THURSDAY, JUNE 11, 1914.

THE PURPOSE OF YOUTH.

The Childhood of Animals. By Dr. P. Chalmers Mitchell. Pp. xiv+269+plates. (London: W. Heinemann, 1912.) Price 10*s*. net.

THIS remarkably fine book is a work of distinction—both of style and insight. When an author has a story of his own to tell and knows how to write, the outcome is often a book of delightful descriptive natural history, but Dr. Chalmers Mitchell has much more to give us than that. He has succeeded in making us read biology without knowing it. With a charming subject to start with, with a wide experience to draw from, with an infectious sympathy for youth, and with a well-thought-out biological system, he has given us a really big book—and happy are those who have found it. A great pleasure it is to discover a work with so many interesting facts and so wholesome a salting with ideas, written in a style that is individual and charming. We congratulate the author on achieving a conspicuous success. Most naturalists like their natural history "dry," and few of them have much use for popular expositions, but "The Childhood of Animals" is a book by itself, which takes a grip. The author has been extraordinarily fortunate in his artists; the Japanesque colour-studies are revelations of character and the black and white drawings are also very pleasing and effective.

Without insisting on it too much, the author divides animals into three sets—those which have no youth, such as amœbæ (but is it not rather that they never grow up?); those which are quite different from their parents when they are young and on a different line of life, such as caterpillars, tadpoles, and other larvæ; and those which are born in the likeness of their parents, but have a very distinct youthful period, such as most higher vertebrates. He contrasts the various kinds of life-history; and shows that in relation to particular conditions one chapter is often lengthened out and another shortened down. Adult life may be condensed into a few days or even hours; it may even be lost altogether, as in pædogenesis. Larval life may be so hazardous, on the other hand, that it is all, as it were, telescoped into the egg. Part of the tune may be played very slowly, part very quickly, and another part left out altogether; and all this is, on the whole, adaptive, the result of selecting out temporal variations in reference to the conditions of life. In some cases, perhaps, it works the other way round, that a type born, as it were, old, seeks out conditions of life suitable for this kind of constitution—parasitism for choice. But our author does not go into this.

From the treasury of interesting things that the book contains it is difficult to select, but we may refer to three. The first is the masterly treatment of the coloration of young animals. Starting with the sound idea that the pigments are primarily by-products of the metabolism, and the patterns expressive of growth-rhythms, Dr. Chalmers Mitchell shows how in one case they are tolerated, and in another toned down, and in another specialised. Young animals tend to show the more primitive types of coloration—a spottiness, for instance, which corresponds to the particulate character of the skin, and while this is often very useful, it requires no special utilitarian interpretation. Later on, the spots may combine into bands and stripes, or the pattern may be blurred and toned down, or it may be overlaid by a new pattern, often of ruptive vividness, which breaks up the natural outlines and makes the animal inconspicuous, or forms startling and attractive sex-decorations. It is in interpreting the post-juvenile coloration that we must call in the aid of the selection theory.

Another subject well dealt with is the progressive reduction of the number of offspring. In the lower reaches of the animal kingdom there is prolific multiplication and high mortality. But it has been one of the great steps in evolution to economise life by parental care, of which affection is a consequence. "The mere toleration of the young by the mother is a new beginning in life, and is the foundation of many of the highest qualities displayed by the highest animals and by man himself. . ." The relations of the young to the mother "are a continuation of the organic relation by which the young are born of the body of their mother, and they exist and become, so to speak, a habit before the individuality, the physical powers, and the senses and aptitudes of the young are really awakened."

Perhaps, however, the most prominent thesis of the book concerns the purpose of youth. This is in a word self-expression. Why as we ascend the scale of being is there this lengthening of the period of youth? Why are the young creatures fed, protected, freed from care, dowered with energy, and given full scope for play? The purpose of youth is to give time for the breaking down of rigid instincts, and their replacement by actions controlled by experience and memory—by remembered results of experiment. Youth is perilous, but the risks run have been justified—are continually being justified—in the complexifying co-ordinations established by the brain-cells. This means the growth of intelligence and the deepening of feeling. And if natural history is asked to give hints to the human educationist, one of them is this: "Youth should be spent in blunting (a term apt to be misunderstood?) every instinct, in awakening and stimulating every curiosity, in the gayest roving, in the wildest experiment. The supreme duty of youth is to try all things."

MANUALS OF BOTANY.

(1) *Pflanzenmikrochemie. Ein Hilfsbuch beim mikrochemischen Studium pflanzlicher Objekte.* By Dr. O. Tunmann. Pp. xx+631. (Berlin: Gebrüder Borntraeger, 1913). Price 18.50 marks.

(2) *Researches on Irritability of Plants.* By Prof. J. C. Bose. Pp. xxiv+376. (London: Longmans, Green and Co., 1913.) Price 7*s.* 6*d.* net.

(3) *Plants and their Uses. An Introduction to Botany.* By F. L. Sargent. Pp. x+620. (New York: Henry Holt and Co., 1913.)

(1) BOTANISTS who have not kept in touch with the more recent advances in the microchemistry of plants will be surprised at the size of this work with its 600 closely-printed pages. The book is divided into a general and a special part. In the first part we have, first, sixty pages dealing with methods of preparing and preserving material and with various other special methods such as filtering, centrifuging, sedimentation, micro-sublimation (a method of great value in many cases), clearing, swelling, bleaching, maceration, etc. In the second part the methods of recognising the various elements of the ordinary inorganic substances of the plant are considered, and later the various classes of organic substances are dealt with fully. The author, however, does not stop here, but in the last 200 pages passes in review the microscopical characters and the chemical nature of protoplasm, cell-wall, and cell-inclusions generally; this section includes details of fixing and of the staining reactions of the various cell elements. It will be seen that the author interprets his subject very broadly as, in fact, coextensive with botanical microtechnique.

The need for such a book is very obvious since the last work covering such a field was very much smaller and was published in 1892. Dr. Tunmann has made many contributions himself to the study of plant microchemistry, and no one could be better fitted to prepare such a work.

The literature of the subject has been worked up in a way which must have taken years to complete and nearly every page bristles with references; the work is, however, no mere compilation, for the physiological aspects of the different substances are briefly dealt with and many methods critically discussed. Of course, it is impossible to read and criticise this book as a whole, but when tested in relation to a number of diverse substances, such as the microscopical recognition of potassium, of formaldehyde, of sugars, etc., it has proved to be thoroughly up-to-date. Botanists, plant biochemists, and those who have to deal with the recognition of vegetable tissues and drugs used in pharmacy are under a heavy debt of gratitude to the author. The book should be on the shelves of every botanical, biochemical, and pharmaceutical library.

(2) This volume is the fourth of the series of books in which Prof. Bose has applied the delicate methods of the physical laboratory to the study of the irritable responses of plants and animals. As his previous work has shown, the author looks upon the plant as a very peculiar machine of which the sole source of energy is that which plays upon it directly from without! Such views, however, should not blind plant physiologists, and animal physiologists interested in the neuro-muscular electrical response, to the solid value of many of the results obtained and to the usefulness of the ingenious and delicate apparatus devised by the author. His resonant recorder is a beautiful piece of apparatus in which the recording lever is made to vibrate to and fro and so to make only an *intermittent* contact with the recording surface; the friction between the lever and blackened surface is thus enormously reduced. By means of this apparatus and of another ingenious instrument, the oscillating recorder, the delicate movements of the leaves of Mimosa and Biophytum have been recorded for the first time without distortion, and so the latent period and the rate of transmission of a stimulus carefully measured. Very good reasons are given for the belief that in Mimosa an impulse cannot pass through dead tissues, in the manner commonly accepted, as a mere hydro-mechanical disturbance, but only through living protoplasm, the mode of transmission being essentially similar to that of a nervous impulse.

There is much other work of importance, especially in connection with electrical responses, and one is glad to note that startlingly unorthodox views are much rarer than in previous works. Prof. Bose, however, must be unaware of, or careless of, the prejudices of biologists or he would not put forward, without the support of further experiments, the conclusion that in a bean leaf "on account of fatigue, the death point was lowered from the normal 60° C. to 37° C."

(3) This book is described as an introduction to botany. The plan of the work is based on the

view that the beginner in botany should first learn about economic plants and classify them scientifically and later deal with other aspects of the subject. In accordance with this view it begins with a preliminary chapter on the way in which botany arose, how plants are named, and the nature of varieties, species, and genera. In the next chapter, thirty-four pages are devoted to the cereals; the characteristics, floral and otherwise, of the various forms are described, maps of their probable origin and present distribution are given, and their suitability to various habitats pointed out. At the end of this chapter, the nutritive value of the grain of various cereals is considered, and the nature of carbohydrates, proteids, and fats briefly indicated. In the third chapter, other food plants are considered, such as nuts, pulse, earth-vegetables, herbage-vegetables, fruit-vegetables, and miscellaneous food-products. After this review of the chief food-plants a discussion of food as a fuel and building material is provided, and the energy available in fats, carbohydrates, and proteids is considered, leading finally to the question of the composition of a suitable ration. Then we have chapters on flavouring and beverage plants, on medicinal and poisonous plants, and on industrial plants, *i.e.* plants yielding fibres, wood, gums, fuel, etc. Then follow chapters on classification, and on the parts of a flowering plant, and a chapter on evolution, adaptation, and natural selection. At the end of the book the chief groups of algæ, fungi, liverworts, mosses, and pteridophyta are all surveyed in no more than eighty pages. Finally we have a chapter on the plant's place in nature, which includes a semi-philosophical discussion of the distinction between the living and the non-living.

This brief statement of the contents of the book will show that the author has great faith in the powers of mental digestion of beginners, and does not hesitate to provide them with plenty of "fine, confused feeding." The earlier chapters of the books might perhaps be usefully read by an advanced student interested in the economic side of the subject and in classification, but they are almost too full of information to be used other than for reference. As an introduction to botany, however, the book is an anachronism. It might have been so used when classification practically embraced the whole subject, but nowadays it is generally agreed that the student should gain as early as possible a clear conception of the plant as a working whole. But in this book the student may peruse 500 pages without gaining any clear idea of the function of the parts of the plant. There is no description of the internal structure of a stem, root, or leaf of a flowering plant, or any mention of a chloroplast, or any description of a cell of a higher plant. Useful as the earlier chapters may be to other readers, the book appears to be quite unsuitable for a beginner, who should not be plagued too severely with information, but by proper selection of material should be led to acquire sound general views of his subject. The author states that he has "tried to write such a book as I believe would have been most useful to me as a beginner." If the author has really succeeded in recapturing his impressions as a tyro in the subject, his needs must have been very different from that of any elementary student that the reviewer has ever met.

V. H. B.

GERMAN POPULAR SCIENCE.

(1) *Bücher der Naturwissenschaft.* Edited by Prof. Siegmund Günther. 21 vols. (Leipzig: Philipp Reclam, jun., n.d.) Price 1 mark each.

(2) *Aus Natur und Geisteswelt: Sammlung wissenschaftlich-gemeinverständlicher Darstellungen.* 442 vols. (Leipzig: B. G. Teubner, n.d.) Price 1.25 marks each.

(3) *Naturwissenschaftliche Bibliothek für Jugend und Volk.* Edited by Konrad Höller and Georg Ulmer. 23 vols. (Leipzig: Quelle und Meyer, n.d.) Price 1.80 marks each.

(4) *Series of Science Books for Austrian Secondary Schools.* Published by F. Tempsky, Vienna, and G. Freytag, G.m.b.H., Leipzig. Price 2 to 5 kronen each.

(1) THE idea underlying Dr. Günther's series is to select a limited area of some scientific subject, and to treat it in a modern and popular manner which combines attractiveness with accuracy. Some of the latest volumes of this series are Lampert's "Vom Keim zum Leben," a very readable account of plant and animal development; Prof. Wieleitner's "Schnee und Eis der Erde," nicely illustrated with photographs of "penitents" and other remarkable ice formations; Dr. Hempelmann's "Der Wirbeltier-Körper," a useful though rapid summary of comparative vertebrate anatomy; Prof. Pahde's "Meereskunde," in which the latest results, such as those of the hydrodynamical theory of ocean currents, are clearly brought to bear; Dr. Speter's "Chemische Verwandtschaft," and Heinrich Leiser's "Welt der Kolloide," the latter a fascinating presentation of the rapidly growing science of colloids; and an excellent little manual on heat by the late Robert Geigel.

(2) Teubner's "Natur und Geisteswelt" series is an exceptionally large undertaking of the same kind. Among typical recent volumes may be cited a very valuable booklet by Max Verworn

entitled "Die Mechanik des Geisteslebens," in which the modern theory of neurons is brought to bear upon a wide range of nervous and psychical processes, from memory and will to fatigue, suggestion, and hypnosis. Among other works of this series we may mention a charming volume on the origin of the universe and the earth according to legend and science, by M. B. Weinstein; several anatomical volumes by K. von Bardeleben; a useful volume on the microscope by Prof. W. Scheffer; a book on radium by Dr. Centnerszwer; some volumes on steam and heat engines by Prof. Vater; and a very readable and up-to-date volume on aeronautics, "Die Luftfahrt," by Dr. R. Nimführ.

(3) The "Naturwissenschaftliche Bibliothek" is frankly intended for juvenile readers. The books are very attractively produced, and some of them leave nothing to be desired as regards simplicity and clearness. This is notably the case in Hahn's "Chemisches Experimentierbuch" and Heller's "Das Aquarium." Otto Krieger's "Wie ernährt sich die Pflanze?" is well written, but more adapted to adults, and this may be said more emphatically of Gothan's "Vorgeschichte der Pflanzen" and Reukauf's "Mikroskopische Kleinwelt unsrer Gewässer." The special volumes on aquatic insects (Ulmer), bees and wasps (Scholz), and singing birds (Voigt) are very readable books, without any striking or original features.

(4) Messrs. Tempsky's manuals are intended for the various stages of the gymnasien, mädchengymnasien, realschulen and realgymnasien of the complex German and Austrian system of secondary education. In some of them, such as Graber's "Leitfaden der Körperlehre und Tierkunde," coloured plates are judiciously supplemented by colouring specially important illustrations in the text, an innovation which deserves to be more widely adopted. The volumes form a highly creditable set of schoolbooks, covering geology, mineralogy, botany, zoology, chemistry, and hygiene. Unlike the other three series, they are printed in Roman type.

OUR BOOKSHELF.

Veröffentlichungen des Königlich Preussischen Meteorologischen Instituts, No. 273. Beiträge zur Geschichte der Meteorologie. Von G. Hellmann. Nr. 1–5. Pp. 148. (Berlin: Behrend and Co., 1914.) Price 5 marks.

FOR many years past meteorological bibliography has been greatly enriched by the laborious and painstaking researches of Prof. G. Hellmann on the origin of observations and instruments. The volume now before us forms No. 273 of the "Publications of the Royal Prussian Meteorological Institute," and contains five contributions, the first of which occupies ninety-eight quarto pages, with many facsimile extracts and plates, and refers to the reign of astro-meteorology. A masterly account is given of the extraordinary literary controversy caused all over Europe by J. Stöffler's prediction of a deluge in February, 1524, due to an unusual number of conjunctions of the planets in the Constellation Pisces. This prediction was contained in the *Almanach nova,* published at Ulm in 1499, with ephemerides in great detail down to 1531 (thirty-two years in advance). Needless to say, the prophecy was not fulfilled; some of the astrologers maintained, however, that it was correct in theory, and the Arab doctrines required amendment to take into account the promise made to Noah. The two following articles refer to the oldest meteorological observations in Germany (Hanover, 1678), and the oldest printed description of aurora borealis (1527), both of which dates are a few years earlier than previously stated. These are followed by a first attempt at arranging the combined literature of meteorology and theology, in so far as the titles give a clue to the contents, *e.g.* special sermons, etc. The last contribution is a very interesting account of the predecessors of the Mannheim Meteorological Society (1780–95), the first really successful establishment of an international meteorological system of observations. The first attempt was due to Ferdinand II, Grand Duke of Tuscany, about 1654.

Photography in Colours. A Text-book for Amateurs and Students of Physics: with a Chapter on Kinematography in the Colours of Nature. By Dr. G. L. Johnson. Second edition. Pp. xv+243. (London: George Routledge and Sons, Ltd., 1914.) Price 3*s.* 6*d.* net.

A REVIEW of the first edition of Dr. Johnson's book will be found in the issue of NATURE for February 23, 1911 (vol. lxxxv., p. 539). The volume has been subjected to a thorough revision. Most of the best-known colour processes are described; an extra chapter has been added dealing with the "Utocolor" process of printing in colour direct from colour photographs; and an outline of modern views as to the nature of light and colour is now included.

Poems of Human Progress and Other Pieces: including One Hundred and Fifteen Sonnets. By J. H. West. Pp. xii+328. (Boston: The Tufts College Press Publishers, 1914.) Price 1.50 dollars.

THE first of Mr. West's poems, "Man's Triumph-Era," was the Phi Beta Kappa poem read at Tufts College, in 1906, at a meeting of the Delta Chapter of Massachusetts, and depicts a walk with college men, with discourse on human progress. The second extended effort, "The Epic of Man," was read in 1908 in Boston, at the annual convention of the Free Religious Association of America. The poems and sonnets may be commended as affording a favourable example of contemporary American verse.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Weather Forecasts in England.

