

THURSDAY, MAY 21, 1914.

*CHEMISTRY: ANCIENT AND MODERN.*

*Some Fundamental Problems in Chemistry—Old and New.* By Prof. E. A. Letts. Pp. xiii + 235 + plates. (London: Constable and Co., Ltd.) Price 7s. 6d. net.

THOSE chemists whose memories can carry them back for a period of about half a century will have experienced several phases in the development of the science which, at their respective periods, were regarded as marking a transition from an older to a newer chemistry. The writer of this notice began his reading when water was HO and so forth. Then came the "new notation" resulting from the proper recognition of Avogadro's law, the doubling of certain atomic weights, and the reconstruction of our formulæ. This was the "new chemistry" of that period. Next arose the more complete elaboration of the conception of constitution or structure based on valency, due to Frankland and Kekulé, and we had a yet newer chemistry—a development which was so extraordinarily prolific in the way of results that chemists were inclined to hug themselves into the belief that they had come to close quarters with the inner mechanism of molecular structure, and the very weaknesses of the theory, which had shown signs of breaking down in certain directions, afterwards became cornerstones of strength in the light of the brilliant hypothesis of van't Hoff and Le Bel, which inaugurated the then new science of stereochemistry. Moreover, about the same period when structural chemistry was undergoing these developments, attention was being more systematically concentrated upon the relationships of the chemical elements among themselves, these studies culminating in that periodic classification associated with the names of Newlands, Mendeléeff, and Lothar Meyer. From that great generalisation arose a still newer chemistry which systematised the whole treatment of the science, both theoretically and practically, and dominates our present teaching. Another "new" chemistry must be added to this record—the application of purely physical methods to the study of chemical phenomena resulting in the foundation of "physical chemistry" as a distinct subject.

All these phases are familiar to the modern student of the history of the science, and they fall into the category of what the author of the present work would term the older chemistry. Dr. Letts does not, however, deal with all these developmental epochs; the older chemistry—as distinguished from ancient chemistry—is limited

by him to the discussion of the methods and results of atomic weight determinations by the older as well as by the most recent workers in this field, and to a very full consideration of the periodic law and its consequences. The reader will find no reference to those fundamental problems relating to chemical statics and dynamics which the physical chemists have formulated as the results of their studies; such familiar terms as mass action, osmotic pressure, electrolytic or ionic dissociation, stereochemistry, etc., do not appear in the index. This criticism amounts simply to the statement that the author professes to deal only with certain of the fundamental problems, and within the limits thus assigned, he handles his subject in a very lucid and suggestive way. His treatment of the periodic law, for example, to which two chapters are devoted, goes far beyond the arid description found in the ordinary textbooks and may be commended as worthy of most serious consideration by all students. Workers on the look-out for new elements may take courage from Dr. Letts's suggested classifications, according to which there remain either thirty-eight or twenty-five gaps in the periodic table now waiting to be filled up (p. 60). Another valuable feature of this section is the new "atomic volume" curve, constructed by the author from the most recent available data, and, for the first time, comprising the group of "inert" elements. As will be seen on reference to the original work, this curve differs in some important particulars from that first given to our science by Lothar Meyer in 1870, and opens up some interesting suggestions with respect to missing elements.

Although the older chemistry is treated of in the present work within the limits specified, the reader will gather from the subsequent chapters that these older workers—and happily for our science that generation has not yet become extinct—have passed on to the newer school a very goodly heritage. By the "newer chemistry" Dr. Letts understands that great body of observed facts and theoretical deductions which have been accumulated since the study of the action of the electric discharge upon highly attenuated, gaseous matter was seriously taken in hand by physicists and chemists, and since the discovery of radioactivity and the radio-active elements. How much of this newer knowledge will be passed on as canonical to future generations it would be very rash to predict. It is, however, certain that chemistry, by the discovery of unexpected phenomena, and by the utilisation of novel methods of attacking the ultimate components of matter, has now entered upon a new era in its history—a state of affairs which both students and teachers,

whether of the older or newer school, must perforce take into consideration.

From this last point of view the present work presents certain special advantages which may be summed up by the statement that the author handles his subject as a chemist. The day has passed away when workers with parochial views of their science can hope to impose upon the present generation stupidly narrow limitations by "method"—to insist that the evidence based upon "purely chemical" methods is alone of weight to chemists, and that the results achieved by "purely physical" methods must be received with suspicion. But for the chemist it certainly is of importance, in view of the bewildering rapidity of the development in this newer domain, to have the results, by whatever method achieved, co-ordinated and fitted in to that older structure with which we were all familiar in the days of our own studentship. Dr. Letts may be congratulated upon having accomplished this task with conspicuous success within the compass of his brief. His historical records, which are fairly given, are as up-to-date as can reasonably be expected, and the descriptive portions are summarised at the end of the chapters with a clearness which shows that the author has a thorough grasp of his subject. Perhaps it may be urged by extreme critics that he is not sufficiently critical—that he appears to accept as established truths and without comment published statements concerning "transmutation," about which there is conflict of evidence. But the present work professes to be but a literary production, and the author, perhaps wisely in the present state of knowledge, simply sets forth the evidence and the suggested interpretations of that evidence. All who have watched the development of this "newer chemistry" have thoroughly realised the extraordinary practical difficulties which confront the experimenter at every stage. The infinitesimal quantities of material which have to be dealt with and the extreme delicacy of the methods of attacking the new problems offered by a subject which is still "in the making" are such as to give much scope for apparently conflicting evidence. The future writer of the history of chemistry will find ample matter for marvel at the results which have even now been achieved in spite of the difficulties referred to. That Dr. Letts is himself appreciative of the skill which has surmounted so many of these obstacles is apparent in many pages of the volume under consideration.

It is now a matter of ancient history that on the discovery of spectrum analysis chemistry and astronomy entered into partnership. But the new chemistry, as understood in the present work, has

also widened the horizon of the science to an extent that renders necessary the consideration by chemists of problems of a cosmical order in a much more definite and concrete form than has hitherto been customary. It is obvious that questions concerning the constitution of the atom and the evolution or disintegration of matter cannot be confined within terrestrial limits. On the first of these questions the author has something to say, and in the ninth chapter will be found a succinct account of the electron theory, with reference more especially to the work of J. J. Thomson. Now it is precisely on this question of the present position of the electron theory that chemists are awaiting further light from the physical side. So far, with the exception of Sir William Ramsay's preliminary attempt, this theory cannot be said to have been brought seriously within the domain of practical chemical politics. It is not mere curiosity that prompts the chemist to ask whether the atom is to be regarded as a complex mechanism composed entirely of electrons or whether there may not be other components. Dr. Letts thus answers the question:—

"From spectroscopic and other evidence it would appear to be certain that electrons are universal constituents of atoms, but on the other hand, there appears to be no sufficient evidence for the assumption that electrons are the sole constituents of these atoms. . . . all but about one-thousandth of its mass is associated with the positive part of an atom, which would tend to show that an altogether exaggerated rôle has been attached to the electron in the constitution of matter."

This at any rate was the view held by the writer of the section on radioactivity in the Annual Reports of the Chemical Society in 1906, from whom the author takes his information.

With reference to the other question—the evolution and dissolution of matter—the reader will find in the tenth chapter a good summary of the observations and conclusions of Lockyer, as set forth in his "Inorganic Evolution" and other publications. One result of the "new chemistry" is thus to bring us back to what may be termed the presentation of the case from the astrophysical side. There is distinct evidence of this reactionary influence of the new chemistry upon the pioneering work of Lockyer now to be found in many recent treatises besides the volume under consideration, in which some twenty pages are devoted to the subject. The "disintegration" theory of radio-activity, which now holds the field, has brought into modern chemistry certain very concrete notions concerning what may be defined as down-grade evolution. It is but natural to ask with Dr. Letts (p. 190) whether the reverse

or up-grade process of evolution from elements of low atomic weight to elements of higher atomic weight occurs anywhere in the cosmos. If evolution is universally true in principle some process of this order must have occurred in the past and may be occurring now. Laboratory results which are indicative of "transmutation" in the sense of degradation are becoming more and more incorporated with modern chemical doctrine, but experimental evidence of the opposite process can scarcely be considered at present conclusive. The notion of utilising the energy of degradation of radium emanation for transmutational purposes was presumably based on the expectation of degradation rather than of aggregation.

The question of the evolution of the chemical elements is an old one, and the suggestion of evolution offered by the periodic law has been taken up by many writers whose speculations are no doubt familiar to chemists. The author of the present work does not discuss any of these speculative attempts to trace the lines of descent, although he gives some very useful tables summarising existing knowledge with respect to the disintegration products of the radio-active elements. But in directing attention once again to the evidence of evolution furnished by the study of stellar spectra by that comparative method which will always be recognised as the work of Lockyer and his school, Prof. Letts does good service by reminding chemists that the newer developments of their science have enhanced the importance of astrophysical (why not astrochemical?) work to an extent quite undreamt of at the time when the spectroscope was first brought to bear upon these problems.

If any justification for undertaking the part of a critic is required on the present occasion it may be permissible to express regret that the author should have devoted so much space to reprinting long extracts from the original writings of the authorities quoted. All the books and papers referred to are easily accessible, and Dr. Letts gives evidence of being such a very clear thinker when he deals with his subject in his own way that we should much have preferred to read his own version and criticisms. This particularly applies to the last chapter, which is devoted to an account of the views of Arrhenius in his now well-known book on "Worlds in the Making" published in 1908. The direct bearing of the views set forth in that work on the fundamental problems of modern chemistry are not very obvious, and we should have been glad if Dr. Letts could have given less space to the extracts from the said book and more space to the discussion of the special reasons for including the subject in his

own volume. The main contribution to purely "astrochemical" thought which must be credited to Arrhenius would appear to be the recognition of heat as an associative as well as a dissociative agency. In theories of cosmical evolution, this point may have been insufficiently realised, although the possibility of endothermic combination between certain elements under high pressure in the sun and stars cannot be generalised into a universal process for all kinds of matter without further evidence.

Enough has been said, however, to warrant the statement that the author has produced a most useful and suggestive little volume which may be profitably read by chemists of both the older and younger generations. R. MELDOLA.

#### GEOLOGY AND GEOGRAPHY.

- (1) *La Face de la Terre*. (Das Antlitz der Erde.) By Prof. Ed. Suess. Traduit de l'Allemand avec l'Autorisation de l'Auteur et Annoté sous la Direction de Emm. de Margerie. Tome 3. (3 Partie.) Pp. xi+957—1360. (Paris: Armand Colin, 1913.) Price 12 francs.
- (2) *Traité de Géographie Physique. Climat—Hydrographie—Relief du Sol—Biogéographie*. By Prof. Emm. de Martonne. Deuxième Edition. Pp. xii+922. (Paris: Armand Colin, 1913.) Price 22 francs.

THE two volumes before us strikingly illustrate the principle that scientific geography—as distinct from mere geographical description—must be based on the deductions of geology and the physical sciences; and no less do they indicate how much geology looks to gain from the study of the present features of the earth's surface, and of terrestrial processes now going on upon it.

(1) That M. Margerie's French edition of the great work of the distinguished Austrian geologist is not a mere translation has been already pointed out in the pages of NATURE. The judicious notes, bringing the text up-to-date, with the exhaustive references to recent literature and the numerous additional illustrations, make the book an absolute necessity in every scientific library. In this third part of vol. iii., M. Margerie has reached the penultimate section of his great task, and an additional coloured plate, with eighty new illustrations in the text, give a measure of the important additions which have been made to the original work.

(2) Nor are the additions which have become necessary to the comprehensive volume of Prof. de Martonne less abundant and important. Since the first edition appeared four years ago, the author reminds us that geographical research has added largely to our knowledge—not the least striking

additions being the visits paid for the first time to both the poles within that period! No fewer than 216 pages, with four plates and fifty figures in the text, have been added to the book to bring it thoroughly up-to-date. The present edition maintains the character of the original one, as an invaluable work of reference upon the subjects of which it treats.

J. W. J.

#### WORKS ON ECONOMICS.

(1) *The Influence of the Gold Supply on Prices and Profits.* By Sir David Barbour. Pp. xii+104. (London: Macmillan and Co., Ltd., 1913). Price 3s. 6d. net.

(2) *Social Insurance. With Special Reference to American Conditions.* By I. M. Rubinow. Pp. vii+525. (New York: Henry Holt and Co., 1913.) Price 3.00 dollars net.

(1) **S**IR DAVID BARBOUR'S long experience in connection with the finances of India gives great weight to his conclusions on questions of currency and of the standard of value, in which he holds a position of authority. In the present work he undertakes to show in what way the quantity of money affects prices, and what are the limitations to the theory that its influence upon them is substantial. This is a question of real importance, because variations in price exercise a "profound and subtle influence" on human affairs. "A general fall in prices sets up stresses in the social fabric which search out the weak points in the structure. A general rise in prices smooths away many difficulties, but may create others." The author puts his theory in the form that "other things being equal, the level of prices is proportionate to the quantity of money." The question arises, What are the "other things" that are required to be equal, in order that this generalisation may be supported? It is important to consider the modern system of credit, as affecting the amount and efficiency of the work money has to do. Sir D. Barbour rightly deprecates the dangerous practice, which appears to be growing, of attempting to remedy by legislation the evils that are due to a rise or fall in prices.

(2) Mr. Rubinow's work is an elaborate study of a subject which has of late years acquired great importance in England and other European countries, and an urgent plea for general adoption of a policy of social insurance in the United States of America. The expression "social insurance" is, indeed, one of comparatively recent introduction, and is used as distinctive from commercial insurance, though there is no real difference of principle between them. The difference in practice arises when voluntary insurance develops into subsidised insurance, and that again into compulsory

insurance. Under these heads the author describes what has been done in Europe towards insurance against industrial accidents, against sickness, against old age, invalidity and death, and against unemployment; and necessarily devotes much attention to the history of the movement in those directions in Germany and in England. In neither country does he consider that all the branches of social insurance have been adequately developed. All leave unrelieved many exceptional cases. The relief is, in general, insufficient. The question of cost becomes a material one if this is to be remedied. Here, we think, Mr. Rubinow takes too optimistic a view. He estimates the burden of the British insurance system as between 85 and 100 million dollars, and compares it with the 160 million dollars that the United States have been (we fear, improvidently) spending for war pensions. Estimating that the wealth of that country increases annually by 5000 million dollars, after all truly wasteful expenditures, both private and public, have been allowed for, he thinks it unnecessary to discuss whether it can afford the expense of a social insurance system.

Both these works are valuable contributions to the study of economics.

#### OUR BOOKSHELF.

*The Riddle of Mars the Planet.* By C. E. Housden. Pp. xi+69+plates. (London: Longmans, Green and Co., 1914.) Price 3s. 6d. net.

THERE are many who have read with real pleasure Dr. Percival Lowell's pleasant diversions based upon his assiduous and careful observations of the planet Mars, which the magnificent equipment of his well-placed observatory have made possible. Whether they have followed him to all his conclusions is immaterial, they have admired his skill and industry, his beautiful photographs, his imagination and the charming way in which he has presented his case. Among his followers the author of the present work is one who is not content with merely following Dr. Lowell, but, being apparently of a constructive turn of mind, he has gone in considerable detail into the engineering works that are obviously required to help the water of the melting snow caps to the parts of the planet where it is wanted for the growing crops. By the use of a coloured plate or diagram on which the colour changes in different latitudes in the course of the Martian year are represented, the author develops the engineering problem of moving the water, using open canals or closed pipes where water is pumped over or to high ground. He wants for this purpose 2,500,000,000 N.H.P.; 170,000 6-ft. pipes, each 1400 miles long, with ten pumping stations of 1150 N.H.P. to each to account for part of the total power required. Oil engines are suggested, the oil being obtained from wells as on earth, but possibly sun power in the clear sky is used

as in Egypt. The author goes into details in other directions which it seems unnecessary to follow, and he estimates the area requiring irrigation and producing crops twice a year by a consideration of the colour changes.

*The Mechanical Engineer's Reference Book.* By H. H. Suplee. Fourth edition, revised and enlarged. Pp. xii+964. (London and Philadelphia: J. B. Lippincott Company, n.d.) Price 18s. net.

THE first edition of this well-known book was published in 1903. Sections are included giving mathematical formulæ and tables, information on mechanics, materials, machine design, heat, air, water, fuels, steam boilers and engines, internal combustion motors, and electric power. While much of the information supplied is good, and renders the book of service to engineers, there is a considerable amount of space taken up with matter which is surely unnecessary in an engineering reference book. Some of the very elementary geometry given on p. 107 *et seq.* might be eliminated. There are few engineers who would require to consult a reference book in order to find out how to bisect a line by another line at right angles. The tables given on pp. 432 and 433 face one another, but the book has to be inverted before the second table can be read. On p. 274 there is a table giving the heights traversed by a falling body to seven significant figures. The American nomenclature in several places makes it somewhat difficult to obtain the precise meaning.

The real test of the value of an engineering reference book is the up-to-dateness of its contents, otherwise the book will be used probably for the sake of the tables of areas and circumferences of circles, logarithms, etc. The present edition is by no means up-to-date in several of its sections; those dealing with the strength and elasticity of materials and the properties of steam may be specially mentioned in this respect, where very little mention is made of the valuable developments which have taken place during the last ten years.

*Outlines of Chordate Development.* By Prof. W. E. Kellicott. Pp. v+471. (New York: H. Holt and Co., 1913.) Price 2.50 dollars.

