THURSDAY, OCTOBER 5, 1916.

THE ORGANISM AS PHŒNIX.

(1) *Senescence and Rejuvenescence.* By C. M. Child. Pp. xi+481. (Chicago: University of Chicago Press; London: Cambridge University Press, 1915.) Price 16*s.* net.

(2) *Individuality in Organisms.* By C. M. Child. Pp. x+213. (Chicago: University of Chicago Press; London: Cambridge University Press, 1915.) Price 5*s.* net.

(1) IN this able study of senescence and rejuvenescence Prof. Child gives us the fruits of fifteen years of research on the age-changes of the lower animals. Much of the book is a record of observations and experiments which have not been previously published; the rest is a thoughtful working-out of a new conception of the organism, which must be taken account of by all biologists. The most prominent new feature is the author's attempt to show that "in the organic world in general rejuvenescence is just as fundamental and important a process as senescence." In the higher forms the possibilities of rejuvenescence seem to be very narrowly limited, and may be scarcely recognisable save in connection with sexual reproduction; but in the simpler organisms, such as the Planarian worms on which the author has published many researches, it is a characteristic feature of life.

In seeking to determine the degree of ageing in an organism we are accustomed to look out for certain structural changes familiar in man and mammals, or we measure the decreasing rate of metabolism per unit of substance. For lower animals, however, other tests must be used; thus advantage has been taken of the general relation between metabolic condition and susceptibility or resistance to cyanides or other narcotics. With differences in susceptibility there also correspond differences in carbon dioxide production as estimated by Tashiro's beautifully delicate "biometer." In other cases the susceptibility or resistance of the organism to the depressing agent may be determined indirectly by the creature's ability to become acclimated to a given concentration.

Numerous experiments on Planarians show that the rate of metabolism, measured by the susceptibility method, decreases with advancing age, and it is concluded that a decrease in rate of metabolism is at least very generally associated with growth and differentiation. An isolated fragment of a Planarian begins by developing a new head and tail, and then undergoes an extensive reorganisation into a new individual of small size. Some parts atrophy and disappear; new parts arise and differentiate; the development in reconstitution is not essentially different from embryonic development. All this and much more is familiar, but the novel point is that the reconstituting Planarians are physiologically younger than those from which the pieces came. As measured by the susceptibility method they exhibit rejuvenescence, and "the degree of rejuvenescence is in general proportional to the degree of reorganisation in the process of reconstitution of the piece into a whole" (p. 118).

The next step in the experimental argument is very interesting: it is the demonstration (by the susceptibility method) that pieces spontaneously isolated in Planarians and Hydroids are physiologically younger than the individuals from which they separate. In other words, rejuvenescence is associated with asexual or agamic reproduction. Furthermore, a Planarian starved for months lives on its own resources and becomes reduced in size. Some cells disappear and others become small. This is well known, but the new fact is that the starving animals undergo rejuvenescence, the degree varying with the degree of reduction. If the susceptibility method is trustworthy they become physiologically younger, and this conclusion was corroborated by estimating the production of carbon dioxide. There is here a strong biological argument for asceticism. The starveling is brought back from an advanced age to the beginning of post-embryonic life; it is almost reborn. "The metabolic current is forced to erode its channel instead of depositing material along its course" (p. 179). Moreover, with certain foods a progressive senescence from generation to generation occurs, while with other foods senescence and rejuvenescence seem to balance in each cycle.

In plants and simple animals, such as polyps, asexual reproduction is frequent, and this brings with it some measure of rejuvenescence. "Often the decrease in metabolic rate with advancing senescence is the primary factor in bringing about physiological isolation of parts, reproduction, and rejuvenescence" (p. 260), and thus senescence may be automatically compensated for. Of great interest, also, are various processes of cellular dedifferentiation which occur in both plants and lower animals, and this also will act as a retardation of senescence. In the higher animals the later atrophic stages of senescence are conspicuous, while in the lower forms they either do not appear or else occur in only a few cells at any given time. "The apparent continuity and irregressibility of senescence in man and the higher forms is responsible for the very general belief that the process is irregressible everywhere, but the plants and lower animals show us clearly enough that this is not the case" (p. 289). In the higher reaches senescence is less frequently interrupted, but it is essentially the same throughout, and occurs "wherever the progressive changes are not balanced or overbalanced by regression." With senescence in man and domesticated mammals everyone is familiar, but what of the alleged rejuvenescence? The author answers that some degree of rejuvenescence occurs in certain tissues, but that on the whole it is grievously limited by the greater stability of the substratum. "For his high degree of individuation man pays the penalty of individual death, and the conditions and pro-

cesses which lead to death in the end are the conditions and processes which make man what he is" (p. 310).

It might seem that the author's thesis was here petering out, but the next step is important. Prof. Child does not believe much in the "segregation of the germ-plasm"; he thinks that the germ-cells, like the somatic cells, exhibit progressive differentiation and senescence, that "the fully developed gametes are physiologically old, highly differentiated cells, which are rapidly approaching death and in most cases actually do die soon after maturity unless fertilisation occurs" (p. 357). They are of advanced physiological age and low metabolic rate. They must undergo de-differentiation and rejuvenescence before they can enter upon a new period of development. The parthenogenetic egg has not lost its capacity of reacting to isolation, but ordinary gametes can undergo de-differentiation and reconstitution only after fertilisation. In this ingenious way, which cannot be justly represented in brief statement, the author interprets gamete formation as a means of securing rejuvenescence. Reproduction is always the reconstitution of a new organism from a part of one previously existing, but the author stands for the new idea that rejuvenescence occurs during early development, and the zoological evidence that he adduces is very interesting. "The organism, when it begins its active independent life at the end of the embryonic period, is certainly very much younger in every respect than the gametes before fertilisation" (p. 403). It has become younger as it has grown older. This seems a little over-ingenious, but the general idea that the early development means very literally making a fresh start becomes concrete and vivid in the author's exposition.

Let us attempt a more compact statement of the author's interpretation of age-changes. The numerous theories of senescence fall into two groups—those which regard it as an incidental imperfection (due to wear and tear, incomplete elimination of waste products, and so on), and those which regard it as an inevitable feature of development. Prof. Child's experiments point to the second view. After the earliest stages of development there is a progressive change in the direction of greater physiological stability in consequence of changes in the substratum and additions to it in the course of growth and differentiation. As the proportion of relatively stable constituents in the substratum increases, there is a decrease in the metabolic activity of each unit of weight or volume of the organism. Thus cells may become loaded with non-protoplasmic enclosures, and skeletal or supporting tissues arise. It is also probable that the increasing density and aggregation of the colloid substratum may lead to an actual decrease in the rate of chemical reactions, and that the increase in density and thickness and the decrease in the permeability of membranes may retard the exchange through them. Thus and thus does ageing begin while the life is still young. "The decrease in rate of metabolism is a part of development itself, and not an accidental or incidental feature of life. The decrease in metabolic rate during development is in fact a necessary and inevitable consequence of the association of the chemical reactions which constitute metabolism with a colloid substratum produced by the reactions" (p. 184). But there is another side to all this, which has been for the most part overlooked because it is inconspicuous in higher forms. There are processes of reduction as contrasted with growth, of retrogressive as contrasted with progressive development. Accumulated substances and structures may be broken down, and the self-fettered metabolism increases in rate. There is a retrogression towards the embryonic condition, as is familiarly seen in the pupa of a fly. "Dynamically rejuvenescence consists in increase in rate of metabolism, and morphologically in the changes in the substratum which permit increase in rate." And this rejuvenescence is as essential a feature of life as senescence. Ageing has been too much regarded as "a rather mysterious process, quite different from anything else in the life cycle," but it is simply a conspicuous expression of what occurs in minor rhythms continually. Thus the period of "loading" of a gland-cell is a period of decreasing metabolic activity (of "senescence"), and the period of discharge one of increasing activity (of "rejuvenescence"), which makes possible a repetition of the cycle. So there are alternations of fatigue and recovery, of quiescence and activity, and "whether we call one cycle an age-cycle and another something else is of little importance, except as regards convenience." It is further suggested that there may be secular senescence and rejuvenescence in racial evolution. "The age-changes in the organism are merely one aspect of *Werden und Vergehen,* the becoming and passing away, which make up the history of the universe."

It is out of the question to express in a few lines more than an appreciation of a carefully executed piece of work of this magnitude. It is rich in suggestiveness and original ideas, and gives us a new view of the organism and its vital tides. Much depends on the soundness of the susceptibility method of determining the rate of metabolism, for a great deal of the evidence relies on this. We confess to a feeling that the superstructure of interpretation is too broad for the Planarian basis on which it mainly rests. Time is required for a consideration of the evidence given of rejuvenescence in the early stages of development in higher animals, and for weighing the author's reasons for rejecting Weismann's conception of the apartness of the germ-plasm. But it is a great satisfaction to meet with such a fine instance of resolute biological thinking, and we offer Prof. Child our congratulations.

(2) The author's main contribution to the problem of organic individuation is the demonstration of a distinct gradient in the rate of metabolic reactions along the chief axis of various axiate types. The apical or head region is primarily the region of highest rate of metabolism, and, in general, regions nearer to it have a higher rate than regions farther away. Moreover, in experimental

reproduction, "the apical or head region develops independently of other parts, but controls or dominates their development, and in general any level of the body dominates more posterior or lower levels and is dominated by more anterior or apical levels." The dominance depends primarily upon the rate of metabolism, and seems to operate by impulses, excitations, or changes transmitted in various ways from the dominant region to other parts of the body.

What Prof. Child seeks is a dynamic conception of the organism, and he maintains that "the individual is primarily a metabolic gradient in a specific protoplasm; the only primary difference between the dominant and other levels of the gradient is a difference of metabolic rate. At this time the products of metabolism at different levels of the gradient are not specifically different, but differ in quantity." But the differences in rate at different levels bring about, sooner or later, differences in constitution and character of the protoplasmic substratum. Here one stable substance and there another remains as a constituent of the colloid substratum. Thus "each level of the gradient develops a characteristic protoplasm, and the character of the protoplasm in turn modifies and alters the character of the reactions, and so specific, or what we call qualitative, differences arise, and different specific substances may be produced at different levels of the gradient." Then for the first time chemical or transportative correlation in the commonly accepted sense becomes possible. The individual is there before the orderly specificities of chemical correlation are present or possible. "The starting point in differentiation is in differences in metabolic rate." The organism is a dynamic reaction system—"a protoplasm of specific constitution with a corresponding metabolic specificity." Individuation is a relation of dominance and subordination of parts. Development is a realisation of the capacities or possibilities which are given in the physico-chemical constitution of the fundamental reaction system. We have said enough to indicate the trend of the author's exceedingly interesting theory, which is doubtless a good one to work with, though it seems to our prejudiced vision to leave half of the Prince of Denmark out of the play. For, colloid substratum and metabolic gradient notwithstanding, we must regard even Prof. Child's Planarians as psycho-physical beings, mind-bodies or body-minds as you will, but organisms as well as mechanisms through and through.

HYDRAULIC FORMULA RECONSTRUCTION.

Hydraulic Flow Reviewed. By A. A. Barnes. Pp. xi+158. (London: E. and F. N. Spon, Ltd., 1916.) Price 12*s.* 6*d.* net.

THE book is in two parts, the first of which deals with the flow of water in pipes and channels. The author had occasion to investigate certain conditions of flow in the Thirlmere aqueduct, which supplies water to Manchester, and, finding the variation in the coefficients of accepted formulæ unsatisfactory, he was led to review the whole subject of the laws of flow, with the result that he has devised a series of formulæ in which the coefficient is independent of variations in the size or gradient of the conduit. Taking the equations of five well-known experimentalists, which he styles "the more salient formulæ" on the subject, he shows that they are of the form $= \mathrm{K}m^{\frac{1}{2}}i^{\frac{1}{2}}$. He then points out that the square root indices of m (the hydraulic mean depth) and of i (sine of slope) are incompatible with a constant value for the coefficient k, for a particular class of pipe or channel. In accordance with the precedent set by Hagen and followed by Thrupp and others, he recommends the adoption of the more general expression $v = \mathrm{K}m^{\alpha}i^{\beta}$, and from the analysis of a considerable number of published data he is enabled to assign a series of values to K, α, and β which give consistent and satisfactory results when applied to a wide range of cases. The formulæ thus obtained are sixteen in number, of which we only quote the first as typical of the rest. For new asphalted cast-iron pipes the value is $v = 174{\cdot}1m^{{\cdot}769}i^{{\cdot}529}$. The results are plotted in diagrammatic form for reference, and the advantages of using a system of logarithmic co-ordinates (which give straight-line diagrams) for this purpose are pointed out.

In the second part of the book, dealing with the measurement of water by means of triangular notches, rectangular weirs, and circular orifices, the author discards the basic expression in common use, and advocates the application of the general formula adopted in part i., which he casts in the form $v = \mathrm{K}m^{\alpha}\mathrm{H}^{\beta}$. For a right-angled V notch this becomes:—

$$v = 2{\cdot}462m^{-{\cdot}00703}\mathrm{H}^{{\cdot}48703}$$

whence $\mathrm{Q} = 2{\cdot}48\mathrm{H}^{2{\cdot}48}$.