MR. MALLOCK'S position in the scientific world is one of distinction and his letters on the subject of weather forecasts in England, which appeared in NATURE of February 26 and June 4, can, accordingly, scarcely fail to be regarded by many who are unfamiliar with the circumstances as reflecting injuriously upon the department of the public service which is in my charge. I ought, therefore, not to let them pass unnoticed.

Let me say that the method of checking forecasts employed by Mr. Mallock as described in the letter of February 26 would be scouted in the Meteorological Office, whatever the result might be, partly because the classification of the weather adopted therein is quite inadequate, and partly because the conditions at a single hour of the day (7 a.m. only) are used as an indication of the weather comprised within the period of twenty-four hours extending from noon to noon. In the Meteorological Office, for checking forecasts, the practice was to use three maps for each day in conjunction with the schedules of observations collected for the daily and weekly reports. For the last year or two these observations have all been charted, so we now use ten maps for each day. Specimens were exhibited at the last soirée of the Royal Society. The stricter examination is sufficiently encouraging to the forecaster.

No one can wonder that Mr. Mallock revives and cherishes an objection to the accumulation of observations, because the picture which he draws of the state of the atmosphere, and upon which, in his second letter, he founds his gloomy forecast of the future of forecasting, will not stand comparison with the facts of observation. There is no belt of north-east or south-east winds *all round the globe,* as represented in Mr. Mallock's diagram; that notion is a survival of times long gone by, and is inconsistent with Buys Ballot's law, as well as the facts set out, for example, in Hildebrandsson and Teisserenc de Bort's "Les Bases de la Météorologie Dynamique: Historique—état de nos connaissances," or, more simply, in "The Barometer Manual for the Use of Seamen."

The notion of a collection of eddies in a quiescent atmosphere covering the temperate and polar regions was also quite familiar to the meteorologists of thirty years ago when the vortex theory was as fashionable as the *quantum* theory is now. It derives much support from the study of the water of a flowing stream, or near a moving ship; only, unfortunately, in the atmosphere there are no huge moving ships to cause eddies of any diameter up to a thousand miles or more; and if there is a flowing stream Mr. Mallock does not describe it. There is no machinery round the tropic of Cancer, like the popular lecturer's smoke-box, for launching a succession of vortices on a brief career of degradation. The theory that cyclonic depressions are vortices has never led to any real advance in our comprehension of the atmosphere, outside the region of tropical revolving storms; whereas the close study of observations such as those of the Daily Weather Report has led, and is leading, slowly but surely towards understanding the physics of the phenomena.

I should like to suggest to Mr. Mallock and other distinguished men of science who are kind enough to take an interest in meteorology, that to stick a pike through the front rank of the fighting line in the manner recently represented by "Mr. Punch," is not very helpful to the promotion of natural knowledge. If they in their turn feel bored by observations, let them help us to attack some of the citadels for the reduction of which we have very few observations to help us. I cannot offer them the surface or the troposphere for the purpose; the observations are too numerous. But the all-embracing stratosphere is open to their imagination with very few observational restrictions. Let me set out my own imperfect idea of the problem with the object, not of prolonging this correspondence, but of eliciting a valuable contribution to knowledge, in the shape of a paper, or even a book.

Imagine a shell of upper atmosphere containing no water-vapour, separated from the moist lower atmosphere by a smooth surface which, for the time being, we will suppose a "level surface." The shell under consideration is isothermal or increases in temperature upwards, until a region of approximately uniform temperature is reached. It is imperfectly transparent to radiation, but it has no convection of the ordinary local character, and is supposed not to be affected by convection from below. In this environment, considerations of stability may lead us to conclude that locally cooled air will find its way over the smooth surface towards the equator and locally warmed air towards the polar regions. So, we shall get primarily a concentration of cold air over the equator and warm air over the poles. That, apparently, does really occur. The wandering of the air poleward will eventuate in an eastward circulation, the wandering towards the equator in a westward circulation. Outside the equatorial region horizontal pressure-differences will be balanced by the easterly motion, the lines of flow, in the temperate and polar stratosphere, being at once isobaric lines and isothermal lines; so far as we are able to tell, low pressure is warm and high pressure cold.

What will happen in consequence of the alternate solarisation and sky-radiation of this stratosphere by day and night I must leave the theoretical theorist to say; observation has not yet told us. I will, however, venture to suggest that the air cap of the winter pole must get colder and colder; ultimately so cold that it will wobble and get displaced by warmer air; and, yielding to the centrifugal influence, it will slide towards the reservoir of cold air over the equatorial regions. On its journey it may give rise to easterly or northerly currents in the temperate stratosphere which are occasionally observed, and which are, at present, unexplained.

Some of the suppositions in the statement which is here presented are based on observations with which I am familiar, though the guidance that can be got from observations in this matter is woefully incomplete; but one, at least, is frankly hypothetical, and my question is, whether, from the mathematical point of view, the picture may be regarded as true to life and, if not, how it should be emended. The problem is quite simple compared with that presented by the observations of the Daily Weather Report. There is no water-vapour, no convection in the ordinary sense, and no surface friction. If some philosopher, who thinks observations unnecessary, will give us a working solution, he will be a real benefactor to meteorology; because we know that the stratosphere exerts a dominant influence upon the distribution of pressure at the surface, which controls our weather, and we have no working outline of what happens up there. Theory might help us; perhaps Mr. Mallock will oblige.

His letters do not, I think, entitle him at present to be placed in the category of benefactors, because his checking is unsound and his theory is out of date. Even if he had succeeded in what appears to be his immediate object, and had cooked the forecaster's goose, it would have made a sorry meal. Those who are acquainted with the history of meteorology in this or any other country know that whatever may be the merits of the bird herself, as long as she lives she may lay golden eggs which are very sustaining for the progress of science.

Official forecasts for twenty-four hours in advance are often right and sometimes wrong, but the study of the daily weather by means of maps has a fascination which increases year by year as the observations become more precise and the area covered becomes wider and wider. "Age cannot wither nor custom stale its infinite variety." The subject is so complex and so varied that it is mere vanity to think of taking up the whole of it at once and producing a complete solution applicable to the whole of time. We must take the pieces which our intelligence, such as it is, enables us to tackle. Quite apart from the practical utility to the public, of which others must judge, and which is not quite a single-valued function of accuracy, the daily forecast is absolutely indispensable for the student of atmospheric physics. The daily map serves also a variety of useful public purposes of which the forecasts are only one.

Notwithstanding Mr. Mallock's theory, the forecasts for twenty-four hours are gradually getting more accurate; but, even if his contention were valid, I should still ask to be allowed to continue the study of the daily observations, as my predecessors did from 1867 to 1879, when the issue of forecasts was, once before, suspended in deference to the representations of the learned.

W. N. SHAW.

June 5.

Cellular Structure of Emulsions.

THE letters and photographs published on this subject do not make it quite clear whether the cellular structure observed is confined to the surface, or exists in the interior of the emulsion. Superficial cellular structure is by no means uncommon, and is shown to advantage by thin layers of heavy tar-oil or benzaldehyde on the surface of water. If the phenomenon under discussion is restricted to the surface, it probably falls, as suggested by Mr. Harold Wager, under the heading of the "cohesion figures" first studied by Tomlinson. If, however, the cellular structure extends throughout, some further explanation is necessary, and it would be interesting to know whether any such cases have been observed.

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β and γ Rays and the Structure of the Atom (Internal-Charge Numbers.)

IN a previous letter to NATURE (December 25, 1913, p. 477) it was suggested that "a cluster of α particles *only* may be at the centre of the atom," and that, though the innermost electrons "may have no influence at all on the properties of the elements, and for an electron (or α particle) penetrating from without will belong to the nucleus (see NATURE, November 27, 1913, p. 372), a β particle ejected from near that cluster must pass all other electrons and excite radiation different for each, as dependent on the (successively changing) charge within."

The word "ring" has here been purposely omitted; for from the wave-lengths of the soft γ rays (L radiation) of radium B (Rutherford and E. N. da C. Andrade, *Phil. Mag.*, vol. xxvii., 1914, p. 861), and of the β-ray spectrum of this substance (Rutherford and Robinson, *Phil. Mag.*, vol. xxvi., 1913, p. 724), it may be seen that these frequencies are nearly equal to the square of (probably all) integers from P, the periodic number to A/2, half the atomic weight, multiplied by a constant ($3{\cdot}942 \times 10^{14}$/sec.), and that the β-ray spectrum contains only velocities equal to (probably all) integers from P to A/2, multiplied by a constant ($3{\cdot}175 \times 10^{8}$ cm./sec.), so that all the radii of the inner electrons should be different, and these electrons must "be moving in a manner prohibiting any two of them from forming a ring," but not "either form a single ring or rings in parallel planes" (J. W. Nicholson, NATURE, May 14, p. 268, and *Phil. Mag.*, April, 1914, p. 557, respectively), forming a "planetary" rather than a "Saturnian" atom. (P = the periodic number = the number of peripheric electrons; see NATURE, December 25, 1913, p. 477, and March 5, 1914, p. 7, and the periodic system in Table II.)

TABLE I.

I. Charge	II. $\lambda . 10^{8}$	III. $\sqrt{\nu} . 10^{-9}$	IV. N_γ	V. β	VI. N_β
107—99	—	—	—		
98	0·793	1·945	98·0		
97	0·809	1·926	97·0		
96	—	—	—		
95	0·838	1·892	95·3		
94	0·853	1·877	94·5		
93	—	—	—		
92	—	—	—		
91	0·917	1·809	91·1		
90	—	—	—		
89	0·953	1·773	89·3		
88	0·982	1·748	88·0		
87	1·006	1·727	87·0		
86	1·029	1·708	86·0		
85	1·055	1·687	85·0		
84	1·074	1·670	84·1		
83	1·100	1·650	83·1		
82	1·141	1·620	81·6		
81	1·175	1·597	80·4		
80	1·196	1·583	79·8		
79	1·219	1·569	79·0		
78	1·266	1·539	77·5	0·823	77·8
77	1·286	1·528	77·0	—	—
76	1·315	1·510	76·0	0·805	76·0
75	1·349	1·499	75·0	0·797	75·3
74	1·365	1·482	74·6	0·787	74·4
73	Faint lines.			—	—
72				0·762	72·0
71				0·751	71·0
70				—	—
69				0·731	69·1
68				0·719	68·0
67				—	—
66				0·700	66·1
65				—	—
64				—	—
63				—	—
62				0·656	62·0
61				—	—
60				0·635	60·0

I. The possible charges for each electron.
II. The wave-lengths of the γ rays of RaB.
III. The square root of these γ-ray frequencies.
IV. The possible charges calculated from III.
V. The velocities of the so-called β rays of RaB.
VI. The possible charges calculated from V.

From the K radiation lines (Moseley, *Phil. Mag.*, April, 1914, p. 706), the very penetrating γ rays of radium B may be expected to have frequencies equal to the square of (probably all) integers from $P=60$ to $A/2=107$, multiplied by 2.48×10^{15}/sec. Hence for uranium frequencies up to 2.85×10^{19}/sec. might exist. Of course, on this view different elements must have partly equal β and γ rays, and the so-called β-ray spectra be those of electrons expelled by the β particle, and not of the β particles themselves.

As "there is also a large group of faint lines between 14° and 22° which do not permit of accurate measurements" (*loc. cit.*, p. 859), it may be observed that 22° corresponds to a charge of 64, so that all lines fall within the limits given above.

TABLE II.—*The "Condensed" Periodic System with* (1–70) *the Periodic Numbers.*

							0H—He
1Li	2Be	3B	4C	5N	6O	7F	8Ne
9Na	10Mg	11Al	12Si	13P	14S	15Cl	16Ar
17K	18Ca	19Sc	20Ti	21V	22Cr	23Mn	24Fe—Co—Ni
25Cu	26Zn	27Ga	28Ge	29As	30Se	31 Br	32Kr
33Rb	34Sr	35Y	36Zr	37Nb	38Mo	39—	40Ru—Rh—Pd
41Ag	42Cd	43In	44Sn	45Sb	46Te	47I	48Xe
49Cs	50Ba	51La, etc.	52, etc.	53Ta	54W	55—	56Os—Ir—Pt
57Au	58Hg	59Tl	60Pb	61Bi	62—	63—	64Nt
65—	66Ra	67Ac	68Th	69—	70Ur	71—	72— — —

It would seem that there is no reason, why such a structure, though not observable by lack of γ radiation, should not belong to all elements. But it is perhaps not compatible with Bohr's atomic model. With Moseley's formula for the L radiation $A(N-7.4)$ it is not; but if here $(N-7.4)$ be multiplied by 1.008, all values for $(N-7)$ are integers (±0.2) also, and the same holds for all Moseley's series, so that, if $N=M$, $\nu=A(M\pm n)$, and n is any number of electrons between certain limits.

A. VAN DEN BROEK.

Gorsel (Holland), May 19.

FORESTRY AND FOREST RESERVES IN NEW ZEALAND.[1]

THE recently-published report of the New Zealand Commission on Forestry contains much that is of general interest, apart from the aspects of the forestry problem affecting that Dominion in particular. New Zealand has magnificent forests, especially of conifers and southern beeches, with a present area of about twelve million acres. The forest area has been reduced by nearly one-half since about 1830, and during the last ten years the annual cut has doubled, so that despite the steps that have been taken since about 1875 to prevent waste and to afforest suitable areas, the forest capital is dwindling at an alarming rate.

Since the New Zealand forest flora includes a number of species which are of unusual interest as representing the most primitive types of gymnosperms, particularly among the families Araucarineæ and Podocarpineæ, it is gratifying from the botanical as well as from the economic point of view that vigorous steps are now being taken by the Dominion Government to conserve the native trees, as well as to inaugurate a far-reaching scheme of afforestation. Of the endemic trees, the "Kauri pine" (*Agathis australis*) is among the most valuable timbers of the world, and though it is still fairly abundant, its distribution is limited to the northern portion of the North Island, it is very inflammable, and it takes from six hundred to about three thousand years to attain its full size. Besides yielding the valuable copal-like resin which is largely exported to the United States and to this country, the Kauri produces timber which is unrivalled for shipbuilding and for other purposes to which it is adapted, owing, above all, to its freedom from knots—a condition secured through the function of an absciss-layer causing self-amputation of branches. The other New Zealand conifers, including timber trees of great value, also suffer, though in a smaller degree, from this drawback of slowness of growth, and it is therefore necessary to plant introduced trees which are found to grow four to ten times as rapidly as the native species.

As we learn from this report, the forestry problem is being faced in a systematic manner by the New Zealand Government, and forestry promises to develop into one of the most important and permanent industries of the Dominion, which, though precluded by its geographical position from becoming to any appreciable extent a contributor to the world's supply of timber, can, at any rate, meet its own wants, and probably continue in an increasing degree to assist Australia, where the shortage of structural (coniferous) timber is now leading to a steady annual rise in the amount imported from Europe and North America, as well as from New Zealand. About 60,000 acres have already been afforested, but this will be greatly increased in the near future, since it is estimated that at the present rate of consumption the indigenous forests will be exhausted in about thirty years.

While much of the report is, naturally, concerned with the special needs of New Zealand—a large section being devoted, for instance, to the question of suitable wood for butter-boxes, in view of the important and increasing dairy industry—there are various matters of general interest, among which we may note particularly the formation of climatic and scenic reserves.

A climatic reserve may be defined as a nature reserve selected for the purposes of protection of soil, prevention of denudation, water conservation, prevention of floods, and shelter from winds. In relation to its area, few countries in the world are in greater need of an adequate forest covering

[1] Report of the Royal Commission on Forestry. (Wellington, New Zealand: John Mackay, Government Printer, 1913.)
Report on Scenery Preservation. New Zealand Department of Lands. (Wellington, 1912.)

on their high lands than is New Zealand. The lofty mountain ranges which traverse both islands, and the excessively broken nature of the land over large areas, together with an average high rainfall, lead to the presence of innumerable streams, and offer ideal conditions for denudation; hence the mountains would, if not forest clad, be a constant source of danger to the farm lands on which the prosperity of the country so largely depends. The original covering of forest, which —except where soil or climatic conditions were adverse—occupied the whole land, and extended to a height of between 3000 and 4500 ft., has now been enormously reduced, and there has been much unnecessary destruction extending to the steep slopes of hills, and even to the upper altitudinal limits of the forest; hence the headwaters of many streams are no longer provided with tree cover, and the general watersheds of the larger rivers have lost their original efficient protection. The commission strongly recommend, therefore, that these mountain forests should be strictly preserved against further interference, and that every factor which is destructive to the forest undergrowth should be rigorously repressed—this will entail the restriction of deer and other destructive animals to limited enclosures.