PROF. W. E. KELLICOTT'S introduction to the study of chordate development begins with Amphioxus, which "affords in simple diagrammatic style, the essentials of early chordate ontogeny"; it lingers over the frog; it treats the chick more briefly, but lays emphasis on the embryonic membranes and the early stages; it ends up with the mammal, with particular reference to the early stages, the foetal membranes and the placenta, and the development of the external form. The book is well arranged, carefully and clearly written, and effectively illustrated. We think that it might have been made more interesting and distinctive by being more definitely correlated with phylogeny and comparative anatomy; but that, of course, is a big business. The well-selected bibliographies point the way.

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## LETTERS TO THE EDITOR.

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### Action of Radium Rays on Bakelite.

A DISC 4.2 mm. thick of the light yellow variety of transparent Bakelite was cut from a rod, polished and radiated with  $\beta$  and  $\gamma$  rays from radium. The colour of the disc darkened to a wine-red after three days, and exhibited an absorption band  $\lambda=5700-6000$ , which was not visible at first. The spectrum beyond  $\lambda=4900 \text{ \AA.U.}$  was also obliterated. A similar disc placed in radium emanation became also rapidly coloured. The coloration extended to a depth of 2 mm., and it could be completely removed by exposure to a temperature of  $100^{\circ} \text{C.}$  for about three hours.

In order to see whether ozone played any part in the action a Bakelite disc was exposed to the gas for six hours both alone and with radium near. Not the slightest coloration occurred. A portion of a rod was coated with paraffin wax and the radium rays caused to radiate the rod partly through the wax layer. There was no diminution in the rate of colouring under the wax. The effect, therefore, appears to be due to the direct action of  $\beta$  rays upon the Bakelite, for it would extend much deeper were it due to the  $\gamma$  rays. This new substance may prove to be a useful filter for therapeutic use, especially as it is cleanly and easy to work.

CHARLES E. S. PHILLIPS.

Physics Laboratory, Cancer Hospital,  
May 14.

### Respiratory Movements of Insects.

THE concertina-like movement observable in the abdomen in the case of wasps and bees is, I believe, the visible evidence of the act of pumping the air in and out for respiratory purposes, and a similar phenomenon may be seen in dragon-flies, except that in the latter the movement is lateral and slow, whilst in wasps and bees it is axial and rather quick. I have not noticed any such movement in other groups of the Hymenoptera, and it is apparently absent in the Diptera, except *Eristalis tenax*, the common drone-fly, which obviously mimics the hive bee and other small species. If this movement really is due to respiration can any reader say why it is so comparatively restricted in the insect world? One would have expected soft-bodied insects, such as Diptera, to exhibit it more obviously than the more chitinous species amongst the Hymenoptera. I, and probably others, should be glad of any information throwing light on this matter.

C. NICHOLSON.

MR. NICHOLSON has hit upon an interesting inquiry, and will probably not be surprised to find that it has already received a good deal of attention. The respiratory movements of insects were experimentally investigated by the late Prof. Felix Plateau, of Ghent ("Recherches Expérimentales sur les Mouvements Respiratoires des Insectes," *Mém. Acad. Roy. de Belgique*, tome xlv., 1884), who contributed a short summary of his results to Miall and Denny's "Cockroach" (pp. 159-64). Respiratory movements can be demonstrated in dipterous flies, but in them the enlarged thorax is alternately contracted in different directions by the action of two sets of muscles, which are figured in Miall and Hammond's "Harlequin Fly," (pp. 100-102). Far more space than NATURE could

grant would be required to discuss the mechanism of respiration in different insects. I do not recollect that any notable progress has been made with the inquiry during the last thirty years, and a new observer would find that much remains to be discovered; it is, however, indispensable that he should employ precise methods of investigation.

L. C. M.

#### THE NUMBER AND LIGHT OF THE STARS.

THE number of stars visible to the naked eye on a clear night, in the whole sky, is roughly 5,000—a very moderate total indeed, in spite of the universal custom of using the number of the stars, in common with that of the sands of the sea, as synonymous with infinity. In all ages mankind in general has rightly preferred rather to admire and wonder at the stars than to count them. In the great problem of the structure of the sidereal universe, however, which astronomers are now attacking with much energy and success, one of the essential data is the number of stars in the different regions of the sky, classified according to their brightness or magnitude.

The telescope early revealed the fact that the stars which by reason of their superior brightness force themselves upon our unaided vision shine forth beyond a host of fainter luminaries, the number of which has never yet failed to show an increase as an augmentation of telescopic or photographic power has enabled us to pierce depths of greater and greater obscurity. These fainter stars enormously outnumber the naked-eye stars, which may be compared with an oceanic island, the tiny, outstanding peak of a great mountain growing ever broader beneath the water level.

The bright stars have been divided into six traditional classes or magnitudes, the brightest being called first magnitude stars, and the faintest visible being termed of the sixth magnitude. Pogson placed this classification on a scientific basis, so that it could be extended to telescopic stars of all degrees of faintness. On the conventional standard scale the ratio of the intensities of two stars differing in magnitude by the amount  $m$  is  $10^{-0.4m}$ . The determination of the magnitude of a star on this scale is not an easy matter, as it involves the measurement of the relative brightness of stars often differing much in luminosity.

Photographic methods have been found most suitable for the purpose; the results are rather different from those obtained by visual methods, especially for stars of different colour, since the photographic plate is more sensitive than the eye to blue rays, and less sensitive to red. Magnitudes determined by ordinary photographic methods are called "photographic magnitudes."

During the past three years the fine series of star charts obtained by the late J. Franklin-Adams has been used in the investigation of the number of stars of determined photographic magnitudes in all parts of the sky. Franklin-Adams, using a specially-designed Taylor-Cooke 10-in. lens

covering a wide field, photographed the whole sky on 206 plates each 16 in. square, the scale being 20 mm. to 1°; the photographs were taken (the northern set in England, the southern in South Africa) with exposures of from two to two and a half hours, which sufficed to show stars down to the seventeenth magnitude on most of the plates. From a star of this magnitude we receive only one-millionth as much light as from a second magnitude star. On each plate the stars in twenty-five uniformly distributed sample areas have been counted and classified according to the size and greyness of their images; altogether, therefore, sample counts have been made on more than 5000 regions of the sky, at intervals of 3° apart. The areas examined were of different sizes, being chosen, in accordance with the star density in the particular region, so that about sixty stars should be counted in each. The stars could not be classified according to their photographic magnitude directly from the plates, as stars of different magnitudes might show images, identical in size and greyness, on different plates, owing to inequality of the atmospheric transparency during the exposures on the two plates. The photographic magnitudes of a selection of the stars counted on each plate needed, therefore, to be determined directly, which was done by comparing them with the stars of the North Polar Sequence, a set of stars the magnitudes of which have been given very accurately by Prof. E. C. Pickering of Harvard. Auxiliary photographs for this purpose were taken with the 30-in. reflector at Greenwich. After the application of corrections depending on their position on the Franklin-Adams plates it was then possible to classify all the stars counted, upon a true magnitude basis. This complete reduction has so far been effected for thirty out of the 206 plates counted; the results from the 750 areas for which sample counts were thus afforded have recently been published.<sup>1</sup>

The first point of importance which will be mentioned as one on which the evidence derived from this work is decisive is that of the relation between the condensation of the stars towards the galaxy, and their magnitude. While the very brightest stars show little regularity of distribution (to their irregular grouping, indeed, much of the beauty of the constellations is due), the fainter naked-eye stars show a distinct concentration towards the plane of the Milky Way, their density in the galactic belt of the celestial sphere being about twice that near the poles of the Milky Way; still fainter stars down to the ninth magnitude show this phenomenon in a more marked degree, the density of these stars in the galaxy being three or four times that at the galactic pole. The galactic plane is a fundamental one in modern representations of the sidereal universe, which, following Sir W. Herschel's ideas, picture the stellar system as formed of a large central cluster

<sup>1</sup> Chapman and Melotte: The number of stars of each photographic magnitude down to 17<sup>m</sup>, in different galactic latitudes. *Memoirs of the R.A.S.*, lx., 4.

Chapman: On the total light of the stars. *Monthly Notices of the R.A.S.*, lxxiv.

of stars in the form of an oblate spheroid, equatorially surrounded by a belt of irregular star-clouds composing the Milky Way. In connection with such a theory it is of obvious importance to know whether the condensation towards the galaxy shown by the stars of magnitudes five to nine persists for still fainter stars, and in what degree. Very different views have been held on this matter. In regard to the stars classified according to their visual magnitudes, Kapteyn concluded that the galactic condensation increases very much with diminishing brightness, giving its value for all the stars brighter than 17<sup>m</sup> as 45. Pickering, on the contrary, found no marked change in the relative densities in the galaxy and at its poles, down to the thirteenth magnitude (the limit of his data). The counts on the Franklin-Adams plates, based on a photographic magnitude classification, lead to a similar result; the density of all the stars brighter than 17<sup>m</sup> in the galaxy does not exceed six times that at the galactic poles, and the ratio is perhaps not more than four. Although it is possible that there may be a systematic change of colour of the stars with increasing faintness, different in different galactic latitudes, which would make results derived from counts of stars of determined *visual* magnitudes differ systematically from those based on photographic magnitudes, yet such evidence upon the point as already exists renders it probable that the galactic condensation is in either case nearly constant from the sixth to the seventeenth magnitude.

On this account the rate of increase in the number of stars per magnitude will be nearly constant all over the sky, so that this rate may conveniently be studied from a table giving the numbers of stars in the whole sky brighter than each magnitude *m*; this will be denoted by *N<sub>m</sub>*. All the best available data have been embodied in the following table, giving *N<sub>m</sub>* for values of *m* down to 17. The values of  $\Delta_m (= \log N_{m+1}/N_m)$  are also given, as they provide a measure of the geometric ratio of increase in the number of the stars.

TABLE I.—The Number of Stars in the Whole Sky Brighter than Magnitude *m*.

<i>m</i>	<i>N<sub>m</sub></i>	log <i>N<sub>m</sub></i>	$\Delta_m$
2 ...	38	1.58	
3 ...	111	2.05	0.47
4 ...	300	2.48	0.43
5 ...	950	2.98	0.50
6 ...	3,150	3.50	0.52
7 ...	9,810	3.99	0.49
8 ...	32,360	4.51	0.52
9 ...	97,400	4.99	0.48
10 ...	271,800	5.43	0.44
11 ...	698,000	5.84	0.41
12 ...	1,659,000	6.22	0.38
13 ...	3,682,000	6.57	0.35
14 ...	7,646,000	6.88	0.31
15 ...	15,470,000	7.19	0.31
16 ...	29,510,000	7.47	0.28
17 ...	54,900,000	7.74	0.27

The data for the stars of magnitudes 2 to 6 are somewhat uncertain, which accounts for the irregular run of the first few values of  $\Delta_m$ , but

beyond this point the steady decrease in  $\Delta_m$  is very noticeable. This clearly shows that modern photographic telescopes now penetrate to regions of space where the stars begin to thin out in numbers to a quite considerable extent, for it is easy to prove that if the stars were distributed uniformly throughout space,  $\Delta_m$  should preserve the constant value 0.6. This assumes, what appears to be fairly correct, that any possible absorption of light in space does not materially diminish  $\Delta_m$ .

From the numbers in the foregoing table, the following simple rational formula can be derived,

$$\log \frac{dN_m}{dm} = a + bm - cm^2,$$

or, in an equivalent form,

$$N_m = A \frac{1}{\sqrt{\pi}} \int_{-\infty}^{B(m-C)} e^{-x^2} dx.$$

The latter formula, which is the integral of the error curve, implies that the total number of the stars is finite, and this is now generally accepted as true; A represents this total number, while C denotes the magnitude which divides all the stars into two equal groups, those brighter being equal in number to those fainter. A, B, C can be deduced from *a*, *b*, *c*, which are readily obtained from the observed values of *N<sub>m</sub>*, but A is not narrowly determined—its value seems to be not less than 1000 million, and probably not greater than 2000 million, so that the total number of the stars is comparable with the population of the earth (this is roughly estimated as 1600 million). The constant C is more closely determined, and is approximately 23 or 24. Stars of this magnitude could just be photographed, with many hours exposure, with the largest telescope in the world, the 60-in. reflector at the Mount Wilson observatory. There remain, therefore, beyond our present powers of exploration still fainter stars equal in number to all those which could possibly be examined at the present time.

These impressive numbers shrink into a smaller compass when the total *light* of the stars is considered. It may readily be shown that if the formula for *N<sub>m</sub>* is correct, the total intensity *I<sub>m</sub>* of all the stars brighter than magnitude *m* can be represented by an expression identical in form with that for *N<sub>m</sub>*; but whereas the peak for the error curve, the integral of which represents *N<sub>m</sub>* or *I<sub>m</sub>*, is in the former case (*C*=23 or 24) beyond the limits of the observed data, in the case of *I<sub>m</sub>* it is well within these limits—in fact, half the total light of the stars comes from those brighter than about 9.5<sup>m</sup>. Up to this point the light received from all the stars of magnitude *m* to *m*+1 increases; beyond this it diminishes rapidly, the increase in the number of the faint stars, great though it is, being insufficient to counterbalance their diminished brightness. Owing to the formula for *N<sub>m</sub>* giving too small a number of bright stars (a defect of little moment for most values of *m*, in the case of *N<sub>m</sub>*, but of serious importance when the

total light of the stars is under consideration), the following table has been constructed from Table I., in order to give the actually-observed light of the stars so far as magnitude 17, the formula being used only beyond this point, where it is quite sufficiently accurate for the purpose. The light is given in terms of the number of first magnitude stars of equivalent intensity. Three very bright stars are given individually.

TABLE II.—*The Equivalent Light of the Stars.*

Magnitude	Number	Equivalent number of 1st magnitude stars	Totals to magnitude <i>m</i>
-1.6 ...	Sirius	11	—
-0.9 ...	<i>a</i> Carinæ	6	—
-0.0 ...	<i>a</i> Centauri	2	—
<i>m</i> <i>m</i>			
0.0-1.0 ...	8	14	33
1.0-2.0 ...	27	17	50
2.0-3.0 ...	73	18	68
3.0-4.0 ...	189	19	87
4.0-5.0 ...	650	26	113
5.0-6.0 ...	2,200	35	148
6.0-7.0 ...	6,600	42	190
7.0-8.0 ...	22,550	56	246
8.0-9.0 ...	65,000	65	311
9.0-10.0 ...	174,000	69	380
10.0-11.0 ...	426,000	68	448
11.0-12.0 ...	961,000	60	508
12.0-13.0 ...	2,020,000	51	559
13.0-14.0 ...	3,960,000	40	599
14.0-15.0 ...	7,820,000	31	630
15.0-16.0 ...	14,040,000	22	652
16.0-17.0 ...	25,400,000	16	668
17.0-18.0 ...	38,400,000	10	678
18.0-19.0 ...	54,600,000	6	684
19.0-20.0 ...	76,000,000	3	687
All stars fainter than 20 <sup>m</sup> .0		3	690

It appears that the total light of the stars is approximately equal to that of 700 first magnitude stars. Previous estimates of this number have greatly erred on the side of excess (more than three times the present value having been given, though these estimates should be reduced by about 20 per cent. for comparison with the present one, since they have been expressed in terms of first magnitude stars on the visual scale). The present value can scarcely be much affected by our ignorance as to the exact numbers of stars fainter than 17<sup>m</sup>, as it is a fairly safe deduction from the above formulæ that the stars fainter than 15<sup>m</sup> contribute less than one-eighth of the total light. Indeed, the fainter half of the stars, several hundred millions in number, account for only  $\frac{1}{4}$  per cent. of the total light, about equal to that of four second magnitude stars. It may be of interest, in conclusion, to express the total light of the stars in terms of the light of the full moon and of the standard candle; using some Harvard data for the brightness of these two sources of light, it appears that the full moon is very nearly one hundred times as bright as a star of magnitude -6.1, the light of which would equal the combined light of all the stars, while light of the same intensity would be received from an ordinary 16-candle-power electric lamp at forty-five or fifty yards' distance.

S. CHAPMAN.

### THE STONE TECHNIQUE OF THE MAORI.<sup>1</sup>

THE Maori have long been famous as past masters in the art of working stone, the ornaments and implements of the beautiful nephrite ("jade") of New Zealand being especially noteworthy. It is, therefore, with peculiar pleasure that we welcome the appearance of a monograph which deals in an adequate manner with this important subject; indeed this is the only complete account we have of stone technique in Oceania. The student must not overlook, however, the beautifully-illustrated monograph on "Ancient Hawaiian Stone Implements," by W. T. Brigham (*Mem. Bernice Pauahi Bishop Museum*, vol. i., No. 4, 1902), in which many implements from New Zealand are figured.

The preparation of the present memoir could not have been entrusted to a more competent student, as Mr. Elsdon Best has gained a deservedly high reputation for his intimate and sympathetic knowledge of the ancient lore of the Maori, and for his acquaintance with the literature of all that pertains to New Zealand. An authoritative account is given of the native terminology for the various kinds of implements and of the stones employed for the blades, as well as of the methods for the manufacture of the ordinary stone tools, the information being culled from numerous published sources and from the natives themselves. There is a certain amount of *tapu* pertaining to the task of cutting nephrite

and no woman was allowed to come near the workers, but there was no *tapu* in connection with the working of any other stone. Holes were drilled in stone by means of the cord drill, but the bow drill (with or without a mouthpiece) and the pump drill seem to have been unknown to the Maori in pre-European times. The same appears to hold good for Polynesia, though it is not easy to see how the pump drill of New Guinea could have been introduced by Europeans. Having chipped and bruised his implement into the desired form,

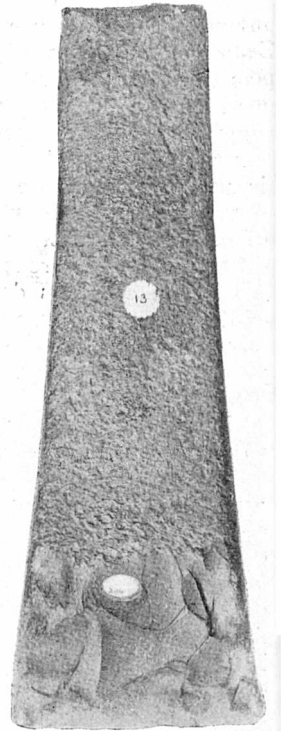


FIG. 1.—Unfinished adze-blade of very fine-grained black aphanite, illustrating the fine symmetrical form attained under the processes of flaking (or chipping) and bruising, without any grinding whatever. The tool could be utilised as an adze if only the lower part of the blade were ground. Length 12½ in. This is also a common Hawaiian type.