It is interesting to note that this latter expression corresponds very closely with the results obtained quite recently by Messrs. Gourley and Crimp in researches made on the river Alwen. Their formula reads:—

$$\mathrm{Q} = 2{\cdot}48n\mathrm{H}^{2{\cdot}47}$$

(n is the tangent of half the included angle of the notch, and, therefore, is unity for a notch of 90°).

For weirs with end contractions Mr. Barnes has determined:—

$$v = 3{\cdot}324m^{{\cdot}11}\mathrm{H}^{{\cdot}38},$$

and for weirs without end contractions:—

$$v = 3{\cdot}324m^{-{\cdot}02}\mathrm{H}^{{\cdot}51},$$

while for circular orifices:—

$$v = 4{\cdot}652m^{-{\cdot}015}\mathrm{H}^{{\cdot}5}.$$

There are a large number of authenticated results incorporated in the volume, tabulated in support of these equations, as well as plates giving the results graphically. The author claims that his formulæ are proved correct by experiment for quantities as small as 0·0034 cubic foot per second, by means of orifices, and as large as 320 cubic feet per second, by means of weirs.

As a concise and comprehensive *résumé* of the results obtained from a wide range of experimental work, combined with a striking revision of their mathematical expression, the volume is a welcome and valuable addition to the literature on the subject. B. C.

SERUM REACTIONS AND BACTERIAL THERAPY.

Applied Immunology: The Practical Application of Sera and Bacterins Prophylactically, Diagnostically, and Therapeutically. By Prof. B. A. Thomas and Dr. R. H. Ivy. Pp. xv+359. (Philadelphia and London: J. B. Lippincott Co., 1915.) Price 16*s.* net.

THIS book gives an account of those "reactions" employed in the diagnosis of disease which are based upon alterations in the body-fluids resulting from the action of micro-organisms or from the introduction of foreign proteins, and of the treatment of morbid conditions with serums, bacterial vaccines, etc. These reactions and treatment may be classed under the term "immunology," since they are based upon processes which commonly result in the living body in a state of immunity or resistance to the material—micro-organism or protein—which produces them. This material is named the *antigen*, and the substances which are the outcome of its action are known as *anti-bodies*.

The opening chapter of the book deals with the subject of immunity, its kinds and mode of production, and with the history and development of immunology; the second and third chapters give an account of antigens and anti-bodies and of Ehrlich's side-chain theory. These subjects are treated simply and briefly, but fully enough for the object of the book, which the authors state has been "to crystallise and detail the practical phases of serum and bacterin applications in medicine, thereby enabling the student and general practitioner, with even a slight laboratory experience, to appreciate the significance of, and more competently apply the principles underlying, immunology." In chap. iv. anaphylaxis or hypersusceptibility is described, but we miss any reference to Bordet's theory of its mode of production. The preparation and properties of the various antitoxins and anti-sera are then described, together with certain miscellaneous sera and extracts, and their use in treatment. While usually full enough, some sections appear to be too brief; thus, anti-tuberculosis sera are dismissed in four lines, and no mention is made of Spengler's I.K. serum.

The subject of agglutination and its use in diagnosis are next considered. Dilution of the serum by means of a Wright's pipette is described, but no mention is made of the "throttled" pipette which is so convenient for this kind of work, nor is the subject of "zones of no reaction" alluded to—an omission of some moment.

In chaps. x. and xi. the precipitin reaction and its application for the recognition of blood-stains, etc., and lysis or solvent action are described.

The important subject of complement fixation is next dealt with, and the employment of this reaction for the diagnosis of syphilis (the Wassermann reaction) naturally occupies the premier place. Full details are given of the method of carrying out this reaction, but we should have liked fuller information on the meaning of the phenomenon of fixation in the absence of antigen and on the reaction with cerebro-spinal fluid.

Miscellaneous biochemical reactions, including the Abderhalden reaction, have a few pages devoted to them; and the important subjects of the tuberculin and similar reactions and tuberculin therapy are next considered at some length, following on conventional lines.

The subjects of phagocytosis and recovery from bacterial infections are then dealt with, leading up naturally to a consideration of bacterial inoculations, the opsonic index, and vaccine therapy. This section is somewhat slipshod, for the authors have not clearly distinguished between *preventive* and *therapeutic* inoculations. Thus it is stated that "treatment" of bubonic plague with bacterial suspensions has been extensively practised, and that "therapeutic" inoculation greatly reduces the severity of attacks; in both cases *preventive* treatment or inoculation is really meant.

In an appendix the serum treatment of hæmorrhage, organotherapy, and chemotherapy with salvarsan, etc., are briefly but sufficiently considered.

The book is illustrated with a number of figures, charts, and plates, some of the last-named being coloured. We notice an error occurring throughout the chart illustrating the Wassermann reaction, the incubation temperature being stated to be 56° C. instead of 37° C.

The book, while capable of improvement in many directions, may be recommended as giving a useful survey, free from too much detail and technicalities, of the subject of immunology.

R. T. HEWLETT.

SCHOOL MATHEMATICS.

(1) *Analytic Geometry.* By Prof. H. B. Phillips. Pp. vii+197. (New York: John Wiley and Sons, Inc.; London; Chapman and Hall, Ltd., 1915.) Price 6*s.* 6*d.* net.

(2) *Problems in the Calculus, with Formulas and Suggestions.* By Dr. D. B. Leib. Pp. xi+224. (Boston, Mass., and London: Ginn and Co., 1915.) Price 4*s.* 6*d.*

(3) *Mathematical Tables for Class-room Use.* By M. Merriman. Pp. 67. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 2*s.* 6*d.* net.

(4) *Rural Arithmetic.* By A. G. Ruston. Pp. xi+431. (London: University Tutorial Press, Ltd., 1916.) Price 3*s.* 6*d.*

(1) PROF. H. B. PHILLIPS believes that the differential calculus should be given to the student in college at the earliest possible moment, and that to accomplish this a short course in analytic geometry is essential. He

has therefore written this text to supply a course that will equip the student for work in calculus and engineering, without burdening him with a mass of detail useful only to the student of mathematics for its own sake. The result is a very attractive little book. The author has picked out the easy and fruitful bits of his subject without concerning himself greatly whether the topics chosen are conventionally elementary or advanced. He gives us a book very different from the stock "analytical conics," for the conic falls into its place among other curves, and is not studied under a microscope. For example, we have nothing about the equation of the tangent to a conic; presumably the author would take tangents after dy/dx. On the other hand, we have sections on periodic functions, empirical equations, parametric representation, co-ordinates in space, surfaces. The book is one that might very well be used with a class of intelligent non-specialists in their last two years at an English public school, at a stage when the function of mathematics is to broaden their outlook. It would serve equally well as an introductory course for a specialist.

The book is full of pleasing practical touches—*e.g.* "But on other problems, *notably in work with alternating currents,* an interpretation can be given to the process of extracting the square root of a negative number, and then such results are entirely real."

(2) Most English text-books on the calculus are fairly well provided with exercises, but anyone who wants more will find a good collection here. The sets on maxima and minima are especially practical. Students of foreign fashions in notation will note the absence of $\sin^{-1}$; arc sin is used instead. The hyperbolic functions have not found admission, which seems a pity. The sets of exercises are prefaced by brief directions and plain warnings; the directions however are, from an educational point of view, too much in the way of rules—*e.g.* "To find d^2y/dx^2 (when x and y are given as functions of t) use the somewhat cumbersome formula

$$\frac{d^2y}{dx^2}=\left(\frac{dx}{dt}\cdot\frac{d^2y}{dt^2}-\frac{dy}{dt}\cdot\frac{d^2x}{dt^2}\right)\Big/\left(\frac{dx}{dt}\right)^3,$$

etc." (p. 29). On p. 81 the precise meaning of "in general" is not clear in the sentence: "Expansion into series is, in general, useful in calculations only when the series is convergent."

(3) This book contains many more tables than are commonly used in British class-rooms—*e.g.* cubes and cube roots, tables of $n^{\frac{1}{2}}$, n^5, $n^{\frac{1}{4}}$, $n^{\frac{1}{5}}$, $n^{\frac{1}{6}}$, areas and circumferences of circles, volumes of spheres, circular segments, chords, etc., together with five pages of weights and measures (from which it appears that the American yard differs from the British yard, being defined as 3600/3937 metres). On the other hand, there is no full table of secs and cosecs. Sine and cosine share a table, as do tan and cot. The "arguments" are given to three significant figures, or for every ten minutes in the trigonometrical tables. There are no difference columns, and to obtain a fourth significant figure, or the intermediate degrees, it is necessary to interpolate. Some of the functions are given to four significant figures, some to five; the principle underlying the choice of four or five is not mentioned. The author has broken with the curious tradition (the origin of which we should like to know) that ten should be added to the log of a circular function.

For British schools this book will probably be considered to contain too much in one way and too little in another (*e.g.* difference columns). The type is too small for young eyes.

(4) This book contains chapters on household accounts, commercial arithmetic, business letters, soils, manures, crops, live-stock, foodstuffs, dairying, mensuration, levelling, brickwork and building construction, water supply, work and power, measurement in the field. The explanations of arithmetical processes are undistinguished and sometimes old-fashioned (*e.g.* inverting the multiplier in contracted multiplication). But we imagine that this is not the part of the book in which the author is most interested. The description of all practical matters concerning farms and farmers is well written, and the numerous examples have a most realistic and practical appearance. How much more interesting it must be to find the volume of a "mangel pie" than of a mere prism! C. G.

OUR BOOKSHELF.

Aids to Bacteriology. By C. G. Moor and William Partridge. Third edition. Pp. viii+278. (London: Baillière, Tindall and Cox, 1916.) Price 3*s.* 6*d.* net.

THIS well-known little book, now in its third edition, contains an extraordinary amount of information within a small compass, though necessarily in a condensed form; in fact, the whole range of subjects included under the term "Bacteriology" is covered by it. Migula's classification of the Bacteria now replaces that of Heuppe, and as regards bacterial mutability, the authors remark that this is largely of academic interest, and that in practice species tend to crop up fairly true to type. Antibodies, apparatus, culture media and methods of examination are surveyed, and all the principal pathogenic bacteria and protozoa are described. In addition, the moulds, yeasts, fermentation, and enzymes are dealt with as well as the bacteriology of water, milk and other foods, air, soil and sewage, and disinfection and disinfectants; little seems to have been missed and few errors occur. It is a pity that *B. perfringens* as a synonym for *B. Welchii* is not mentioned, for it is so commonly used now. Agricultural bacteriology has two or three pages devoted to it, including nitrogen fixation, nitrification and sterilisation of soil. The filterable viruses are dealt with, and some recent work on the meningococcus and other topics is referred to in a brief appendix. Altogether we may congratulate the authors upon having compiled an exceedingly comprehensive and useful little book.

Mind and Health Series. The Influence of Joy. By George Van Ness Dearborn. Pp. xviii+223. (London: William Heinemann, 1916.) Price 5*s.* net.

PROF. PAVLOV of Petrograd has shown in famous experiments that digestion is affected favourably or unfavourably by emotional conditions, and his work has been followed by Cannon, Carlson, Crile, and others. The author of this volume has studied the influence of joy on blood pressure, and has devoted some attention to the psycho-biology of the emotions. His thesis is that joy is an important factor in the health of the body, and his illustrations refer to the influence of joy (1) in stimulating secretion, the movements of the food canal, and the process of absorption; (2) on the circulation; and (3) on the general integrative function of the nervous system.

The evidence given as to the influence of joy on secretion and blood pressure is more convincing than that under the third head. Much attention is given to the influence of emotion on the secretion of adrenalin and all that follows even a slight increase in the amount of that powerful substance.

The author writes with enthusiasm and occasionally with exuberance, but it is with good science that he confirms the good sense of the cheerful-minded in all ages, who have realised that "a merry heart is the life of the flesh." There is much salutary counsel in what Prof. Dearborn has to say regarding the cultivation of the will to be glad, and he has made a very useful contribution to psycho-biology.

Manual of Russian Commercial Correspondence. By Mark Sieff. Pp. xx+232. (London: Kegan Paul, Trench and Co., Ltd., 1916.) Price 3*s.* 6*d.* net.

THIS is a welcome addition to the student's library. Admirably qualified for the task, the author has compiled a veritable *multum in parvo*, and the student who masters its contents will have little to apprehend when called upon to deal with Russian correspondence. A valuable feature is the section, modelled on the plan adopted by N. A. Blatov in his "Manual of Russian Commercial Correspondence," setting forth with admirable clearness the general plan on which letters on various subjects should be constructed. It constitutes a lesson in orderly arrangement and concise statement which might be profitably studied by correspondents in any language. Where so much is excellent it seems almost hypercritical to point out that the English phraseology is in places somewhat cumbersome and might with advantage be simplified, and also that here and there the English idiom is not quite correct. But these are minor blemishes which in no way detract from the utility of the work. As it is one thing to read print and a very different matter to decipher handwriting, we would suggest that it might be of assistance to students if a future edition contained a few facsimile specimens of actual Russian letters.

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.*]

Optical Deterioration of the Atmosphere in July and August, 1916.