The importance of scenic reserves, which includes several distinct classes of reserve, is fully realised by the enlightened Government of the Dominion, which is annually adding large areas to its already long list of such reserves, and is in this respect setting a splendid example to older countries. In this connection it may be noted that of the seventeen hundred species of trees, shrubs, herbs, ferns, and fern allies included in the New Zealand flora, more than three-fourths are found nowhere else in the world, and that this vegetation is, except where disturbed by human occupation, of a truly primitive type. In 1903 Sir Joseph Ward, then Minister in charge of the Tourist Department, introduced the Scenery Preservation Act, which provided for a Royal Commission to report upon all areas possessing scenic or historic interest, or on which there were thermal springs, and submit recommendations for the acquisition of such as seemed desirable, whether Crown, freehold, or native. After this commission had worked for two years, it was terminated by an amending Act substituting a small permanent advisory board of Government officials, the Scenery Preservation Board, which investigates and reports from time to time on all areas worthy of inspection, and by a further Act passed in 1910 the whole of the reserves were made sanctuaries for the flora and fauna, so that no firearm may be discharged on a scenic reserve, nor may any bird or game be killed thereon. The reserves now set aside for scenic purposes number 518, and there are also five national parks consisting for the greater part of extremely steep land, much of which is at a high altitude and more or less barren, while three islands have been set apart for the protection of New Zealand birds. The Forestry Commission recommend the constitution of a further series of scenic reserves.

The report for 1912 of the Scenery Preservation Board shows that during the year ended March 31, 1912, there were acquired no fewer than ninety-six additional reserves, with an aggregate area of 94,000 acres, at a total cost to the Government of less than 6000*l.*, the latter figure including as the two heaviest items the expenditure involved in survey and the compensation paid for private and native lands acquired. F. C.

THE PRINCIPLE OF RELATIVITY.

I.

PERHAPS the most comprehensive generalisation in physical science since Newton's enunciation of the law of gravitation is the conception of an all-pervading æther, the medium of transmission of light and of electrical and magnetic disturbances. From the time when Maxwell adopted this conception from Faraday and established the identity of light and electric waves, the "æther" has become a fundamental element of our thought about the physical world.

But it has been a standing puzzle for many years to find out whether the æther is pushed and carried along by the earth as it moves or whether it is of such a nature that it can pass through solid matter so that we may think of it as undisturbed by the motion of bodies through it. Without going over the history of the controversy it may be stated that by the beginning of this century it had been almost universally accepted that the simplest way to think of the æther was to suppose it to be stagnant and immovable. Thus there seemed a possible solution to an older puzzle, that of the failure of mechanics to specify a unique and universal frame of reference for the motion of bodies. The æther promised to supply one. But, unfortunately, when experiments were devised to determine the velocity of the earth relative to the æther, they one and all failed. Thus came into being the principle of relativity, which is simply the *hypothesis* that *we never shall know or be able to define what is the exact velocity of the earth or any other body relative to the aether.*

Of course, this must not be taken as a dogmatic assertion or a philosophic doctrine, but as a working hypothesis, the consequences of which are to be examined and verified at every possible point by comparison with experiment. But the boldness of the hypothesis requires a little justification. It arose, as a matter of fact, directly out of the theory built up by Lorentz and Larmor on the basis of a stagnant æther for the purpose of explaining the failure of the experiments that have been referred to. This theory was so comprehensive that it distinctly predicted the failure of all conceivable experiments designed for the purpose of identifying the æther as a frame relative to which the velocities of bodies might be measured; just as the comprehensive dynamical theory of Newton, though at the outset it postulates a standard of absolute position, involves the consequence that this standard cannot be a unique one. When, for example, Lord Rayleigh conceived and carried out in 1902 an experiment in which he sought to find evidence of double refraction in a plate of glass owing to its motion through the æther, Sir Joseph Larmor gave it as his opinion that the negative result was to be expected on theoretical grounds.

It may be taken indeed as proved that in so far as matter is electrically constituted, the form of the equations which embody the theory is such that effects due to the motion of bodies as a whole through the æther must always be concealed.

But is matter of purely electromagnetic constitution? Are existing theories able to give a complete account of those phenomena which have actually been experimentally investigated?

The classical experiment of Michelson and Morley may be taken as an example on which to test these questions. It is generally admitted that this experiment shows that we cannot detect a difference in the velocity of light relative to the earth in two directions at right angles one of which may be thought of as parallel and the other perpendicular to the motion of the earth through the æther. Such a difference must exist if light is thought of as being propagated with the same velocity in all directions relative to the æther.

The only suggestion that could be made to reconcile the failure of the search for this difference with the theory of a stationary æther was that of FitzGerald, that the motion of the apparatus through the æther so modifies its internal constitution that it automatically contracts to an extent which exactly neutralises the effect which would otherwise be observed. It was in the effort to give a reason for this contraction that the theory that has been referred to was developed. But whether we take the presentation given by Larmor or Lorentz we find that the general equations of the electromagnetic field have to be supplemented at some point by a hypothesis as to the nature of the electrons which are the elementary constituents of matter, in order to make the scheme sufficient to determine the way in which they will move. Now the length of a body, thought of as constituted by electrons, depends upon the motions of those electrons. If we are to think of any piece of matter whatever as contracting according to FitzGerald's hypothesis, we are bound to think of the paths of the electrons within the body as being modified in some corresponding way. Thus the hypotheses that may be adopted as to the nature of the electron are not arbitrary, but must be such as will lead to the contraction hypothesis as a consequence.

Similarly, if we consider the experiment of Rayleigh referred to above, the refracting properties of glass are conceived to be due to the light waves falling upon electrons which have inertia and which have to be moved by the electrical forces produced by the light. If we were to assume that the electrons have a definite mass in the Newtonian sense, then Rayleigh's expectation of a double refraction when the glass is moving would be justified. Lorentz is able, however, by assuming *among other things* that the electron is a spherical nucleus which itself is subject to the FitzGerald contraction, to extend his argument to cover the null result of this experiment. But the special assumptions which he makes were all made with an eye towards the result, namely, the failure of experiment to give a positive evidence of motion through the æther. They were hypotheses *ad hoc,* and to that extent they were really, though the name had not been invented, applications of the principle of relativity. It cannot be shown from the form of the general equations of the electromagnetic field alone that null effects are to be expected, for the experimental results most certainly extend into regions where these equations are insufficient; they do not cover, for instance, the whole theory of refraction, of conduction of electricity, or of the exterior configuration of a given body.

It is for this reason that the hypothesis that the *fact of motion relative to the aether must be for ever concealed,* becomes of importance as a general and independent principle. It becomes a criterion and a guide, for example, as to the form that is to be chosen for the constitutive relations which connect the electric force and displacement, the magnetic force and induction, and the current in moving bodies. It leads us to the conclusion that the Newtonian conception of a constant mass needs some revision if the hypothesis is true, and at this point comes into touch with the experiments on the variation of the apparent inertia of a negative electron with its velocity, and in fact is here confirmed.

But although experiment suggested and has so far confirmed the validity of the hypothesis, yet two serious objections are raised against it. The first is that it conflicts with our simplest ideas as to the measurement of space and time, and the second is that it abolishes the æther as a unique and objective medium, the seat of all electrical activity. In a succeeding article an attempt will be made to indicate what position in regard to these two very important points the adoption of the hypothesis requires us to take.

E. CUNNINGHAM.

DR. J. REYNOLDS GREEN, F.R.S.

THE announcement of the death of Dr. Reynolds Green, on June 3, will have been received with unfeigned regret by all his scientific fellow-workers, whether botanists or physiologists. For those who, like myself, have known him throughout his career with a considerable degree of intimacy, regret amounts to a deep sense of personal loss. It is some consolation to me to have this opportunity of writing a few words in appreciation of him who was so closely associated with me first as pupil, then as collaborator, always as friend.

Joseph Reynolds Green came up to Cambridge in 1880 as a scholar of Trinity College, in which year he also took the B.Sc. degree in the University of London. In 1883 he duly gained a first-class in the Natural Sciences Tripos, part i., a success which was followed in 1884 by a first class in part ii., his subjects being botany and animal physiology. After taking his B.A. degree, there was some uncertainty as to which science he would pursue, but his inclination was to botany, his first scientific contribution being a paper on the glands of the Hypericaceæ, which appeared in the Journal of the Linnean Society, 1884. Circumstances, however, led him to devote himself for a time to animal physiology; in 1885 he was appointed senior demonstrator in that subject by the late Sir Michael Foster, a position which he held for two years. Nevertheless, he was engaged, during that time, in botanical research, the results of which were published in two papers read before the Royal Society: the one on the proteid substances in latex (Proc. Roy. Soc., 1886); the other, larger and more important, on the changes in the proteids in the seed which accompany germination (Phil. Trans., 1887), in which he confirmed for the Lupin the discovery by von Gorup-Besanez (1874) of a proteolytic enzyme in the seeds of the Vetch. These papers indicated the direction in which his future work was to lie.

His appointment, in 1887, as professor of botany to the Pharmaceutical Society of Great Britain enabled Green to devote himself entirely to botany, and this he did whole-heartedly. During the twenty years that he held this office, his literary output was voluminous. The first twelve volumes of the *Annals of Botany* (1888–98) contain a number of papers by him on various points in the biochemistry of plants; and he contributed several articles to the first series (1894–8) of *Science Progress*. Perhaps the most important of his investigations during this period were, that on the germination of the seed of the castor-oil plant (Proc. Roy. Soc., 1890), in which he detected the fat-splitting enzyme (lipase), a subject to which he returned years afterwards (Proc. Roy. Soc., 1905); that on the germination of the pollen-grain (Phil. Trans., 1894), proving the presence and activity of amyloclastic enzymes both in the grains and in the tissue of the style; and that on the action of light on diastase (Phil. Trans., 1897), where the effect of light on diastase is investigated and it is shown that whereas the red and the blue rays favour the formation of the enzyme, the green, the indigo, the violet, and especially the ultra-violet rays destroy it; and the striking suggestion is made that "vegetable structures have a power of absorbing radiant energy, which is not connected with the presence and activity of chlorophyll."

In addition to these papers and articles, Green found time to write three considerable books: "A Manual of Botany based upon that of the late R. Bentley, 1895–6; "An Introduction to Vegetable Physiology," 1900; and "The Soluble Ferments and Fermentation," 1899. All three went on to a second edition, but the last was the most successful and important of them; a German translation of it, by Windisch, was published. They are characterised by the lucidity of exposition that he possessed in a high degree.

Owing to failing health, Green resigned his professorship in 1907, and undertook the less onerous duties of the Hartley lectureship on vegetable physiology in the University of Liverpool, still, however, residing at Cambridge. He was commissioned by the delegates of the Clarendon Press, Oxford, to write a continuation, published in 1909, of Sachs's "History of Botany" (1530–1860), to bring the record up to the end of the nineteenth century; a difficult task which he performed with as much success as the circumstances permitted. He became so interested in work of this kind that he planned, and I believe completed, a history of botany in England, which, unfortunately, has not yet been published.

A few personal details in conclusion. Green proceeded M.A. at Cambridge in 1888, D.Sc. in 1894; he became a Fellow of the Linnean Society in 1889, and was elected to the Royal Society in 1895. He was president of Section K (botany) at the Belfast meeting of the British Association in 1902; and in the same year he was elected Fellow of Downing College, Cambridge.

S. H. VINES.

NOTES.

THE June conversazione of the Royal Society will be held on Tuesday next, June 16.

SIR WILLIAM OSLER, F.R.S., Regius Professor of Medicine in the University of Oxford, has been elected a foreign Associate of the French Academy of Medicine.

PROF. A. LACROIX, professor of mineralogy at the Paris Natural History Museum, has been elected permanent secretary of the Paris Academy of Sciences in succession to Prof. Van Tieghem.

DR. R. S. LULL, professor of vertebrate palæontology at Yale, will this summer conduct another western expedition from the Peabody Museum for the purpose of securing skeletons of prehistoric horses.

THE council of the Royal Society of Arts, with the approval of the president, H.R.H. the Duke of Connaught, has awarded the Albert medal for the current year to Chevalier Guglielmo Marconi, "for his services in the development and practical application of wireless telegraphy."

THE Khedive has conferred the third class of the Order of the Medjidieh upon Mr. W. Lawrence Balls on the occasion of his retirement from the service of the Egyptian Government. This is, we believe, the first decoration given for agricultural work since the foundation of the Department of Agriculture in 1910.

PROF. H. HERGESELL, of Strassburg, has been appointed to the direction of the Royal Prussian Aeronautical Observatory at Lindenberg, near Berlin, and desires that communications intended for him or the International Commission for Scientific Aeronautics, of which he is president, should be addressed to the

Königl. Preussisches Aeronautisches Observatorium Lindenberg (Kreis Beeskow).

DR. F. J. BECKE, professor of mineralogy in the Imperial and Royal University of Vienna (Austria); Dr. T. C. Chamberlin, professor of geology in the University of Chicago (Illinois), U.S.A.; Dr. F. J. Lœwinson-Lessing, professor of mineralogy and geology in the Polytechnic Institute of St. Petersburg (Russia); Dr. A. P. Pavlow, professor of geology and palæontology in the Imperial University of Moscow (Russia); and Dr. W. B. Scott, professor of geology in the Princeton University, Princeton (New Jersey), U.S.A., have been elected foreign members of the Geological Society of London. Dr. P. Choffat, Geological Survey of Portugal, Lisbon, and Dr. Charles R. Van Hise, president of the University of Wisconsin, Madison (Wisconsin), U.S.A., have been elected foreign correspondents of the society.

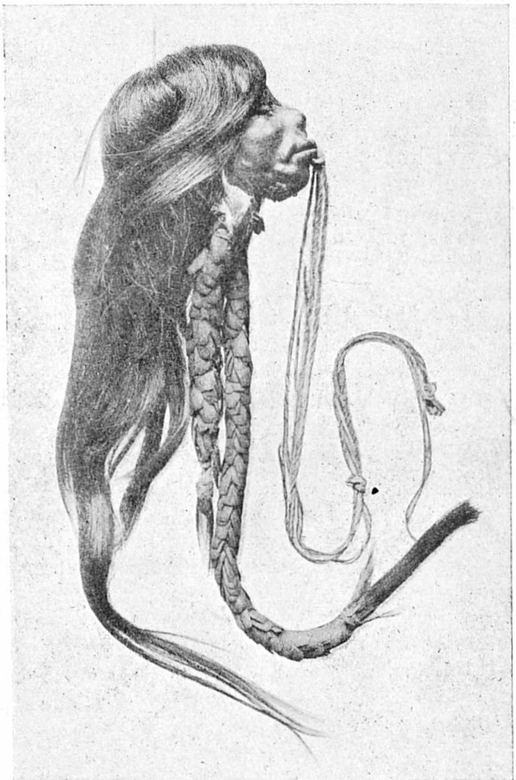
THE Elliott Cresson medals have been presented by the Franklin Institute, Philadelphia, this year as follows:—To Prof. Karl P. G. Linde, for his scientific investigations of the processes of refrigeration and the liquefaction of gases, and his inventions of machinery for applying these processes in the manufacture of ice and for the purposes of cold storage; to Dr. E. F. Smith, for his work in the field of electrochemistry, his contributions to the literature of chemical science, and his service in university education; to Prof. J. M. Eder, for his researches in photochemistry and his contributions to the literature of that science and of the graphic arts; to Mr. Orville Wright, for the work accomplished by him, at first together with his brother Wilbur and latterly alone, in establishing on a practical basis the science and art of aviation.

THE Dorset Field Club intends this month to reopen the Dewlish Trench, about which there has been much discussion. This trench is in chalk, and is filled with fine sand below, and above by loam with bones of *Elephas meridionalis*. An open gash in soft chalk is so exceptional as to lead the Rev. Osmond Fisher to suggest lately that this must be an artificial elephant-trap; other geologists take it to be natural, though formed in some way not clearly understood. Should it prove to be an elephant-trap, several interesting questions are raised. *Elephas meridionalis* is not definitely known as Pleistocene; it occurs in Pliocene or pre-Glacial strata, and seems to have disappeared from Britain at the incoming of the cold. The association of this elephant with man would be a new point, though some supposed "eoliths" have been picked up near the trench. The infilling of the trench is peculiar. The bones belong to several individuals, and if they were trapped it seems to have been for the meat alone, for the tusks remain. Below the elephant-layer is fine dust-like desert sand, with highly polished flints. The circular sent to us by the Earthworks Committee of the Dorset Field Club shows that the work will be properly done. Mr. Charles Prideaux will camp on the spot, which will be carefully enclosed. The trench will be opened from end to end, until the undisturbed chalk-bottom is reached. All fossils and flints will be carefully collected and examined. The Dorset Field Club proposes to visit the trench on June 30.