<sup>1</sup> Dominion Museum Bulletin No. 4. The Stone Implements of the Maori. By Elsdon Best. (Wellington: J. Macay, Government Printer, 1912.)



the Maori had then to smooth the surface by rubbing it on a piece of sandstone, usually in a longitudinal manner, as he had no knowledge of a rotatory stone for this purpose.

The methods of hafting the implements are described and evidence is adduced to show that, contrary to what was formerly believed, the Maori did use tools helved as axes, but they were not nearly so numerous or commonly used as were tools hafted and used as adzes.

All the available information about nephrite and the tools made from it is summarised by Mr. Best. Many legends have grown up in connection with this precious stone, for this there has been ample time, since "Polynesians, or a mixed people, must have been settled in New Zealand for at least one thousand years, and possibly for a longer period. It is also highly probable that the old-time people of these isles, who here flourished long before the immigration of *circa* 1350, were acquainted with nephrite of the South Island, and also that they worked it to some extent." The memoir is illustrated by fifty-one plates which leave nothing to be desired.

A. C. HADDON.

#### NOTES.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 6.

THE Faraday lecture of the Chemical Society will be delivered by Prof. Svante Arrhenius in the theatre of the Royal Institution on Monday, May 25, upon the subject of "Electrolytic Dissociation."

DR. ROBERT CHODAT and Dr. Richard Wettstein, Ritter von Westersheim, have been elected foreign members of the Linnean Society. The council of the society has decided to award the Linnean medal at the forth coming anniversary meeting on May 25 to Prof. Otto Bütschli, of Heidelberg.

A REUTER message from Ottawa states that an Order in Council has been passed setting aside as a national park an area of ninety-five square miles situated within the railway belt of British Columbia, in the vicinity of Mount Revelstoke, on the line of the Canadian Pacific Railway. It will be known as the Revelstoke National Park.

THE death is announced, on May 15, of Miss Ida Freund, late staff lecturer at Newnham College, and author of several papers on chemical subjects, as well as of a valuable work published in 1904, entitled "The Study of Chemical Composition: an Account of its Method and Historical Development."

DR. J. C. KONINGSBERGER, director of the Botanic Gardens—'s Lands Plantentuin—Buitenzorg, Java, informs us that the new laboratory for foreign scientific visitors is now open. The laboratory is consecrated to the memory of his predecessor, the late Prof. Melchior Treub, and consequently bears the name "Treub Laboratorium." We are asked to announce that, as hitherto, the director and staff of the gardens welcome visitors, and will do all that is in their power to make a scientific voyage to Java and a stay in Buitenzorg as profitable as possible.

THE annual meeting of the British Science Guild will be held at the Mansion House to-morrow, May 22, at 4 p.m., the Right Hon. the Lord Mayor presiding. Sir Ronald Ross, K.C.B., will deliver an address, and other speakers will be the president of the guild (the Right Hon. Sir William Mather), Sir Boverton Redwood, Bart., the Right Hon. Lord Blyth, Sir William Beale, Bart., Mr. C. Bathurst, M.P., Major O'Meara, C.M.G., Mr. Alexander Siemens, and Mr. Carmichael Thomas. The dinner of the guild will be held on the same date, at 7 p.m., at the Trocadero Restaurant, under the chairmanship of Sir William Mather.

THE President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to consider and report upon the effect of the present arrangements for the sale of the small-scale maps of the Ordnance Survey. The Committee consists of Sir Sydney Olivier, K.C.M.G., Permanent Secretary of the Board of Agriculture, chairman; Mr. F. Atterbury, C.B., Controller of his Majesty's Stationery Office; and Colonel C. F. Close, C.M.G., Director-General of the Ordnance Survey. Mr. J. L. Bryan, of the Board of Agriculture, will act as secretary to the Committee.

THE young of the grey seal (*Halichoerus grypus*) are stated to differ from those of all other European seals by their inability to swim until several weeks after birth; and as they are born above high-water mark on rocks and skerries in the open sea, they are peculiarly liable to destruction by those acquainted with the haunts and habits of the species. Despite the small value of the pelt of the pup and of the oil of the parent, expeditions have of late years been made to the breeding-places of these seals on the British coasts, with the result that the species is in jeopardy of imminent local extermination. To put matters on a better footing a Bill has been introduced in the House of Lords to enact an annual close time for these seals from October 1 to December 15; it recently passed the third reading in the Upper House.

AT the beginning of this year the *Biologische Versuchsanstalt* at Vienna passed into the possession of the Imperial Academy of Sciences. The institution is for the experimental investigation of organisms, especially experimental morphology and developmental physiology; also of comparative physiology and the borderlands of biophysics and biochemistry. The Academy of Sciences has appointed a committee of trustees for the institution. A limited number of tables is exempt from fees, and may be awarded by the director of the Anstalt or directors of its departments. The Austrian Ministry of Education has reserved four tables of which as a rule one is to be awarded in every department. Applications for research tables may be addressed to the director of the Anstalt, or to one of the following directors of departments:—*Botany*, W. Figdor and L. v. Portheim; *Physical Chemistry*, W. Pauli (until December 31, 1914); *Physiology*, E. Steinäch; *Zoology*, H. Przibram.

THE annual meeting of the Société Helvétique des Sciences naturelles is to be held at Berne on August

31-September 3 next. Prof. E. Fischer is the president for the year, and Dr. H. Rothenbühler is the secretary of the committee of management. The following addresses to general meetings of the society have been announced:—Dr. Bluntschli, of Zürich, on the biology and ontogeny of the primates of the New World; Prof. E. Hugi, of Berne, on the geology of the Gaster range and the Lötschberg tunnel; Prof. Kohlschütter, of Berne, on physico-chemical factors in the origin of natural forms; Prof. Noelting, of Mulhouse, on the synthesis of colouring matters; and Prof. H. Sahli, of Berne, on the influence of natural science on modern medicine. The Swiss Mathematical, Physical, Chemical, Geological, Botanical, and Zoological Societies will also hold their annual meetings at Berne on September 2. Members desirous of presenting papers at any of the meetings of sections should communicate with Prof. Fischer, Kirschenfeldstrasse, 14, Berne, before July 1.

ON Monday last a Committee of the House of Lords threw out a Bill promoted by the Glasgow Corporation under which they sought powers to make an electric tramway with a double line of rails along University Avenue, which for nearly half a mile forms the northern boundary of Glasgow University and of the Infirmary. The University opposed the Bill on the ground of magnetic disturbance and vibration, which would adversely affect the physical, botanical, and biological laboratories. Technical evidence was given in support of the opposition by Profs. Gray, Kerr, and Bower, of Glasgow University, Prof. Nuttall, of Cambridge, and by Mr. C. V. Boys and Mr. Sellon. This decision is one of the first importance for the protection of our universities from encroachments upon their amenities and the quiet which they have enjoyed; it is necessary for their welfare, and will establish a useful precedent when town councillors and other promoters are trying to force their schemes regardless of the injury which they would do.

IN the issue of the *Revue générale des Sciences* for December 30, 1909, an article by M. Ernest Solvay was published dealing with "Physical Chemistry and Psychology." In that article M. Solvay propounded ten questions which opened up numerous researches; and to encourage investigation in these directions he announced that he would devote 2000*l.* to the award of prizes for work designed to answer his questions. The theses had to be sent in by January 1, 1914, to the Institut Solvay de Physiologie in Brussels. The awards were made by a commission consisting of Prof. L. Fredericq, of Liège, Prof. J. Verschaffelt, of Brussels, and Prof. O. Dony-Hénault, of Mons, and were announced in the issue of our contemporary for April 30. The prizes were awarded as follows:—To Prof. G. Bredig, of the Technical High School, Karlsruhe, for his researches on catalysis; to M. G. De Meyer, of the Institut Solvay, for his work on muscular action; and to M. J. Boselli, of Paris, for his research on the speed of reaction in heterogeneous systems.

THE plans for the Meteorological Conference which is to be held in Edinburgh in September next are taking definite shape. A strong general committee

with seventy-six members has been formed. The lamented death of Sir John Murray has left the office of president vacant. The other officers of the conference are the following: *Vice-presidents*: C. J. P. Cave, president of the Royal Meteorological Society; J. Mackay Bernard, of Dunsinnan, president of the Scottish Meteorological Society; Major-General Ruck, president of the Aeronautical Society; Dr. W. N. Shaw, director of the Meteorological Office; Dr. H. R. Mill, director of the British Rainfall Organisation; Sir William Turner, principal of Edinburgh University; the Right Hon. Robert K. Inches, Lord Provost of Edinburgh. *Treasurer*: Captain H. G. Lyons. *Hon. Secretary*: F. J. W. Whipple, Meteorological Office, South Kensington, S.W. *Convener*, Edinburgh committee: Dr. E. M. Wedderburn, 2 Glenfinlas Street, Edinburgh. The programme of the conference, which will open on Tuesday, September 8, includes general discussions on meteorological questions, such as the use of pilot balloons for forecasters and aeronauts, wireless telegraphy in relation to forecasting, the electricity of thunderstorms, and evaporation and rainfall, as well as two evening lectures, which will probably be open to the public, a reception to which the members have been invited by the Lord Provost of Edinburgh, demonstrations with sounding balloons, and an excursion to Eskdale Observatory. Further particulars may be obtained from the hon. secretary, at the Meteorological Office, South Kensington.

IN the University of California's Publications on American Archaeology and Ethnology, vol. x., No. 6, Mr. P. E. Goddard contributes notes on the Chilula tribe of Indians, who up to recent times inhabited the banks of Redwood Creek, Humboldt County, California. They have now ceased to exist as a separate people, and if a full account of the tribe were possible its chief interest would be found in the deviations from the Hupa type of culture due to environmental differences, and certain transitional features. A curious discovery is that of a pond round which the girls during their adolescence ceremonies used to run in a direction contrary to the course of the sun. If the girl was able to run once round without drawing breath it was assumed that she would be a good basket-maker.

IN the April number of *Bedrock* Prof. G. Elliot Smith replies to certain criticisms tending to belittle the morphological importance of the Piltdown skull (*Eoanthropus dawsoni*). After remarking that, in spite of his relatively high brain-development, his face still retained many ape-like traits, the author goes on to observe that "the Piltdown man is the nearest approximation that has yet been discovered to the direct ancestor of the genus *Homo*, and all of its many varieties that made their appearance in Pleistocene and more recent times." In a later passage he adds that "it must be regarded as definitely settled, with as high a degree of probability as any question of phylogeny can be said to be settled, that the genus *Eoanthropus* represents the immediate ancestor of the genus *Homo*."

IN *Man* for May Mr. Eldon Best discusses the question of the peopling of New Zealand. He thinks it is going too far to speak of two distinct races in the island; but we have certainly the blending of two races: the fair-skinned Polynesian, with good features, and the swart, thick-lipped, flat-nosed Melanesian type. The former has hair with a slight wave in it; the hair of the latter, if allowed to grow, has the frizzy and bushy appearance of that of the Fijians. Between them is an intermediate type, the result of blending. Besides these, again, in the Urukehu strain we find a fair-haired, light-skinned type, the origin of which is still a mystery. Cannibalism, he supposes, was by no means a common custom in the Society group, whence the Maori came to the island; but it was well established in Fiji, and was probably introduced by the Maruiwi—a folk with pronounced Fijian affinities—and was thus acquired by the Polynesian Maori, or rather, was inherited by the mixed descendants of these two peoples.

THE current number of the *Quarterly Review* contains an interesting account of the family of Sadi Carnot from the pen of Mr. James Carlill. Sadi himself was a captain of engineers, and died in 1832 when only thirty-six, having published his "Reflexions sur la puissance motrice du feu" in 1824. He was the eldest son of General Lazare Carnot, the "organiser of victory" of the first Republic, and member of the Committee of Public Safety. His younger brother Hippolyte became Minister of Education in, and his nephew Sadi President of, the French Republic (1887). His uncle Feulint was almost as distinguished a soldier as his father, and three other uncles became judges, one of the Cour de Cassation. His grandfather was a distinguished notary of Nolay in Burgundy, and his grandmother a woman of great beauty. Families of ten, twelve, or fourteen members are common in his pedigree. According to the author, the family mind, which enabled the Carnots for a century and a half to supply men to fill the highest offices in the State, was the normal brain encouraged from childhood to take an active interest in everything, and invigorated by constant use.

THE fishes collected during the Duke of Mecklenburg's first expedition to Central Africa are described by Messrs. P. Pappenheim and G. A. Boulenger in vol. v., *Zoologie* iii., Lief. 2, of the *Wissenschaftliche Ergebnisse* of the expedition, published at Leipzig by Klinkhardt and Biermann. A new genus (*Schubotzia*) of cichlids and a number of new species of various groups are named. The same publishers are also issuing the scientific results of the Duke's second expedition ("Ergebnisse der Zweiten Deutschen Zentral-Africa Expedition, 1910-11," etc., etc.), of which we have received Lief. 2 of the zoological section of the first volume, dealing with the copepod and cladocerotine crustaceans.

THE whole of vol. xxv. of *Anales del Museo Nacional de Historia Natural de Buenos Aires* is devoted to the mammalian Tertiary faunas of the "Araucanian" formations of Argentina, as specially represented by

those of Monte Hermoso and the Rio Negro, the monograph being illustrated by thirty-one plates and ninety-two text-figures. The author, Señor Cayetano Rovereto, records a very large number of species, some of which are described as new, and likewise names several new genera. Most, at any rate, of the forms belong to types already familiar through the works of Ameghino, Dr. W. B. Scott, and others, and it may be a question whether at least some of the generic types described as new are not based on trivial characters or on those due to immaturity.

OF late years it has been very generally accepted both in this country and on the Continent, that the name "aurochs," or "urochs," belongs of right to the extinct wild ox, or ur (*Bos taurus, primigenius*), and not to the bison (*B. bonasus*). This, we believe, was first definitely pointed out in this country on p. 14 of a paper on the zoology of ancient Europe read by the late Prof. A. Newton before the Cambridge Philosophical Society in 1862, and published later on in the same year by Messrs. Macmillan in pamphlet form. The writer's actual words are that the ur or urus "has been so very commonly confounded by writers with the zubr, or European bison (*B. bonasus*)—the aurochs, as it is commonly, although erroneously, called in France and England, that it is not easy to make out anything with certainty with regard to it." A similar view, adopted by others of his countrymen, was subsequently expressed in Germany by the late Prof. A. Nehring, who considered that the name aurochs was gradually transferred centuries ago to the wild ox, as the latter became exterminated. Recently Dr. B. Szalay, of N.-Szeben-Hermanstadt, in an article published in vol. vi. of *Zoologische Annalen* (p. 54), controverts this view, and maintains that the term aurochs properly belongs to the bison or zubr. To discuss the merits of the question in this place is impossible, but we may quote the legends to Herberstein's sixteenth-century pictures of the wild ox and the bison, which are respectively as follows:—"Ich bin der Urus welchen die Polen Thur nennen, die Deutschen Aurochs, die Nichtkenner Bison," and "Ich bin der Bison, welchen die Polen Subr nennen, die Deutschen Wysent, die Nichtkenner Urochs." Again, we have the statement by Herberstein, as summarised by Prof. A. Mertens (*Abh. Mus. Magdeburg*, vol. i., p. 7, 1906), "dass der Ur, der dort mit einheimischen Namen Thur genannt wird, bei den Deutschen Aurochs heisst."

ATTENTION was directed to the interesting excursions of the *Oberrheinischer geologischer Verein* in *NATURE* of May 30, 1912 (vol. lxxxix., p. 328). The *Jahresbericht* of the society for March, 1914, gives the programme of an April visit to the Vorarlberg area. The same number contains a paper on the origin of the Black Forest and the Vosges, by Paul Kessler, which will be welcomed on account of its systematic treatment of a long series of events. The thirteen sections, illustrating the region now occupied by the trough-valley of the Rhine, from the close of Devonian times to the present day, are worthy of reproduction as diagrams for class-instruction. The most mountainous condition of the region, when it

resembled the present Alpine chain, is shown as resulting from the Armorican folding. Immense intrusions of igneous rocks then took place, and some of the gneisses of the Vosges and the Black Forest are now recognised as granites of Carboniferous age. While the great lowering of the Rhine-trough by down-faulting dates from Middle Oligocene times, and while this was emphasised by the Miocene uplift of its flanking walls, it is interesting to reflect that the Rhine itself played no part in the modification of the valley until it flowed for the first time northward at the opening of the Glacial epoch.