DR. MAURER, director of the Swiss Federal Meteorological Institute, has forwarded to me a note on the optical deterioration of the atmosphere noticed in the Alps in the summer which has just passed. At his request I enclose a translation of his note, as the subject is likely to interest your readers.

NAPIER SHAW.

Meteorological Office, South Kensington,
London, S.W., September 21.

Remarkable optical deterioration of the atmosphere became apparent in the Swiss Alps during the last ten days of July by the persistently abnormal magnitude and unusual intensity of the bright patch round the sun, to which the name aureole is sometimes assigned. Observations in previous years have established a well-defined minimum during the summer months, both in the diameter and the intensity of the solar aureole, but during the present year, from July 23 until the middle of August, the diameter generally attained 120° to 130°, and on August 25 even 140°, with relatively great intensity. Abnormal extension of the aureole was also observed after July 21 at high levels on the Alps, above 3000 metres, and a true brown Bishop's-ring was seen on August 3–4 on the high peaks of the Upper Engadine.

On August 6 twilight phenomena were very abnormal. The "purple light" was entirely absent; the westerly earth-shadow was very indefinite, and the eastern twilight-arch of the zodiacal light was similarly affected. The western sky, at first of a homogeneous pale yellow colour, showed a peculiar cirrus-like structure for some time after sunset. At first the stratification was strictly horizontal, but later on it appeared undulating, or in flaky form. It did not disappear until darkness set in. Similar phenomena were observed in 1883–4, 1902–3, and 1912, in connection with the much-discussed optical deterioration of the atmosphere in these years. After the end of July this remarkable cirrus-like layer could be seen best in the higher Alpine regions, but a bright "purple light" was not seen there either in July or August. The cause of the deterioration is for the time being still in doubt. Up to the present no reports of volcanic eruptions have come to hand from any part of the globe.

Zürich, September.

Science in Education.

IN reply to "F.R.S.; F.B.A." (NATURE, September 28, p. 69), may I express the hope that, whatever may be the custom in France, those who discuss the place of science in education, when they say science will mean science, and not "Egyptology, classical archæology, history, art, linguistics, Indics, Sinics, Hellenics, philology (Latin and Celtic), French language and literature, Italian, Spanish, English, German, law, and economics"? No one wants to deny that the study of man holds as large a place as the study of Nature. Man has never yet tired of studying himself, and needs little encouragement to continue doing so. But the progress of the modern world is due to the fact that an increasing number of minds have escaped the vicious circle of these introspective examinations and begun to study the realities of external Nature.

Mr. Carnegie in 1901 gave a million pounds to provide funds "for improving and extending the opportunities for scientific study and research in the Universities of Scotland, my native land," to quote from his trust deed. In the University of Aberdeen, of which I have the honour to be a member, out of 132,000*l.* allocated from this benefaction in the period of $15\frac{3}{4}$ years, a bare one-quarter has gone to science; 52,118*l.* has gone to endow one professorship in history and five lectureships in French, political economy, German, education, and constitutional law and history; 24,750*l.* has been assigned to provide new buildings for teaching arts subjects, a new examination hall, and an extension of the library; 26,750*l.* has gone, 15,750*l.* to maintenance of the library and 11,000*l.* for provisional assistance in teaching, science being represented in this to an indefinite extent. The remaining 28,382*l.* has gone to science, 15,750*l.* for the equipment of laboratories, and 12,632*l.* as an endowment for a lectureship in geology. With reference to the latter, the Geological Department, taking the figures for the year before the war, was entirely supported by the fees paid by the students, and geology got the interest of the 12,632*l.* in the same sense as the Postmaster-General gets the sovereign when you purchase a 20*s.* postal order. Personally I think calling science what is not science needs to be watched and checkmated.

FREDERICK SODDY.

University of Aberdeen, September 30.

AN IMPERIAL DEPARTMENT OF MINERAL PRODUCTION.

THE presidents of the technical institutes most closely connected with the production and utilisation of our mineral resources have addressed to the Advisory Council for Scientific Research a memorandum advocating the establishment of a central Government Department, the duty of which should be to foster the development of the mineral resources of the British Empire. Whatever form such a department may take, the need for its creation is very obvious. In Great Britain no such department exists. The Geological Survey, under the Board of Education, records the existence of mineral deposits, but always from the point of view of the geologist, whose main interest lies in their mode of occurrence and not in their exploitation. The Inspectorate of Mines under the Home Office is concerned only with the due policing of mines from the point of view of safety; its ideal would be a state of affairs in which mining accidents were reduced to zero; and even though this were brought about by the cessation of all mining, the Inspectorate of Mines would have fulfilled the object for which it exists. The Board of Trade, the Imperial Institute, and many other departments of the Government take a more or less desultory interest in mineral production, but there is no one department the special duty of which it is to watch over the development and proper utilisation of our mineral resources.

What is needed is a Ministry of Production, or something equivalent thereto, which should have for its particular object the care of developing all the natural resources of the Empire. All natural products may be divided into three groups: they are produced by the cultivator, by the hunter or fisherman, or by the miner. Of all these the last-named needs the most careful attention, because minerals alone constitute a wasting asset; unlike the other products, they are not renewed, and, once exhausted, are gone for ever. The cultivation of a field on wrong principles will entail losses for a year or two, but these are quite remediable, and the application of proper methods will restore it to fruitfulness; but a mine worked on wrong principles is ruined for ever, and mineral not properly wrought is in the vast majority of cases lost irrecoverably.

It is this consideration that renders the need for a Ministry or Department devoted to the administration of our mineral resources so very urgent. In most Continental countries the minerals have remained the property of the State, and the State has therefore a direct pecuniary interest in seeing to their development as an integral part of the national revenue. In this country and in America the State has found it advantageous to relinquish the State ownership of minerals, it being held that the development of the national mineral resources is thus facilitated, and that such free development is of more benefit to the nation than the revenue which might be derived from its mineral concessions. As regards purely fiscal reasons, these two nations are accordingly not directly concerned in the development of their mineral wealth, but it by no means follows that they should treat the subject with indifference. In the United States there is a Department of Mines that takes a very active interest in encouraging the mineral output. In Canada there is a Department of Mines upon somewhat similar lines, which is doing excellent work, and under the fostering care of which the mineral output of Canada is making rapid advances.

There was a time when Great Britain stood at the head of all nations as a mineral producer, at any rate as regards a considerable number of important minerals and metals; that we have fallen far behind to-day is due no doubt in great measure to natural causes, but their effect has been and is being accelerated by the fact that it has been nobody's business to see to it that our mineral resources were worked to best advantage; whenever legislation has touched mining, it has been to hinder, not to help, mining operations, mainly because there was no great Department of State to look after our mineral interests. Wastefulness in the production and utilisation of our mineral resources has gone on and is going on unheeded and unchecked, mainly again for the same reason. The need for a State Department administered on sound economic lines, as free from political bias as our national methods admit of, is perhaps more urgent for the British Isles in the first instance, but together with this and above this, there should be an organisation for protecting the mineral industries of our whole world-wide Empire, for consolidating the resources of the Empire, and for rendering it impossible that in the future the control of any portion of the Empire's mineral production should ever pass into alien hands.

HENRY LOUIS.

THE SURVEY LINK CONNECTING THE TRIANGULATIONS OF INDIA AND RUSSIA.[1]

AT the meeting of the International Geodetic Association held in London in 1909 the way was cleared for the completion of a connecting link between Indian and Russian triangulations which would carry scientific measurement from Cape Comorin to Petrograd. This necessitated the extension of a geodetic series across some of the highest and most unapproachable of the snow-capped ranges in the northern Himalayan system. Between Gilgit and Salisbury Peak on the Nicolas (Russian spelling) range of the Pamirs there intervene about 100 miles of inconceivably wild and rugged mountain country distinguished

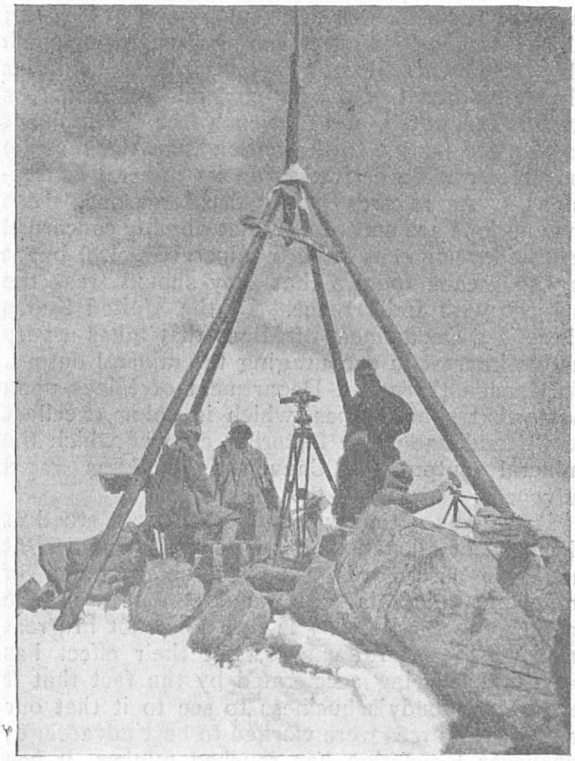

FIG. 1.—On the Russian East Station of Sarblock, 17,284 ft. From "Records of the Survey of India."

by groups of peaks running to altitudes of more than 20,000 ft. and seamed with a most amazing series of waterways containing the biggest glaciers in the world. Salisbury Peak, near the western end of the Pamir boundary between Russia and Afghanistan, looks southwards across the valley of the river Ab-i-Panja (flowing westward to the Oxus and skirting the southern foot of the Nicolas range) on to the great ridge of the Hindu Kush. From the Hindu Kush southward to the Gilgit river flow three great mountain streams, which afford the only possible approaches northward, *i.e.* the Yasin, the Ashkuman, and the Hunza.

[1] "Records of the Survey of India." Vol. vi., "Completion of the Link connecting the Triangulations of India and Russia, 1913." Prepared under the direction of Sir S. G. Burrard. (Dehra Dun, 1914.) Price 4 rupees or 6*s*.

Setting aside, for the present at any rate, any consideration of making this geodetic connection through Afghanistan or Persia (which, for political reasons chiefly, is out of the question), the choice of an approach to the Russian boundary in the Pamirs lay between these three most difficult routes. The line of the Hunza was eventually selected as leading more directly to a point on the Russian border close to the Chinese frontier, and involving no question of crossing the valley of the Ab-i-Panja, which, lying low between the Nicolas range and the Hindu Kush, is a narrow strip of Afghan territory. Between 1909 and 1911 a series of principal triangulation had been carried

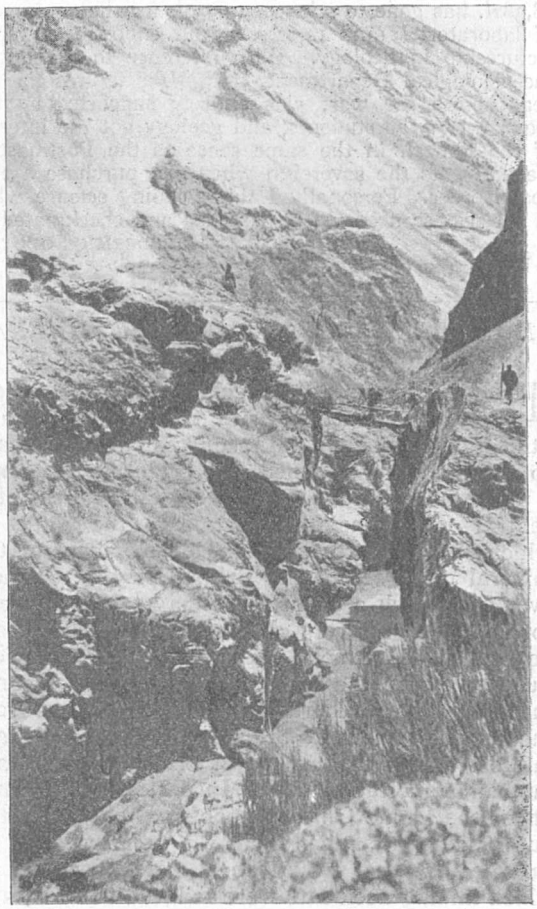

FIG. 2.—A log bridge over the Chapursān. From "Records of the Survey of India."

from Rawal Pindi to Gilgit, thus furnishing a first-class base from which to take off for this northern extension. At the other end of the line two trigonometrical stations had been fixed by the Russian surveyors at the eastern end of the Little Pamir, not far from the Beyik Pass, which offered the necessary points for final connection.