THE *Amnauer Hansen*, of Bergen, a vessel of about fifty tons, but replete with all up-to-date apparatus for the investigation of the hydrography of the sea, started from Plymouth on June 2 on a two months' cruise in the Atlantic. The scientific work of the cruise will be conducted under the direction of Prof. Helland-Hansen, director of the Marine Biological Station at Bergen, and he will also have the advantage of the advice of Prof. Fridtjof Nansen, who, with his son, accompanies the party. The vessel, which is only some 25 yards in length, is worked partly by motor and in part by sail. It has been built to stand any weather, being constructed somewhat after the plan of the Norwegian lifeboats. From Plymouth the *Amnauer Hansen* will proceed in a south-westerly direction across the Atlantic for approximately five hundred miles, and then return eastward to Lisbon, where the party expects to arrive in a fortnight. From Lisbon the vessel will proceed to the Azores, and thence return, according as time permits, either by way of the English Channel or along the west coast of Ireland and Scotland, and *viâ* the Faröes to Bergen. During the cruise a detailed survey will be made in regard to such hydrographical factors as temperatures, currents, circulation, salinities, dissolved gases, penetration of light, points which in due time will prove to be not only of theoretical but of practical importance. The boat is manned by a crew of six and the scientific staff consists of Messrs. Grein, Grondahl, Gaarder, and Birkeland. The expenses of the cruise have been partly defrayed by the Nansen Fund.

BY the death of the great French electrometallurgist, Paul Héroult, which took place at Antibes on May 9, at the early age of fifty-one, modern metallurgical industry loses a figure of outstanding importance. Héroult's fame chiefly rests on the invention of the process which bears his name for the manufacture of aluminium, an invention which had the effect of creating a new industrial metal, but his work in the field of the electrometallurgy of steel, though less widely known, is scarcely less important. Héroult's early interest in aluminium was concerned with aluminium-bronze, for which it was supposed there might be a ready market, and his first patent in this direction was taken out in 1886. It was in 1888 that he tackled the problem of making pure aluminium, in conjunction with Dr. Kiliani, and in that year were founded the first aluminium works at Neuhausen. Héroult's master-discovery was that of a suitable solvent for alumina, and this he found in fused cryolite, $3NaF.AlF_3$. The establishment of the works of la Société Electrométallurgique française at Froges (Isère), followed soon after that of the Swiss works, and since then the manufacture of aluminium by the Héroult process has become an established industry in most of the chief countries of Europe. Héroult commenced his work on the manufacture of steel in the electric furnace in 1899, and in the following year a small trial furnace of 3000 kg. capacity was working successfully at La Praz. The part Héroult has since played in the development of the electrometallurgy of steel may be conveyed most convincingly by merely stating that more Héroult furnaces are in use than are those of any other type; no fewer, indeed, than thirty-one, consuming some 19,000 kw., out of a total of 129 furnaces taking 50,000 kw., a capacity, moreover, which will be doubled in the near future, when the large 22–25-ton Héroult furnaces now in course of erection will be put into operation. If the foundations of the new method have now been firmly laid, to Héroult can justly be accorded the chief share of the credit.

IN the February issue of the Proceedings of the Academy of Philadelphia for 1914 Mr. H. N. Wardle describes and figures two specimens of the diminutive mummified human heads prepared by the Jibaro (Jivaro) tribes dwelling in the eastern valleys of the



A "Tsantsa," or diminutive mummified head of a Jibaro Indian. From Proc. Ac. Nat. Sci. Philadelphia.

Andes around the head-waters of the Amazon, by whom they are called *tsantsa*. Although such mummies have been known to science since the year 1862, when one was described by Dr. Moreno-Maiz, in the Bull. Soc. Anthrop., Paris (vol. iii., p. 185), they are still so rare that each merits a separate description. Of the two specimens described by Mr. Wardle, one (figure here reproduced) has been recently acquired by the Philadelphia Academy; it was formerly in the Museum Umlauf, Hamburg. The second is in the private collection of Mr. S. Castner, of Philadelphia, by whom it was purchased at a sale in 1903, and wrongly stated to have come from Oceania. Accounts vary as to the method by which these heads—of which two examples are shown in the Natural History Museum—were prepared.

To vol. xliii., part 4, of the Rec. Geol. Surv. India, Dr. G. E. Pilgrim contributes an article on the correlation of the Siwaliks with European mammaliferous horizons, in which it is concluded that while the topmost conglomerates of the former (with remains of camels and Indian buffaloes) represent the Upper Pliocene, the Bugti beds correspond to the Lower Burdigalian or Upper Aquitanian of Europe. Several forms, including two genera of machærodont tigers, and a genus of bear, are described as new.

PAPERS recently received on American faunas include one, by Mr. N. de Witt Betts, on the birds of Boulder County, Colorado (Univ. Colorado Studies, vol. x., no. 4); a second, by Mr. M. M. Ellis, on the fishes of Colorado (*ibid.*, vol. xi., no. 1); and a third, by Dr. P. S. Welsh, on the North American worms of the family Enchytræidæ (Bull. Illinois State Lab. Nat. Hist., vol. x., art. 3). The last-named group, which has hitherto received scant attention from naturalists, comprises sixteen genera and many species (inclusive of several described as new by Dr. Welsh), ranging over America and Europe, and reported to occur in Siberia, N. Africa, and New Zealand, but mainly restricted to cold areas, including even glaciers. Allied in many respects to ordinary earth-worms, in others the Enchytræidæ display affinities with the lower Oligochæta.

MR. L. WALMSLEY has written a concise illustrated "Guide to the Geology of the Whitby District" (Horne and Son, Whitby, price 1*s*.), which should be useful to the hundreds of summer visitors who go forth with hammers in their hands. We hope that this edition will be appreciated, since we are promised in that case a subsequent one on a somewhat fuller scale. A reference to the colour-printed drift map of the Geological Survey, Sheets 35 and 44, would seem desirable. The variety of Ammonite types, St. Hilda's "headlesse snakes," is well brought out in the illustrations.

DR. C. DIENER's description of the "Triassic Faunæ of Kashmir" appears as one of the folio memoirs of the Geological Survey of India ("Palæontologia Indica," vol. v., Mem. 1, price 4*s*. 4*d*.). In dealing with the fine series of ammonites, the author abandons his genus Danubites in favour of Waagen's Xenodiscus, of which several species are described. A new genus, Kashmirites, is introduced, allied to Xenodiscus and Sibirites. The Ceratite group is well represented in the zones corresponding to the European Muschelkalk. Although a passage is proved from the Tethys (Mediterranean) marine region to that of the Himalayas, communication was evidently restricted throughout the whole Triassic period, so far as cephalopoda are concerned.

THE connection between ice and fog is well known, and within little more than two years both have taken a disastrously heavy toll of life. Both conditions are necessarily frequently referred to in the monthly meteorological charts of the North Atlantic published by the United States, Germany, and this country. Among the chief causes of ocean fog formation (quoted in the American charts) may be mentioned the mixture of masses of moist air of different temperatures, and the direct cooling of moist air coming into contact with icebergs or cold northern waters. The Meteorological Office chart for June points out that near the Banks of Newfoundland the risk from fog is about eight times greater in midsummer than in midwinter; in May and June the fog zone stretches from Europe to America. The German chart for June states that up to May 19 numerous bergs and extensive icefields were met with to the east of the Newfoundland Banks between 47° and 50° W. longitude. In some cases bergs were sighted so far south as 42° N. latitude. The southerly advance of drift ice usually ceases about the middle of June, and by the middle of July the ice limit rapidly recedes.

A SUMMARY of the weather for the past spring as shown by the results for the thirteen weeks ended May 30 has been issued by the Meteorological Office. The mean temperature for the period is above the average in all districts of the United Kingdom, the excess being as much as 3° in the north-east of England, 2·5° in the east of England, and from 1°–2° in all other districts. The south-east and the east of England are the only districts where the absolute temperature rose to 80°. The rainfall is only 85 per cent. of the average in the north-east of England, and the only other districts with a deficiency of rain are the midland counties with 97 per cent. of the average, and the north-west of England with 99 per cent. of the average. The greatest excess of rain is 140 per cent. of the average in the south-east and south-west of England, and 131 per cent. in the Channel Islands. In the east of England the rainfall is 113 per cent. of the average, and in the north of Ireland 112 per cent. The absolutely largest rainfall is 10·82 in. in the north of Scotland, and 10·21 in. in the south-west of England, whilst the least is 4·26 in. in the north-east of England. The mean temperature at Greenwich for the spring months, March, April, and May is 49·7°, which is 1·7 in excess of the average; it is precisely the same as in the spring of last year, but 1·8° colder than in 1912.

No. 5 of vol. iii. of the Memoirs of the Department of Agriculture in India contains a study by Messrs. F. J. Warth and D. B. Darabzett, of the "Fractional Liquefaction of Rice Starch." It is shown that different specimens of rice show very different behaviour as regards the temperature at which liquefaction of their starch occurs. The method adopted consisted in estimating the percentage of starch liquefied at intervals of temperature of 5°. The results published in this paper show that the cooking quality of rice is distinctly correlated with its starch quality, and that there is also a certain parallelism between these features and the ease with which the different samples undergo disintegration by dilute alkalis. Some kinds of grain contain a variety of starch which is far more resistant than that of others.

THE importance of the mineral elements in the nutrition of farm animals has recently begun to receive recognition, and Research Bulletin No. 30 of the Agricultural Experiment Station of the University of Wisconsin, by Messrs. E. B. Hart, H. Steenbock, and J. G. Fuller, deals with the relation of the supply of calcium and phosphorus in the ordinary farm feeds to the animals' requirements; from the data considered a number of interesting conclusions are drawn. Grains in particular are deficient in calcium but rich in phosphorus, and rations wholly made up of grains will supply to the growing animal an amount of calcium dangerously near the critical level of intake. The supply of calcium also becomes an essential factor when continuous and high milk production are aimed at, and the diet must be suitably adapted in order to achieve this result, if necessary by the artificial use of calcium carbonate and phosphate.

PROF. IGNAZIO GALLI has published in the memoirs of the Pontifical Academy of the *Nuovi Lincei*, of Rome, a fourth memoir on globular lightning, and on its effects on trees and on grass. The memoir quotes in an uncritical manner an enormous number of reputed instances of lightning of globular form, most of which were recorded by wholly untrained observers, and extend over several centuries. Prof. Galli adds little to the facts collected by Flammarion and other writers. He directs attention to observations which seem to show that the lightning stroke following a spiral path is usually *dextrorsum* in horse-chestnuts, cherry-trees, apple-trees, and willows, but *sinistrorsum* in plum-trees, whitethorns, oaks, and sycamores; in beech-trees sometimes one way, sometimes the other. He discusses whether this is due to inherent spiral structure of the fibre of the wood or to some special gyratory property of the discharge. Most of the observations are of such ancient date that critical discussion of them is out of the question.

AN article in the Paris *Matin* was referred to by the Paris correspondents of several London daily papers last Saturday. It relates to some interesting experiments in wireless telephony carried out by Captain Colin, of the French Navy, who has been at work on the subject for some years in collaboration with Lieutenant Jeance. The details of the apparatus are not given, but it would appear that some improvement has been made in the direction of maintaining steady and continuous oscillations at the transmitting end. Speech, it is stated, has been transmitted from Paris to Finisterre, a distance of 300 miles, and a type of field apparatus with a mast about 90 ft. high has, it is said, been developed, which can be unloaded from a motor-car and set to work by a crew of six men in twenty-one minutes, and will transmit without difficulty over a distance of from 60 to 120 miles.

THE most interesting communication brought before the meeting of the Bunsen Gesellschaft für angewandte physikalische Chemie at Leipzig on May 21–24 was a paper by K. Fajans on the different atomic weights of lead. According to a line of reasoning simultaneously developed by Fajans and by Soddy during the last few years, lead derived from radium and lead derived from thorium by the loss of five and six atoms of helium respectively should be identical except in atomic weight. Throughout the past year Dr. Fajan's assistant, Dr. Lembert, has been working in Richard's laboratory at Harvard in order to obtain atomic weights of as high a degree of trustworthiness as possible. The differences established by the series of determinations announced at the meeting by Fajans amount to about 0·3 per cent. (Soddy and Hymans read a paper before the London Chemical Society on May 7, in which they likewise described experiments which showed a difference between thorite lead and ordinary lead of 0·5 per cent.) The keen discussions which followed the various papers showed quite clearly that the chief subjects at present of general interest to physical chemists in Germany are: (1) applications of the theory of quanta; (2) the nature of sorption; (3) the photochemistry of gases; and (4) the generalisation made by Bredig and Snethlage, in extension of the work of numerous other investigators, as to the parallelism between the catalytic activity of undissociated acids and their strength. A striking illustration of the wide bearing of some of the (at first sight) apparently uninteresting special investigations were afforded by E. Cohen's paper on unstable modifications of pure metals. His results demonstrate that most measurements hitherto made of physical constants of metals, such as density and Hall effect, have not been carried out on chemical individuals, but on unknown mixtures of these unsuspected metastable forms, so that they require to be revised.

WE have received the catalogue of microscopes, etc., made by C. Reichert, of Vienna, for which Messrs. Angus and Co., of Wigmore Street, are the British agents. Since the foundation of the firm in 1876, 55,000 microscopes have been produced. The catalogue comprises microscope stands of varying complexity, achromatic and apochromatic objectives, comparison eye-pieces and other accessories, polarimeters, and microtomes. Both workmanship and prices compare favourably with those of other well-known makers.

WE have seen the March issue of *Gendai no Kagaku* (*Scientific Gazette*)—a new Japanese journal similar to NATURE, printed in Japanese characters. It has been designed to meet an increasingly felt need for a serious and authoritative general organ for the growing body of men of science and students of research in Japan. The journal is well printed, and its contents are written and edited by professors of the Tokyo and Kyoto Imperial Universities. The issue before us contains special articles on insects and their pupæ, the relation between zoology and medicine, great men of science, and inertia and relativity; reviews of books; notes and abstracts classified under the various sections of astronomy, physical geography, biology, chemistry, and applied sciences; meteorological reports and ephemerides of celestial phenomena, and proceedings of societies. In the last-named section no fewer than eight learned societies of Tokyo are represented. The illustrations include a collotype portrait of Prof. Simon Newcomb, and a star chart, to be continued serially. The publication is to be welcomed as a sign of the increase of interest in scientific subjects in Japan.

PROF. W. BATESON'S work on "Mendel's Principles of Heredity" has been translated into German by Alma Winckler, and published with an introduction by Prof. R. von Wettstein, under the title, "Mendel's Vererbungstheorien," by Mr. B. G. Teubner, Leipzig and Berlin, at the price of 12 marks. Another translation just received from the same publisher is "Pflanzenanatomie," translated by Dr. S. Tschulok from the fifth Russian edition of Prof. V. I. Palladin's work. We have also received a volume entitled "Theory of the Atom," by Prof. T. Mizuno, of Kyoto Imperial University, Japan, published by the Maruzen Co., Ltd., Tokyo, but as it is in Japanese characters it is intelligible only to a few European men of science, and no useful purpose would be served by reviewing it in these columns.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JUNE:—

June 11. 9h. 0m. Jupiter stationary.
„ 15h. 33m. Uranus in conjunction with the Moon (Uranus 1° 48′ N.).
12. 12h. 32m. Jupiter in conjunction with the Moon (Jupiter 0° 44′ N.).
18. 20h. 0m. Mercury at greatest elongation (24° 55′ E.).
21. 18h. 55m. Sun enters Sign of Cancer. Summer commences.
22. 12h. 24m. Saturn in conjunction with the Moon (Saturn 6° 1′ S.).
25. 21h. 9m. Venus in conjunction with the Moon (Venus 0° 46′ S.).
27. 15h. 58m. Mars in conjunction with the Moon (Mars 0° 36′ N.).

COMET 1914*b* (ZLATINSKY).—*Astronomische Nachrichten*, No. 4737, publishes the elements and ephemeris of the comet discovered by Zlatinsky (1914*b*) calculated by Mr. Crawford and Miss Levy. These agree very closely with those computed by Prof. H. Kobold, and published in this column on May 28 (p. 330). A further communication to this number by Prof. E. C. Pickering states that Dr. Perrine cables the similarity of Zlatinsky's comet with comet 1790 III., Caroline Herschel. The following ephemeris has been calculated by Dr. Ebert, and appears in *Das Weltall* for May:—

		R.A. h. m. s.		Dec. ° ′
June 11	...	8 55 57	...	+1 17·9
13	...	9 1 51	...	−0 50·3
15	...	9 7 1	...	2 45·3
17	...	9 11 37	...	4 26·1
19	...	9 15 44	...	−5 56·2

FIREBALLS.—Mr. W. F. Denning writes that on June 3 at about 10.30 p.m., and June 4 at 11.7 p.m., brilliant meteors were observed by Mrs. Fiammetta Wilson, of Bexley Heath. The former had a path from 80° + 46° to 33° + 59°, which it traversed in $6\frac{2}{5}$ seconds, carefully timed by stop-watch. The latter was placed near the N.W. horizon, close to the stars Castor and Pollux, and seemed to explode with a flash brighter than Venus.

The fireball of June 3 was seen at Bristol, and a comparison of the pair of observations shows its height to have been about fifty-one to forty-eight miles. It flight was almost horizontal from a radiant near the S.E. horizon in 281° − 25°. Path about 160 miles long, velocity twenty-five miles per second. It began over The Wash and ended over the county of Durham.

The radiant point in Sagittarius represents a well-known June and July meteoric shower.

Further observations of the large meteors seen on June 3 and 4 are required. Many observers must have noticed them in the north of England.