SINCE the description by Prof. Malladra, in May, 1912, of the existence of a practicable path by which the bottom of the Vesuvian crater can be reached, several observers have availed themselves of the opportunity of making investigations concerning volcanic action under these unique conditions. In the *Geologische Rundschau* (Band v., Heft 2, 1914) a very interesting account of a visit to the crater is given by Mr. Max Storz, of Munich. Among the valuable results published as the outcome of this visit, we may direct attention to the temperature observations, made by means of metallic wires with different melting points, and to the determination of the acids and bases present in the emanations. The acids found were hydrochloric and sulphurous-acid gases, and indications of the following metals were detected—lead, copper, calcium, magnesium, potassium, and sodium. Useful plans of the crater and of the bocca at its bottom are given, together with photographs which are similar in every respect to those obtained by Mr. Burlingham, three of which appeared in *NATURE* of February 5.

THE Californian earthquake of 1906 originated in a movement along the San Andreas fault-rift extending over a distance of 290 miles. Since that year three slight earthquakes have been traced to slips along the same fault. The first, on September 12, 1912, occurred near the south end of San Francisco Bay; the second, on October 25, 1913, to the north-west of Berkeley; the third, on January 23, 1914, in an intermediate position close to San Bruno. The epicentre of the last was determined by Mr. E. F. Davis (*Bull. Seis. Soc. America*, vol. iv., pp. 25–28) by means of Omori's formula for local shocks from the duration of the preliminary tremors at the Lick, Santa Clara, and Berkeley Observatories.

THE report for 1913 of the Stonyhurst College Observatory (Lancs.) has been received from Father Sidgreaves, and contains *inter alia* mean and extreme meteorological values at that important station for the last sixty-six years. The observatory has recently severed its principal connection with the Meteorological Office (as explained in the last annual report of the meteorological committee), but it still furnishes the latter body with weekly reports; the automatic recorders remain at Stonyhurst, and their continuous registrations are uninterrupted.

THE yearly report for 1913 of the *Deutsche Seewarte* (Hamburg) bears witness to the great activity of that useful institution with regard especially to (1) mari-

time meteorology, (2) weather telegraphy, and, generally speaking, to all matters connected with the welfare of the seafaring community. Much attention is given to the proper installation of the mariner's compass, and to the application of the theory of magnetism to navigation; these matters also engaged the earnest attention of the late Dr. v. Neumayer. During the year the number of complete sets of observations received from observers at sea exceeded three-quarters of a million. These are utilised in the preparation of monthly meteorological charts, sailing directions, and daily synoptic weather charts of the North Atlantic. The daily report has undergone several recent improvements, and it now includes small charts showing separately the changes of air-pressure during the preceding day and night by lines of equal values of these changes (isallobars); these values are fully discussed by Dr. N. Ekholm in No. lxiv. of the publications of the international council for the study of the sea (*NATURE*, September 18, 1913).

BOLTZMANN'S formula for entropy considered in relation to the theory of probability has recently been made the basis of many of our modern radiation theories; but objections have been raised by Einstein and others, in particular to the validity of the formula when applied to systems other than isolated systems the energy of which is constant. A short note on this question is published by Dr. Karl F. Herzfeld in the Vienna *Sitzungsberichte* for 1913 (recently received), in which the author confirms the more general formula according to which the entropy in any state is proportional to the logarithm of the number of possible cases plus a constant, but the value of this constant is not definite, as it was in the usual Boltzmann formula.

A SHORT time ago Mr. Jenkins described (*Philosophical Magazine*, vol. xxvi., p. 752) a method devised by Prof. Hicks for determining a magnetic field, in particular the horizontal component of the earth's field, by a method which reduced the measurement to that of an electric current. In the case of the earth's field a solenoid through which a measured current flows is used to reverse that field. The state of the joint field is judged by the time of oscillation of a small magnet at the centre of the solenoid. In the March number of *Terrestrial Magnetism*, Prof. Schuster describes a similar method which he has had tested at the National Physical Laboratory. It seems probable that when the coil is wound with the degree of accuracy used in current-measuring instruments, the accuracy of a determination will be at least as great as with the Kew magnetometer, and the time required will be five minutes instead of an hour.

An electrical sterilisation process has been in successful operation at one of the milk depôts of the Liverpool City Corporation for the past six months, and a report on this process drawn up by the city bacteriologist, Prof. Beattie, was presented last month to the Health Committee of the City Corporation. The process depends upon the use of an alternating current of high potential for destroying, by shock, the bacteria contained in the milk. The sterilising appa-

ratus consists of a long tube with copper electrodes inserted in tube-shaped depressions at suitable points, the milk being passed continuously through this tube, from a raised tank, at a predetermined rate of flow. The current used varies from 2 to 3 amperes at an E.M.F. of 3900 to 4200 volts, and each unit quantity of milk is exposed to the action of this current for such a brief period of time, that no heating effects are produced. Details of the bacteriological results are given in the report, from which it is seen that *B. coli* and the ordinary milk-souring bacteria have been invariably absent from the electrically-treated milk, and that the average percentage reduction in the number of total bacteria, over a period of fifteen days' operation of the plant, was 99.93 per cent. The electrical sterilising apparatus in use at the Earle Road Milk Depot of the Liverpool Corporation has a capacity of 125 gallons of milk a day, and this quantity is distributed in 3000 bottles. The question of extending the plant is now being considered.

A PAPER on recording pyrometers, read by Mr. C. R. Darling at a meeting of the Faraday Society on April 22, was accompanied by a full display of the most recent types of instruments. The marked improvement which has been effected in the accuracy of these instruments was attributed by the author, and by several speakers in the subsequent discussion, to the admirable work of the National Physical Laboratory as an impartial standardising agency. Some recent advances include (1) the introduction of electric power to operate the pyrometers, either by means of relay-circuits or in place of clockwork, in such a way that the automatic control of large technical furnaces may easily be provided for; (2) arrangements whereby the same instrument may be used either with a resistance thermometer or with thermal couples; (3) automatic switches with the help of which the records from several furnaces may be recorded by the same machine.

THE Chemical Society's journal for April contains two papers by Dr. Pickard and Mr. Kenyon on the dependence of rotatory power on chemical constitution. The first paper, recalling the monographs of Sir William Perkin on magnetic rotatory power, contains a description of no fewer than seventy-three optically-active esters of the fatty series. Unlike the alcohols from which they are derived, which exhibit the simplest type of rotatory dispersion at all temperatures, the esters show marked deviations from the simple law when the temperature is raised; in certain solvents they even exhibit anomalous rotatory dispersion. The second paper includes a description of the optical properties of naphthyl methyl carbinol  $C_{10}H_7.CH(OH).CH_3$ . This substance obeys the simple dispersion law at temperatures above  $160^\circ$ , but shows anomalous rotatory dispersion in the superfused condition at temperatures below about  $10^\circ$ . It is suggested that the anomalous dispersion is caused by the actual presence in the superfused liquid of two of the hypothetical varieties of the naphthalene nucleus which have long been postulated by organic chemists.

THE transportation problem in Canada, and Montreal Harbour, were discussed in a paper read at the

Institution of Civil Engineers on April 7 by Mr. F. W. Cowie. It appears that the farmer receives for his wheat 67 per cent. of the price paid by the consumer; the remaining 33 per cent. represents the cost of transportation, handling, and selling profits. It is important that the latter percentage should be reduced to the lowest possible figure, so that the farmer may receive the full due for his toil, and the cost of living in Great Britain may not be unduly enhanced. Montreal Harbour handled sixty million bushels of grain in 1913, and nearly a hundred million bushels of Canadian grain were shipped in the same year through Buffalo in the United States. The loss to Canadian transportation and selling organisations by reason of the latter shipments amounts to about 18,000,000 dollars. The magnificent railway systems between New York and Buffalo are the most powerful rivals of the "all Canadian" routes. Great efforts are being put forth by the Canadian Government and others interested to improve facilities and render available Canadian routes. The author is of the opinion that the advantages for future transportation should lie with the St. Lawrence route. It is believed that improvements for the storage and handling of grain in the ports of Great Britain are not advancing in measure equal to the Canadian ports.

Six new volumes have been added to "The People's Books," which Messrs. T. C. and E. C. Jack are publishing at sixpence net each. The additions fully maintain the high standard of this excellent series, which is bringing within the reach of all readers the results of modern studies in many branches of human knowledge. Particular attention may be directed to Dr. W. E. Carnegie Dickson's little book on bacteriology, and Mr. Ford Fairford's on Canada. Dr. Dickson, in the sub-title to his volume, "Man's Microbe Friends and Foes," sufficiently describes the point of view from which he has written. He gives a brief historical summary of the growth of the science, explains the relation between health and disease, describes some of the commoner organisms which produce disease, and explains the importance of bacteria in the arts and industries. Mr. Fairford's book should prove of service to students of commercial geography, and interest general readers in an important part of the Empire.

#### OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A Kiel telegram, dated May 17, reports the discovery of a new comet, stated to be of the fourth magnitude, by Zlaitinsky. On May 15 the comet was situated close to  $\eta$  Persei, while on the following day it was recorded as being half a degree north of  $\alpha$  Persei.

A further telegram from Kiel communicates an observation by Prof. Schorr. On May 16, at 11h. 12.9m. Bergeford mean time, the comet was of the 4th magnitude, and its position was R.A. 3h. 17m. 37s., declination  $+49^\circ 51' 7''$ .

TELESCOPIC METEORS.—One of the interesting contributions to the *Observatory* for May is an account by Mr. W. F. Denning of observations of telescopic meteors. Thirty years ago Mr. Denning directed attention to the importance of making combined ob-

ervation of these bodies, for he and others were of the opinion that these faint shooting stars were at vastly greater distances than those visible to the naked eye, for their slowness of movement and diminutive size suggested such remoteness. While ordinary meteors rarely become visible at a greater height than about 100 miles, these telescopic objects require distances of 1000 to nearly 2000 miles to explain their appearance assuming as standard the ordinary velocity and length of flight of naked-eye meteors. From four objects Mr. Denning inferred heights of 1260 to 1820 miles, and these he states were "only examples of a class and not rarities." The whole question is interestingly summarised in this contribution, and the author describes in detail observations extending over the period 1881 to 1902, and reproduces numerous diagrams of various forms of trails observed.

A NEW PHOTOGRAPHIC CHART OF THE MOON.—In the April number of *L'Astronomie*, M. Camille Flammarion gives an account of the new photographic chart of the moon, which has recently been prepared by M. C. Le Morvan. M. Le Morvan during the last eighteen years has been associated with the production of all the plates for the great atlas of Loewy and Puiseux, and this important and unique collection of clichés, taken with the Paris equatorial coudé, provides him with a rich assortment of material. The object of the work is to provide in a more convenient form as perfect a representation of the lunar surface as is possible in every detail. The plates are reproduced in héliogravure, and are issued in two parts, each part consisting of twenty-four sections, and representing increasing and decreasing phases respectively. The publication of this chart is rendered possible by a grant of 4000 francs out of the Bonaparte funds by the Académie des Sciences. M. Le Morvan communicates also a brief account of the construction of lunar charts.

#### THE ROYAL SOCIETY CONVERSAZIONE.

THE annual May conversazione of the Royal Society was held on Wednesday, May 13, and was, as usual, largely attended. During the evening demonstrations were given in the meeting-room by Prof. J. P. Hill and Mr. P. Schilowsky. Prof. Hill gave a short account of the work of the Percy Sladen Expedition to Brazil, 1913, illustrated by lantern-slides of material collected and regions visited; and Mr. Schilowsky demonstrated the application of gyroscopes to locomotion on land, on sea, and in air. The gyroscope's stabilising property can be applied to unstable bodies like monorail cars or monorail automobiles, making them stable; that property can be used for stable but oscillatory bodies like ships, submarines, flying machines, preventing their rolling movement and rendering them perfectly steady. A description of the application of the system to a two-wheeled motor-car appeared in *NATURE* of May 7 (p. 251). Dr. J. G. Gray exhibited gyrostats with accessories for showing the more obvious properties of the gyrostat, and a series of what may be called "animated" gyrostats. The latter consist of gyrostatic acrobats, bicycle riders, and gyrostatic motor-cars, both two-wheeled and four-wheeled. A two-wheeled car was provided with a gyrostatic "chauffeur," which stabilised the car and presided at the steering wheel. This car illustrated the action of directing and stabilising apparatus for use on torpedoes, airships, and aeroplanes. A further form of two-wheeled car demonstrated methods of stabilising and manœuvring an airship by means of forces derived from the propellers, which apply a direct push to the moving body. Dr. Gray's bicycles and motor-cars

can be steered by the wireless transmission of electrical action. There were many other exhibits of objects and devices of scientific interest, and we give descriptions, from the official catalogue, of some of the most interesting grouped according to related subjects.

*The Astronomer Royal*: Transparencies of the Milky Way (selected from the Franklin-Adams chart). The whole sky was photographed on 206 plates by the late J. Franklin-Adams. The plates have been presented to the Royal Observatory, and the number of stars of different magnitudes from the 12th to the 17th have been determined. There are altogether fifty-five million stars on the plates, and from the sequence of the numbers for different magnitudes it is shown (S. Chapman and P. J. Melotte, Mem. R.A.S., vol. lx.), that the total number of stars in the sky is not less than 1000 millions, and cannot much exceed twice this amount, and that half the stars are brighter than the 23rd or 24th magnitude. *Mr. George H. Cobb*: A terrestrial globe, dated 1620, constructed to serve as a timepiece; supported by a gilt bronze figure of Atlas. Inside the globe is a movement of the verge type, so geared to the axial spindle that the globe revolves once in twenty-four hours.

*The National Physical Laboratory*. (Mr. F. E. Smith): Photographic record of the variations in the horizontal intensity of the earth's magnetic field at the National Physical Laboratory. The record shows the variations in H from 1 p.m. on Saturday, April 19, to 11 a.m. on Sunday, April 20. The time scale (abscissa) is 43 cm. to the hour (7 mm. to the minute), and the intensity scale (ordinate) is 2.5 mm. for a change in H of 17 (0.0001 c.g.s. unit). The sudden variations are principally due to the earth currents produced by the London United Electric Tramway system. These sudden changes are not in general greater than 5γ. *Mr. W. A. Douglas Rudge*: Electrification produced during the raising of a cloud of dust. During the raising of a cloud of dust by almost any method, considerable charges of electricity are produced. A charge of one sign is found upon the dust itself, and another charge of opposite sign, either upon the air, or else upon fine particles of dust which remain suspended in the air. Generally, dust of an acidic nature, such as silica or molybdic acid, give a negative charge to the air, metallic oxides and organic bases give positive charges to the air.

*Dr. J. A. Fleming*: An apparatus for the production of stationary vibrations on strings, loaded and unloaded. Various arrangements have been employed for the production of stationary vibrations on strings to illustrate the laws of wave motion. The apparatus exhibited consists of an electric motor having on one end of its shaft a counting mechanism, and on the other a disc to which is fixed a pin carrying the end of a rocking lever. This lever has on it a hook to which a string can be attached. The other end of the string is fixed to a slide rest arrangement, by means of which any required tension can be put on the string. When the motor revolves it gives to one end of the string an irrotational motion in a circle and propagates waves along the string. By adjusting the tension these waves can be made stationary. By employing a cotton cord, either single or multiple, in various degrees, it is easy to prove the fundamental laws of wave motion along cords. By using strings loaded with glass beads the effects of reflection at loads, or the laws of vibration of loaded cords, can be shown. *Mr. W. Duddell*: Water model of the electric arc. One of the essential properties of the electric arc is that, when the current through the arc increases, the potential difference between its terminals decreases. The model exhibited consists of a mushroom

valve. The pressure tending to reseal the valve is so arranged that it diminishes very rapidly as the valve lifts. In this way, when the flow of water is increased through the valve, the difference of pressure between its two sides decreases and thus represents one of the properties of the electric arc. When a steady flow is established and a column of water having a definite periodic time is connected to the valve oscillations can be set up similar to those obtained with an electric arc. Other properties of the arc discharge can also be demonstrated.

*The Cambridge Scientific Instrument Co.*: An aerodynamic balance. Designed for the experimental investigation of the stability of aeroplanes. The main part of the balance consists of three arms mutually at right angles, each arm being counterbalanced. These arms meet in a point at which a steel centre is fixed, and the weight of the balance is taken on this point. The vertical arm passes through the underside of a wind channel and supports the model under test. The horizontal arms are arranged respectively parallel and at right angles to the wind direction. The arrangements allow of the measurement of the forces on the model along three fixed rectangular axes, and also of the three moments about these axes for any angle of incidence of the wind on the model.

*Mr. F. W. Aston*: A simple microbalance for the determination of the densities of small quantities of gases. The balance is made entirely of fused quartz, and consists of a beam of the simplest possible construction, bearing at one end a small closed bulb and at the other a solid counterpoise. The whole is supported by a knife edge working on a polished quartz plate. The system is made to balance in air at some convenient pressure, and its sensitiveness made extremely high, turning at about one-millionth of a milligram. The gas is admitted to the balance case and the pressure determined at which it causes the beam to balance in a given position. The corresponding pressure for a gas of known density (*e.g.* oxygen) is then measured, the ratio of the pressures giving the inverse ratio of the densities.

*Mr. E. Leitz*: A new binocular microscope. The body consists of a flat casing containing the system of prisms. At the upper end are situated two eyepieces the distance apart of which can be regulated to suit the eyes of the observer by means of a milled head which actuates two levers inside the casing. The interpupillary distance can be varied between 54 and 70 mm. The eyepiece tubes slide in guides so that dust cannot enter the prism casing. The left eyepiece tube is provided with an independent adjustment to accommodate eyes of unequal vision. All kinds of eyepieces and objectives may be used, and the instrument can be employed for the same purposes as the ordinary monocular microscope. An important feature in this microscope is the parallel eyepieces which obviate the actions of accommodation and adjustment for convergence as is necessary in binocular microscopes constructed hitherto. *Prof. A. W. Bickerton*: The polyscope. A kaleidoscope rendered so optically perfect that a hundred reflections of a point or object may be seen. The angles of one are 30°, 60°, and 90°; of the other, two angles 45° and one of 90°. They produce two classes of patterns, one suitable for textile fabrics, cretonnes, etc., the other suitable for floor cloths, tiles, etc. *The Polychromide Company (The Dover Street Studios, Ltd.)*: Instantaneous photographs on paper taken in natural colour by the polychromide system. The optical separation of the natural colour of the object photographed is accomplished by means of the Hamburger-Conrady colour separation camera, which exposes three plates

simultaneously—representing the red, yellow, and blue sensations in the superposed positives on gelatin-silver emulsions, which constitute the complete colour records exhibited.

