure Iron, Part 1; W. V. Mayneard: Part 2.—Dr. E. A. Owen and G. D. Preston: The Atomic Structure of Two Intermetallic Compounds.—Prof. A. O. Rankine: Demonstration of an Anomaly in Frictional Electricity.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. L. Rea: Wanderings in Northern Italy (Lantern Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. A. Balfour: Historical Aspects of Malaria.

SATURDAY, MAY 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. G. Alcock: Musical Ornamentation: Its Origin and Development.

PUBLIC LECTURES.

TUESDAY, MAY 20.

UNIVERSITY COLLEGE (Department of Applied Statistics and Eugenics), at 5.30.—Miss M. Tildesley: Sir Thomas Browne, Author of "Religio Medici"—His Skull and Portraits.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomers of Four Centuries. (Succeeding Lectures on May 21, 22, and 23.)

WEDNESDAY, MAY 21.

IMPERIAL COLLEGE, ROYAL COLLEGE OF SCIENCE, at 5.15.—Prof. P. Zeeman: The Optical Effects of Motion (in English).

KING'S COLLEGE, at 5.30.—Prof. L. T. Hobhouse: Religions of the Empire.

THURSDAY, MAY 22.

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, at 5.—Dr. M. Greenwood: Is the Statistical Method of any Value in Medical Research?

UNIVERSITY COLLEGE, at 5.30.—Prof. T. P. Nunn: The Nature of Science.

FRIDAY, MAY 23.

KING'S COLLEGE, at 5.30.—Dr. E. R. Bevan: Ancient Ghost Stories and Theories about Ghosts.