OBSERVATIONS OF NOVÆ.—Prof. E. E. Barnard continues to keep watch on the behaviour of novæ with the large Yerkes instrument after they have passed out of reach of ordinary telescopes, and communicates some further observations concerning the Novæ Geminorum 1 and 2, and Nova Persei 2. With regard to Nova Geminorum 2 (Enebo), he states that this nova seems to have changed its focus and general appearance back again to the normal. This rapid change to the abnormal and back to the normal focus suggests a resemblance to that of Nova Persei 2 (Anderson), this object having been examined frequently by him. In the case of Nova Geminorum 1 (Turner), which was examined in February of this year, the star was faint but not difficult. The estimation of its magnitude would make the object 16·8; it is still fading, but Prof. Barnard hopes to be able to follow it with the 40-in. refractor for another year at least.

REPORT OF THE CAPE OBSERVATORY.—The report of his Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the year ending 1913 has just been issued. In the eight pages we are introduced to a large programme of work which has either been accomplished or is in progress. Among the observations with the reversible transit circle were 6948 meridian transits, 1330 observations of meridian marks, 6670 determinations of zenith distance, 690 nadir determinations, etc. The 8-in. transit circle has had a self-registering micrometer mounted at the eye end, and worked in conjunction with a special chronograph. The combination is for the determination of stellar parallax, and after preliminary trials a regular programme of observations was commenced. The heliometer has been employed on the major planets at the times of opposition, and 177 observations were made. The Victoria telescope was chiefly occupied in securing stellar spectra for radial velocity determinations, and 151 plates were obtained. During a portion of the year the spectroscope was dismounted and photographs were taken of Jupiter and the Galilean satellites near the epoch of quadrature of the planet. The astrographic telescope was for the main part used for the magnitude plates, while with the photoheliograph 634 negatives of the sun, taken on 311 days, were secured for inclusion in the Greenwich series. The report concludes with statements concerning the reductions, publications, time signals, and personal establishment.

THE ADMINISTRATION OF ANÆSTHETICS.

DEATH under anæsthesia is always a most lamentable occurrence, and these accidents fall into three categories: first, those which no human skill can avert, for example, in unsuspected cases of status lymphaticus; secondly, those due to want of knowledge on the part of the medical practitioner; and, thirdly, those which occur in the practice of unqualified persons. The second class of cases can be met by ensuring that instruction in anæsthetics is an essential part of medical and dental education, and this has been in a measure secured by recent alterations in the regulations of examining bodies. The deaths which occur under the third heading can only be prevented, and the public protected, by making the administration of anæsthetics by unqualified persons illegal. There is reason to believe that such accidents occur more frequently than reports in the public Press would lead one to suppose, but statistics are obviously difficult to obtain. A Government measure, regulating the administration of anæsthetics and prohibiting their use by unqualified persons, was suggested by a Departmental Committee of the Home Office some years ago, but this has never come to fruition, and private bills introduced into Parliament have shared the usual fate of private bills. The question, however, has been kept alive by the energy of Sir Frederick Hewitt, Prof. Waller, and others, and year by year fresh evidence has accumulated showing the urgent need of legislation; since the introduction of cocaine the evil has increased. We are glad to learn that the council of the British Association, at its last meeting, passed a resolution (inspired by the anæsthetic committee of the association) by a large majority, asking the Government to introduce a measure limiting the use of these dangerous drugs to properly qualified persons, or to those acting under their immediate supervision. The council is to be congratulated on thus fulfilling one of the objects of the association, namely, to attempt to remove disadvantages of a public kind. We can only trust that Parliament, having got the burden of its three large measures off, or nearly off, its shoulders, may now find time to do so some really useful work.

WIRELESS TELEGRAPHY RESEARCH.

THE report of the committee appointed by the Postmaster-General "to consider and report how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with ordinary telegraphy and telephony," has just been published (Cd. 7428, price 1½*d*.). We propose to deal later with the scheme put forward for the appointment of a national committee for telegraphic research, and the establishment of a national research laboratory in connection with it; and here limit ourselves to a statement of the conclusions arrived at from a consideration of the research work undertaken in the United States and Germany. (1) That it is desirable to establish some body or institution to initiate and control research in matters of general principle which cannot conveniently be investigated in departmental laboratories, to coordinate so far as may be the work now undertaken by the Post Office, Admiralty, and War Office, respectively, in connection with experiment and research in wireless telegraphy, so as to prevent work undertaken by one department overlapping work undertaken by another, and thus secure economy, and to discuss any difficulties arising in practice. (2) That the work now being done by the departments should be continued and extended, opportunities being also found for the departmental engineers to carry out such experiments and tests as may be approved by the body or institution to be established for the purposes above referred to, and may require high power and service conditions. (3) That it is desirable to establish a research laboratory (as distinguished from the existing departmental laboratories and service stations), in which research work bearing on the practical needs of the services should be carried out under the guidance of the body or institution above referred to. (4) That though the work to be undertaken by the new body or institution and in the new laboratory, the establishment of which we recommend, will principally concern wireless telegraphy, it is undesirable to exclude therefrom the problems of ordinary telegraphy and telephony.

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE eighth annual conference of the Association of Teachers in Technical Institutions was held at the Central Technical School, Liverpool, during Whitsuntide, and was very successful from every point of view.

In the course of his presidential address Mr. P. Abbott reviewed the recent developments in educational and professional matters. He submitted that the education of the adolescent was the first problem of the century, and one closely associated with the future of technical education. The State must recognise its responsibility for the complete education of the youth; it had so far failed in its duty by bringing the education of the child to a dead end at the age of thirteen or fourteen. It was not with our elementary education that the fault was to be found. There must be an extension of the age of full-time instruction to fourteen or fifteen, followed by compulsory part-time instruction to eighteen or twenty, aided by compulsion on employers to diminish the hours of work to a corresponding degree. The Denman Bill now before Parliament would be welcomed as a step forward, giving, as it does, power to the local authority to extend the leaving age to fifteen, to compel attendance at continuation classes to sixteen, to restrict hours of child labour, and to restrict street trading for young people. The Bill was defective in its permissive qualities, but represented an advance in educational reform.

We were in the midst of a movement to free technical education from the thraldom of external examinations the results of which, as the President of the Board of Education had felicitously expressed it, might be called "snap-judgments." The true function of an examination should be *one* of several factors—attendance, home work, laboratory work, etc.—by means of which the teacher could satisfy himself that the pupil had worked satisfactorily through the course. It is not the examination that matters: it is the *course* that is all-important, and the training received during the course.

In an age of continuous progress and change it was essential that technical education should possess elasticity, flexibility, and adaptability. If teachers were expected to mould their work to the requirements of a cast-iron syllabus—such as obtained wherever external examinations prevailed—these properties could not exist.

It was to the credit of the Board of Education that it had taken the initiative by abolishing some of its own external examinations. Some remain, and it was difficult to see what good was obtained by their retention. Unfortunately, the abolition of the Board's examinations had induced the growth of certain unions of institutions so far beyond their original and ostensible purpose, that they were seeking to impose their systems of external examinations upon technical institutions and to deprive them of that freedom so necessary for the proper development of their work. The examinations of such bodies were the worst kind of external examinations; and these unions, which jealously exclude the practising teacher from their councils, had become the attractive centres of those who still cling to the fallacy that external examinations are an integral part of technical education. No system of external examination prevails in America, Germany, France, Austria, or Switzerland, and yet their technical education is so highly efficient that the results cause apprehension in our British industries.

Papers on internal examinations were read by Prof. Haldane Gee, and Messrs. Harrison, Bower, and Small. Mr. W. Hewitt, the director of technical education for Liverpool, read an interesting paper on a retrospective glance at the rise of scientific and technical education in England.

Resolutions welcoming the formation of the Teachers' Register and approving the report of the Departmental Committee on the superannuation of secondary and technical teachers were carried unanimously, as were those welcoming the Denman Bill, and advocating the formation of advisory boards composed of representatives of teachers, local authorities, inspectors, employers, and employees, to draw up courses of work, and to assist institutions in the conduct of their internal examinations.

DEVONIAN OF MARYLAND.[1]

THE three volumes before us comprise, in the first volume, an introduction on the general relations of the Devonian (67 pp.), an account of the Lower Devonian strata, their stratigraphy (122 pp.), and their palæontology (322 pp.), with descriptions of all the fossils, whether new or previously known.

The second volume treats of the Middle and Upper Devonian, the stratigraphy of the former occupying 114 pp. and its palæontology 224 pp. The Upper Devonian stratigraphy occupies 196 pp., and the descriptions of the fossils 165 pp. The third volume is filled with plates, seventy-three in number, showing all the species which have been found in the Devonian of Maryland.

It will be seen, therefore, that a large amount of space is given to the descriptions and figures of fossils. The stratigraphy is described from a purely scientific point of view; there is no chapter on economics, but perhaps that part of the subject is reserved for a special memoir.

The introductory chapter includes a section on the palæogeography of the Devonian in North America, with eight maps of successive phases, contributed by Dr. Ch. Schuchert, but this seems somewhat out of place; for the Appalachian portion of Maryland is very narrow, and includes but a very small part of the long Devonian outcrop in the range, so that as the author himself says, "if restricted to maps of the State, the palæogeography of Maryland would teach very little." In other words, the State does not furnish any basis for such restorations; moreover, Dr. Schuchert's method of restoring ancient lands and seas are very different from those employed in Europe.

The authors of this memoir review the classification of the Devonian in America; they divide the Lower Devonian into two stages, the Helderberg (limestones) and the Oriskany (sandstone and shale), this series being only about 700 ft. thick. The Middle Devonian consists mainly of shales, in three divisions—the Onondaga Shale, the Marcellus Shale, and the Hamilton Beds—the average thickness being 1600 ft. The Upper Devonian consists of two different types of sediment, a lower marine type, which they call the Jennings formation, and an upper "continental" type, called the Catskill formation. The former is composed of variously coloured shales and sandstones, and is from 4000 to 4800 ft. thick, the latter of red and grey standstones and shales, from 2000 to 3800 ft, in which no fossils have yet been found.

From the above it will be seen that the Appalachian Lower Devonian is a concentrated and largely calcareous formation, the Middle Series of a normal varied composition, while the Upper (though marine)

1 "Maryland Geological Survey." Middle and Upper Devonian. Text. Pp. 720+vi plates. Lower Devonian. Text. Pp. 560+xvi plates. Devonian. Plates xvii-lxxiii. (Baltimore: The Johns Hopkins Press, 1913.)

must have been deposited near a large area of land. In this connection it is noticeable that beds of coraliferous limestone are repeatedly called "coral-reefs," without a tittle of evidence that they ever formed true coral-reefs.

Dr. Schuchert correlates the Lower Devonian fauna with that of the Koniepprus Limestone (F^2) of Bohemia. It is rich in corals, echinoderms, bryozoa, and brachiopods, with a fair number of mollusca and trilobites. Most of the species are different from those of the European equivalent, and even the form hitherto known as *Pentamerus galeatus* is now distinguished as *coeymanensis*. The orthids, Dalmanella and Rhipidomella, are specially abundant in the Helderberg limestones.

In the Middle Devonian, corals and bryozoa are rare, and no echinoderms are found, so that the fauna has a different aspect from that of the European series, consisting chiefly of brachiopods and pelecypod mollusca, with a few gasteropoda, cephalopoda, and trilobites. It is noteworthy that Bactrites and Agoniatites make their appearance.

The Upper Devonian fauna is more interesting, not only because it includes species of Tornoceras and Bactrites, Buchiola and Styliolina, but also because some of the species are European, such as *Spirifer disjunctus, Atrypa reticularis, Buchiola retrostriata,* and *Schizophoria striatula.*

In conclusion, it may be mentioned that the figures of fossils are well executed, and that the whole work is creditably produced, though owing to the use of thick paper the volumes are very bulky and heavy. Such tomes may be liked in America, but in this country we prefer more handy and less weighty productions.

A. J. JUKES-BROWNE.

THE ROYAL OBSERVATORY, GREENWICH.

ON Saturday last, June 6, the Astronomer Royal presented his report at the annual visitation of the Board of Visitors of the Royal Observatory. The report refers to the year commencing May 11, 1913, and exhibits the state of the observatory on May 10 of the present year.

Reference is first made to the new building, which has been erected in the magnetic enclosure in the park for the purpose of housing a set of modern instruments for recording the variations of the magnetic elements. The significance of the building consists in the fact that it is composed of a thickly walled outer room, containing an inner room well insulated by a considerable air-space, the constancy of the temperature of the latter being controlled by electric heaters regulated by a thermostat. After reference to the principal moveable instruments at the observatory or on loan from or to the observatory, we are informed that a silver-gilt inkstand presented to Sir G. B. Airy in 1852 by the River Dee Company has been presented to the observatory by his son, Mr. Osmund Airy. A portrait of Sir William Huggins has also been presented by Lady Huggins, and Sir William Christie has given one of himself.

Turning to the astronomical observations we find that with the transit circle the following observations have been made:—

Transits	16,423
Determinations of collimation and level error	311 and 632
Circle observations	16,455
Determinations of nadir point and reflection observations of stars (included in the number of circle observations)	607 and 417

With the altazimuth the following observations have been made:—

Meridian transits	1862
Meridian zenith distances	1031
Extra meridian observations	72
Determinations of collimation and level error	252 and 184
Determinations of nadir point ...	152

The travelling-wire micrometer has been used throughout the year for the determination of right-ascensions, and it is intended to replace the present eye end of the transit circle also by a travelling-wire micrometer which is now under construction.

The excess of the number of observations of R.A. in relation to those of N.P.D. is due to the inclusion in the working list of a number of faint and bright stars for comparison with the transit circle, and the determination of the magnitude equations of the observers with the latter instrument. The N.P.D.'s having been observed with the new printing micrometer, an interesting table is given of the comparison with Newcomb's catalogue for different periods.

The mean error in right ascension of the moon's tabular place for 1913 is given as -0.81s. from meridian observations and -0.87s. from extra-meridian observations of the moon's limb, and -0.81s. from meridian observations of the crater Mösting A. The transit circle gives 0.832s. Attention may be directed to the great increase in recent years of the mean tabular error of the moon's longitude. From 1883, when Newcomb's empirical correction was introduced into the Nautical Almanac, the values (all reduced to the same equinox) are:—

1883	$-0.03''$	1899	$-2.18''$
1884	-0.16	1900	-2.69
1885	-0.09	1901	-2.77
1886	-0.11	1902	-3.15
1887	$+0.21$	1903	-3.08
1888	$+0.76$	1904	-3.16
1889	-0.38	1905	-5.29
1890	-0.27	1906	-5.91
1891	$+0.72$	1907	-5.96
1892	$+0.79$	1908	-5.97
1893	-0.06	1909	-6.41
1894	-1.20	1910	-7.85
1895	-1.47	1911	-8.34
1896	-1.68	1912	-9.79
1897	-2.77	1913	-11.8
1898	-3.03		

After a short reference to the observations made with the Cookson floating zenith telescope and the equatorial observations, mention is next made of the 28-in. refractor which has been employed on all known double stars showing appreciable relative motion, and a few other stars for special reasons. The measures have consisted of 105 pairs with separation less than $0.5''$; 110 pairs with separation between $0.5''$ and $1.0''$; 123 pairs with separation between $1.0''$ and $2.0''$; 125 pairs with separation greater than $2.0''$.

While the early publication of the mean results is communicated each year to the Royal Astronomical Society, the measures from 1893 to 1915 will be formed into one catalogue, each separate observation being given. This catalogue will contain 3000 double stars and notes on the more interesting stars.

The work with the Thompson equatorial has been confined to parallax and photometric determinations, the 26-in. refractor being used throughout. For the parallax observations an exposure of the same plate at two different epochs, approximately six months apart, is required. During the year the first exposure has been given to 292 plates, and a second exposure to 219 plates. The work of the measurement of these plates is well advanced, and in the report the parallaxes of seven stars have been determined and indicate the high standard obtained.

Photographic magnitudes determined with the 6-in. astrographic triplet are next dealt with and we notice that great progress has been made with the work in hand. The same may be said of the work on the photographic magnitudes with the 26-in. refractor on the Kapteyn areas and the central regions of the Franklin-Adams charts, and of the astrographic equatorial for the determination of photographic magnitudes of stars in the Greenwich section of the Astrographic Catalogue by comparison with the standard magnitudes of the stars round the north pole.

With regard to heliographic observations, photographs of the sun were secured on 258 days, and of these 515 have been selected for preservation. Photographs were received from the Royal Observatory, Cape of Good Hope, to March 1, 1914; from Dehra Dûn, India, to December 7, 1913, and from Kodaikanal, India, to December 13, 1913, the series for the year 1913 being made up from the four contributing observations. The mean daily spotted area of the sun has been eight millionths of the sun's visible hemisphere during 1913, as against thirty-seven in 1912, and sixty-four in 1911. The appearance of a moderately large spot in March pointed to the end of this very low minimum of solar activity.

An expedition is in preparation to proceed to Minsk, in Russia, to observe the total solar eclipse visible on August 20–21. The programme is stated to be similar to that attempted in Brazil in 1912.