*The National Physical Laboratory (Dr. W. Rosenhain and Mr. J. L. Haughton)*: A new reagent for etching mild steel for microscopic examination. The reagent consists of an acid solution of ferric chloride containing small proportions of chlorides of copper and tin. Iron or steel sections exposed to this solution become covered with a very thin adherent layer of copper by a process of electrochemical substitution. This film of copper is deposited upon and thus darkens the ferrite areas, leaving the pearlite areas white, this effect being the reverse of that obtained with other reagents, such as picric acid.

*Prof. E. W. MacBride and Mr. H. G. Newth*: Double tadpoles of the frog, and double sea-urchins. The duplicity in the frog larvæ is of varying degree, and was produced experimentally. Fertilised eggs were inverted immediately upon the completion of the first cleavage-furrow, and were kept inverted until gastrulation was complete. The duplicity in the sea-urchin larvæ consists in the development of an urchinrudiment on both sides, or of pedicellariæ on both sides, whereas the normal larva has its rudiment on the left, its pedicellariæ on the right. *Dr. W. T. Calman*: *Bathynella natans*, a Crustacean of the order Anaspidacea. This minute Crustacean has hitherto been known only from a solitary specimen obtained in 1882, by Prof. Vejdovský from a well in Prague. It has recently been re-discovered in a well near Basle by M. Chappuis, by whom specimens have been sent to the British Museum (Natural History). It is a blind and otherwise degenerate member of the Anaspidacea, an ancient and primitive order of Crustacea represented by fossils in carboniferous rocks of Europe and America, and by three other recent species in Australia and Tasmania. *The Zoological Department of the British Museum (Nat. Hist.)*: Cast of the "paddle" or fore limb of a humpback whale. The humpback is the species of whale which has been most hunted during the last few years in Subantarctic waters. Immense numbers of these animals have been killed annually, and it can scarcely be doubted that the number will be enormously reduced unless steps are taken to control the rate of destruction. The late Major G. E. H. Barrett-Hamilton was sent to South Georgia by the Colonial Office, at the end of 1913, in order to obtain information with regard to whales and whaling in the far south. He died during the progress of his investigations. The cast shown measures 14 ft. 6 in. in length, and illustrates one of the most striking peculiarities of the humpback, the paddles of which are exceptionally long.

*Dr. H. Eltringham*: Preparations showing the urticating apparatus in *Porthesia similis* (gold tail moth). The female insect has long been known to possess urticating properties similar to those of the larva. It has lately been proved that the moth deliberately collects the spicules shed by its larva, and by means of a special apparatus stores them in the anal tuft. They subsequently serve as a protection for the eggs. *Prof. E. B. Poulton*: A family of *Papilio dardanus*, bred by Mr. W. A. Lamborn, near Lagos, S. Nigeria. The family was bred from a captured female of the *hippocoon* form—the black and white butterfly, which is by far the commonest female form of this species in the locality. Six previous families, bred by W. A. Lamborn from the same female form, contained *hippocoon* females and no others. This, the seventh, contains approximately equal numbers of *hippocoon* and *dionysus*, a non-

mimetic female form occurring, but in very small proportions, along the tropical west coast. The facts are best explained by supposing that *hippocoön* is a Mendelian recessive, *dionysus* a dominant, and that the male parent was a heterozygote.

*Dr. Vaughan Cornish*: Photographs illustrative of landslides and upheavals on the Panama Canal. The photographs were taken in 1910, 1912, and 1914. That of the Culebra Cut in 1910 shows an upheaval of the solid rock of the canal bottom due to unbalanced pressure of the banks. That of the Naos I. breakwater, taken in 1912, shows the upheaval of the sea bottom at a distance from the subsiding mass of the breakwater. The photographs of the Cucuracha slide, in 1914, show the downward flow of inclined strata. The ground is broken for a height of 580 ft. above canal bottom.

*Mr. Charles Dawson*: Lower canine tooth of the Piltown man (*Eoanthropus dawsoni*). This canine tooth was found on August 30, 1913, near the spot where the right mandibular ramus of *Eoanthropus* was discovered in 1912. As it is a lower canine of the right side, is of a new form, and has been much worn by mastication, it presumably belongs to the same jaw. It is relatively large, and is shown to have completely interlocked with the upper canine, as in the apes. *Mr. R. Elliot Steel*: Palæolithic engraving of a horse on a bone from Sherborne, Dorset. The bone is part of the rib of a horse, and was found in an old heap of debris from a quarry in the Inferior Oolite, near Sherborne. It was probably derived from a rock-shelter destroyed by quarrying. *Mr. W. N. Edwards*: "Paper coal" from the Coal Measures of Central Russia. The "paper coal" forms a bed 3-4 ft. thick, over an area of several square kilometres. It is composed exclusively of the practically unchanged cuticles of a Lepidodendroid plant, with a certain amount of carbonaceous matter. It has been suggested that the preservation of the cuticles alone was due to selective bacterial action, and Renault considers that a species of micrococcus is present.

#### CATALYSIS IN ORGANIC CHEMISTRY.

BY the invitation of the University of London, Prof. Paul Sabatier, of Toulouse, delivered two lectures on catalysis at King's College on May 14 and 15. On Wednesday evening, May 13, he was entertained by the Faraday Society at a complimentary dinner, at which Prof. Arrhenius and Prof. Heyn, of Berlin, were also present as guests. The two lectures were delivered in French, and were illustrated by a series of experiments in which the catalytic action of nickel, of copper, of alumina, of zinc oxide, of titanium dioxide, and of thoria were shown in actual operation. Prof. Sabatier is a whole-hearted advocate of the chemical as opposed to the physical theory of catalysis. He holds that in all cases intermediate compounds are formed, e.g. PtO in catalytic oxidations in presence of platinum, and NiH<sub>2</sub> in catalytic reductions in presence of finely divided nickel. He finds ample support for his views in the totally different effects that are often produced by catalysts which are almost identical in their physical properties. Thus formic acid vapour is decomposed wholly into hydrogen and carbon dioxide when passed over zinc oxide, but into water and carbonic oxide when passed over titanium dioxide:—

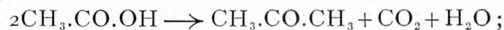


Ethyl alcohol in like manner may be converted into aldehyde and hydrogen by finely divided copper, or into ethylene and water by alumina:—

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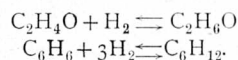


Different catalysts also differ very widely in their efficiency in promoting any given chemical change. Alumina can be used very effectively to convert alcohol into ethylene and water, but it becomes clogged with tarry matter which cannot be burnt off without destroying the catalytic properties of the oxide; thoria, on the other hand, becomes contaminated less readily, and can be purified by ignition without losing its activity. Again, thoria is a very useful catalyst for converting acids into ketones, e.g. :—



but titanium dioxide is so efficient and acts at so low a temperature that it can also be used to prepare aldehydes from mixtures of fatty acids with formic acid, and esters from acids (such as formic acid) or alcohols (such as the secondary and tertiary alcohols), which lose water so easily that it is difficult to esterify them without decomposition. On the other hand, the best catalyst for preparing ketones and other derivatives from benzoic acid is ordinary chalk. A very important catalyst is manganous oxide, which can be prepared easily and cheaply from manganous carbonate, and can be used in almost every case for the preparation of ketones in place of thoria or titanium dioxide.

Prof. Sabatier laid stress on the reversibility of catalytic actions. Thus nickel will promote dehydrogenation as well as hydrogenation, and very small differences of conditions are required to cause the reversal of actions such as those which are shown by the equations:—



An interesting account was given of the way in which acetylene in contact with nickel at different temperatures and in presence of varying proportions of hydrogen gives rise to complex products which are in every respect identical with natural petroleum. By varying the conditions the product can be made to resemble the four chief natural types as derived from North America, from the Caucasus, from Galicia, and from Roumania. These observations suggest a theory of the origin of petroleum that has a far higher claim to acceptance than most of those that have been put forward hitherto.

Prof. Sabatier touched only lightly on the technical applications of his new methods. The vast industry which has sprung up within the last two or three years, in this country, on the Continent, and in America, was illustrated by two small samples of oils that had been hardened by the action of hydrogen in presence of finely divided nickel; reference was also made to the fact that in the process of hardening the disagreeable taste and smell of the fish-oils are completely removed.

It is not too much to say that Prof. Sabatier has introduced a new era in organic chemistry. The advantages of catalytic methods are obvious: the catalyst will last for an indefinite period unless its activity is destroyed by overheating, which is generally fatal, or by "poisonous" impurities, such as sulphur or the halogens which quickly arrest the catalytic hydrogenation of organic compounds by nickel. The only materials required are those which are essential constituents of the products, and in almost every case the first effect of the successful introduction of catalytic methods is to bring about a great reduction in the cost of production. The rapid extension of these methods is therefore a matter of great scientific and technical importance.

T. M. L.



RECENT GEOLOGICAL WORK IN  
AUSTRALASIA.

THE Australian Commonwealth Bureau of Meteorology at Melbourne, in its Bulletin No. 8, publishes a memoir by Griffith Taylor on the physiography of Eastern Australia, in which it is urged that a repeated shifting of the divide between the eastern coast-streams and those running towards the Darling or the interior has occurred during Cainozoic times. The former streams have in consequence been able to lengthen themselves by captures in the region of the divide, and a very considerable reversal of drainage, assisted by the outpouring of lavas, has taken place. The author pictures the rise of eastern Australia on an earth-wave that proceeded westward from the New Zealand area. The large amount of "unreduced plateau" on the crest of the wave is well seen in E. C. Andrews's model of New England (New South Wales), which is described and illustrated by him in Proc. Royal Society N.S.W., vol. xlvi., p. 143. Andrews directs attention to the agricultural possibilities of the inland slopes of Eastern Australia.

The Bulletins of the Geological Survey of Western Australia include, in No. 50, a general account of "The Geology and Mineral Industry of Western Australia," by A. G. Maitland and A. Montgomery, which is reprinted from a cyclopædia issued in Adelaide. The preparation of authoritative essays of this nature is one of the best functions of a public survey, since the ordinary citizen cannot piece together the history of his country from detailed memoirs. From the price-list given in this bulletin, which unfortunately mentions it as in preparation, we conclude that it can be obtained for about 2s. A geological sketch-map is included.

The West Australian goldfields are described in Bulletins 41 (West Pilbara), 42 (East Coolgardie), 45 (North Coolgardie and East Murchison), 46 (Yilgarn and North Coolgardie, southern portion), and 47 (Kanowna). The quartz-reefs that penetrate crushed and metamorphosed conglomerates in these areas are in close relation with intrusive quartz-porphyrries, and E. S. Simpson and C. G. Gibson remark (No. 42, p. 64) that at Kalgoorlie sulphur and potash were introduced with gold, silver, mercury, and tellurium, through the influence of a late igneous intrusion which may or may not have reached the surface. It is pointed out that a solution of potassium sulphide dissolves both gold and tellurium. The illustrations of thin sections of the actual ore-materials are well produced and are of considerable petrographic interest. T. Blatchford and J. T. Jutson (No. 47) give a detailed account of the sheared conglomerates of Kanowna, and R. A. Farquharson discusses (p. 58) numerous types of igneous rocks, including a quartz-fuchsite-carbonate rock. This is believed to represent a former peridotite, of which chromite and fuchsite are the only unaltered relics. The type is also described in Bulletin 43, "Petrological Contributions to the Geology of Western Australia." It is clear that the official petrologist will render important service in determining the relations of the very interesting series of intrusive rocks, among which the ores have reached the surface.

Among recent publications of the Geological Survey of South Australia, general interest attaches to L. Keith Ward's Bulletin (No. 2) on the possibility of the discovery of petroleum on Kangaroo Island and Eyre's Peninsula. The author concludes (p. 25) that the asphaltum thrown up on the beaches is brought from an unknown source by oceanic currents. "Coorongite," on the other hand (p. 15), which is not proved to be in any way connected with petroleum,

appears to be still accumulating from local sources as a scum on lagoons, being left behind when a shrinkage of the water takes place. Incidentally, we learn from this inquiry that Kangaroo Island is believed to have been isolated from the mainland by a system of Cainozoic fractures.

J. E. Carne describes the somewhat fitful antimony mining industry of New South Wales (Geol. Survey N.S.W., Mineral Resources, No. 16, price 2s.).

The Geological Survey of Queensland in Publication No. 234 deals with the Etheridge Goldfield, near Einasleigh, where barren areas of granite, composite gneiss (p. 7), and Upper Cretaceous sandstone occur along the Copperfield River. Here again, as in Western Australia, quartz-porphry dykes appear to have some relation to the gold-bearing quartz veins; but the latter are on the whole richer in the more permeable adjacent rocks than in the porphyries themselves (p. 13). L. C. Ball (Publication 237) describes the Mount Mulligan Coalfield, about fifty miles west of the port of Cairns on the Cape York Peninsula. The Coal Measures, lying unconformably in gently sloping synclinals on uptilted grits and slates, are associated with the *Glossopteris* flora, and no Mesozoic plants have been found. The field is roughly estimated to contain 84,000,000 tons of somewhat friable coal.

The Geological Survey Bulletins issued by the Department of Mines in Tasmania now number thirteen, beginning with that by W. H. Twelvetrees, the Government geologist, "The Mangana Goldfield," in 1907, and extending to "The Preolenna Coal Field and the Geology of the Wynyard District," by Loftus Hills, published in 1913. They are printed, like those of Western Australia, in a convenient small octavo form, with folding maps, and are in the main devoted to mining considerations. The gold ores seem to have been deposited in the veins that accompanied intrusions of granite, and these occurred at the close of an epoch of folding between Silurian and Permo-Carboniferous times. The principal folding in Tasmania is thus probably contemporaneous with the Caledonian movements of the European area. Bulletin No. 5 contains (p. 35) an interesting correlation of the Cambrian beds of Railton with those of Britain and America, and the Government geologist regards this north-western district as adding largely to our knowledge of the Older Palæozoic rocks of Tasmania. In Bulletin 8, "The Ore-bodies of the Zeehan Field," an interesting problem is raised (p. 42) by the occurrence of a glacial conglomerate dipping under "Cambro-Ordovician" beds, but probably as an inverted layer of Permo-Carboniferous age. Bulletin 9 introduces the excellent plan followed by the Survey of New Zealand, by showing on a sketch-map the position of the area described in relation to the region as a whole. W. H. Twelvetrees, in considering the more basic and hornblende envelope of the Scamander granite (p. 19), concludes that it is a product of differentiation rather than of assimilation. The memoir on the Tasmanite shale fields of the Mersey district (No. 11, 1912) provides a valuable review of the literature on tasmanite, which is shown to be a resinous and somewhat sulphurous shale in the Permo-Carboniferous (*Glossopteris*) series. The seam was formed in sea-water (p. 47), and its spore-like contents may be washed-down spores of land-plants or algæ deposited with the silt. Pp. 40-54 embody a thoughtful account of the mode of occurrence and relationships of the material, and two photographs of thin sections are appended. The Mersey district, with its range of rocks from Pre-Cambrian schists to Cainozoic basalts, is made still more interesting by the maps and sections pub-

lished as a supplement to the bulletin. The Preoleña Coalfield (Bulletin 13, 1913) contains Permo-Carboniferous seams amounting in the aggregate to 6 ft. 6 in., situated under the Campbell Range some fifteen miles south-west of the north coast at Wynyard. Prospecting by diamond-bores is advised. No coal is to be expected near Wynyard (p. 71).

The Geological Survey Branch of the Department of Mines of New Zealand continues its handsome series of quarto publications. Petrographers may be disappointed with Bulletin No. 12, "The Geology of the Dun Mountain Subdivision," since the exceptionally fresh olivine-rocks of Dun Mountain have made the district famous for half a century. The bibliography on pp. 6-8 perhaps explains why little more need be written on their nature and alliances. The authors, J. M. Bell, E. Clarke, and P. Marshall, describe a new rock-species, Rodingite, on p. 31. This consists of grossularite and diallage, the percentage of silica being 40, of lime 31, and the specific gravity being as high as 3.4. The authors do not see their way towards explaining this rock either by absorption of the Maitai limestone or by differentiation in the ultrabasic mass. The main object of the present bulletin has been a review of the prospects of the associated copper ores. The mineral from which the more superficial ores are derived (p. 44) is a cupriferos pyrrhotine, containing traces of gold, silver, cobalt, and nickel. This is interestingly associated with serpentinised peridotites. The chromite in the peridotites has not been mined since 1865. Dun Mountain, a rounded mass supporting little vegetation, is figured on plate iv.

Bulletin No. 13, by P. G. Morgan, who is now director of the Survey, describes the Greymouth subdivision of North Westland, where coal-seams occur, conformably overlain by marine Eocene strata. The Pleistocene glacial gravels are worked for gold, and there is said to be a probability that the Kotuku oil-field will prove profitable on further exploration. The petroleum occurs in various Cainozoic rocks above the local Coal-Measure series, and its source is at present unknown.