The report under review deals with the efforts of the Indian Survey officers to bridge this gap and reach commanding observation points in the barren and rugged *entourage* of the Hunza Valley, by means of which a geodetic series could be carried successfully to the Hindu Kush. Probably no scientific surveyors in the world have ever

been faced with quite such a problem. The difficulties were not merely those of mountaineering and excessive altitude or of narrow valleys flanked by gigantic mountain walls. These regions are subject, *inter alia*, to storms of great violence and suddenness, and it was during one such storm that the camp of a native assistant was struck and his whole party practically put out of action. The roads, or mountain tracks, which lead to the passes of the Hindu Kush have often been described by travellers, and there is no indication in this report that they have improved of late years. Certainly no very great trouble was caused by the nature of the transport requisitioned. All sorts and conditions of men were impressed into service. The regular native staff of the Survey Department and the trained Gurkha assistants drawn from the frontier regiments were all trustworthy under any conditions of stress and difficulty, whilst the coolie carriers, who were chiefly recruited from the Baltis, were quite satisfactory. Lieut. Mason's appreciation of their services is pleasant reading, and speaks well for his tact and consideration in dealing with natives.

It was, on the whole, the technical difficulty of selecting sites for stations of observation, and the incessant demand for strenuous exertion in climbing mountains which possess absolutely no attraction beyond that of the grandest and most savage scenery in the world, which hindered the progress of the party; and it was the successful facing of these difficulties which rendered the completion of this series such a brilliant achievement among the great records of Indian triangulation.

The work in the Pamir highlands was laid out by Lieut. Bell, R.E., whose sudden death ere the work was completed was deeply felt by the whole party. The linking up of two magnificent systems of triangulation, such as those of India and Russia, which would give a continuous and unbroken geodetic system of earth measurement through sixty degrees of latitude, has ever been a most fascinating objective to the scientific geodesist in India, Russia, and England; but whether a narrow series such as this, with uneven sides and angles as factors in the successive figures, will fully satisfy the requirements of geodesy may be questionable. Some of the sides of the figures are very short, restricted by narrowness of the Hunza Valley, and the angles are far from fulfilling the condition of equality in arc. It is, therefore, not claimed for it by the Surveyor-General of India that it represents anything more than a "secondary" series, and it still remains for geodesists to say how far it has succeeded in fulfilling the high scientific requirements that were anticipated from its completion. Incidentally, however, it has been of the greatest practical use, for it has confirmed the values determined by the measurements of the Pamir Boundary Commission in 1895, and proved that the process then adopted of interpolation from distant and definite peaks (which were already fixed by the Indian triangulation on the Gilgit frontier), supported by a constant repetition of observed azimuths, was accurate to a degree which seems to have been unexpected by the present Survey Staff in India, although the coincidence in final values causes no

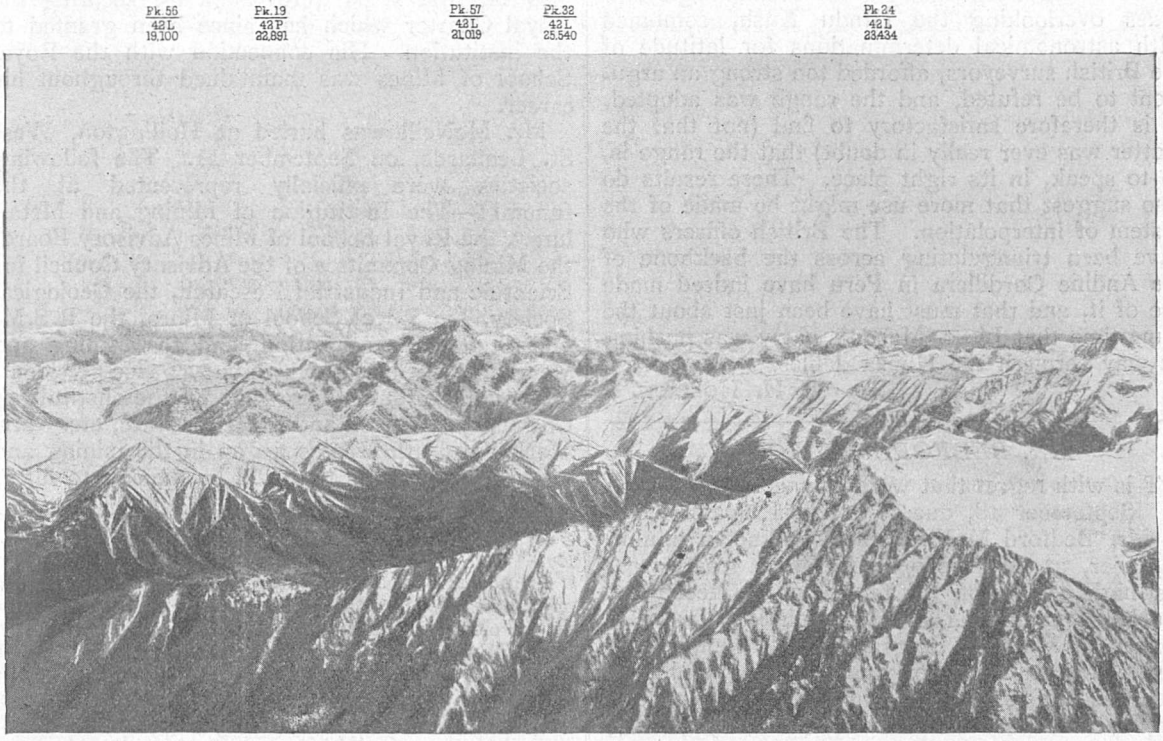

FIG. 3.—The distant Karakoram Range from Tomtek, h.s. 18,608 ft. From "Records of the Survey of India."

surprise to those who were concerned in that Commission work. Roughly, it may be said that the Commission values obtained in the course of a month or two by the method referred to are in excess of those now fixed by about two seconds of arc both in latitude and in longitude, a displacement which has no effect whatever on the validity of that international boundary which was then demarcated.

This is not unimportant, for it need be no longer a political secret that the adoption of the crest of the Nicolas range as the boundary in question depended on the fact that no part of it was north of the latitude of Lake Victoria. The Russians, by astronomical deduction, maintained that it did in fact bulge over that parallel, but the results of the Pamir triangulation, based on those mighty peaks which were visible from certain high altitudes overlooking the Hindu Kush, combined with astronomical determinations for latitude of the British surveyors, afforded too strong an argument to be refuted, and the range was adopted. It is therefore satisfactory to find (not that the matter was ever really in doubt) that the range is, so to speak, in its right place. These results do also suggest that more use might be made of the system of interpolation. The British officers who have been triangulating across the backbone of the Andine Cordillera in Peru have indeed made use of it, and that must have been just about the same time that Lieut. Mason's party was pushing its way through the Hunza defiles.

T. H. HOLDICH.

MR. BEDFORD MCNEILL.

IT is with regret that we announce the death on September 18, due to cerebral hæmorrhage, of Mr. Bedford McNeill, the well-known mining engineer, at fifty-five years of age. Apart from his high reputation as a mining engineer, Mr. McNeill's name was almost a household word in connection with the telegraphic code compiled by him, which was issued originally in 1893, and in an enlarged and revised form in 1908. This code is employed almost without exception by mining companies and engineers, to whose use it was specially dedicated, and other business men have found it extremely practical for cable communications.

As a mining engineer Mr. McNeill graduated at the Royal School of Mines in 1880, when the school was still in Jermyn Street; and his professional career as consulting engineer, which began in the office of the late Mr. John Darlington, took him into many parts of the world. He was a member of many learned societies, including the Institute of Chemistry, the Geological Society, of which he was also a Member of Council and Treasurer for some years, and the Iron and Steel Institute. In 1895 Mr. McNeill was elected a member of the Institution of Mining and Metallurgy, of which he soon afterwards became vice-president, and he occupied the presidential chair in 1913–14. His inaugural address in that capacity dealt with the present and future problems confronting the mining profession, particularly as regards the speculative nature of mining and its close association with capital. He pointed out that mining was likely to become more speculative in its character in the future, since, though there were still large areas not yet properly prospected, the engineer may ultimately be driven to working that class of mineral occurrence which presents no visible evidence whatever at surface, and the location and working of which will inevitably demand higher technical skill and involve greater risk of loss of capital than those deposits at present dealt with. During Mr. McNeill's term of office the Institution of Mining and Metallurgy acquired its freehold house at No. 1 Finsbury Circus, which was formally opened on January 13, 1914, by the Lord Mayor of London, and during his presidency also the first steps were taken for securing the Royal Charter which has since been granted to the institution. His connection with the Royal School of Mines was maintained throughout his career.

Mr. McNeill was buried at Hollington, West St. Leonards, on September 21. The following societies were officially represented at the funeral:—The Institution of Mining and Metallurgy, the Royal School of Mines Advisory Board, the Mining Committee of the Advisory Council for Scientific and Industrial Research, the Geological Society, the Royal School of Mines, the R.S.M. Old Students' Association, and the Mining and Metallurgical Club, of which he was vice-president, while floral tributes were sent by the Institute of Chemistry, the Iron and Steel Institute, etc. Mr. McNeill's death creates a gap in the mining and kindred professions that will be difficult to fill.

NOTES.

AN account of a new means of delineating internal organs *in vivo*, and the localisation of injuries to them, by an electrical method devised by James Shearer, M.D. (Washington, D.C.), at present a sergeant in the R.A.M.C., is given in the *British Medical Journal* for September 30. It is difficult to realise from the description the exact nature of the electrical installation used, but the principle is said to be to impose upon two alternating electric fields of equal strength at right angles the effect of a third field having its origin in the organ under examination. The patient lies on an insulated table, and near him are placed two screens of perforated zinc plate, one horizontal and the other vertical, connected to two separate batteries. A sheet of waxed paper is then put upon a cylinder which is set in rapid rotation, and a needle scribes upon this paper a tracing of the organ under examination, showing at the same time any lesions in it. Prints can afterwards be taken from the record by contact printing with photographic paper. Five illustrations are given in the *British Medical Journal* showing respectively pictures of the brain, kidney, cæcum and appendix, intestine, and liver of injured patients submitted to the process. The brain picture is as clear a delineation of the blood-vessels as is given in text-books of anatomy, but how it could possibly have been produced by a tapping needle upon a rapidly revolving cylinder cannot readily be conceived. Without further details to enable electro-physiologists to repeat Sergeant Shearer's work it is

impossible to say more than that the results, if confirmed, represent a very remarkable discovery, which may be of immense advantage in delineating the soft internal structures of the body. So many inventions at first received with incredulity have turned out to be truly useful that we hesitate to speak of this present one as incredible. But with the imperfect details and explanation which are as yet forthcoming, we may be excused if we adopt the attitude of scientific expectancy. We trust it will not be long before the new method is examined by proper experts, and its scientific soundness properly investigated.

AT 3 a.m. (Summer Time) on Sunday last, October 1, Greenwich Time again became the standard time of Great Britain. By an order issued by the Home Office, "the hour 2–3 a.m. Summer Time" was followed by "the hour 2–3 a.m. Greenwich Time." All railway clocks and clocks in post offices and Government establishments were put back one hour, and the Government requested the public to put back the time of all clocks and watches by one hour during the night of Saturday-Sunday, September 30-October 1. From October 1 onwards Greenwich Time will be used for all purposes instead of being limited to the needs of navigation, astronomy, and meteorology, as it has been since May 21. It is announced that the Home Secretary, while satisfied with the results of the Summer Time Act, has appointed a committee to consider the question in all its aspects. A Daylight Saving Bill will probably be reintroduced next year, but Mr. Samuel thinks that certain objections, coming chiefly from northern manufacturing districts, and a number of suggestions and recommendations should be inquired into first. The late experience has shown that the State need not hesitate to introduce any changes which are believed to be for the good of the community. In NATURE of September 28 a correspondent suggested certain modifications of the customary use of a.m. and p.m., so as to avoid the designation of half an hour after midday by 12.30 p.m., while 11.30 p.m. occurs eleven hours later. Mr. C. T. Whitmell writes to say that he made the same suggestion in the *Yorkshire Post* of August 4, and remarks that "some definite agreement as to the way of representing the times between noon and 1 p.m. and between midnight and 1 a.m. is certainly desirable." The Home Secretary's committee might consider this matter, and also the question of designating hours from 0 to 24, so as to avoid the use of a.m. and p.m. altogether.

MR. BENJAMIN KIDD, the author of important books and articles in which a system of social philosophy is developed from an original point of view, died on October 2, at fifty-eight years of age. His first work, "Social Evolution," is the best known, and when it was published in 1894 its originality and force were recognised immediately. The keynote of the work was the declaration that religion is not the enemy of science and enlightenment, but, on the contrary, through the ethical principles of its teaching, has been one of the most important agencies in social development, and is closely bound up with that portion of our nature to which all modern social advance is due, and by which the course of future progress will be decided. Mr. Kidd thus found the causes of the evolution of society and of modern civilisation, not in the growth of intellect and of science, but in the continuous action of religious beliefs. In 1898 was published his book, "The Control of the Tropics," which directed attention to the importance of the tropics in the development of civilisation; and in 1902 appeared his "Principles of Western Civilisation," which made "efficiency in the future" the determining quality of social development. This "projected Arkhangel Society is raising a fund of 2500*l.* to be spent during the next three years in prizes for information throwing any light on the fate of the explorers. It is almost impossible that there can now be any survivors.

THE *Philippine Journal of Science* for January contains an interesting paper by G. W. Heise on the for the eleventh edition he wrote the article on sociology. In 1908 he delivered the Herbert Spencer lecture at Oxford upon the subject of "Individualism and After."