Coming now to the magnetic observations, we find that the mean values of the magnetic elements for 1913 and three previous years from observations in the magnetic pavilion are as follows:—

Year	Declination W. (° ′)	Horizontal force in C.G.S units	Dip (3-inch needles) (° ′ ″)
1910	15 41·2	0·18532	66 52 37
1911	15 33·0	0·18529	66 52 6
1912	15 24·3	0·18528	66 51 46
1913	15 15·2	0·18514	66 50 27

In 1913 there were no days of great magnetic disturbance; one day was classified as of lesser disturbance. The new magnetic house being now complete, will shortly receive the new instruments to be set up in it; these are briefly described in the report.

A short *résumé* regarding the present state of the meteorological reductions is followed by a summary of the weather conditions for the period covered by this report.

The mean temperature for the year 1913 was 50·5°, or 1·0° above the average of the seventy years, 1841–1910. For the twelve months ended April 30, 1914, the mean temperature was 50·8°. During the twelve months ended April 30, 1914, the highest temperature in the shade (recorded on the open stand in the enclosure of the magnetic pavilion) was 87·1° on June 17. On eight days the highest temperature in the shade equalled or exceeded 80°, but five of these days occurred in May and none in July. The lowest temperature of the air recorded during the same period was 19·9° on January 24.

The mean daily horizontal movement of the air in the year ended April 30, 1914, was 288 miles, which is four miles above the average of the previous forty-six years. The greatest recorded daily movement was 759 miles on April 6, and the least seventy-nine miles on October 24. The greatest recorded pressure to the square foot was 26·0 lb. on December 26, and the greatest velocity in an hour forty-four miles on March 16 and April 6.

The number of hours of bright sunshine recorded during the twelve months ended April 30, 1914, by the Campbell-Stokes instrument, was 1446 out of a possible 4457 hours, giving a mean proportion of 0·325, constant sunshine being represented by 1. This is not far below the average amount, a very fine April nearly counterbalancing an exceedingly dull July.

The rainfall for the year ended April 30, 1914, was 22·30 in., being 1·82 in. less than the average for the period 1841–1905. The number of rainy days (0·005 in. or above) was 164. January with 0·50 in. was the driest month, and March with 3·93 in. the wettest.

The sections dealing with the chronometers, clocks, and time service indicate a considerable state of activity. Thus under the first-named, it is stated that in the year ended May 10, 1914, the average daily number of chronometers and watches being rated was 712, the total number received was 2094, the total number issued was 2110, and the number sent to repair 934.

An interesting table is that showing the times sent out from the time-distributing centres, namely, the Eiffel Tower and Norddeich, as recorded at the observatory. These signals are regularly received and compared with the Greenwich time. The results to May 10, 1914, using the impersonal micrometer of the altazimuth as the standard for the personal equations of the Greenwich observers, are as follows:—

Observer	No. of obs.	Signal late on G.M.T. s.	Personal equation s.	Mean discordance s.
Eiffel Tower.				
L (Morn.) ...	412	0·002	—	±0·110
W B (Morn.) ...	539	0·044	—	±0·114
L—W B ...	375	—	−0·057	±0·060
Rhythmic signals	175	0·041	—	±0·065
W B (Night) ...	256	0·050	—	±0·122
Norddeich.				
L (Morn.) ...	336	0·016	—	±0·225
W B (Morn.) ...	526	0·060	—	±0·209
L—W B ...	300	—	−0·051	±0·075
Rhythmic signals	—	—	—	—
W B (Night) ...	242	0·062	—	±0·214

In the Astronomer Royal's general and concluding remarks he states:—"The excellent spirit which animates both the permanent and temporary staff of the observatory is shown by the large number of observations and by the extent to which measurements, computations, and other work are kept up to date. Attention may be directed to the improvement in the altazimuth observations by the introduction of the impersonal micrometer and new eye-end to the instrument, to the success which has so far attended the observations for stellar parallax, and to the changes which are in progress in the magnetic observations."

The reader should be reminded that the above brief summary of the Astronomer Royal's report to the Board of Visitors only conveys a very general idea of the work carried on during the past year. The original report should undoubtedly be read to gain a proper indication of the great amount of work summarised in the brief but concise paragraphs which compose it.

THE DEVELOPMENT OF THE AEROPLANE.[1]

DR. GLAZEBROOK dealt mainly with the work of experiment and scientific research in the development of the aeroplane, referring especially to the work of Dr. Stanton, Mr. Bairstow, and their colleagues at the National Physical Laboratory. The experiments are conducted in an air channel in which a

[1] Abstract of the second Wilbur Wright Memorial Lecture, delivered before the Aeronautical Society of Great Britain on May 20, by Dr. R. T. Glazebrook, C.B., F.R.S.

model of the aeroplane or the part of the aeroplane the behaviour of which it is desired to study, is supported on the arm of a balance by means of which forces and moments acting on it, when a current of air is produced in the channel by a suitable fan, can be measured. The velocity of the air current is measured by a Pitot tube, and a constant distribution of velocity across nearly the whole of any section of the channel is secured by special arrangements. At the National Physical Laboratory there are now two channels, one 3 ft. square and the other 4 ft. square, in daily work. A third channel, 7 ft. square, is nearly complete. The results of lift and drift experiments on the same aerofoil, when measured by different observers in the two channels recently, were found to be practically identical.

As to the means of stepping from the model to the full-scale aeroplane—the force on a surface due to the wind may be written as KSV^2, where S is the area of the surface, V the speed of the wind, and K a quantity which for two similar surfaces similarly placed is approximately a constant, independent, that is, of the velocity and the area. Experiment proves that the force is not strictly proportional to the square of the speed. Curves are given in the paper showing that as a result of determinations of the lift and drift coefficients for an aerofoil at speeds changing from 10 to 50 ft. per sec., it appears there is a growth in the coefficients as the speed increases. Lord Rayleigh has pointed out that if K be not constant for similar surfaces it must be expressible as a function of VL/ν, where V is the velocity of the current, L some linear dimension of the surface, and ν the kinematic viscosity of the air. From experiments on model and full-sized aerofoils, it appears that at the highest value of VL yet reached in the model experiments the value of the lift/drift ratio is somewhat less than for the full-scale experiments, but that values for the coefficients found from the 50 ft. per sec. observations in the channel do not differ greatly from those belonging to the actual machine. This point will be checked more fully when the large wind channel is complete.

A method of checking the accuracy of the model work is to calculate the forces on an aerofoil from the pressure distribution. This has been done at the N.P.L., and in the case of the lift the agreement is complete; in the case of the drift the calculated results are too low, which is to be expected, as in the calculations, air friction on the surface is neglected. Reference is made to the fact that in designing a wing, the shape of the upper surface is more important than the lower.

The results are given of measurements made on a model of a monoplane of ordinary type, of the forces and moments produced in the plane of symmetry when the attitude of the machine changes, but without yawing; and the forces and moments produced by yawing without alteration of the angle of pitch, so that flight is horizontal. Curves are also given of the pitching moment of a biplane model for various settings of the elevator. As the result of experiments of this kind it appears that the wash from the main planes reduces the moment on the tail very greatly. The curves given show that on comparing the moment about the C.G. of the machine as calculated from a knowledge of the shape and position of the tail, the elevators being at a small positive angle, with the measured moment, the latter is of only half the calculated amount. Further study is being made to determine the best position for the tail.

Mathematical Investigation into the Stability of an Aeroplane.—Mr. Bairstow and Mr. Nayler, of the National Physical Laboratory, have recently determined the coefficients for the monoplane model previously mentioned, and used them to determine its motion in a variety of circumstances, and some account of their results is given. The effect of a single horizontal gust in the direction of motion is first taken. The results of the calculations are given in curves which show that the particular machine when struck by a horizontal gust loses longitudinal speed at first, and after passing through a series of changes of velocity, settles down after a few oscillations in less than a minute to its original speed relative to the wind. The initial loss of speed is accompanied by an increase of normal velocity; the machine rises for a fraction of a second, acquiring a rapid positive angular velocity, but these motions soon change sign and die away like the horizontal velocity. The nose of the machine rises for 5 sec., at first rapidly, then more slowly, and the pitching oscillation thus started dies down in the same manner as the others, the motion being stable.

The effect of a single downward gust in the plane of symmetry is next described. The curves show that relatively to the air the machine acquires an upward velocity which dies down in about one second and is followed by the slow oscillations as before. The changes in the other quantities are shown in the curves, and the motion of the machine can be traced as before. By combining the results, the effect can be found of a change in the direction of the wind or an alteration in the propeller thrust or the position of the elevators.

Two cases of lateral disturbance are next considered. This motion in the particular machine dealt with is unstable. Curves are given showing the effect of a side-wind striking the machine on the left-hand side. The machine quickly picks up the velocity of the wind After about 7 sec. the relative sideways motion is very small, but it gradually increases, and after 40 sec. has reached some 9 per cent. of the original disturbance. Unless the controls are altered the side-slipping will continue to increase. A large angular velocity of roll is started almost immediately and at first this gradually dies down, but after 6 sec. or so the divergence term begins to tell and the rolling increases unless checked by the pilot. The velocity of yaw is at first negative, the machine yaws to the left, a motion opposite to that which corresponds to the bank. After a time this is reversed, and the yaw and bank increase together.

In another series of curves is recorded the effect of sudden banking. After 40 sec. the angle of banking exceeds its original value by 63 per cent., while the velocity of yaw also increases rapidly, as does the side-slipping velocity, which takes place in the negative direction. Thus the machine turns to the right, increasing the angle of banking, and side-slipping inwards and downwards at the same time.

In the descriptions above it has been assumed that the controls are not touched, but a comparison of the curves referred to above with the curve obtained when the effect of warping or of turning the rudder are considered, shows that the control of such an unstable machine is not easy.

Messrs. Bairstow and Nayler have in this way solved the following problems:—An aeroplane is in flight in the air. (1) At a given instant the wind changes either in speed or direction, or both, and the new conditions remain for a time steady. The motion of the aeroplane is determined by the curves given in the paper: (2) at a given instant the controls of the aeroplane are altered. The ensuing motion is defined by other curves: and (3) by a suitable combination of the curves the effect of change of wind and change of control occurring simultaneously can be determined.

If the motion of an aeroplane when moving through successive gusts is analysed for a few minutes it can be determined whether either the safety of the machine or the comfort of the passenger requires a modification of the stability.

Messrs. Bairstow and Nayler have analysed the motion for a complete minute of an aeroplane moving over the ground with steady speed of 60 ft. per sec. in a wind as registered on an open-scale record of velocity changes, obtained at Kew Observatory. The velocity of the wind ranged from 11 to 33 ft. per sec., the average being 20 ft. per sec. Curves are given in the paper showing the changes in the wind velocity during the minute, and the variation in the velocity of the air relative to the machine during the same minute. The similarity of the two curves is marked. Curves are also given which show that if the speed of the aeroplane over the ground in still air is taken as 80 ft. per sec., its speed relative to the gusty air (as shown in the anemogram referred to) varies from 70 to 94 ft. per sec. The aeroplane has not time to respond to the rapid changes in the wind. While the changes in the actual horizontal velocity of the aeroplane are considerable, they occur much more slowly than in the wind-velocity curve; the minor alterations are wiped out; a rise in the wind velocity causes a fall in the velocity of the machine, provided the changes are sufficiently prolonged, but a very rapid rise and fall of the wind velocity is scarcely noticeable. It is assumed that the controls have not been touched while this motion is in progress. Curves are, however, also given, showing the effect of altering the elevator during the gust, and it appears that the elevator can without difficulty be so manipulated as practically to cancel the effect of the gust. The curves deal only with the longitudinal motion of the machine. Messrs. Bairstow and Nayler are now engaged in the similar problem for the lateral motion of the machine, and when this is completed, propose to attack in the same way the motion of a biplane of standard form.

The practical outcome of work of this kind is shown in the Army aeroplane R.E.1. The importance of this machine arises from the fact that it was designed to have inherent stability as the result of calculations based on scientific experiments, such as have been described in this lecture.

The Advisory Committee for Aeronautics has given much attention lately to the consideration of the stresses to which a machine may be subject in flight. The normal stress coming on any part of the machine is usually taken as that which it has to bear in steady horizontal flight, produced, that is, by a loading equal to the weight of the machine; if the breaking stress is N times this, N, according to present usage, is called the factor of safety. A machine, however, in its ordinary use may frequently have to carry a load much in excess of what it bears in steady horizontal flight. It would be more consistent with engineering practice to estimate what is the maximum stress the machine in its daily use may have to bear, and then take as the factor of safety the ratio of the breaking stress to this maximum stress. The factor of safety would thus take account of imperfections of workmanship or of material, not of varying load. If the maximum stress to be allowed for is taken to be equal to a loading N_1 times the weight of the machine (the normal loading in horizontal flight), and the breaking stress is n times this, then the ratio of the breaking stress to that occurring during steady horizontal flight is nN_1. This is called N, so that $N=nN_1$, and N, not n, is the factor of safety as ordinarily but mistakenly used in aeronautics.

The value of N has been determined by calculation and, in some cases, by direct experiment, for a number of machines, and appears to range from 3 to 7 or more. It is shown that a sudden gust may cause stresses on a machine four times as great as those occurring in steady horizontal flight at maximum speed. Another cause of serious sudden increase in loading is rapid flattening out after a dive, and calculation shows that stresses from eight to ten times those due to normal loading may be experienced due to this. From a consideration of these figures it is clear that it is essential to make an effort to strengthen machines so that N_1, the load factor, is at least six. Giving n the value of two (although an engineer would certainly think it too low for his work) the value of N would be twelve. There are great difficulties in attempting to reach so high a value at present, but it is not thought that the degree of safety specified is beyond reach.

THE METRIC SYSTEM.[1]

SINCE its introduction into the United Kingdom the metric system or question has had its ups and downs. Surely it is very curious that, although in 1862 a Parliamentary Commission recommended its introduction—a recommendation since repeated two or three times—and that a Bill was actually passed by the House of Lords, the metric system has not been adopted in this country. Why do people go on agitating? Well, the reason is the necessity for such a system. The facilities for intercommunication between various countries have a great deal to do with the continual agitation to introduce an international system of weights and measures. You may say the first person who put this down in black and white was James Watt. Writing to a friend in 1783 he said it was very awkward that the scientific results of workers in various countries could not be compared readily because of the measurements and weights being so different, and he proposed that they should agitate for the adoption of an international unit of weights and measures for scientific purposes. He wrote to French savants on the subject, and the result of the agitation was that in 1790 Prince Talleyrand brought in a Bill before the Legislative Assembly of France proposing that a Commission should be nominated to deliberate on this subject. It was a provision of that measure that the Royal Society of London and the French Academy should nominate the members of the Commission because it was agreed that the Commission ought to be an international affair and not merely a national one. The Royal Society would not agree to it because, as you know, England and France were at war at that time. Eventually, however, some other countries joined and constituted a Commission.

Another feature of the metric system was also suggested by Watt. He suggested that the unit of length should be cubed, a vessel constructed, filled with water at its greatest density, and that that should be the unit of weight. This cube should be the unit of capacity. In carrying out this idea insuperable difficulties have arisen of an absolutely mechanical nature, and so a kilogram is not any more a decimetre cubed and filled with water, but it is a piece of platinum kept in Paris at a certain temperature and at a certain barometric pressure. But the difference is very slight and does not affect the value of this co-relation between length, capacity, and weight. That is just the same as the standard of British measure—in fact, the real standards of English weights and measures were burned in 1835 in the Houses of Parliament and had to be reproduced afterwards as best they could. Secondary standards have now been made and have been distributed over the country, so that there is no danger of the standards being lost again.

After giving you this short history of the beginning

[1] From a report published by the Decimal Association of an address to the members of the Bradford Textile Society and of other Trade Organisations at Bradford, on November 17, 1913, by Mr. Alexander Siemens.

of the metric system, I wish to direct your attention to the greatly different circumstances of communication between the various countries from what formerly existed. The interchange of products between the various countries has increased very much, and it is to the interests of everybody that this interchange should be facilitated as much as possible. One of the greatest facilities is that the same weights and measures should be used everywhere. Now the real requirements of such an international system are two in number. One is that the measures and weights should have the same base ratio throughout; that means to say one pound in the English system should be 16 oz.; one ounce should be 16 drams; one foot 16 in.; one yard 16 ft., and so on. That would be a system with the same base ratio throughout. Only 16 is not a good one. I am, of course, aware that people say 12 is a good ratio because there are so many aliquot factors in 12—three times four, twice six—and that consequently 12 is handy. We are, however, faced by the fact that all people on earth who count, count by tens, and that has fixed the base ratio for any international system. If you attempt to put in any other ratio it would lead to confusion, and would not be so convenient. Therefore the base ratio of 10 is essential.