Bulletin 14, by E. Clarke, is also concerned mainly with petroleum, in the New Plymouth subdivision of the Taranaki division, on the jutting promontory of the west coast of the North Island. The iron-sands that compose the Recent sand-dunes and beaches are also considered, owing to their well-known richness in magnetite and ilmenite. Bulletin 15, by J. M. Bell and C. Fraser, takes us to the Hauraki division of the North Island, where the town of Waihi, picturesquely situated, and illustrated in a folding plate, is the active centre of gold and silver mining. The ore is electrum for the most part, and the veins occur in altered Cainozoic andesites or dacites resembling the propylites of Hungary. Deposition is believed to have taken place from hot solutions, which brought up silica also, and to have been promoted by a fall of temperature near the surface (p. 179). Siliceous geyser-deposits occur in the middle of the volcanic series, and cinnabar has been found in them at Mackaytown (p. 59). The physiography of the rugged country is well described, and its irregular structure is attributed to the occurrence of epochs of denudation between those of volcanic deposition (p. 27).

R. Speight, L. Cockayne, and R. M. Laing have made an interesting study of the Mount Arrowsmith district, on the eastern slope of the Southern Alps in Canterbury (Trans. New Zealand Institute, vol. xliii., p. 315), in which the physiography described by the first named author is used by his colleagues as a basis for a report on plant-distribution. The paper, with its details of glacial sculpturing and deposition,

is a good example of modern geographical inquiry into the origin of surface-forms. The rivers of Canterbury are held (p. 320) to radiate from a lost highland to the west, which has been cut away by denudation, and formed the higher part of the peneplain on which they originally flowed.

G. A. J. C.

#### THE DEVELOPMENT AND PROPERTIES OF THE COTTON FIBRE.

THE standard accounts of the cotton fibre are curiously inaccurate. Mr. W. Scott Taggart has directed attention to some of the more glaring errors in his "Cotton Spinning" (vol. i., 1896; London: Macmillan and Co., Ltd.), as did also the present writer independently in 1905 (Khedivial Agricultural Society's Yearbook, 1905), when the cytology of the fibre was traced up to a week after the opening of the flower. Some additions to this account were outlined in my "Cotton Plant in Egypt" (London: Macmillan and Co., Ltd., 1912), and a serious attempt was then made to ascertain how and when environmental effects operated on the properties of the fibre during maturation, and also to elucidate the real nature of the infinitesimal differences which the "sixth sense" of the expert classifier of lint cotton can perceive.

(1) By pickling a complete series of bolls from flowering to maturation in 1912 we showed definitely that the first half of the maturation period is occupied in the lengthening of the lint, and in the enlargement of the capsule and seed. Thickening processes take place in the second half of the maturation period. Thus a fibre may be short, but subsequently thicken satisfactorily, or conversely. Bad weather or soil in the latter half of maturation may weaken the fibres, but cannot affect the "predetermined" length.

(2) A number of open flowers in a wide-sown pure strain were marked every day for sixty days in 1912 and allowed to ripen normally. Each sample was then combed, measured, and ginned, weighed to determine various constants, tested for breaking strain of the fibre on an automatic invention, and graded for strength; the results were examined statistically and graphically. They confirmed the developmental evidence; on shifting the breaking-strain curve backwards over thirty days' displacement, it was found to be substantially identical with the lint-length curve.

The cause of fluctuation in ginning-out-turn (ratio of lint to seed-cotton) has long been a puzzle. With this material it was traced provisionally to fluctuation in the number of lint-hairs which sprout from the seed-coat; its determination is therefore effected when the flower is about to open, which was, *a priori*, the least likely time.

Plotting breaking-strains against "strength" as determined in hand-pulling by an expert (Mr. H. C. Thomas, of Alexandria), the two were found to be completely independent; the expert unconsciously integrates breaking-strain with sectional area; samples of the same pure strain with respective breaking-strains of 12 grams and 2 grams were both graded as "SS" in a scale of seven grades. This leads on to a new definition of "fineness" in cotton fibre; it is not due primarily to differences in fibre-diameter, but to differences in the thickness of the lint cell-wall. "Weakness" of a sample is thus mainly irregularity in breaking-strain.

Determinations of fibre-weight with a micro-balance showed incidentally that an ordinary seed of Egyptian cotton bears about 10,000 fibres, and that weight is closely related to breaking-strain. The spinning into yarn introduces fresh complications, with which we have not dealt.

It should be obvious to those familiar with the sub-

ject that the discovery of this phenomenon of pre-determination has shattered almost all accepted beliefs about the fibre of cotton, and has at the same time coordinated the old data afresh into a straightforward story. The practical applicability of the results is slight, since every boll passes through a different life-history, on account of the continuous fruiting of the plant.

In 1913 a series of daily pickings was made from a group of pure-strain plants growing in field-crop conditions, over a period of ninety days, with parallel records of flowering, etc. The examination of these having been delayed by unavoidable circumstances, the present note has been prepared. It should be noted that this last material is unique in the history of long-staple cotton.

These results were obtained incidentally during my tenure of the post of botanist to the Khedivial Agricultural Society, and to the Egyptian Government at the Giza Cotton Experiment Station, 1904-13.

W. LAWRENCE BALLS.

NEW ZEALAND SURVEY.<sup>1</sup>

THE report before us gives a full account of the work of the Department of Lands and Survey, New Zealand, for the year ending March 31, 1913. As in previous years, not only surveying, but also the direction of the magnetic observatory falls within its purview. Most of the work dealt with in the report has been undertaken in connection with cadastral requirements, and the higher grade work, which is termed "standard" survey, is in great request in town and suburban holdings, where land that could probably have been purchased sixty or seventy years ago for a mere trifle is now reported as having a value of 1200*l.* a foot. Under such conditions work of the highest precision is essential, but the new secondary triangulation is as yet available for a small part of the country only. This triangulation is the equivalent of second order triangulation, since the triangular error is kept below 6", and is usually considerably less. This is as much as can be expected from the instrument used, a 10-in. vernier theodolite, and the Conference of Surveyors-General supported the New Zealand Survey in the opinion that a modern instrument of higher class was indispensable. A standard bar of nickel-steel 10 links long has been obtained from the Société Genevoise, Geneva, as well as a comparator from the Cambridge Instrument Company for use with it. Both of these have been examined and verified at the National Physical Laboratory. Four bases, from 5.2 to 11.5 miles in length, have been measured since 1909, but only two are as yet part of the finally accepted triangulation.

In the magnetic observatory a new set of Eschenhagen-Toepfer magnetographs were received at the end of 1912, and were installed at Amberley, thirty-four miles north of Christchurch.

Considerable assistance was given to the officers and scientific staff of the British Antarctic (*Terra Nova*) expedition, who took magnetic observations and determinations of gravity as controls to the work carried out in the Antarctic. The report also publishes ten seismograms of those recorded during the year by the Milne seismograph. Maps showing the progress of the work and extracts from Conference of the Surveyors-General of the Commonwealth of Australia, which was held at Melbourne in May, 1912, complete a report which is of much interest, and contains a record of much valuable work.

H. G. L.

<sup>1</sup> Report on the Survey Operations for the Year 1912-13. Department of Lands and Survey, New Zealand. By James Mackenzie, Surveyor General. Pp. 77+6 maps+5 diagrams. (Wellington, 1913.)

THE ENCOURAGEMENT OF RESEARCH  
BY THE CARNEGIE INSTITUTION  
OF WASHINGTON.

THE Year Book for 1913 of the Carnegie Institution of Washington is now available. The information provided in its 336 pages shows convincingly that there has been no relaxation of effort on the part of the trustees of the institution to administer wisely the funds placed at their disposal for the encouragement of scientific research, and that the results arrived at by the men of science who have received assistance are as promising and as full of interest as in previous years.

The following list shows the amounts of the grants made for the present year and the purposes to which they are being devoted:—

	£
Administration ... ..	10,000
Publication ... ..	12,000
Division of Publications ... ..	2,000
Departments of Research ... ..	137,929
Anthropology ... ..	4,000
Embryology ... ..	5,380
Minor Grants ... ..	18,980
Index Medicus ... ..	2,500
Insurance Fund ... ..	5,000
Reserve Fund ... ..	50,000
Exhibit at Panama-Pacific International Exposition ... ..	2,000
	£249,789

The next table shows the departments of scientific investigation to which the larger grants were made by the trustees for the financial year 1912-13, and the amounts allotted from these grants by the executive committee during the year:—

	£
Department of Botanical Research ...	7,601
Department of Experimental Evolution ...	19,028
Geophysical Laboratory ... ..	15,600
Department of Historical Research ...	5,920
Department of Marine Biology ...	6,378
Department of Meridian Astrometry...	5,036
Nutrition Laboratory ... ..	9,310
Division of Publications (office expenses ... ..)	1,800
Solar Observatory ... ..	33,126
Department of Terrestrial Magnetism ...	42,053
Researches in Anthropology ... ..	1,400
Researches in Embryology ... ..	3,000
	£150,252

The following extracts from the *résumé* of the investigations of the year included in the report of the president of the institution, Dr. R. S. Woodward, will give some indication of the work which has been initiated and encouraged:—

All the departments of research of the institution are now well-defined organisations, each of them independent of and more or less isolated from the others, and each of them devoted to a field which, while in some cases related to, does not encroach upon, the fields of others. Each of them possesses a degree of autonomy which calls for a corresponding degree of freedom in the character of their annual reports and accounts of progress.

Studies of the Salton Sea, carried on during the past seven years by the department of botanical research in collaboration with a number of contributing specialists, have been brought together during the year in a volume now in the press under the title "The Salton Sea: A Study of the Geography, the Geology, the Floristics, and the Ecology of a Desert Basin."

Among many researches carried on by the director, mention may be made of his cultivation of second and third generations of mutants arising from ovarial treatments of plants and resulting in further noteworthy morphological and physiological departures from the original parent stocks.

The work of the year in the department of experimental evolution records, among many other advances, additional contributions to the laws of human inheritance; the results of further and more conclusive studies of the transmission of traits in plants of the genera *Bursa* and *Cnothera*; and some preliminary indications of specially instructive investigations in the field of biochemistry. The director has divided his time between researches based on breeding experiments carried on at his station and studies of data bearing on human heredity collected under the auspices of the Eugenics Record Office, of which he is also the directing head.

In his annual report the director of the geophysical laboratory gives instructive accounts of the effects of pressure in the formation of minerals, of progress in the perfection of adequate appliances for calorimetric measures of minerals, of the factor of temperature in optical studies of crystals, of the results thus far obtained in volcano studies, and of the important economic investigations of the secondary enrichment of copper sulphide ores. It had been hoped that the signal success attending the studies of Kilauea a year ago might be followed up during the past year, but in this the staff has met disappointment, for the volcano has been inactive and gives no warning of renewed opportunities.

When the laboratory of the department of marine biology was established on Loggerhead Key, Dry Tortugas, Florida, now nearly ten years ago, Fort Jefferson, on an adjacent island, was an important base station of the United States Navy, and transportation to and from points on the Gulf coast was a matter of daily occurrence. In the meantime, however, this station has steadily diminished in importance, and is now virtually abandoned as a naval base. This change of conditions shifts the burden of transportation between the laboratory and the nearest port, Key West, about thirty miles distant, wholly upon the department; and the resulting increased cost and inconvenience have led the director to recommend a gradual transfer of his laboratory and activities to a more favourable site. Preliminary investigations indicate that such a site may be had in Jamaica, where health conditions and transportation facilities have been much improved in recent years, where the cost of labour and subsistence is low, and where such an international scope as best befits marine biology could be readily developed. It may be anticipated that definite plans for an advantageous change of site will be matured during the present year, and ready for submission to the board of trustees in December, 1914.

The extensive computations essential in the derivation of the great number of stellar positions observed at the temporary observatory at San Luis, Argentina, are going forward in the department of meridian astrometry at a favourable rate, so that the inclusive catalogue of precise positions for stars in both hemispheres may be expected in due time. Some instructive results of these computations, showing the stability of the San Luis meridian mark (mire), the diurnal variation of the clock corrections, and the changes of personal equation for day and night observations are given in the report. As in most lines of fruitful research, the work of this department is noteworthy for its by-products, or for contributions it is making to allied lines of inquiry. Obviously, a first requisite to a knowledge of stellar motions lies in

precise determinations of stellar positions at different epochs. The so-called proper motions of stars are thus brought to light, and from these it is possible to determine also the motion of our solar system. But now comes the surprising discovery that these proper motions, hitherto supposed to be of a random character, are of a systematic nature dependent in large degree, apparently, on the stage in evolution any individual star has reached and on the group to which it belongs. A new and peculiarly fascinating field is thus opened to astronomers of all kinds, and the by-products referred to seem destined to prove not less important than its primary object in positional astronomy. The world of astronomy, however, is anxiously awaiting the attainment of this object, as is well shown by the fact that the preliminary catalogue issued by the department three years ago is already out of print.

One of the noteworthy events of the year for the department of terrestrial magnetism is the completion of the second cruise of the non-magnetic ship *Carnegie*. She arrived in New York in February last, having been continually in service since June 20, 1910. The aggregate distance traversed in her two cruises is in round numbers 100,000 miles. The corresponding distance covered by the chartered ship *Galilee*, in the Pacific Ocean during 1905-8 is 60,000 miles. Thus the total distance traversed up to date in the magnetic survey of the oceans is 160,000 miles, or about six times the circumference of the earth. Accurate magnetic data have been obtained thereby in all of the oceans between the parallels of 50° north and 50° south latitude, or near the courses usually followed by vessels. By reason of the expedition attained in deriving from these surveys the results of chief interest to mariners, it has been practicable for chart-publishing establishments to make prompt revision of defective sailing charts or to issue corrections thereto; and a distinct improvement in these aids to navigation is already noticeable in the charts issued by the leading maritime nations. In the near future it is considered that the *Carnegie* should make surveys in areas not yet covered and along some stretches already traversed where cloudy or stormy conditions have prevented the securing of adequate observations. She will at the same time cross her previous tracks as often as practicable in order to determine for such intersections the information now most needed by chart-makers, namely, the annual changes in the magnetic elements.

In the near future it is anticipated that the department will have sufficient data to permit the construction of a new set of magnetic charts, including all three magnetic elements (declination, dip, and intensity), especially for that part of the globe included between the parallels of 50° north and 50° south of the equator. It will then be practicable to study the general problem of the earth's magnetism by aid of a large mass of homogeneous data surpassing in definiteness any mass hitherto available for this purpose. In anticipation of the need of experimental facilities for studies of this problem and others closely related thereto the office and laboratory building of the department was authorised a year ago and has recently been completed.

From the date of its establishment nine years ago the solar observatory has been one of the most important of the enterprises fostered by the institution. It has called for heavy annual appropriations; it has grown with extraordinary rapidity and with equally extraordinary productivity; and it is now an organisation of which the staff of investigators, research associates and collaborators, constructors, computers, designers, mechanics, and operators includes upwards of sixty individuals. The report of the director

of the observatory has been described already (April 23, p. 201) so it need not be summarised here.

The complexity of the relations which research associates and collaborators sustain to the institution is so great as to preclude any comprehensive explanation within the limits allotted to an annual administrative report. Their work embraces a wide range of subjects, and varies in its conduct from individual independence to intimate collaboration with the departments of research and with the division of publications. During the past year more than twenty distinct fields of research have been cultivated, and a total of more than one hundred investigators have contributed to the output. Summaries of the work of associates proceeding independently are given by them in the Year Book.

### THE TOTAL ECLIPSE OF 1914 IN TURKEY AND PERSIA.

ON account of the unfavourable weather prognostications for the approaching total eclipse of the sun throughout the European countries traversed by the track of totality, it seems particularly desirable that stations should be occupied beyond the Black Sea, nearer the sunset limit of eclipse, in eastern Turkey and western Persia.

The central line of the eclipse passes very nearly through Baiburt and Bitlis, just a few miles to the west of Lake Van, in the former country. In Persia it passes through Kermanshah and Khorremabad, to the south-west of Teheran, and through a point about midway between Persepolis and Dehbid, and slightly to the north-east of Shiraz, only a few miles distant from Bushire, a port in the north-east of the Persian gulf.

The desert character of a large part of this region would indicate that the probability of a cloudless afternoon sky in August is very good. Most of this region traversed by the shadow is quite elevated, some of it being as much as five or six thousand feet above sea-level; and this would, in large measure, if not entirely, compensate for the lesser altitude of the afternoon sun at local totality. Throughout the Turkish region the approximate local time of totality is 3h. 50m. p.m., the duration of total eclipse being about 120s. Throughout the Persian region the time is about 4h. 50m., with totality shortened to about 105s. As very little of the European track has a likelihood of less than 50 per cent. of cloud, it seems highly desirable that some of the observers now contemplating European location should undertake the extra journey into Turkey, at least in order to diminish, if possible, the chances of entire failure of the eclipse, such as befell astronomers in 1887, and was nearly repeated in 1896.

The region of western Persia is not especially difficult to reach by way of Batum, at the east end of the Black Sea, thence through Tiflis to Baku on the Caspian, thence to Resht on the south-west coast of the Caspian, whence Kermanshah is easy by caravan through Kazbin; or, better, first to Teheran to receive Government authority and facilities. Most of the roads of Persia would permit the use of wheeled vehicles only with difficulty. Allow four weeks from London or Paris to Teheran, and two weeks thence to Kermanshah. Camping outfit and subsistence for the most part should be taken along, as only chicken, fruits, and similar edibles can be depended on for the last stage of this journey. Roads are in part built, in part old roads and trails. From Teheran the best route is to Kum, and thence to Sultanabad and Kermanshah; also Bouroudjird, quite a large town with a telegraph station, and the chief city of Luristan.