A SKIEN newspaper announces the discovery in Telemark, Norway, of a rich mineral field covering several kilometres. Bismuth and silver have been found there, and it is said that there are traces of gold.

THE Faraday Society will hold a general discussion on "Refractories" at its first autumn meeting, the date of which is provisionally fixed for Wednesday, November 8. The discussion will be presided over by Sir Robert Hadfield, president of the society, and the opening paper will be read by Dr. J. W. Mellor.

A LECTURE on "Stresses in Transparent Materials as Revealed by Polarised Light" will be delivered by Prof. E. G. Coker before the Optical Society on Thursday next, October 12, at the rooms of the Chemical Society, Burlington House, Piccadilly, W.

ACCORDING to the *Times* a "meteorite (commonly known as a 'thunderbolt')" fell at Dinas Powis, near Cardiff, on the night of September 26–27, and did some damage. The cause of the damage was, however, not a meteorite, but a lightning-flash. There had been thunderstorms on or about the same day of the month in the previous May, June, and July, whilst it was on March 27 that the famous storm occurred.

MR. LLOYD GEORGE'S allusion to the absence of the nightingale from Wales has caused a long and sharp discussion in the local Press. It is authoritatively stated that during the last thirty years the nightingale has been steadily moving westward in the Principality. In East Glamorgan it is a regular visitor, but has also been reported from Carmarthen, and was heard as far west as Aberystwyth in 1911.

A WIRELESS station has been established on Dickson Island, at the mouth of the Yenisei, by an expedition under the leadership of Dr. Kuchakov, for the purpose of sending meteorological telegrams to the physical observatory in Petrograd. The value of these telegrams will be felt chiefly in Siberia.

DURING the past summer a party of forty men, including five engineers, has been working the large coalfield on Bear Island, between Spitsbergen and Norway. The field has proved of greater extent than was anticipated, and the coal seams crop out on the north side of the island. A cargo has already been dispatched, and it is possible to continue the export throughout the year. The Norwegian Government proposes to establish wireless and meteorological stations there.

the case of small divergences from a state of steady motion no such representation is possible; (2) in the case of small oscillations three planes are insufficient, but it is possible to represent the system by six surface-elements, namely, two in each of the three coordinate planes.

WHILE the claims of Napier as the discoverer of logarithms have received ample recognition in connection with the tercentenary celebration in 1914, it is interesting to notice that a system

surprise to those who were concerned in that Commission work. Roughly, it may be said that the Commission values obtained in the course of a month or two by the method referred to are in excess of those now fixed by about two seconds of arc both in latitude and in longitude, a displacement which has no effect whatever on the validity of that international boundary which was then

THE Y.M.C.A. is organising a series of microscopic exhibitions in the military and naval camps for the interest of the men in their leisure hours. An organising committee consisting of fellows and members of the Royal Microscopical Society, Quekett Microscopical Club, and the Photomicrographic Society has been formed, and already many fixtures have been made for exhibitions to be held in the Y.M.C.A. huts in various centres throughout the metropolitan area and the home counties. The exhibitions generally take place in the late afternoons or the evenings, and ladies and gentlemen who can spare the time to give service with their microscopes are invited to communicate with the hon. sec., Microscopical Department, Y.M.C.A., Tottenham Court Road, W.

SIR WILLIAM ASCROFT, a pioneer advocate of technical education, died on September 29, in his eighty-fifth year. He was president of the council of the Harris Institute, Preston, for more than thirty years (resigning in 1912), one of the original members of the council, and one of the trustees. The *Preston Guardian* remarks:—"Sir Wm. Ascroft's zeal for education, and particularly technical education, made the Harris Institute not only an incalculable benefit to Preston, but also one of the most influential pioneers of technical education in this country, setting an example which has been followed in many other centres. It was in recognition of his great services in this connection that his name was included in the list of Royal birthday honours in 1908."

IN the *South African Journal of Science* for June the Rev. S. S. Dorman deals with the question of the ruins at Zimbabwe and other sites in Rhodesia from the point of view of native tradition. He rejects the views advanced by Bent, Peters, and Hall that these buildings were erected by Semites, or under Semitic influence, from 2000 B.C. to A.D. 900. He has recorded the evidence of two intelligent natives, who allege that the buildings are of comparatively recent age, and that they were probably abandoned under pressure from marauding tribes. The so-called "temple" is now said to be only the residence of the chief, and the writer states that the buildings at Zimbabwe have not an appearance of antiquity, and that from the amount of weathering they do not appear to be more than 500 years old. He also produces evidence to show that gold mining was carried on by the natives at sites where these ruins do not exist, and he sums up by saying:—"As a large part of the Semitic theory of the origin of Zimbabwe and its associated ruins rests upon the ignorance of the natives of rock mining and the excessive antiquity of the mines, the bottom is absolutely knocked out of it by these and similar facts."

IN spite of adversity, the Geological Society, stone

which he was also a Member of Council and Treasurer for some years, and the Iron and Steel Institute. In 1895 Mr. McNeill was elected a member of the Institution of Mining and Metallurgy, of which he soon afterwards became vice-president, and he occupied the presidential chair in 1913–14. His inaugural address in that capacity dealt with the present and future problems

hitherto undescribed, and not even marked on the maps of the Ordnance Survey. At Greenhill a new ogham stone, with a fragmentary inscription, has been recently discovered; the Island group of monuments in the parish of Rahan forms a remarkable collection, and the stone circle at Lissard, in the parish of Grenagh, is fairly complete. On the whole, in this communication as many as eighty-five examples are described. This large collection from a small area shows the great abundance of these monuments, and the need for a complete survey of the whole of Ireland before these valuable antiquities are destroyed.

WITH the conception of the cancer problem as essentially a biological problem English readers have been familiar for many years, and Prof. L. Loeb's summary of the present position in the September number of the *Scientific Monthly* will be generally accepted. In several matters of detail, however, it is doubtful if his formulation of the problems will be useful. The attempt to separate the internal and external factors, as, for example, heredity and chronic irritation, disregards the fundamental truth that the influence of chronic irritation in the causation of cancer can only be conceived as acting through modification of the intracellular mechanism. It is a pity that the article does not distinguish between hypothetical views and generally accepted truths. An example of this is the statement that cancer of the mamma in mice cannot develop in the absence of a rhythmical repeated stimulus from the ovaries, although Loeb himself claims to have proved that the diminution of spontaneous mammary cancer in mice by castration can only be obtained if it is performed before sexual maturity. The contrast between spontaneous and transplanted cancer and the nature of immunity to the latter are well brought out. The paper ends with an attempt to combine the parasitic hypothesis of cancer etiology with the purely biological conceptions of its nature, mainly on the assumption that the explanation of the proliferation of cancer is to be found in analogies with the plant tumours caused by the *Bact. tumefaciens* and the bird tumours discovered by Peyton Rous to be due to a filtrable virus.

THE September issue of the *Journal of the Board of Agriculture* contains a useful summary of the results of co-operative experiments carried out in the years 1911–13, under the auspices of the Union of German Experiment Stations, with the view of obtaining further evidence as to the validity of the so-called "citric solubility" as a measure of the fertilising value of basic slag. The question is one which has aroused much controversy in recent years in Germany and also in this country, and has acquired considerable practical importance through the official recognition of the conventional Wagner method of determination of "citric solubility" in the Fertilisers and Feeding Stuffs Acts and regulations made thereunder. With one exception the reports from the five experiment stations co-operating in the tests are unanimous in upholding the validity of the Wagner test and justify the unanimous resolution of the Union of German Experiment Stations that there are no grounds for departing from the customary methods of evaluation of basic slag. It may be added that similar, though less comprehensive, tests carried out during the past three years at various centres in this country, under the auspices of the Agricultural Education Association, have also given results which in the main bear out this conclusion.

THE revised edition of Special Leaflet No. 46, recently issued by the Board of Agriculture and Fisheries, bears testimony to the vigorous criticism sustained from practical agriculturists since the first

issue by reason of the advocacy in the leaflet of the application of sulphate of ammonia to the wheat crop during the autumn months. In view of this criticism it has been thought desirable to embody in the new issue a reasoned justification of the recommendation. It is admitted that on the average of years, if a dressing not exceeding, say, ¾ cwt. sulphate of ammonia is to be used, spring dressing may be expected to pay better than autumn dressing. It is argued, however, that with wheat high in price much heavier dressings can be profitably applied, that these must in any case be given in two or more instalments, and that the best result may be expected from them if a portion be applied in the autumn and the balance in the spring. It is further urged that the common fear of loss of soluble salts by leaching throughout the winter is largely groundless in the case of sulphate of ammonia, since the ammonia is firmly retained by the soil and is only readily removed by water after conversion to the form of nitrate. Such nitrification being the outcome of bacterial activity, little change of ammonia is likely to take place at the low temperatures obtaining in the soil during the winter months.

THE attention of teachers of geography should be directed to the fine illustrations which are a feature of the *National Geographic Magazine*, published in Washington. The magazine is ostensibly a popular publication, and fulfils its object of increasing and diffusing geographical knowledge. The issue for August, 1916 (vol. xxx., No. 2), contains, among others, articles on Sardinia, Argentine and Chile, and San Domingo and Hayti. The chief feature of each article is the illustrations, many of which have considerable geographical value, and all of which are admirably reproduced. It is not easy to get illustrations of the negro republic of Hayti, and those in this magazine give a vivid impression of the island and its chief towns. The people of the countries concerned are well illustrated in all the articles.

ON the Monthly Meteorological Chart of the North Atlantic and Mediterranean for October there appears the usual inset map of "phenomenal drifts and heights" of North Atlantic ice. We notice in this map a record, which has appeared in many previous issues, of ice, presumably an iceberg, recorded near the island of Colonsay, off the Firth of Lorne, in the west of Scotland. It was sighted by fishermen in July, 1902. It is a little difficult to credit this remarkable occurrence, and if the fishermen were not mistaken the iceberg would surely have been seen by other observers, but the chart makes no mention of this. There are conditions of sea and weather in which ice can easily be imagined, and this suggests one of those cases. Unless the record is established beyond all doubt, it would be well to query this occurrence or to remove its indication from the chart.

WE learn from the *Geographical Journal* for September that the Arkhangel Society for the study of the Russian North is taking steps to obtain information as to the fate of the two Russian polar expeditions, of which there has been no news for several years. Rusanoff's expedition in the *Hercules* visited Spitsbergen in the summer of 1912, and was last heard of the same year in Novaya Zemlya, on its way through the Matochin Shar to the Kara Sea. Ice conditions were exceptionally severe in Arctic seas in 1912. The other expedition, in the *St. Anna*, passed through Yugor Strait in September, 1912, with the intention of making the north-east passage. It was afterwards learnt that the *St. Anna* was abandoned in April, 1914, in 83° N., 63° E. Several Russian search expeditions have failed to reveal any further news. The Arkhangel Society is raising a fund of 2500*l.* to be spent during the next three years in prizes for information throwing any light on the fate of the explorers. It is almost impossible that there can now be any survivors.

THE *Philippine Journal of Science* for January contains an interesting paper by G. W. Heise on the water supply of the city of Manila. The water is derived from the upper reaches of the Mariquina River, and the only physical purification it receives is storage in a reservoir for about three and a half days, which reduces the bacteriological count by about 90 per cent. The water is then treated with chloride of lime in doses varying from 0·5 to 0·75 part of available chlorine per million parts of water. This treatment appears to be still in a more or less experimental stage, and while, on the face of it, the sterilisation does not quite come up to expectations, some interesting results were obtained. Perhaps the most noteworthy of these is that the benefit derived from increasing the dose from 0·5 part of available chlorine per million to 0·625 part is very much greater than that derived by a further increase from the latter figure to 0·75 part. These results are chiefly judged by bacteriological counts made on the water before treatment and three-quarters of an hour after treatment. Possibly, if the results were judged on tests for *B. coli* done on various volumes of water (say 100 c.c., 10 c.c., 1 c.c., 0·1 c.c., etc.) instead of only on 2 c.c., and after longer contact (say three or four hours) of the water with the germicide, they would then wear a more favourable aspect, and at the same time give a truer estimate of the effect of the treatment.

UNDER the title "Mathematical Portraits and Pages" Messrs. Ginn and Co. have issued an attractive illustrated pamphlet of about twenty pages, drawn up by Prof. David Eugene Smith. The contents include reproductions of portraits of Newton, Isaac Barrow, John Wallis, Nicholas Saunderson, and Brook Taylor (of Taylor's theorem), also facsimiles of pages of "The Craft of Nombryng," Tonstall's "De Arte svppvtandi," Recorde's "Grovnd of Artes" and his "Whetstone of Witte," and the title-page of Digges and Son's "Stratioticos."