Now as regards a little more of the history of the metric system. In 1861 the old Federation of German States instructed a Commission to propose a national system of weights and measures, and after they had deliberated a short time they came back to the Federation and said, "We must say that the only sensible thing"—the only thing that would justify the upsetting of the old measures which were very confusing in Germany at the time—"the only reason for disturbing people and introducing new weights and measures can be to have an international system." At that time the metric system was not as widely introduced as now, and the Commission very carefully went into the question whether they should adopt the English or the French system of weights and measures. It must be remembered that the superiority of England at that time was still very overpowering. It was a little less so than in 1850, but still it was preponderant. The United States and Colonies of England all had the English system of weights and measures, so this Commission, consisting of sensible men, might have thought: "We will go with the majority of the manufacturing people and adopt their weights and measures." But when they saw the English weights and measures and went into them they unanimously decided that the metric system was the only possible international system. In the metric system there is the same base ratio and divisions everywhere, so you have to learn nothing. It is the same base ratio as you use in calculation. I remember in 1895 I had to give evidence before the Parliamentary Committee on Weights and Measures, and I handed in a German school-book on arithmetic. The Committee said, "How many pages are devoted to the metric system?" I showed them that on the back cover there was a note: "Remember a hectolitre is 100 litres; a kilogram is 1000 grams." The other things were so self-evident that it was considered unnecessary to say anything about them.

The Commission instituted by the old Federation of German States submitted their proposals to the Reichstag in due course; then came the year 1866, which delayed the introduction somewhat, but in 1868 the Act was passed that the metric system should be permissible from January 1, 1870, and compulsory from January 1, 1872. This disposes of the idea that the metric sytem can only be introduced in times of great commotion and so on. The date of the introduction of the metric system was decided upon long before anybody knew anything about the Franco-Prussian War, and was, therefore, introduced rather in spite of it than as a consequence of it. About the same time a Committee was appointed by the English Parliament to report on the introduction of the metric system, and after hearing all sorts of witnesses, they reported in 1862 that "in their opinion it would involve almost as much difficulty to create a special decimal system of our own as simply to adopt the decimal metric system in common with other nations." Furthermore, if we did so create a national system we would in all likelihood have to change it again in a few years into an international system owing to the increase of commerce and intercourse between nations."

More than fifty years ago the upshot was that the Committee said it would be a waste of energy to introduce a special English system because owing to the ever-increasing intercourse between nations the nations would be forced into the adoption of an international system whether they liked it or not. That is the real reason why the Decimal Association believes that the metric system is coming. It may be coming slowly, especially here in England—we cannot help that—but if you consider this point of view, that the international intercommunication is ever increasing, that the nations are becoming more and more dependent upon the produce of other nations, you will see—you must come to the conclusion that an international system of weights and measures is desirable, and that the refusal of such a system will impede progress.

What are the objections? The first that is made is to the decimal point. Owing to the base ratio being 10, and 10 throughout, there is no necessity to use a decimal point. For instance, anybody making drawings puts all the dimensions on the drawings in millimetres. That has two advantages. You need not put millimetres every time as you put feet and inches (′, ″), and it avoids a lot of misunderstanding if the drawing has not been very carefully figured. 1′ 1″ is often taken for 11 in., 2′ 4″ for 24 in., and all that sort of thing, but if you use millimetres you have not that difficulty.

The decimal point objection is really non-existent because you always take the next lower unit if you find that what you want to express is less than the higher unit, and that is generally quite sufficient. The second objection taken is the size of the unit. That really is an argument that shows into what desperate straits the opponents of the system have reached to find an objection, because I cannot for the life of me see that the metre and the yard are so very much different. Nor are a half-kilogram and a pound so very unlike each other.

The next thing is that the opponents of the compulsory introduction of the metric system say:—"Well, you have got all you want, you have permission to use the metric weights, the Board of Trade will verify them for you; they have the standards—so what more do you want?" That is just it. Do not these people see that in compelling manufacturers and traders to have two standards, one for home consumption, and one for dealing with metric countries, they handicap the manufacturers and traders here? And there is another point of view. There was a discussion before the Institute of Inspectors of Weights and Measures on the metric system; they are the people who go about among all the tradespeople and have to verify weights and measures, and they ought to know their business. One inspector said that "from the inspector's point of view there is one point which advocates should not favour, and that is the argument that the proposed general Act should be permissive. To have two sets of weights on the shop counter at the same time is not wise. We know what it would be to have a 14-lb. set and a kilogram set alongside the scale; the changes would be rung. The kilogram is very near the size of a 2-lb. weight; the metre near the length of the yard, and the litre near the size of a quart. With these facts before us the Act should, in our opinion, be compulsory."

These are the two arguments:—So long as it is permissive, people who deal with metric countries have to have two standards, and they are handicapped in that way, and poor people are exposed to the danger of being defrauded.

The last objection is on the ground of cost. In order to have a fair idea of what the cost would be it is preferable to examine in detail how various interests would be affected if the metric system were made compulsory after a transition period of, say, two years. Taking first the case of the retail trader with whom the general public have most of their dealings. I think it fair to quote an inspector of weights and measures who spoke in the discussion just now alluded to. He said:—"The change to the metric weights and measures would really be very little cost to the shopkeeper, but he does not realise that this is the case. The shopkeeper imagines that the whole of the weighing machines and weights have to be changed, and it is the weighing instruments that are the greatest factor with him. The effect so far as weights and measures are concerned is very small indeed. It does not cost much to change either his weights or his measures, and I refer to measures of length as well as to those of capacity. With regard to the changing of lever machines, we know as inspectors that it is a very common thing for a weighing-machine maker to have to change the whole of his steel-yard markings and to have to rub out the old markings and to mark it anew. In this case it would be a very easy thing to change the markings, which would also apply to platform machines and counterpoise weights. The cost would be very small indeed." We may take it on the authority of the persons whose business it is to know everything about the weights and measures of the retail trade that the cost of the change would not be an insuperable obstacle.

The next interest to consider is the textile trade. Here, the opponents of the system contend, the cost of the change would be appalling because all present looms would become obsolete and would have to be replaced by new ones adapted to produce metric widths of fabrics. I had better take that with the engineering trade, because about that the same is said. I say in reply to all these arguments, "What are you doing now? Are you not exporting to metric countries, are not engineers exporting to metric countries? Have not we in our works plenty of metric dimensions to manufacture to; have we ever found any difficulty in doing it? Have we ever had to introduce new machinery specially to make a metric thing? Never!" Even leading screws of English pitch can be used to produce screws of French pitch and *vice versâ*. You must put in one wheel with 127 teeth which makes the changes right. You will find you are absolutely correct. When before a Parliamentary Committee I was asked:—"Seeing that in the cotton trade the standard make is what is called 79 in., 37½ yards, 8¼ lb. shirting—which is known all the world over—would it not in some way damage the reputation of the shirting if the figures had to be recalculated in all the markets of the world?" Well, at the time I had not sufficient time in which to make the calculation. What do you get when you recalculate? Seventy-nine inches are 2 metres within one-third of 1 per cent.; 37·5 yards are equal to 34 metres to within one-third of 1 per cent.; and 8¼ lb. are 3¾ kilograms. So you see you have been entertaining angels unawares. You have been manufacturing to metric measure. So why say it is difficult? The general experience is that wherever the metric system has been introduced it has at once been accepted as by far the simplest and easiest to comprehend, while it has the great advantage of being international, which is more and more necessary nowadays where the intercourse between countries is increasing.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At a meeting of the council on June 3, a letter from Sir George Kenrick was read, in which the offer was made to endow the Chair of Physics by placing in the hands of the treasurer securities the income from which should be used exclusively for the salary of the professor and objects intimately connected with the Chair, the latter to bear in future the title of the "Poynting Chair of Physics." It was proposed by the vice-chancellor, seconded by Principal Sir Oliver Lodge, and unanimously resolved: "That the council most gratefully accepts the generous offer of Sir George Kenrick to endow the Chair of Physics as a memorial to the late Prof. John Henry Poynting. The council desires to record its great appreciation of this act of munificence which follows so many other proofs of Sir George Kenrick's interest in the welfare of the University; . . . That the Mason Chair of Physics be henceforth called the Poynting Chair of Physics." It is proposed that the title of "Mason Professor" shall be transferred to another Chair specially associated with the late Sir Josiah Mason. We understand that the endowment will consist of securities of the value of 18,000*l.*

Under the will of the late Mr. J. Tertius Collins a sum of 200*l.* has been given to the University, the interest to be applied to the founding of a yearly prize or prizes for proficiency in chemistry or metallurgy or some kindred object in science.

Profs. Boulton, Cadman, and Turner have been appointed delegates to represent the University at the International Congress of Mining, Metallurgy, Engineering, and Practical Geology.

Dr. W. E. Fisher has resigned his demonstratorship in mechanical engineering on his appointment to the engineering department of the Staffordshire County Institute at Wednesbury.

CAMBRIDGE.—During the Michaelmas term Dr. Myers will give a course of lectures in the psychological laboratory on general and experimental psychology, considered especially in relation to medicine.

The Vice-Chancellor has published a summary of benefactions received by the University during the year ended December 31, 1913. The total amount of the benefactions acknowledged by Grace is 20,861*l.*, and this included an anonymous gift of 10,000*l.* for the endowment of a professorship of astrophysics, 366*l.* from subscribers to the Humphrey Owen Jones Fund, to establish a lectureship in physical chemistry, and 1500*l.* from Mr. C. E. Keyser, for the building fund of the new museum of archæology and of ethnology. In addition a sum of 2496*l.* has been received in smaller sums by the Cambridge University Association.

A studentship on the Arnold Gerstenberg foundation will be offered for competition in the Michaelmas term of 1915. The studentship will be awarded by means of essays; it will be of the annual value of nearly 90*l.*, and will be tenable for two years.

Prof. Nuttall has received the following benefactions with which to further the research work that is being conducted in the Quick Laboratory:—Sir Dorabji J. Tata, 250*l.*; Mr. P. A. Molteno and Mrs. Molteno, 400*l.*, of which the sum of 100*l.* is to help toward the expenses of publishing the scientific work from the laboratory; the advisory committee of the Tropical Diseases Research Fund (Colonial Office), 100*l.*, to serve as a stipend for a helminthologist, and 300*l.* to enable the Quick professor to send his assistant, Mr. E. Hindle, on an expedition to East Africa.

At the Congregation on May 30 new regulations for the diploma in anthropology received the approval of the Senate. Up to the present time, a candidate has had to keep certain terms and to prepare a thesis, and upon the latter if approved the diploma was awarded. The new regulations provide an examination as an alternative method of acquiring the diploma, and the examination is divided into parts, which may be taken separately or collectively. Moreover, the conditions of residence have been modified specially with reference to officers of various services, whether Colonial or other.

The new physiological laboratory was opened on June 9 by Prince Arthur of Connaught. The following honorary degrees were conferred in connection with the proceedings:—*LL.D.*: Prince Arthur of Connaught, Lord Esher, Lord Moulton of Bank, and Colonel Benson, master of the Drapers' Company. *Sc.D.*: Sir William Osler, Sir David Ferrier, Sir Edward Schäfer, and Prof. E. H. Starling.

LONDON.—Prof. J. Millar Thomson, F.R.S., is retiring at the end of this session from his position as vice-principal of King's College, London, and head of the chemical department of the college. Prof. Thomson's retirement marks not only the close of a personal connection with King's College as a member of its teaching staff for forty-three years, but also the end of an unbroken association with education in Great Britain where members of his family have held university professorships for a period of 130 years.

A lecture entitled "Some Problems in Cardiac Physiology" (being contributions to a study of the relations which exist between the various chambers of the Mammalian heart) will be given in the Physiological Laboratory of the University, South Kensington, S.W., by Prof. A. F. Stanley Kent, on Thursday, June 18. The lecture is addressed to advanced students of the University and others interested in the subject. Admission is free, without ticket.

WE learn from *Science* that Prof. Rudolf Tombo, jun., of Columbia University, died on May 22. He was known for his articles on university registration statistics, to which attention has been directed in NATURE on many occasions.

PROF. D. K. PICKEN, of Victoria College, Wellington, University of New Zealand, has been appointed master of Ormond College, Melbourne University. He has held the chair of mathematics at Wellington since 1907, and has taken a prominent part in the university reform movement in connection with which a New Zealand Parliamentary Committee held an inquiry last autumn. Arrangements are to be made through the High Commissioner for New Zealand for receiving applications in London for the professorship of mathematics (pure and applied) vacated by Prof. Picken.

A CUTTING from the Wellington *Evening Post*, New Zealand, of April 21, announces the award of a Martin Kellogg fellowship in the Lick Astronomical Department of the University of California to the Government Astronomer, Mr. C. E. Adams. The purpose of the fellowship is to provide opportunities for advanced instruction and for research to students who have already received the degree of Doctor of Philosophy or the equivalent, or to members of staffs of observatories. The fine instrumental equipment of the Lick Observatory offers opportunities to research students which can scarcely be equalled at other observatories, and the valuable experience derived from a stay there will be sure to imbue Mr. Adams with new energies and ideas for work on his return to New Zealand.

THE thirteenth annual congress of the Irish Technical Instruction Association was held at Killarney on May 26, 27, and 28, under the presidency of Principal Forth, of the Municipal Technical Institute, Belfast. The congress was very largely attended, delegates being present from practically every technical instruction committee in Ireland. The president, in his opening address, reviewed the developments which had taken place in technical instruction in Ireland during the past twelve months. He stated that on all hands there was a fixed determination to place the work of technical instruction in the most intimate and most helpful relationship to the industrial requirements of the country. He also dealt with some of the problems which await solution if technical instruction is to realise its fullest aims and ambitions; and he dwelt upon the decline which takes place in attendances at evening classes as the session progresses, giving some reasons why this wastage in numbers occurs, and indicating methods by which it could be checked. During the course of the congress an important address was given by Mr. T. P. Gill, and a number of valuable papers were presented, amongst which the following may be cited:—"The Technical Training of Skilled and Unskilled Workers in France and Germany," Dr. Garrett; "Technical Instruction for Small Holders," Mr. U. U. Humphrey; "Technical Instruction in the Woollen Industry," Mr. J. F. Crowley; "The Relation between Employers and Technical Instruction Committees," Mr. A. Williamson; "Cooperation between Counties, County Boroughs, and Urban Technical Instruction Committees," Mr. John Pyper. A paper on the problem of small industries, read by Mr. G. Fletcher, was illustrated by lantern slides, and also by kinematograph films which had been specially prepared to illustrate the working of machines for making embroidery. A highly instructive illustrated lecture was given by Mr. T. Macartney-Filgate, upon "An Industrial Survey of Ireland." The town of Larne, in the county Antrim, was fixed as the place of meeting for the congress in 1915.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—Sir William Crookes, president, in the chair.—Prof. W. **Watson**: Anomalous trichromatic colour vision. It is shown from the results of measurements made on some forty subjects that anomalous trichromates are sharply divided into two distinct classes, and two experimental methods of distinguishing these classes are described.—Dr. H. J. H. **Fenton**: Diformdiol-peroxide. The conditions of coexistence, and the mode of interaction, of hydrogen dioxide and formaldehyde are of some interest in connection with certain theories which have been advanced in order to account for the photosynthesis of carbohydrates in the living plant. During the course of some experiments in this direction, it has been found that, under appropriate conditions, these two substances combine to form a compound, $2H.CHO.H_2O_2$, which crystallises in large transparent plates or prisms. The general behaviour of the substance indicates that it is to be regarded as an "atomic" compound, in the ordinary sense of the term, rather than as a compound containing hydrogen dioxide of crystallisation.—Prof. H. E. **Armstrong** and E. E. **Walker**: Studies of the processes operative in solutions. XXIX.—The disturbance of the equilibrium in solutions by "strong" and by "weak" interfering agents. The effect of a large number of substances on the optical rotatory power of an aqueous solution of fructose has been measured and the views put forward in No. XXVI. of these studies with regard to the action of interfering agents have been confirmed and elaborated. "Strong" solutes, such as the sugars and metallic salts, increase the negative rotatory power of fructose, whereas "weak" solutes, such as the alcohols, ketones, and ethers, decrease it. The observed effect of the added substance ("the interfering agent") is regarded as the algebraic sum of two opposing factors:—(1) A diluent effect causing *dissociation* of hydrates and other complexes in solution; (2) an influence, opposite in effect to the first, depending on the reciprocal chemical attractive powers of the molecules of solvent and interfering agents promoting *association*. A simple mathematical expression involving these two factors has been developed by means of which (2) has been evaluated. This value is denoted by A. Thus calculated, A is found to be *very nearly proportional to the number of atoms of oxygen in the molecule*.—Prof. H. E. **Armstrong** and E. H. **Rodd**: Morphological studies of benzene derivatives. VII.—The correlation of the forms of crystals with their molecular structure and orientation in a magnetic field in the case of hydrated sulphonates of dyad metals.—Dr. E. E. Fournier **d'Albe**: A type-reading optophone. A description is given of a new construction of the "optophone," an instrument capable of translating light action into sound, and so making light recognisable by means of the ear. The new instrument is intended to enable totally blind persons to recognise and "read" ordinary letterpress by means of the ear. It consists essentially of a rapidly rotating disc perforated like a siren disc with several concentric circles of holes. A Nernst lamp is placed behind the disc with its filament stretched radially across the circles. The light, shining through the holes, gives regularly recurring flashes which, when of suitable frequency, can be detected by means of selenium and a telephone. An image of this line of intermittently luminous dots is thrown upon the type to be read, and the light diffusely reflected from the type is received on a selenium bridge. As each dot has a characteristic note, the sound heard in the telephone will vary with every variation in the reflecting power of the surface under examination. As the letterpress is moved on in the direction of the line of type, the sound changes rapidly with every change in the shape of the letters, and with some practice the latter can be "read" by ear. Type 5 mm. high can be thus read by means of an ordinary high-resistance telephone receiver. The effect becomes rapidly fainter as the type diminishes in size, but ordinary newspaper type is readable with the help of a highly sensitive Brown telephone relay.—L. H. **Walter**: An application of electrolytically-produced luminosity, forming a step towards a form of telectroscopy. The author has investigated the conditions under which it should be possible to make practical use of the luminosity of anodes of alloyed aluminium forming part of a "valve" cell arrangement. The alloy known as "duralumin" is found to give the best results, and with sodium tungstate solution as electrolyte, corrosion is practically eliminated when this alloy is used as the anode. The arrangement permits of the construction of an apparatus having a multiple anode, comprising a vast number of equal units in quite a small compass, each such unit being capable of being rendered luminous in any order or sequence desired and at a speed of some hundreds of times per second. Such an apparatus is capable of being employed as a receiver in phototelegraphy for the reproduction of pictures, etc., especially where these are received as electrical impulses.—P. G. **Nutting**: The axial chromatic aberration of the human eye.—L. V. **King**: 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.