Summer clouds are said to be highly improbable. From Bushire to Shiraz and Persepolis is rather more than 100 miles by caravan, the particular drawback at this season being the intense heat, which renders travel exceedingly uncomfortable, except at night. There are telegraph lines traversing this region which would make it feasible for the eclipse observer arriving early in the field to check up his longitude as well as latitude, so as to make sure of being within a few miles of the line of central eclipse. Bushire is very accessible; the steamers of the British India Company are scheduled to sail from Bombay every Thursday; from Karachi every Saturday, and are due in Bushire on Wednesday. The Bombay steamers of the P. and O. are due to arrive at Bombay on Friday, and there is direct rail connection for Karachi, and while the British India steamers are scheduled to sail from Karachi on Thursday, if the English mails are late, the steamers will be held pending their arrival. Transportation from Karachi to Bushire is approximately 15l.

The Turkish region is very accessible from Trebizond. The eclipse is total at Trebizond itself, the line of exact centrality intersecting the coast a few miles west of Trebizond, about midway between that port and Tereboli. While at the coast towns themselves, including Plattana, Eskiefe, and Jaueboli, the chances of clear weather are not at all good, one can, by ascending the cliffs and entering the elevated tableland of the interior, select observing stations which apparently decrease in probable cloudiness, the farther inland one goes. Of course, there are no railways; but travelling so far as Erzerum, about 150 miles south-east of Trebizond, is not particularly arduous, because it is the first section of the early caravan route through Tabriz to Teheran. Wheeled vehicles are now possible so far as Erzerum, and packages of any size and weight required by the eclipse astronomer are not prohibited.

Probably the most detailed map of this region is Richard Kiepert's "Karte von Kleinasien," on a scale of 1:400,000, published in 1902 by Dietrich Reimer, Berlin. The sheets which should be consulted are AVI, Tirabzon, and BVI, Erzurum. Another good map is the "Map of Eastern Turkey-in-Asia, Syria, and West Persia," published by the Royal Geographical Society, 1910, and is accompanied by notes. Consult also "Zug des Zenophon bis zum Schwarzen Meere" (Karte ii.), Entworfen von E. v. Hoffmeister, accompanying "Durch Armenien und der Zug Zenophons," (1911) and "Wandkarte des Osmanischen Reiches," von W. v. Diest and Dr. M. Groll (Geogr. Verlag, Berlin W. 35, 1911); scale 1:1,250,000.

Erzerum itself is within the belt of totality, though not far from the north-eastern edge of it, so that totality would not last more than a very few seconds there. Besides this, Erzerum is quite likely to be cloudy; and the same might be said of Bitlis itself, which is located in a sheltered valley. But about fifteen miles west of Bitlis begins the elevated tableland of Moush, which, according to the best information I have been able to secure from those resident in Bitlis, would probably be cloudless. At the time of the eclipse, this whole region rarely experiences any rain from the latter part of June until the middle of September. The atmosphere is very clear, being only a trifle cloudy during that season, and clear skies can be depended upon, although it is extremely hot.

Officers of the Turkish customs are not inclined to cause trouble over the baggage of travellers, and it is probable that the English and American Consuls would be able to get instruments passed without examination, especially if the observer brought a letter visé by the Turkish Consul nearest his home.

It would be highly desirable, before leaving home,

to pack all parcels of instruments with especial reference to caravan travel, as otherwise repacking in Trebizond would be necessary and much delay occasioned. Two hundred pounds is too heavy, and it is better if no package exceed 150 lb., as a mule must carry two of them; the average load is about 300 lb. As a mule must have a perfectly balanced load, it is well to have the paraphernalia so divided that pairs of packages will be of the same weight. The nearer a parcel approaches a cube, the easier it is to handle, though moderately oblong packages are not particularly troublesome. Packing must, of course, be done much more thoroughly than for transit by railway and steamship, as the continued motion of a pack animal will cause screws and delicate parts of instruments to disconnect themselves. I have found nothing better for packing than granulated cork, such as Malaga grapes are packed in.

As before said, travel so far as Erzerum can be accomplished in fairly comfortable carriages, and even a rubber-tired vehicle is possible. Baggage might go in a species of lumber wagon, or springless vehicle; but beyond Erzerum carriages would not go, except at great expense. From Trebizond to Erzerum eight days of travel should be allowed, by starting promptly every morning. From Erzerum to Bitlis would require eight or nine days; and before leaving either Trebizond or Erzerum, it is necessary to make the drivers or muleteers agree to arrive at the desired place on a certain day; then, in addition to this, the traveller must keep prodding them to see that they make their schedule. They much prefer to travel in the very early morning, starting from three to five o'clock. The journey from Erzerum to Bitlis cannot be called an easy one; but the country and its people are very interesting.

The eastern end of the plain of Moush is a day's journey from Bitlis on the route to Erzerum, and on this plain at this time of year the American residents of Bitlis usually spend two or three quiet and healthful months in camp.

To the west of Bitlis and far outside the path of totality, although in the same generally elevated region of Turkey, is Kharput, where records of cloudiness for the month of August have been kept for many years past. The average for five years gives 70 per cent. of the afternoon observations in August entirely cloudless, with not a single record of a sky totally overcast. Most of the cloudiness is of the order of 0.1 or 0.2, only occasionally an afternoon being largely overcast. These afternoon observations were taken at 2.30, and there is a slightly greater chance of cloudiness at 4.

For most of the foregoing information I am indebted to the Rev. Dr. Henry H. Riggs, of Kharput, Dr. Harrison A. Maynard, of Bitlis, Rev. Robert A. Stapleton and Dr. Edward P. Case, of Erzerum, and Rev. L. S. Crawford, of Trebizond. All are greatly interested in the coming eclipse, and are ready to assist in observing it so far as possible.

Prof. A. G. Sivaslian, of Anatolia College, Marsovan, will proceed eastward to the Trebizond region to observe the eclipse. He is an astronomer trained at the Northfield Observatory in Minnesota, and will be of great assistance to whatever party of observers he may join; also Prof. A. H. Joy, of the Syrian Protestant College at Beirut, is expecting to join the ranks of the eclipse observers, but he may go to the Crimea instead of Trebizond.

Of course, it is well known that Trebizond is very accessible. The easiest route from western Europe is *viâ* Marseilles, whence a weekly steamer of the Messagerie leaves for Trebizond without change at Constantinople or elsewhere. The same from Trieste

also, by the Austrian Lloyd. From Paris the through rate by rail to Marseilles, and thence by steamer to Trebizond is about 141. first class. From Constantinople steamers leave every Friday and Saturday, reaching Trebizond the following Tuesday and Wednesday mornings.

Fuller information regarding the Persian region can be obtained from the house of Messrs. Lynch Brothers in London, and concerning Armenia the standard work is by the late senior member of this firm, Mr. H. F. B. Lynch, recently published in two fine volumes by Longmans. DAVID TODD.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The completion of the third edition of "The Golden Bough" has suggested to the many friends and admirers of Dr. J. G. Frazer that the present is a suitable time to offer him some token in recognition of his great services to learning. It is proposed that a Frazer Fund for Social Anthropology be established to make grants to travelling students of either sex, whether connected with a university or not, with a view of their investigating problems in the culture and social organisation of primitive peoples, a department of anthropology which Dr. Frazer has always been eager to promote. Contributions to the fund may be sent either direct to the secretary and treasurer, Mr. F. M. Cornford, Trinity College, Cambridge, or to the "Frazer Fund Account," Messrs. Barclay and Co., Mortlock's Bank, Cambridge.

LONDON.—Presentation Day on May 13 passed off without special incident. The Principal reported a slight falling off of examinees, particularly for matriculation. Of the 1807 candidates for degrees 900 were internal and 907 external; 1301 degrees and diplomas were granted, and the total number of internal students is now 4888. Sir Philip Magnus, M.P. for the University, in his speech after the presentation of graduates, suggested that a committee of the Senate should be appointed to consider without prejudice or bias the recommendations of the Royal Commission on University Education in London with the view of deciding which of them should be adopted with or without legislation.

MR. ALFRED E. CAMERON, Board of Agriculture scholar in entomology, of Manchester University, has taken up economic work in the United States, where he is temporarily attached to the entomological department of the New Jersey Agricultural Experiment Stations, New Brunswick, New Jersey.

MR. MALCOLM E. MACGREGOR, of Trinity College, Cambridge, has recently been appointed collaborator with the U.S. Bureau of Entomology, to join the Robert M. Thompson Pellagra Commission (formerly the Thompson-Macfadden Pellagra Commission), at Spartanburg, South Carolina, to study the possible rôle played by insects in the transmission of the disease.

WE learn from the Paris correspondent of the *Chemist and Druggist* that the council of the University of Paris has just decided to distribute 3600*l.*, being interest of a bequest by the late M. Loutreuil for the encouragement of scientific laboratories of French universities. The Chemical Institute of Nancy University is receiving 400*l.* for extension and enlargement, and Toulouse 800*l.* for the foundation of a similar establishment. Montpellier University will

get 160l. for its biological laboratory, Rennes 320l. for the botanical and physical science laboratories, Lille, Clermont, and Grenoble are getting goodly sums for electrical equipment, and Paris 100l. for the herbarium of the Academy of Sciences.

THE Association of Teachers in Technical Institutions will hold its eighth annual conference at Liverpool during Whitsuntide, May 30–June 3. The open meetings begin on Monday, June 1, when the chairman of the Liverpool Education Committee, Councillor J. W. Alsop, will welcome the conference to Liverpool, and the president, Mr. P. Abbott, will deliver his presidential address. During the conference papers will be read by Mr. W. Hewitt, director of technical education for Liverpool, Prof. Haldane Gee, Mr. W. E. Harrison, Mr. Laurence Small, Mr. W. R. Bower, and others. Sectional meetings will be held on the afternoon of June 2, when papers of special interest to the various sections of technical education will be read. Resolutions on matters of educational and professional interest will be discussed at the various meetings.

A LIMITED number of free places at the Imperial College of Science and Technology, South Kensington, S.W., will be awarded by the London County Council for the session 1914–15. The free places will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study which they intend to follow, and generally upon their fitness for advanced study in science as applied to industry. Candidates will not be required to undergo a written examination. It is possible that the free places may be extended to two or more years. Parents (or guardians) of candidates must be resident within the administrative county of London, except in the case of self-supporting candidates above twenty-one years of age on July 31, 1914, who must themselves be resident within the county. Application forms (T. 2/268) may be obtained from the Education Officer, L.C.C. Education Offices, Victoria Embankment, W.C., and must be returned not later than Saturday, May 23.

IN addition to much other matter of interest and importance, the recently published Report of the Board of Education for the year 1912–13 (Cd. 7341), contains particulars as to the main provision for full-time education in connection with the industries of the country. This has been provided in the past either by means of advanced courses known as technical institution courses at the larger technical schools, or by means of day technical classes, which, as a rule, take younger pupils and give more elementary instruction. There are twenty-six institutions giving technical institution courses, the total number of separate courses in these institutions being eighty-one in 1911–12. But of these twenty-two were courses in preparation for matriculation. Fifty-four were courses in engineering, chemistry, and subjects connected with the building, mining, textile, and leather trades. Five were purely scientific courses. The number of students taking full courses was 1246, of whom 528 were in their first year, 414 in their second year, 245 in their third year, and fifty-nine in later years of their courses. The number of day technical classes recognised in 1911–12 was in all 324, and these were held in 111 institutions. The students in attendance numbered 12,041. One hundred and fifty-four of the courses were full-time day schools, and these will in future receive aid from the State to a degree more commensurate with their importance. The report may well point out that the provision for full-time education in applied science is regrettably small in bulk compared with the industrial development of the country.

## SOCIETIES AND ACADEMIES.

LONDON.

**Royal Society, May 14.**—Sir William Crookes, president, in the chair.—Dr. A. D. Waller: The various inclinations of the electrical axis of the human heart. Part 1A.—The normal heart.—Effects of respiration. Continuation of previous observations (Phil. Trans., 1889, p. 169) in which the electrical effects of the human heart were first demonstrated, and the distinction made between favourable and unfavourable leads dependent upon the obliquity of the cardiac axis, and of subsequent observations (Proc. R.S., B, vol. lxxxvi., p. 507, 1913) to determine the angular value of the inclination of the electrical axis.—Dr. D. H. Scott and Prof. E. C. Jeffrey: Fossil plants showing structure from the base of the Waverley Shale of Kentucky. The specimens were collected by Prof. C. R. Eastman and Mr. Moritz Fischer, near Junction City, Boyle County, Kentucky. The nodule layer containing the plants is described by Prof. Eastman as lying at the base of the Waverley (Lower Carboniferous) and immediately above the Genessee Black Shale of Upper Devonian age. The anatomical structure is, on the whole, well preserved.—F. Kidd: The controlling influence of carbon dioxide in the maturation, dormancy, and germination of seeds. Part ii. The inhibitory effect of carbon dioxide on the germination of seeds previously described is dealt with in relation to temperature and oxygen supply. In relation to temperature the result obtained is unusual, the inhibitory action being more pronounced at low temperatures than at high. At 3° C. complete inhibition was obtained with 4 per cent. CO<sub>2</sub>; at 17° C. as much as 24° C. had to be employed to obtain the same result. Varying partial pressures of oxygen also effect the inhibitory action of carbon dioxide, but to a less degree than temperature. Thus with 5 per cent. oxygen, 15 per cent. CO<sub>2</sub> produced inhibition; with 20 per cent. oxygen, 27 per cent. CO<sub>2</sub> was necessary. The author emphasises the fact that the adjustments of the moist seed by which it is enabled to continue dormant in the presence of oxygen and water, rather than those of the dry seed, are likely to have formed the central problem of seed life in nature. A low temperature and a decreased oxygen supply are often the natural conditions of a seed's environment in the soil. Correlating the results obtained in this and in a former paper, the author strongly emphasises the controlling influence of carbon dioxide in the biology of seeds. It appears that the normal resting stage of a seed is primarily a phase of narcosis.—D. Thomson and J. G. Thomson: The cultivation of human tumour tissue *in vitro*. Small portions of tissue from two human tumours, (a) intracystic papilloma of the ovary, and (b) carcinomatous lymphatic gland, have been cultivated successfully in a medium composed of fowl blood plasma+extract of embryonic chick. This proves that human tissue can be grown *in vitro* in a medium obtained entirely from a bird. This is contrary to what was previously believed, since it was considered that the tissue of a certain animal could only grow in a medium composed of the blood plasma of the same species of animal.—H. G. Thornton and G. Smith: The nutritive conditions determining the growth of certain fresh-water and soil protista. Experiments made on the growth of *Euglena viridis* in artificial media showed that, in addition to those inorganic constituents necessary for the growth of a green plant, which were supplied by Miguel's formula for growing diatoms, a certain quantity of organic material, e.g. infusion of hay, was necessary. In order to determine the constituent in this organic material which stimulated growth, various pure sub-

stances, such as carbohydrates, tartaric acid, saccharin, allantoin, peptone, and various amido-acids, were used in dilute solutions. Of these, only very weak solutions of amido-acids favoured a really strong growth, the most favourable substances being tyrosin and phenyl-alanine, which are very slightly soluble in water. Experiments with soil flagellates, especially *Provaechkia terricola* (Martin), showed that they could be cultivated in many solutions in which bacteria flourished, the flagellates feeding on several different kinds of bacteria. Samples of various types of soil and water were tested for the presence of bacterial-feeding flagellates, and these were found in all the samples, being most abundant in highly manured soil. The wide distribution and abundance of these soil flagellates, and their very rapid growth in the presence of bacteria, suggests that they are of importance in the economy of the soil.

**Zoological Society**, May 5.—Dr. Henry Woodward, vice-president, in the chair.—Surgeon G. Murray **Levick**: Manners and customs of Adélie penguins (*Pygoscelis adeliae*). The penguins were observed at the Cape Adare rookery while the author was with Scott's Antarctic Expedition. Their mating habits, the making of their "nests," hatching of the eggs, and rearing of the young were described.—R. C. **Lewis**: Two new species of tapeworms from the stomach and small intestine of a wallaby from Hermit Island, Monte Bello Islands. The parasites belong to the genus *Cittotænia*, having two full sets of genital glands in each proglottis.—Oldfield **Thomas**: A remarkable case of affinity between animals inhabiting Guiana, West Africa, and the Malay Archipelago. The case referred to was that of the pygmy squirrels (*Nannosciurinae*), known to the natives of West Africa and the Malay Archipelago, and of which Mr. Thomas was now able to state that the Guianan *Sciurus pusillus* was also a member. It was sufficiently distinct to need generic separation (*Sciurillus*, gen. nov., was suggested as a name for it), but was unquestionably assignable to the *Nannosciurinae*, and not to the *Sciurinae*, to which all the other American, all the European, and all the Asiatic continental squirrels belonged.—H. B. **Preston**: Diagnoses of new general and species of *Zonitidae* from equatorial Africa. The material on which the paper is based was recently collected from many localities in British East Africa, Uganda, and the Belgian Congo, by Messrs. A. Blayne Percival, Robin Kemp, and C. W. Woodhouse, and descriptions are given of seventy-six new species, two new varieties, and eight new genera of *Zonitidae*, to which latter a number of hitherto described forms are also referred.

**Mathematical Society**, May 14.—Prof. A. E. H. Love, president, in the chair.—Prof. W. H. **Young** and Mrs. **Young**: The reduction of sets of intervals.—Prof. H. M. **Macdonald**: Diffraction by a straight edge.—J. **Proudman**: Diffraction of tidal waves on flat rotating sheets of water.—H. F. **Moulton**: Quadratic forms and factorisation of numbers.—F. S. **Macaulay**: The algebraic theory of modular systems.