WHILE the late Captain Ferber was probably the first to consider lateral stability in applying the equations of rigid dynamics to the motions of aeroplanes, he unfortunately assumed that an aeroplane could be replaced by a system of three mutually orthogonal plane surface-elements, and it is greatly to be feared that the accident in which he lost his life may have arisen through the consequent misunderstanding of the problem. In the *Tôhoku Mathematical Journal*, ix., 4, Mr. Selig Brodetsky has now taken up the question as to how far it is possible, even on the simple "sine-law" hypothesis, to replace an aeroplane by three or more equivalent surfaces in three planes at right angles. The investigation leads to some exceedingly heavy algebra, which Mr. Brodetsky may claim to have worked out to the bitter end, with, briefly speaking, the following results:—(1) Except in the case of small divergences from a state of steady motion no such representation is possible; (2) in the case of small oscillations three planes are insufficient, but it is possible to represent the system by six surface-elements, namely, two in each of the three co-ordinate planes.

WHILE the claims of Napier as the discoverer of logarithms have received ample recognition in connection with the tercentenary celebration in 1914, it is interesting to notice that a system

of logarithmic tables was invented and drawn up almost contemporaneously with Napier's work by Jost Bürgi, a Swiss. A brief note dealing with Bürgi's work is contributed to the *Mitteilungen der naturforschenden Gesellschaft in Bern* for 1914 (p. 318) by Dr. A. Bohren. Bürgi was born at Lichtenstein, in Toggenburg, about the year 1552, but of his early life little is known. He was originally a clockmaker by trade, but developed a talent for astronomical work, and, under the patronage at first of the Landgraf Wilhelm of Hesse, and later of Rudolf II. of Bohemia, he not only invented new astronomical instruments, but greatly assisted Kepler with his observations. His treatise on logarithmic methods described under the title "Arithmetical and Geometrical Progression-Tables" first saw the light in 1620, but it is certain that the tables were calculated and used by him long before that date, and their publication had been delayed by the war in Bohemia. Probably for the same reason the instructions which were to accompany the tables were never published, and in consequence they failed to come into general use. Both Bürgi and Napier built up their tables by forming successive positive integral powers of a number differing from unity by a very small decimal, but Bürgi's tables are based on the relations $x=10n$, and $y=10^8\ (1{\cdot}0001)^n$, while Napier calculated his logarithms from the successive powers of $1-10^{-7}$. It would thus appear probable that Bürgi was the first to use a base greater than unity, and so to obtain a scale more suitable for use with integral numbers. Whether Napier was acquainted with Bürgi's work is considered doubtful. Possibly Napier may have got the idea from Bürgi, and his choice of a system the base of which is less than unity may have been intended as an improvement to facilitate the use of the tables in trigonometry.

CIRCULAR No. 58 of the Bureau of Standards contains much valuable information as to the properties of invar and related nickel steels. Invar is a nickel steel containing about 36 per cent. of nickel, together with small amounts of carbon and manganese, and metallurgically negligible amounts of sulphur, phosphorus, and other elements. It melts sharply at about 1425° C. Above 200° C. to its melting point it may be considered to consist of a homogeneous solid solution of the above elements. Below 200° C., and at a temperature dependent on its history and exact composition, it undergoes a reversible transformation of such a nature that for any sample the transformation may be incomplete. This condition of thermochemical instability gives rise to both slowly and quickly changing values of its physical properties—changes which are particularly manifested in the expansion. It can be rolled, forged, turned, filed, and drawn into wires, and it takes a beautiful polish, giving an excellent surface on which fine lines may be ruled. It will withstand without spotting the corrosive action of water, even when immersed for several days. Its electrical resistivity is about eight times that of pure iron, and its temperature-coefficient of electrical resistance about 0·0012 per degree Centigrade. It is ferromagnetic, but becomes paramagnetic in the neighbourhood of 165° C. The mean coefficient of linear expansion between 0° and 40° C. is for ordinary invar of the order of one millionth, and samples have been prepared with even small negative coefficients; the amounts of carbon and manganese appear to exercise considerable influence on the expansion. Above 200° C. its expansion is nearly the same as that of ordinary Bessemer steel. It is subject to changes in length due to "after effects" following cooling from a high temperature, and even following slight alterations in temperature. A mathematical formula, $\Delta h/h=-0{\cdot}00325\,.\,10^{-6}t^2$, holds for temperatures between 0° and 100° C.

THE results of the measurements of the rate of vaporisation of platinum vessels raised to high temperatures which have been made at the U.S. Bureau of Standards by Messrs. Burgess and Waltenberg are given in Scientific Paper No. 280, recently issued by the bureau. At temperatures below 900° C. there is no appreciable vaporisation, whatever be the composition of the platinum alloy of which the vessel is made. At 1000° C., however, the loss from 100 sq. cm. of a vessel of pure platinum is 0·08, and at 1200° C. 0·81 milligram per hour. For an alloy containing 1 per cent. iridium the corresponding rates are at 1000° C. 0·30, and at 1200° C. 1·2 milligrams per hour. For a 2·5 per cent. iridium alloy they are at 1000° C. 0·57, and at 1200° C. 2·5 milligrams per hour. Rhodium alloys, on the contrary, vaporise at lower rates. For an 8 per cent. rhodium alloy the rates of loss are at 1000° C. 0·07, and at 1200° C. 0·54 milligram per hour.

SINCE the appearance three years ago of the last edition of Prof. G. Lunge's "The Manufacture of Sulphuric Acid and Alkali," vol. i., many additions to the subjects treated of have been made. To deal with the new developments, Prof. Lunge has prepared a supplementary volume, which Messrs. Gurney and Jackson announce for publication this autumn.

MR. F. EDWARDS, of High Street, Marylebone, announces for early publication "The Fauna and Ethnology of New Guinea," being the official records of the collections formed by the British Ornithologists' Union Expedition, 1909–11, and the Wollaston Expedition, 1912–13, in Dutch New Guinea. The work will be in two volumes, and the edition limited to 150 copies.

OUR ASTRONOMICAL COLUMN.

THE ASTRONOMICAL COMPASS.—The utilisation of the heavenly bodies as a means of determining direction has attracted considerable attention since the outbreak of war, and various attempts to simplify the problem for general use have been made. Simplified azimuth tables, in conjunction with maps of the stars, have mostly been employed, but it is evident that such tables may be replaced by graphical projections of the circles of the celestial sphere. Under the title of the "Rev. William Hall's Visible Astronomical Compass," an arrangement for the direct solution of the chief problems depending upon the diurnal motion of the heavens has been published by Mr. J. D. Potter, 145 Minories, E.C. (price 1*s.* net, post free). A circle 6 in. in diameter, on a card 10 in. × 8 in., contains a stereographic projection on the plane of the horizon, for latitude 50° N., showing the circles of each even degree of declination, and hour circles at intervals of ten minutes. Circles of azimuth and altitude are not drawn, but the outer edge of the horizon circle is graduated for true bearings, and altitudes may be read off on a scale provided, after measurement with dividers along a travelling thread fixed at the zenith point. Given the time, or an approximate measurement of altitude, the bearing of any object is, of course, readily determined, and the "compass" can then be adjusted so as to show true directions. No new principle is involved, but the arrangement provides a stereographic projection in a convenient form, and the necessary instructions for its use are given. It should be understood, however, that a star map and an almanac are also requisite, and that some means of measuring altitudes would greatly extend the usefulness of the projection.

EFFECT OF HAZE ON SOLAR ROTATION MEASURES.—The extensive determinations of the sun's rotation which have been made by the spectroscopic method have shown remarkable variations, even among results obtained at the same observatory at different times. Thus the values for the equatorial velocity range from 1·86 to 2·11 km. per sec., and observers have not agreed as to the inequality of the values obtained from different lines at the same time. Again, while some observers have found values of the rate of rotation progressively increasing with the wave-length, many other observations have not shown this effect. A valuable contribution towards tracing the source of such discordances has been made by R. E. De Lury, of the Dominion Observatory, Ottawa, in a careful investigation of the effects of haze on the spectroscopic measurements (Journ. R.A.S. Canada, vol. x., p. 345). The effect of terrestrial atmospheric haze is obviously to superpose a weakened solar spectrum, coming mainly from the centre of the sun's disc and showing no displacements at all, upon the limb spectra. The measured displacements of the blended lines at the limb would then be too small, and would vary from line to line, according to the character of the line at the limb as compared with the centre. Correction for the haze effect can be made by correlating accurate determinations of the relative strengths of haze and limb spectrum with displacements of groups of lines of different intensities. Further investigations may be necessary, but Mr. De Lury appears to be already convinced that variations hitherto ascribed to the sun are mainly due to variations in haze.

THE MASSES OF VISUAL BINARY STARS.—Mr. R. T. A. Innes has been led to some remarkable conclusions by a discussion of data relating to binary stars (*South African Journ. Sci.*, vol. xii., p. 453). All close pairs of stars, with few exceptions, are apparently to be regarded as binaries, whether they show relative motion or not. On the assumption that a binary has the same brightness as the sun, Mr. Innes calculates its distance from the apparent magnitude, and thence the mass, if the period be known. When no orbit has been computed, he proceeds in a similar manner, and calculates the annual angular motion at the distance of the companion which would be produced if the primary had the same mass as the sun. The calculated motion is mostly much in excess of that observed, and Mr. Innes concludes that very few double stars have a mass, or "gravitative power," as he prefers to call it, equal to that of the sun. He has been led to suppose that gravitative power is small in stars of types B and A, moderate in F, and large in G and K stars; in types Oe and M it appears to be absent altogether. The A type is considered to be poorly represented among binaries, because stars of this class have but little effective gravitative power, notwithstanding their great brilliancy. There appears to be a limiting distance below which double stars cannot exist, and for solar-type stars this is apparently about five times the earth's distance from the sun. It is suggested that light-pressure may partly or wholly neutralise gravitative power in stars of small density and great luminosity.

MUTATION AND EVOLUTION.

PROF. ARTHUR DENDY'S presidential address, delivered in February last, before the members of the Quekett Microscopical Club appears in the journal of the club for April, and will probably be much discussed, inasmuch as it is devoted to an analysis of the relation of mutation to the evolution theory, the arguments being based on data drawn from the sponges. The phenomena of mutation, it is contended, is more a chemico-physical than a biological phenomenon. Mutations, such as are observable in sponge spicules, in his opinion, strongly suggest the existence of definite factors in the germ plasm. The factorial hypothesis, he considers, is further supported by evidence which is accumulating as to the general course of evolution followed by the Tetraxonida. On the whole this evolution seems to have been progressive, accompanied by increasing complexity or structure, manifested especially in the skeleton. Along certain lines of descent, however, it appears that the culminating point has been passed, and regressive evolution is taking place, resulting in simplification of structure, by the dropping out of certain types of spicule. This loss cannot be regarded as an adaptive modification, nor can it be explained as due to mechanical necessities. Prof. Dendy concludes, therefore, that it is due to some change in the germ-plasm, affecting the power of the sponge to produce the particular spicules in question.

How can we reconcile these facts, it is asked, with the belief that evolution has taken place, in the main, by slow, successive modifications, rather than by sudden mutations? The conception of factors is intimately bound up with that of mutations, and the existence of the one would seem to imply the occurrence of the other.

As to which set of characters is to be regarded as the more important from the point of view of the student of progressive evolution Prof. Dendy holds there can be little doubt, but how far the division into adaptive and non-adaptive corresponds to the distinction between fluctuating variation and mutation is a different question. Certainly the chances are greatly against a mutation, when it first appears, having any adaptive significance. The evidence seems to him to show that the slow, successive variations of the Darwinian theory have had far more to do with the evolution of sponges than the process of mutation, and are mainly responsible, under the guidance of natural selection, for adaptive modifications.

It is not easy to follow Prof. Dendy in his attempt to discriminate between, and apportion the value of, adaptive and non-adaptive characters. It would seem, however, that he would regard the former as directly affecting viability, in proportion to their responsiveness to the demands of natural selection. They are characters which are of necessity immediately and continuously functional. The latter seem to be regarded as accretions or fortuitous variations, tolerated until they acquire survival value—that is to say, until they come under the sway of natural selection. If this is so, then all non-adaptive characters are potentially adaptive. They afford the basis for further evolutionary phases, or, in other words, the material which will determine the trend of future development and the fate of the organism for good or ill.

W. P. P.

SOME PROBLEMS IN EUGENICS.

STUDENTS of human heredity from the sociological point of view are indebted to the American Eugenics Record Office (Long Island, N.Y.). Its last-issued Bulletin (No. 15) contains the study of a family indicated by the pseudonym of "Dack," showing markedly a "hereditary lack of emotional control." The author of the bulletin is Mrs. A. W. Finlayson, and Prof. C. B. Davenport contributes a preface in which he emphasises the importance of such "eugenics field-work." Mrs. Finlayson has collected data with regard to 150 descendants of the pair of "Dacks" who emigrated from Ireland to Pennsylvania

in 1815, three generations being passed under review. Forty individuals are not recorded to have shown anti-social traits, but the remainder all failed in self-control, many being dishonest, and tending to alcoholism, or to profligacy, forty-one of these being "obviously a burden to society." These objectionable features were most pronounced in the case of offspring of a marriage of first cousins; Prof. Davenport's conclusion that violence of temper is a "dominant" character is confirmed, as in this family it was not found to "skip a generation." Most thoughtful readers of the bulletin will agree with the suggestion at the end of the preface that "unless society steps in and trains the trainable and segregates the uncontrollable, things will go from bad to worse."