Geological Society, May 27.—Dr. A. Smith Woodward, president, in the chair.—L. F. **Spath**: The development of *Tragophylloceras loscombi*, Sow. During his investigation of the Charmouth Lias, Mr. W. D. Lang collected fossil material with reference to its exact stratigraphical horizon. In the material *Tragophylloceras loscombi*, Sow., is represented by hundreds of specimens (chiefly young), and a study is given of the ontogeny of this ammonite. A number of specimens were dissected back to the protoconch, and their development traced in detail. Tables of measurements are given, and the other species of the genus are reviewed. The evolution of the suture-line was worked out in detail, and an important point brought out was the demonstration of a simple Psiloceras-like suture-line persisting to a late and post-constricted stage. The development of the suture-line in Psiloceras and Rhacophyllites is given for comparison.—Prof. P. **Marshall**: The sequence of lavas at the North Head, Otago Harbour, Dunedin (New Zealand). The North Head forms a precipitous cliff ranging from 300 to 530 ft. in height; it presents a clear section of a succession of lava-flows, including trachyte, trachytoid phonolites, kaiwekites, trachydolerites, and basalts. It appears that all the lavas were erupted from the same vent. Each sheet is covered by a bed of scoria, the coarseness of which proves that the centre of volcanic activity was not far distant. The lowest lava is a trachyte composed entirely of anorthoclase-felspar, and is succeeded by a phonolite in which sanidine is the conspicuous mineral. This is followed by a series of ten basalts of moderately basic character. The next flow is a kaiwekite, a lava of entirely different type, in which a hornblende allied to barkevikite forms the largest crystals. The basalts are succeeded by a phonolite which contains a few phenocrysts of anorthoclase. It is pointed out that in the lowest trachyte lime and magnesia are practically absent, but that the phonolite, although still deficient in these constituents, shows a distinct advance. The basalts as a whole are low in magnesia and above the average in alkalies. In the kaiwekite the alkalies advance, and there is an increase in silica and decrease in lime and magnesia. The higher basalts are somewhat richer in alumina and poorer in lime than those which occur lower in the section. The majority of the rocks fall into well-known and readily recognised groups. The porphyritic rocks of intermediate composition may have formed from an undifferentiated magma. The chemical composition of the intermediate lavas, as well as their mineral composition, would suggest that the original magma was that of essexite. It is important to note that in the Island of Tahiti, where there is a similar assemblage of alkaline and basic lavas, the reservoir has been laid bare by denudation and contains essexite as the dominant rock.

PARIS.

Academy of Sciences, June 2.—M. P. Appell in the chair.—L. E. **Bertin**: The instability in steamers resulting from a collision. A statement of the advantages of horizontal watertight compartments.—E. L. **Bouvier**: New observations on viviparity in Australian Onychophores. It is shown that in spite of their name all the Ooperipatus are not oviparous.—M. **Considère**: Deformation and fatigue of reinforced concrete. Application to arched roofs. In the present state of knowledge it is impossible to calculate the total pressure at any given point of an arch.—Ph. **Barbier** and R. **Locquin**: The constitution of linalol. This alcohol was reduced by hydrogen at the ordinary temperature in the presence of platinum black. The resulting saturated alcohol was proved to be $(CH_3)_2.CH.(CH_2)_3.C(OH)(CH_3)(C_2H_5)$. This leads to the constitution for linalol proposed by Tiemann and Semmler.—J. **Guillaume**: Observation of the occultation of the planet Mars on May 30, 1914, made at the Observatory of Lyons.—J **Guillaume**: Observations of the Zlatinsky comet (1914*b*) made at the Observatory of Lyons. Positions given for May 29 and 30. The comet appeared circular, about 2′ in diameter, and with a condensation round a nucleus of the 10th magnitude.—Georges **Meslin**: The inclination of the spectral lines and the equatorial acceleration of the solar rotation. A revision and correction of a formula of Cornu.—Patrick J. **Browne**: A direct formula for the solution of an integral equation of Abel.—G. **Armellini**: The problem of two bodies of variable masses.—Léon **Bouthillon** and Louis **Drouët**: Experimental study of the telephone receiver. The theory explaining the sound produced by the telephone simply by the transversal vibrations of the whole membrane is in good agreement with the results given by experiment.—G. Gouré de **Villemontée**: The propagation of electricity through paraffin oil. The influence of the thickness of the dielectric and of charges of very short duration.—G. A. **Dima**: The initial velocities of the photoelectric electrons. An apparatus for determining the initial velocities is figured and described in which the disturbing influences due to the reflection of light and the electrons are reduced to a minimum. The results for tin, zinc, aluminium, and magnalium are in agreement with those of Richardson and Compton.—M. and Mme. **Chauchard**: The action of monochromatic ultraviolet rays on amylase and lipase from the pancreatic juice. The amylase is attacked only by rays with wave-length smaller than 2800, the action increasing very rapidly as the wave-length diminishes. Lipase is destroyed by rays for which $\lambda=3300$, the amylase not being affected.—Henri **Wohlgemuth**: Researches on the acyclic γ-halogen acids. These acids are obtained by the action of hydrochloric, hydrobromic, and hydriodic acids upon γ-valerolactone. The yield and purity of the products depend on details of manipulation which are given in full. Examples of the chemical behaviour of these acids are also given.—M. **Tiffeneau**: The migration of a methoxyl group in the course of the decomposition of a quaternary ammonium hydrate by Hofmann's method.—G. **Chavanne** and Mlle. J. **Vos**: The ethylenic isomerism of the acetylene di-iodides. A mixture of the two iodides was obtained by the action of acetylene upon iodine at 150°–160° C. From a study of the rate of elimination of hydriodic acid the *cis* configuration is attributed to the liquid isomer.—J. **Giraud**: New observations on the eruptive rocks of the south and west of Madagascar.—R. **Fosse**: The quantitative gravimetric analysis of urea in urine. The method is based on the insoluble compound formed by the interaction of urea and xanthydrol in acetic acid solution.—Emile **Fleurent**: Remarks on the diminution of the gluten in French wheats. Discussion of a recent paper by M. Balland on the same subject.—L. and M. **Lapicque** and R. **Legendre**: The alterations of the myeline sheath produced by various nerve poisons. Reply to a recent note by M. Nageotte.—C. **Levaditi** and A. **Marie**: The organism of general paralysis. Reasons are adduced for the view that there is a marked biological dissimilarity between the virus of general paralysis and that of cutaneous and mucous syphilis.—Pierre **Thomas**: The relations between the proteid substances of yeast with sucrase.—A. **Boutaric**: The influence of the polarisation of diffused light by the sky on the values obtained for the solar constant. The value of the solar constant varies inversely with the polarisation. This invalidates the usual extrapolation for deducing the solar constant.—J. **Deprat**: The tectonic accidents and the zones of crushing of the Black River (Tonkin).

HOBART.

Royal Society of Tasmania, April 15.—Sir William Ellison-Macartney in the chair.—Prof. A. **McAulay**: Quaternions applied to physics in non-Euclidean space. I.—An outline of methods, for elliptic space and for hyperbolic space, to be used in subsequent papers.—J. H. **Maiden**: Notes on some Tasmanian eucalypts. In a paper read before the society in 1912, R. T. Baker and H. G. Smith proposed certain species on the basis of essential oils obtained by distillation. The author criticises these species, and discusses the relations between essential oils (and other accessory characters) and the species which yield them.—H. Stuart **Dove**: Stone implements used by the aborigines of Tasmania. The author describes some examples of the disc-shaped stones, sometimes called "hammerstones," found in the middens of the extinct aborigines of Tasmania, and discusses their use.

BOOKS RECEIVED.

The Care of Home Aquaria. By Dr. R. C. Osburn. Pp. 63. (New York: N.Y. Zoological Society.)

Biologen-Kalender. Edited by Drs. B. Schmid and C. Thesing. Erster Jahrgang. Pp. ix+513. (Leipzig and Berlin: B. G. Teubner.) 7 marks.

Die Kultur der Gegenwart. By A. Voss. Pp. vi+148. (Leipzig and Berlin: B. G. Teubner.) 5 marks.

Arithmetische Selbstständigkeit der europäischen Kultur. By Prof. N. Bubnow. Translated by Prof. J. Lezius. Pp. viii+285. (Berlin: R. Friedländer und Sohn.) 10*s.*

The Fixation of Atmospheric Nitrogen. By Dr. J. Knox. Pp. vii+112. (London: Gurney and Jackson.) 2*s.* net.

Luxor as a Health Resort. By W. E. N. Dunn and G. V. Worthington. Second edition. Pp. 36. (London: H. K. Lewis.) 1*s.* 6*d.* net.

Smithsonian Institution. U.S. National Museum, Bulletin 87. Culture of the Ancient Pueblos of the Upper Gila River Region, New Mexico and Arizona. by W. Hough. Pp. xiv+139+plates 29. (Washington: Government Printing Office.)

Les Hypothèses Cosmoganiques Modernes. By Dr. A. Véronnet. Pp. iii+171. (Paris: A. Hermann et Fils.)

La Forme de la Terre et sa Constitution Interne. By Dr. A. Véronnet. Pp. 32. (Paris: A. Hermann et Fils.)

Die Typen der Bodenbildung, ihre Klassifikation und geographische Verbreitung. By Dr. K. Glinka. Pp. iv+365. (Berlin: Gebrüder Borntraeger.) 16 marks.

Routledge's New Dictionary of the English Language. Edited by C. Weatherly. Pp. viii+1039. (London: G. Routledge and Sons, Ltd.) 3*s.* 6*d.*

Syllabus of the Lessons on Marine Biology and Navigation for Fishermen, given at the Marine Laboratory, Piel, Barrow-in-Furness, by the Lancashire and Western Sea-Fisheries Joint-Committee. Third edition. Pp. 105+xiv plates. (Liverpool: C. Tinling and Co., Ltd.)

Report for 1913 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. Pp. 376. (Liverpool: C. Tinling and Co., Ltd.)

The Microscopy of Drinking Water. By Prof. G. C. Whipple. Third edition. Pp. xxi+409+plates xix. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

Nature in Books. By J. L. Robertson. Pp. 156. (Oxford University Press.) 2*s*.

Evolution and the Need of Atonement. By S. A. McDowall. Second edition. Pp. xx+183. (Cambridge University Press.) 4*s*. 6*d*. net.

Perception, Physics, and Reality. By C. D. Broad. Pp. xii+388. (Cambridge University Press.) 10*s*. net.

The Philosophy of Biology. By Dr. J. Johnstone. Pp. xv+391. (Cambridge University Press.) 9*s*. net.

Memoirs of the Geological Survey of Great Britain. Palæontology. Vol. i. Part 4. The British Carboniferous Producti: i., Genera Pustula and Overtonia. By Dr. I. Thomas. (London: H.M.S.O.; E. Stanford, Ltd.) 6*s*.

New Zealand Department of Mines. New Zealand Geological Survey. Palæontological Bulletin. No. 1. Materials for the Palæontology of New Zealand. By Dr. J. A. Thomson. Pp. 104. (Wellington, N.Z.: J. Mackay.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 11.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Bearing of Cytological Research on Heredity: Prof. E. B. Wilson.

ROYAL INSTITUTION, at 3.—Faraday and the Foundations of Electrical Engineering: Prof. S. P. Thompson.

FARADAY SOCIETY, at 8.—Presidential Address: Advances in the Metallurgy of Iron and Steel: Sir R. Hadfield.

FRIDAY, JUNE 12.

ROYAL INSTITUTION, at 9.—Some Aspects of the American Democracy: The Hon. W. H. Page.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Magnitude of η Argûs, and Discovery of a Close Companion to it: R. T. A. Innes.—A New Variable Star in Carina: H. E. Wood.—The Nebula HV 25 Ceti: Mrs. Isaac Roberts.—Comparison of Hill's and Le Verrier's Tables of Saturn: H. H. Turner.—An Area of Long-continued Solar Disturbance, and Associated Magnetic Storms: Rev A. L. Cortie.—Correction to Note on Spectroscopic Binaries and the Velocity of Light: R. S. Capon.—Note on the Number of Components of a Compound Periodic Function: J. B. Dale.—Three Variable Stars in the Region of χ Persei: Dunsink Observatory.—Note on the Velocity of Light and Doppler's Principle: H. C. Plummer.—Dimensions of Saturn and his Rings, as Measured on Prof. Barnard's Photograph of 1911, November 19: the Transparency of Ring A and other Details shown on the Photograph: P. H. Hepburn.—Nebulæ seen on Mr. Franklin-Adam's Plates: J. A. Hardcastle.—Note on the Star 41 Virginis: E. W. Barlow. *Probable Paper:* Periodic Inequalities in the Epochs of Sun-spot Maxima and Minima: J. B. Dale.

PHYSICAL SOCIETY, at 8.—Note on the Connection between the Method of Least Squares and the Fourier Method of Calculating the Co-efficients of a Trigonometrical Series to Represent a Given Function or Series of Observations: Prof. C. H. Lees.—A Magnetograph for Measuring Variations in the Horizontal Intensity of the Earth's Magnetic Field: F. E. Smith.—The Atomic Weight of Copper by Electrolysis: A. G. Shrimpton.—Note on an Improvement in the Einthoven String Galvanometer: W. H. Apthorpe.

MALACOLOGICAL SOCIETY, at 8.—*Sulcobasis concisa*, Fer., and its Nearest Allies: C. R. Boettger.—Note on the radula and maxilla of *Orthalicus zebra*, Müller: Rev. E. W. Bowell.—(1) Invalid Molluscan Generic Names; (2) A New Cassid: T. Iredale.—The Relative Claim to Priority of the Names *Helix carduelis*, Schulze, and *Helix fruticum*, Müller: G. K. Gude.

SATURDAY, JUNE 13.

ROYAL INSTITUTION, at 3.—Studies on Expression in Art. II.: Right Expression in Modern Conditions: Sigismund Goetze.

TUESDAY, JUNE 16.

MINERALOGICAL SOCIETY, at 5.30.—Childrenite from Crinnis Mine, Cornwall, and Eosphorite from Poland, Maine: J. Drugman.—Sartorite: R. H. Solly.—Redeterminations of Nickel in the Baroti and Wittekrantz Meteorites: G. T. Prior.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Cheddar Man, a Skeleton of Late Palæolithic Age: Profs. C. G. Seligmann and F. G. Parsons.

ROYAL STATISTICAL SOCIETY, at 5.—Economic Relations of the British and German Empires: E. Crammond.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—An Expedition in Brazil: Hon. Theodore Roosevelt.

WEDNESDAY, JUNE 17.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Rainfall of the Southern Pennines: B. C. Wallis.—The Relation between Wind Direction and Rainfall: H. J. Bartlett.

THURSDAY, JUNE 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* (1) Trypanosome Diseases of Domestic Animals in Nyasaland. *Trypanosoma Caprae* (Kleine). III: Development in *Glossina morsitans*; (2) Trypanosomes found in Wild Game in the "Fly-Belt" of the Upper Shire Valley; (3) The Food of *Glossina morsitans*; (4) Infectivity of *Glossina morsitans* in Nyasaland during 1912 and 1913: Sir D. Bruce, Maj. A. E. Hamerton, Capt. D. P. Watson and Lady Bruce.—The Relation between the Thymus and the Generative Organs, and on the Influence of these Organs upon Growth (With a Note by G. U. Yule): E. T. Halnan and F. H. A. Marshall.—The Vapour Pressure Hypothesis of Contraction of Striated Muscle: H. E. Roaf.—The Validity of the Microchemical Test for the Oxygen Place in Tissues: A. N. Drury.—Man's Mechanical Efficiency: Prof. J. S. Macdonald.—The Colouring Matters in the Compound Ascidian *Diazona violacea*, Savigny: Dr. A. Holt.

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