#### MANCHESTER.

**Literary and Philosophical**, May 12.—Mr. F. Nicholson, president, in the chair.—F. R. **Lankshear**: The chemical significance of absorption spectra and a new quantitative method of measuring them. The author reviewed the history of the study of the relation between chemical constitution and absorption spectra, and the various theories as to the cause of absorption bands. He pointed out that for further progress to be achieved quantitative methods were necessary.—Dr. J. R. **Ashworth**: Note on the intrinsic field of a magnet.

An experiment on the electromotive force between magnetised and unmagnetised iron in a solution, from which an argument was drawn in favour of the view that in the interior of a magnet there is an enormously strong field acting on the molecular magnets.

#### DUBLIN.

**Royal Irish Academy**, May 11.—Rev. J. P. Mahaffy, president, in the chair.—J. G. **Leatham**: Doublet distributions in potential theory. The paper discusses the formulation of the problem of irrotational liquid motion as a double-sheet problem. In connection with the hydrodynamical application it examines some aspects of doublets and doublet distributions, and the manner in which these and their fields fit into Kelvin's theory of inversion. A surface concentration of tangential doublets is also considered, and an account is given of the convergence or semi-convergence of the potential and force integrals associated with it. J. R. D. **Holtby**: Some human bones from an ancient burial ground in Dublin. The paper dealt with a collection of human bones discovered about a year ago buried deeply under the basement of the City Hall. These were considered to represent inhabitants of Dublin about the twelfth to fourteenth centuries. Apart from the worn condition of the teeth, found in almost all ancient remains, the chief interest lay in the form of the bones of the lower limbs and in the impressions on them. These were such as to suggest full and frequent flexion at the hip, knee and ankle joints, such as would occur in squatting.

#### PARIS.

**Academy of Sciences**, May 11.—M. P. Appell in the chair.—Ch. **Lallemand**: The question of the litre. For scientific purposes the author considers the definition of the litre as the volume of a kilogram of water at 4° C., and 76 cm. pressure should remain. The correction to a cubic decimetre is +27 millionths (0.027 gram).—Mme. **Ramart-Lucas** and A. **Haller**: Syntheses by means of sodium amide. The action of the epihalohydrins on the dialkylacetophenones. Oxypropylene-dimethylacetophenone and its derivatives. The dialkylacetophenones treated with sodium amide and epihalohydrins give substitution products in which the halogen is replaced in a normal manner, whilst with acetophenone itself only tarry reaction products are obtained.—E. **Jungfleisch** and Ph. **Landrieu**: Researches on the acid salts of the dibasic acids. Oxalates. From the experiments detailed the conclusion is drawn that acid potassium oxalate should be represented as  $(K_2C_2O_4 \cdot H_2C_2O_4)$  and not as  $KH_2C_2O_4$ . The results are analogous with those previously obtained for the acid camphorates.—Charles **Richet**: General anaphylaxy. Phosphorus poisoning and chloroform. It has been shown in a preceding note that a dog chloroformed for the first time never subsequently shows leucocytosis, but that a month later the same dog, although in perfect health, if submitted a second time to chloroform, always subsequently shows leucocytosis. It is now shown that an animal, after treatment with non-toxic doses of a phosphide, and then a month later submitted to chloroform, presents the same phenomenon. This entails a modification of the generally accepted view of the specific nature of anaphylaxy.—A. **Calmette** and V. **Grysez**: A new experimental demonstration of the existence of a generalised lymphatic stage preceding localisations in tuberculous infection. It is shown that whether the tubercle bacilli enter by the eye, throat, alimentary canal, skin, or lungs, before local lesions appear, the bacilli can be proved to be present in the tracheo-bronchial, submaxillary, and mesenteric ganglia, in the spleen and blood.—H. **Parenty**: A



regulator for the flow of water in streams and reservoirs with constant level.—J. W. **Nicholson**: The atomic weights of the elements of nebulae. A discussion of the results recently published by MM. Bourget, Fabry, and Buisson on the spectra of nebulae.—A. **Buhl**: The geodesic torsion of closed contours.—N. E. **Nörlund**: Series of faculties and the methods of summation of Cesarò and Borel.—Léopold **Fejér**: The number of changes of sign of a function in an interval and its moments.—Léon **Brillouin**: The diffusion of light by a homogeneous transparent body.—André **Léauté**: The mathematical theory of the working of electric lines formed of two different trunks.—J. de **Kowalski**: The oscillating spark as an economical source of ultra-violet light.—Alexandre **Dufour**: A cathodic oscillograph.—René **Constantin**: Fluctuations of concentration in a colloidal emulsion.—André **Helbronner** and Gustave **Bernstein**: The vulcanisation of solutions of india-rubber by ultra-violet light.—Echsnor de **Coninck** and M. **Gérard**: The determination of the atomic weight of nickel. The figure 58.57 was obtained as a mean of five determinations of the amount of nickel obtained by the reduction of the hydrated oxalate in hydrogen at 270° C.—M. **Picon**: The preparation of normal pentene. Remarks on the melting and boiling points of the first terms of the true normal acetylene hydrocarbons. This hydrocarbon has been prepared by the interaction of normal propyl iodide and an ammoniacal solution of monosodium acetylene at -20° C. Its physical constants are given.—Georges **Dupont**: The synthesis of the acetylene  $\gamma$ -diketones. Good yields are obtained by the oxidation of the acetylene  $\gamma$ -glycols by chromic acid in acetic solution. Three examples of the reaction are given.—André **Brochet**: The catalytic hydrogenation of liquids under the influence of the common metals at moderate temperatures and pressures.—Charles **Tanret**: The plurality of the starches.—R. **Souéges**: New observations on the embryology of the Cruciferae.—Paul de **Beauchamp**: The evolution and affinities of the genus *Dermocystidium*.—MM. **Variot** and **Fliniaux**: Tables of the comparative growth of infants raised at the breast or by the bottle during the first year of life. Contrary to current ideas, there is a very small difference between the size and weight of children raised at the breast or by the bottle, if the food in the latter case is properly made up.—Louis **Roule**: The influence exercised on the migration of salmon (*Salmo salar*) by the proportion of dissolved oxygen in the streams. On the coast of Brittany it has been noticed that the salmon select certain rivers in preference to others and for no obvious reason. Determinations of the proportions of dissolved oxygen in the river waters shows that the salmon select those in which this proportion is highest.—Rémy **Perrier** and Henri **Fisher**: The existence of spermatophores in some Opisthobranchs.—Ch. **Gravier**: The Madrepores collected by the second French Antarctic Expedition (1908-10).—A. **Malaquin** and A. **Moitié**: Experimental observations and researches on the evolutive cycle of *Aphis euonymi*, destructive to the beetroot.—R. **Fosse**: The simultaneous presence of urea and urease in the same plant.—Em. **Bourquelot** and Alex. **Ludwig**: The biochemical synthesis of  $\beta$ -anisylglucoside.—L. **Lematte**: The estimation of the monoamino-acids in the blood. The albumenoids and ammonia are precipitated by phosphotungstic acid, neutralised with soda and the excess of the phosphotungstic acid precipitated by calcium chloride, and excess of the latter by oxalate. The solution then contains the amino-acids, and can be determined by the formal method.—Louis **Mengaud**: The tectonic of the neighbourhood of Infiesto, Arriondas and Rivadesella (Asturia).—M. **Dalloni**: The Neocomian in the west of Algeria.

## BOOKS RECEIVED.

- Plague and Pestilence in Literature and Art. By Dr. R. Crawford. 1 p. viii+222+31 Plates. (Oxford: Clarendon Press.) 12s. 6d. net.
- Ministerio de Fomento. Boletín del Cuerpo de Ingenieros de Minas del Peru. No. 80. Estadística Minera, 1912. By C. P. Jimenez. Pp. 125. (Lima.)
- Report of the Agricultural Research Institute and College, Pusa, 1912-13. Pp. 3+119. (Calcutta.) 8d.
- The Forty-Second Annual Report of the Board of Directors of the Zoological Society of Philadelphia. Pp. 51. (Philadelphia.)
- Sammlung Vieweg. Heft 1, Die Lichtelektrischen Erscheinungen. By Drs. R. Pohl and R. Pringsheim. Pp. v+114. Heft 4, Die Lichtbrechung in Gasen als Physikalisches und Chemisches Problem. By Dr. St. Loria. Pp. vi+92. Heft 5, Die Radioaktivität von Boden und Quellen. By Prof. A. Gockel. Pp. v+108. (Braunschweig: F. Vieweg und Sohn.) Each 3 marks.
- Sammlung naturwissenschaftlicher Praktika. Band iv. By Prof. O. Emmerling. Pp. vii+200. (Berlin: Gebrüder Borntraeger.) 7.20 marks.
- Lehrbuch der Anthropologie in systematischer Darstellung. By Prof. R. Martin. Pp. xvi+1181+Taf. iii. (Jena: G. Fischer.) 35 marks.
- The West India Committee Map of the West Indies. (London: G. Philip and Son, Ltd.) Mounted, 10s. 6d.
- The University of Colorado Studies. Vol. xi. No. 1, Fishes of Colorado. By Dr. M. M. Ellis. Pp. 136+xii plates. (Boulder, Colorado.) 50 cents.
- The Modern Method of Photographing Furniture. Pp. 16. (London: Kodak, Ltd.) 3d.
- Union of South Africa. Province of the Cape of Good Hope. Marine Biological Report, No. 1, for the Year Ended December 31, 1912, and for the Half-Year ending June 30, 1913. Pp. iii+70+ii+plates iii. (Cape Town: Cape Times, Ltd.)
- Canada. Department of Mines. Mines Branch. Researches on Cobalt and Cobalt Alloys, conducted at Queen's University, Kingston, Ontario, for the Mines Branch of the Department of Mines. Part i. Preparation of Metallic Cobalt by Reduction of the Oxide. By Dr. H. T. Kalmus and others. Pp. x+36+plates viii. (Ottawa.)
- Beiträge zur Geschichte der Meteorologie. By G. Hellmann. Nr. 1-5. Pp. 147. (Berlin: Behrend and Co.) 5 marks.
- Constructive Text-Book of Practical Mathematics. By H. W. Marsh. Vol. iv., Technical Trigonometry. Pp. x+232. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6s. 6d. net.
- The Theory of Numbers. By Prof. R. D. Carmichael. Pp. 94. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4s. 6d. net.
- The Wilds of Maoriland. By Dr. J. M. Bell. Pp. xiii+253+plates. (London: Macmillan and Co., Ltd.) 15s.
- The Schools and the Nation. By Dr. G. Kerschensteiner. Translated by C. K. Ogden. Pp. xxiv+351+plates. (London: Macmillan and Co., Ltd.) 6s. net.
- Hereditary Genius. By F. Galton. Reprint. Pp. xxviii+379. (London: Macmillan and Co., Ltd.)
- The Quaternary Ice Age. By W. B. Wright. Pp. xxiv+464+xxiii plates. (London: Macmillan and Co., Ltd.) 17s. net.
- Marine Engineering. By Engineer-Captain A. E. Tompkins. Fourth edition. Pp. viii+812. (London: Macmillan and Co., Ltd.) 15s. net.
- The Childhood of the World. By E. Clodd. New edition. Pp. xiii+240. (London: Macmillan and Co., Ltd.) 4s. 6d. net.

Canada. Department of Mines. Geological Survey. Memoir 25. Report on the Clay and Shale Deposits of the Western Provinces. (Part ii.) By H. Ries and J. Keele. Pp. 105. Memoir 44, No. 37, Geological Series. Clay and Shale Deposits of New Brunswick. By J. Keele. Pp. viii+94+xvi plates. Memoir 48, No. 2, Anthropological Series. Some Myths and Tales of the Ojibwa of South-eastern Ontario. Collected by P. Radin. Pp. v+83. Museum of the Geological Survey, Canada. Archæology. The Archæological Collection from the Southern Interior of British Columbia. By H. I. Smith. Pp. ii+40+xvi plates. (Ottawa: Government Printing Bureau.)

Theory of the Atom. By Prof. T. Mizuno. (In Japanese.) Pp. 3+285+6. (Tokyo: Maruzen Co., Ltd.)

Researches into Induced Cell Reproduction in Amœbæ. By J. W. Cropper and A. H. Drew. (The John Howard McFadden Researches, vol. iv.) Pp. 112. (London: J. Murray.) 5s.

A Path to Freedom in the School. By N. MacMunn. Pp. 162. (London: G. Bell and Sons, Ltd.) 2s. net.

The History and Economics of Indian Famines. By A. Loveday. Pp. xi+163. (London: G. Bell and Sons, Ltd.) 2s. 6d. net.

Effetti dei Fulmini Globulari. By Prof. I. Galli. Pp. 70. (Roma: Tipografia Pontificia.)

The World Set Free. By H. G. Wells. Pp. vi+286. (London: Macmillan and Co., Ltd.) 6s.

How to Understand Aeroplanes. By S. L. Walkden. Pp. xiii+99. (London: P. Marshall and Co.) 1s. net.

The Horticultural Note Book. Compiled by J. C. Newsham. Third edition. Pp. xx+418. (London: Crosby Lockwood and Son.) 4s. 6d. net.

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere. Edited by Prof. A. Oettel. vii. Teil. Pp. x+417. (Jena: G. Fischer.) 18 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 42 Lief. Band iii. Hälfte 1. Pp. 1447-1598. (Jena: G. Fischer.) 5 marks.

## DIARY OF SOCIETIES.

### THURSDAY, MAY 21.

ROYAL SOCIETY, at 4.30.—The Effect of the Magnetism in the Scattering of  $\alpha$  Rays: Prof. W. M. Hicks.—Luminous Vapours Distilled from the Arc, with Applications to the Study of Spectrum Series and their Origin. I.: Hon. R. J. Strutt.—The Ionisation of Gases by Collision and the Ionising Potential for Positive Ions and Negative Corpuscles: W. T. Pawlow.—The Determination of Elastic Limits under Alternating Stress Conditions: C. E. Stromeyer.—The Emission of Electricity from Various Substances at High Temperatures: G. W. C. Kaye and W. F. Higgins.

ROYAL INSTITUTION, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Gulf Stream: Commander Campbell Hepworth.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on the Leaching of Oxidized Copper Ores by Modified Dorr Classifiers at the Butte-Duluth Mine: C. S. Herzog.—(1) A Graphic Method for Recording Grading Analyses; (2) The Application of Kick's Law to the Measurement of Energy Consumed in Crushing: S. J. Speak.—Notes on Mine Contract Work in Mexico and the Argentine Republic: A. Livingstone Oke.—The Ore Veins of the Fundkofel Gold Mine near Oberdrauburg in Carinthia: F. W. Penney.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Census of 1911: Ethnography and Occupations: E. A. Gait.

ILLUMINATING ENGINEERING SOCIETY, at 8.—The Nomenclature and Definitions of Photometric Quantities: A. P. Trotter.

### FRIDAY, MAY 22.

ROYAL INSTITUTION, at 9.—The Mortuary Chapels of the Theban Nobles: R. Mond.

PHYSICAL SOCIETY, at 5.—Volatility of Thorium Active Deposit: T. Barratt and A. B. Wood. The Passage of  $\alpha$ -Particles through Photographic Films: H. P. Walmsley and Dr. W. Makower.—A Null Method of Testing Vibration Galvanometers: S. Butterworth.—Experiments with an Incandescent Lamp: C. W. S. Crawley and S. W. J. Smith.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Neglected Steam Car: R. S. Box.

### SATURDAY, MAY 23.

ROYAL INSTITUTION, at 3.—Fiords and their Origin. I.: The Nature and Distribution of Fiords: Prof. J. W. Gregory.

### MONDAY, MAY 25.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—The Economic Development of British East Africa and Uganda: Major E. H. M. Leggett.

CHEMICAL SOCIETY, at 6.—Faraday Lecture: Electrolytic Dissociation: Prof. Svante Arrhenius.

### TUESDAY, MAY 26.

ROYAL INSTITUTION, at 3.—Natural History in the Classics. II.: The Natural History of Aristotle and of Pliny: Prof. D'Arcy W. Thompson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Ravhas of Assam: J. E. Friend-Pereira.

ROYAL SOCIETY OF ARTS, at 4.30.—The Singing of Songs: Old and New. III.: Modern Songs: H. Plunkett Green.

### WEDNESDAY, MAY 27.

GEOLOGICAL SOCIETY, at 8.—The Development of *Tragophylloceras loscombi* (Sow.): L. F. Spath.—The Sequence of Lavas at the North Head, Otago Harbour, Dunedin (New Zealand): Prof. P. Marshall.

ROYAL SOCIETY OF ARTS, at 8.

### THURSDAY, MAY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Studies of the Processes Operative in Solutions. XXIX.: The Disturbance of the Equilibrium in Solutions by "Strong" and "Weak" Interfering Agents: Prof. H. E. Armstrong and E. E. Walker.—A Type-reading Optophone: Dr. E. E. Fournier d'Albe.—An Application of Electrolytically-produced Luminosity forming a Step towards Telectroscopy: L. H. Walter.—The Convection of Heat from Small Cylinders in a Stream of Fluid and the Determination of the Convection Constants of Small Platinum Wires, with Applications to Hot-wire Anemometry: L. V. King.

ROYAL INSTITUTION, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

### FRIDAY, MAY 29.

ROYAL INSTITUTION, at 3.—Plant Autographs and their Revelations: Prof. J. C. Bose.

### SATURDAY, MAY 30.

ROYAL INSTITUTION, at 3.—Fiords and their Origin. II.: Fiords and Earth Movements: Prof. J. W. Gregory.

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