Human endowments of a more pleasing kind are discussed by Dr. H. Drinkwater in a paper entitled "Inheritance of Artistic and Musical Ability," published in the last number of the *Journal of Genetics* (v., No. 4). He gives pedigrees—extending in some cases over four generations—of several families of artists and musicians, which indicate that where both parents are talented all the children inherit the talent, while a non-artistic or non-musical pair never have talented offspring. Hence he infers that artistic or musical ability is a recessive Mendelian character. When only one parent is musical, the number of children showing the recessive character may be more than the 50 per cent. required by the theory, but the records are too few for this to be regarded as a fatal difficulty to Dr. Drinkwater's interpretation. It will, however, be surprising if further research confirms the view that the complex nervous specialisation which must be supposed to accompany marked artistic or musical ability is determined by a simple genetic factor comparable with that which settles the colour of the eyes.

To the Journal of the Royal Statistical Society (vol. lxxix., part 2) Major Leonard Darwin contributes a paper on the inquiries needed after the war in connection with eugenics. He dwells on the selection of the best men generally for the fighting-line, shows that a higher death-rate may be expected to affect the more daring and self-sacrificing, and points out the meaning for the nation's future of the abnormally heavy losses among officers. His plea for a full investigation of the problem and of possible remedial measures may meet with a disappointing response, but nobody can read his paper and the report of the subsequent discussion—especially after studying the American bulletin summarised above—without realising the "reversed selective action" of the present world-conflict, and perceiving how absolutely opposed to the biological principles enunciated by Major Darwin's great father are those modern "people that delight in war."

G. H. C.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION C.

GEOLOGY.

OPENING ADDRESS (ABRIDGED) BY PROF. W. S. BOULTON, D.Sc., F.G.S., PRESIDENT OF THE SECTION.

IF we attempt to compare the growth of applied geology in Britain with that, say, in the United States of America, or even in our great self-governing Dominions, or to appraise the knowledge of, and respect for, the facts and principles of geology as directly applicable to industry in these countries and in our own, or to compare the respective literatures on the subject, I think we shall have to confess that we have lagged far behind the position we ought by right of tradition and opportunities now to occupy. The vast natural resources of the countries I have named have doubtless stimulated a corresponding effort in their profitable development. But making due allowance for the fact that Britain is industrially mature as compared with these youthful communities, we cannot doubt that in this special branch of geology, however splendid our advances in others, we have been outstripped by our kinsmen abroad.

To attempt an explanation of this comparative failure to apply effectively the resources of geology to practical affairs would demand a critical analysis of the whole position of science in relation to industry and education which is being so vigorously debated by public men to-day. It is unquestionably due, in no small measure, to our ignorance and neglect of, and consequent indifference to, science in general, more especially on the part of our governing classes. This war, with all its material waste and mental anguish, may bring at least some compensation if it finally rouses us from complacence and teaches us to utilise more fully the highly trained and specialised intelligence of the nation.

Here I digress for a moment to lay stress upon a great and needless loss of valuable and detailed knowledge of our Coal Measure geology. It is well known that the Home Office Regulations demand that plans of workings in the different seams at a colliery shall be made and maintained by the colliery officials; and that on the abandonment of the mine copies of such plans shall be kept at the Mines Department of the Home Office for future reference. For ten years, however, they are regarded as confidential. Such information is recorded primarily with a view to the prevention of accidents due to inrushes of water and accumulations of gas.

Unfortunately, as mining men can testify, the plans are often woefully incomplete, inaccurate, and positively misleading as regards such features as faults, rolls, wash-outs, and so forth, and this is notoriously so along the margin of the plans where workings have been abandoned. Cases have been brought to my notice where plans of old workings have been consulted when adjacent ground was about to be explored, and afterwards the plans have proved to be grossly inaccurate, with the consequent risk of serious economic waste. I believe this unfortunate state of things is partly the effect of the complete official severance of the Geological Survey and the Mines Department of the Home Office. When the Geological Survey was first established, and for many years afterwards, a Mining Record Office for the collection and registration of all plans relating to mining operations was attached to it; but afterwards the Mining Record Office was transferred to the Home Office.

I would suggest that it ought to be made possible for all mining plans to be periodically inspected by Government officials with geological knowledge, not merely after the plans are deposited in a Government office, but during the working of the mine; so that, if desirable or necessary, the geological facts indicated by the mine-surveyor on the plan can be tested and verified. If accurate and properly attested plans of old workings were always available, the opening up of new ground would be greatly facilitated and much waste of time and money would be avoided.

Need for Systematic Survey by Deep Borings.

When we turn our attention to the possible extension of the Coal Measures under the newer strata of South-Central England, the geological data at our disposal are lamentably and surprisingly few. Notwithstanding our eagerness to unravel the difficulties, and so to open up new fields for mining activity, very little positive

progress has been made in the last twenty years. Of late a few deep borings have been sunk; one near High Wycombe, after piercing the Mesozoic cover, ended in Ludlow rocks; another at Batsford, in Gloucestershire, fifteen miles north of the well-known Burford boring, struck what are regarded as Upper Coal Measures, also resting on Silurian rocks.

At the present time it seems specially fitting to direct attention once again to our haphazard method of grappling with this great economic question. Are we to go on indefinitely pursuing what is almost "wild-cat" boring, to use the petroleum miner's expressive slang? Or shall we boldly face the fact that systematic exploration is demanded; and that this pioneer work is a national obligation, the expense of which should be a national charge?

At a meeting of the Organising Committee of Section C a recommendation was forwarded to the council in the following terms:—

"The council of the British Association for the Advancement of Science recommends that the site, depth, and diameter of every borehole in the British Isles exceeding 500 ft. in depth be compulsorily notified and registered in a Government office. That all such boreholes be open to Government inspection during their progress. That copies of the journals and other information relating to the strata penetrated by the boring be filed in a Government office under the same restrictions as those relating to plans of abandoned mines."

I would go further and urge that the Government should undertake the sinking of deep borings at selected points. This is no new idea. In his presidential address to the Geological Society of London in 1912 Prof. Watts pleaded most forcibly the vital importance of a State-aided underground survey of the area to which I have referred. The work is too vast for individual effort, or even for a private company to undertake. It is not suggested that deep borings should be sunk with the express purpose of finding coal. What is wanted is a systematic survey by borings at such spots as are likely to throw light upon the structural framework of the Palæozoic floor and the thickness of its cover.

Of course, there are difficulties in the way of such a scheme. There is the expense. But in view of the enormous economic possibilities of the work, and remembering that it is now possible to sink a boring to a depth of, say, 1200 ft., and to bring up 18-in. cores at a cost less than 2000*l*., it cannot be reasonably argued that the expense is beyond the nation's power to bear. A levy of a farthing a ton on the coal output of the United Kingdom for a single year would yield something like 300,000*l*., a capital sum that would provide in perpetuity an additional yearly grant to the Geological Survey of 15,000*l*., which would suffice not only to carry on this work, but would enable the Survey to extend its functions in the other directions I have indicated.

As to legal obstacles and vested mineral rights, I wish to say nothing except that if the country could be convinced that this work is urgently needed on national grounds, all scruples and doubts, so agitating to the official mind, would speedily vanish.

For many years I lived near our great exporting centres of the finest steam coal in the world, and as I watched the steady and incessant streams of coal-waggons, year in, year out, coming down from the hills, I was constantly reminded that we are rapidly draining the country of its industrial life-blood. Is it an extravagant demand to ask that an infinitesimal fraction of this irreplaceable Nature-made wealth should be set aside to provide the means for the discovery and development in our islands of new mineral fields?

Chemical and Microscopical Investigation of Coal Seams.

The recovery of by-products in the coking of coal, which up to the beginning of the war was almost exclusively undertaken by the Germans, is likely in the future to become an important British industry. This will ultimately demand a thorough knowledge of the microscopic and chemical structure of all the important coking seams in our coalfields.

Remembering how varied both in microscopical structure and chemical composition the individual laminæ of many of the thick coal-seams are, it will readily appear how important such a detailed investigation may become, having regard to the great variety of these by-products and their industrial application. Moreover, thin seams, hitherto discarded, may pay to be worked, as may also an enormous amount of small coal, estimated at from 10 to 20 per cent. of the total output, which up to the present has been wasted.

Geology of Petroleum.

It has been frequently remarked that in order to account for the vast accumulation of coal in the Carboniferous strata, it is necessary to postulate a special coincidence over great areas of the northern hemisphere of favourable conditions of plant growth, climate, sedimentation, and crustal subsidence, conditions which, although they obtained at other geological periods over relatively small areas, were never repeated on so vast a scale. Having regard to the estimates of coal deposits in Cretaceous and Tertiary strata, published in our first international Coal Census, the "Report on the Coal Resources of the World,"[1] it would appear that we might reasonably link the Cretaceo-Tertiary period with the Carboniferous in respect of these peculiar and widely prevalent coal-making conditions. For I find that of the actual and probable reserves of coal in the world, according to our present state of knowledge, about 4½ million million tons of bituminous and anthracite coal exist, the vast bulk of which is of Carboniferous age; while there are about 3 million million tons of lignites and sub-bituminous coals, mostly of Cretaceous and Tertiary age.

When we look to the geological distribution of petroleum, we note that it is to be found in rocks of practically every age in more or less quantity, but that it occurs *par excellence*, and on a great commercial scale, in rocks of two geological periods (to a smaller extent in a third); and it is significant that these two periods are the great coal-making periods in geological history—the Carboniferous and the Cretaceo-Tertiary. It would take me beyond my present purpose to explore the avenues of thought and speculation opened up by this parallel. I will only remark that it seems to afford some support for the view that coal and petroleum are genetically as well as chemically related. While the terrestrial vegetation of the two periods was accumulating under specially favourable physiographical conditions, ultimately to be mineralised into seams of coal, the stores of petroleum believed to be indigenous to strata of the same periods were probably derived from the natural distillation of the plankton which must have flourished, too, on an enormous scale in the shallow, muddy waters adjacent to this luxuriant land growth. The phytoplankton, including such families as the Diatomaceæ and Peridiniæ, may well have played the chief *rôle* in this petroleum formation, while affording unlimited sustenance to the small and lowly animal organisms, like Entomostraca, the fatty distillates of which doubtless contributed to the stores of oil. It is possible, then,

[1] Report on "The Coal Resources of the World" for the Twelfth Intern Geol. Congress, 1913.

that a prodigious development of a new and vigorous flora during both periods—the spore-bearing flora, in the main, of the Carboniferous, and the seed-bearing flora of the Cretaceo-Tertiary period—was the chief contributory factor in the making of the world's vast store of solid and liquid fuel. It contributed directly by supplying the vegetable matter for the coal, and indirectly by stimulating the development of a prolific plankton, from which the oil has been distilled.

The world's production of petroleum has trebled itself within the last fifteen years. In 1914 the United States of America produced 66·36 per cent., and North and South America together nearly three-fourths of the world's total yield; while the British Empire (including Egypt) produced only a little more than 2 per cent. In the near future Canada is likely to take its place as a great oil- and gas-producing country, for large areas in the Middle-West show promising indications of a greatly increased yield. But Mexico is undoubtedly the country of greatest potential output. Its Cretaceous and Tertiary strata along the Gulf Coastal Plain are so rich that it has been stated recently on high authority that "a dozen wells in Mexico, if opened to their full capacity, could almost double the daily output of the world."[2]

As is well known, natural supplies of petroleum are not found in the British Isles on a commercial scale; but for many years oil and other valuable products have been obtained from the destructive distillation of the Oil Shales of the Lothians. If Mr. Cunningham Craig is right in his views recently expressed,[3] these shales, or, rather, their associated freestones, have been nearer to being true petroliferous rocks than we thought; for he believes that the small yellow bodies, the so-called "spores" in the kerogen shales, are really small masses of inspissated petroleum, adsorbed from the porous and once petroliferous sandstones with which the shales are interstratified.

If recent experiments on peat fulfil the promise they undoubtedly show, we shall have to take careful stock of the peat-bogs in these islands. It is well known that peat fuel has been manufactured in Europe for many years. But my attention has been called to a process for the extraction of fuel-oil from peat which has been tried experimentally in London, and is now about to be launched on a commercial scale, utilising our own peat deposits, like those of Lanarkshire and Yorkshire.

The peat is submitted to low-temperature distillation at ordinary pressure, or at a slight negative pressure, the highest temperature reached being about 600° C. From a ton of Lanarkshire peat, after the moisture is reduced to 25 per cent., 40 gallons of crude oil, 18 to 20 lb. of ammonium sulphate, about the same quantity of paraffin wax, 30 to 33 per cent. of coke, and 5000 to 6000 cubic ft. of combustible gas are obtained. The coke is said to be of very good quality. By the same process it is hoped to get satisfactory results from the lignites of Bovey Tracey.

Considering the rapid development of oil as fuel, and its supreme industrial importance in many other ways, it is remarkable that British geologists should have given such little attention to the *origin and occurrence of petroleum*. Among American geologists a lively interest in this subject has been aroused and a voluminous technical literature is already published. And yet the fact remains that we are still in a cloud of uncertainty as to this vital question, upon the solution of which depends whether the prospector of the future is to work by hazard or on scientific and reasoned lines.

Mr. Murray Stuart, now of the Indian Geological Survey, offered in 1910[4] a simple explanation of the occurrence of petroleum, based upon his own observations in Burma, a research which seems to have attracted far more attention in America than in this country. He showed that the oil of the streams and swamps in Burma is carried down to the bottom of the water in small globules by adhering tiny particles of mud. Thus there is formed a deposit of mud containing globules of oil and saturated with water. If afterwards this deposit is covered by a bed of sand, the oil and part of the water, as the pressure of overlying sediment increases, are squeezed into the sand, so that by a repetition of the process a petroliferous series of clays and sands may be accumulated. In examining lately a large quantity of the well-known "landscape marble" from the Rhætic of Bristol, I obtained from it small but appreciable amounts of petroleum; and towards the end of my investigation I was pleased to discover that I was in thorough agreement as to the origin of this curious landscape structure with Mr. Beeby Thompson, whose research was published more than twenty years ago.[5] In these thin deposits of hydrocarbons among laminated silts, with their striking tree-like growths and hummocky surfaces, may we not have, in miniature, an illustration of the deposition and partial migration of petroleum which occurs on so vast a scale in the oilfields of the world?

It is not suggested that all petroleum deposits have had such an origin. I am convinced, however, that in all geological ages such sedimentary accumulations have occurred; and that, except where the conditions of cover have been favourable for its imprisonment, the oil is, and has been throughout geological time, incessantly escaping at the surface. Thus we may conceive the earth as continuously sweating out these stores of oil, either in the liquid or gaseous form, especially where rocks are being folded and rapidly denuded.

It is sometimes asked whether the adoption of mineral oil as a power-producer is likely to supplant coal, and thereby seriously reduce the output of that mineral. The world's yield of petroleum will doubtless go on increasing at a very great rate; but from the experience gained in some of the fields in the United States and eastern Canada, it seems unlikely that this increase can continue for a very long period. Practically complete exhaustion of the world's supply is to be looked for within 100 years, says one authority.[6] Even if the output rose to ten times the present yield, it would represent only about half the present world output of coal, and it is practically certain that so high a yield of oil could not be maintained for many years. Owing to the almost certain rapid increase in the output of coal, estimates made by the same authority indicate that the total production of petroleum could never reduce the world's output of coal by more than about 6½ per cent.[7]

For us, and probably for those of the next generation, the geology of petroleum will continue to be of immense practical importance; but coal will doubtless remain our great ultimate source of power.

An obligation rests upon us to see that the oil resources of the British Empire and of territories within our influence are explored, if possible by British geologists, with all the special knowledge that can be brought to bear; and I am glad to think that the University of Birmingham and the Imperial College of Science and Technology, London, with this end in view, are doing pioneer work in giving a systematic and specialised training to our young petroleum technologists.

2 Ralph Arnold, "Conservation of the Oil and Gas Resources of the Americas," *Econ. Geol.*, vol. xi., No. 2, 1916, p. 222.

3 Institution of Petroleum Technologists, April, 1916.

4 "Rec. Geol. Surv. India," vol. xl., 1910, pp. 320–33: "The Sedimentary Deposition of Oil."

5 Q.J.G.S., 1894, pp. 293–410.

6 H. S. Jevons, "British Coal Trade," 1915, p. 710.

7 *Ibid.*, p. 716.

Organisation of Expert Knowledge.

We are reminded by the report of a Royal Commission—that on Coast Erosion in 1911—that systematic observations and the collation and organisation of geological and engineering knowledge are urgently needed in connection with the protection of our coasts and the reclamation of new lands. For it will be remembered that the Commission found that during the last thirty-five years the gain of land, as shown by Ordnance Survey maps, has been more than seven times the loss by erosion.

Here, again, the British Association may reflect with pride that it paved the way for this national inquiry. For many years its Committee on Coast Erosion gathered and collated evidence on erosion, and induced the Admiralty to instruct the coastguard to observe and report upon changes that take place from time to time.

After recommending "that the Board of Trade should be constituted the Central Sea-Defence Authority for the United Kingdom for the purpose of the administration of the coast-line in the interest of sea defence," the Commissioners go on to urge that "that Department should have the assistance of scientific experts to collate information and to secure systematic observations with regard to questions such as the changes taking place below the level of low water, the travel of materials in deep water, the movements of outlying sandbanks, etc., which are continually happening on the coasts of the kingdom, and with regard to which the information at present is scanty and vague."[8]

In economic geology, as in the case of other applied sciences, we must rely in the future less upon chance individual effort and initiative. We must concentrate, centralise, and organise; and at every stage we shall need expert control and advice as regards those larger scientific issues of national importance which have a direct practical bearing.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The annual report of the Department of Coal, Gas, and Fuel Industries, of which Prof. J. W. Cobb occupies the chair as Livesey professor, has just been issued by the University. It begins with a reference to the number of students who have entered the Army or are connected with the war work of the department, and also to the election of candidates to the recently founded Corbet-Woodall scholarship and Arthur Walker exhibition. Courses of lectures, which have been given in the past by specialists connected with the gas and fuel industries, have had to be restricted owing to the demands made by the war upon the lecturers. The research work of the department during the year includes two important publications. The Ventilation Research Committee, representing the Institution of Gas Engineers, has issued its third report. The work has been carried out, as before, by Mr. W. Harrison, who has made a careful and interesting study of causes of down-draughts, the effect of ventilating burners, etc. The second research, by Prof. Cobb and Mr. H. Hollings, on "Thermal Phenomena in Carbonisation," was read before the Institution of Gas Engineers in June last. The other work of the department has been mainly on behalf of the Ministry of Munitions and the Royal Society War Committee.

THE chemical courses of the Finsbury Technical College, which commenced on Tuesday, October 3, are undergoing modification and extension in order to cope with the increased demand for chemists trained to take up industrial posts. Commencing at first with a two-year curriculum, the courses have in recent years been extended over a period of three years, and in many instances students have, with profit to themselves, continued their advanced studies into a fourth year and even longer. If the renascence of British chemical industry is to be fruitful, there will not only be a demand for more chemists, but it will be essential that these newcomers should be better trained than their predecessors. The Executive Committee of the City and Guilds of London Institute has placed at the disposal of the chemical department of the Finsbury college a new suite of rooms, to be fitted as advanced laboratories of applied chemistry. The work of adaptation is in full progress, and the laboratories will be sufficiently ready for advanced students early in the new year. The installation of technical appliances is being extended, partly by purchase and partly by construction in the chemical department. Factory methods of conducting filtration, evaporation, distillation, desiccation, heating under pressure, and other generalised processes will be studied, and the possession of this plant and apparatus will render possible the execution of industrial researches in many branches of inorganic and organic chemistry, as, for example, the extraction of metals, preparation of alloys, cements, glazes, porcelains, glass, enamels, pigments, synthetic dyes, artificial perfumes, and pharmaceutical products. One gratifying feature of this development is the fact that the effort to develop along industrial lines is so far appreciated by certain firms that they have assisted by gifts of plant and chemicals.

IN a pamphlet of thirty-six pages, entitled "Scientific Method in Schools" (Cambridge University Press, price 1s.) Mr. W. H. S. Jones, senior classical master at the Perse School, has put forward some well-timed suggestions upon a subject now universally admitted to be of first-rate importance. Starting from the assumptions (1) that all subjects, in different ways and to different degrees, can be made to give a training in scientific method, and (2) that the scientific training even of the future researcher in physics or chemistry will be more effective if it is not confined to his special subject, but rests on a broad foundation, he puts forward the thesis that "whatever subjects are included in the curriculum, each one should contribute its quota to a comprehensive scheme of scientific method." He does not demand a strict "heuristic" treatment of every subject, but maintains that in lessons occurring regularly "once a week or once a fortnight in each subject," the pupil should be confronted with problems to be attacked by strict application of the methods of deduction and induction—particularly the latter—and should be taught to be constantly conscious of the necessity of working according to fixed laws. Mr. Jones introduces his proposals by quotations from Cicero and Charles Lamb, but does not show whether he is aware how entirely they are congruent with the results of the best relevant psychological researches of the present day. Be that as it may, the practical teacher will be more directly interested in the eleven detailed examples, drawn from courses in languages, history, geography, biology, and mechanics, which the author gives in illustration of his thesis. Of these, some represent the joint work of master and class, some the unaided work of schoolboys or undergraduates. It would be unreasonable to expect them to be proof against criticism (indeed, Mr. Jones disclaims any intention of offering them as models), but all will be found interesting and instructive as exemplifying a method of procedure of the general soundness and importance of which there can be no doubt.

[8] Royal Commission on Coast Erosion, etc., 1911. Third (and Final) Report, pp. 160–61.

ON Monday, October 2, her Majesty the Queen opened the extension of the science laboratories of the London Royal Free Hospital School of Medicine for Women. The ceremony took place in the anatomical department, where more than 600 guests were accommodated. The Queen was addressed by the dean of the school, Miss Aldrich Blake, M.D., who gave a brief account of the school, comparing its position in 1874, when it was founded by Dr. Sophia Jex-Blake, with a total of fourteen students, and its present condition, with splendidly equipped laboratories and more than 400 students; by Dr. Winifred Cullis (lecturer in physiology), who thanked the Queen for the interest she had shown in the work and education of medical women, and all those who by their help had made it possible to carry out this much-needed extension; and by the chairman of the council, who, having handed to the Queen a key presented by the architects, asked her to open the extension. After the Queen had declared it open, her Majesty made a tour of the new laboratories. The extension which has now been carried out was planned and arranged for before the war, owing to the steadily increasing annual entry of students. When war broke out it was for a time uncertain whether the extension should be proceeded with, but the number of students entering the school in 1914 was so great that there was no alternative. Consequently an appeal for 30,000*l.* was issued, the appeal was generously responded to, and within seventeen months the whole sum was obtained. On the top floor the whole extension is given to the anatomical department, which now has one of the finest dissecting rooms in the country (an excellently lighted room, 140 ft. in length), private rooms, demonstration room, preparation rooms, and mortuary. The next floor is given to the physiological department, and the extension provides an advanced laboratory, demonstration theatre, dark-room, storeroom, and private and research rooms. In the floor below is an extension of the chemical department, adding to it an organic laboratory, balance room, and private and research rooms; on this floor is found also a students' union room. Below this is the extension of the physics laboratory, including lecture room, dark-rooms, and research room, and also some laboratories for pathological research.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 18.—M. Camille Jordan in the chair.—A. **Lacroix**: The riebeckite syenites of Alter Pedroso (Portugal), their mesocrate forms (lusitanites), and their transformation into leptynites and into gneiss.—E. **Picard**: Certain subgroups of the hyperfuchsian groups, corresponding with certain ternary quadratic forms.—E. **Esclangon**: Doppler's principle and the whistling of projectiles.—H. **Bordier**: The action of the X-rays upon iodine and iodide of starch in aqueous solution. The solutions are decolorised, a few minutes' exposure to the X-rays giving the same effect as several hours' exposure to ultra-violet light.—M. **Mauger**: The minettes of Jersey.—Ph. **Flajolet**: The perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the first quarter of 1916.

BOOKS RECEIVED.

Science from an Easy Chair. By Sir Ray Lankester. Pp. xii+292. (London: Methuen and Co., Ltd.) 1*s.* net.

Doctors at War. By J. W. Barlow. Pp. 144. (London: D. Nutt.) 2*s.* 6*d.* net.

Evolution by Means of Hybridization. By J. P. Lotsy. Pp. viii+166. (The Hague: M. Nijhoff.) 6*s.* net.

History of Manufactures in the United States, 1607–1860. By V. S. Clark. Pp. xii+675. (Washington: Carnegie Institution.)

The Classics of International Law:—

Le Droit des Gens. By E. de Vattel. 3 vols. (1) Photographic Reproduction of Books I. and II. of the First Edition (1758), with Introduction by Albert de Lapradelle. Pp. 600. (2) Photographic Reproduction of Books III. and IV. of the First Edition (1758). Pp. 375. (3) Translation of Edition of 1758 (by Charles G. Fenwick), with translation (by G. D. Gregory) of Introduction by A. de Lapradelle. Pp. 486. (Washington: Carnegie Institution.) 8 dollars.

De Jure Naturæ et Gentium Dissertationes. By S. Rachel. 2 vols. (1) Reproduction of Edition of 1676, Introduction by L. von Bar, and List of Errata. Pp. 361. (2) Translation of the Text, by J. P. Bate, with Index of Authors Cited. Pp. 255. (Washington: Carnegie Institution.) 4 dollars.

British Rainfall, 1915. By H. R. Mill and C. Salter. Pp. 288. (London: E. Stanford, Ltd.) 10*s.*

Illustrations of the British Flora. By W. H. Fitch and W. G. Smith. Fourth, revised, edition. Pp. xvi+338. (London: L. Reeve and Co., Ltd.) 9*s.* net.

Results of Meteorological Observations in the Five Years 1911–15; also of Underground Temperatures in the Twelve Years 1898–1910, made at the Radcliffe Observatory, Oxford. Vol. li. Pp. xv+215. (Oxford: H. Milford.)

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