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A CONTRIBUTION TO THE HISTORY OF EVOLUTION.

The Coming of Evolution. The Story of a Great Revolution in Science. By Prof. J. W. Judd, C.B., F.R.S. Pp. iv+171. (Cambridge Manuals of Science and Literature.) (Cambridge: University Press, 1910.) Price 1s. net.

So much has been written within the last few years about the history of evolution and its founders that the first question that arises on meeting with the title of this new work is whether it is possible to say anything new upon a subject which has already been dealt with so fully by the founders of the doctrine themselves, or has been handled from so many different points of view by the historians of science and philosophy. The title of the little volume under notice need not, however, act as a deterrent, because in the first place the name of the author will command the confidence of scientific readers, and, in the next place, because, in the words of the general prospectus, the series of small manuals to which it belongs is

"not intended primarily for school use or for young beginners. The educated reader often experiences a difficulty in obtaining short books in which recent discoveries or modern tendencies are treated in a semi-popular and broad style."

With the objects thus set forth we are in complete sympathy. There is ample scope, not to say a crying need, for the authoritative enlightenment of the public mind on scientific questions. With respect to the present contribution to the series it is only necessary to remind readers of the fact that Prof. Judd is among that small and diminishing group of men who can claim to have been personally acquainted with Scrope, Lyell, Darwin, and Huxley, and whose qualifications for instructing the public on that subject which has been placed in his hands are therefore of an exceptionally high order.

By "The Coming of Evolution" the author means both the preparatory work of the great pioneers in geology, such as Hutton, Scrope, and Lyell, and the history of the revelation of the working mechanism of organic evolution by Darwin and Wallace. Of course, there is not much scope for novelty as regards the main facts in such a work since most of the materials have been public property for many years. It is in the handling of the material, in the presentment of the history and in the personal touches which here and there enliven the story with actual reminiscences that will be found the chief interest and value of this fascinating little book. As a geologist it is but natural that the author should bring into prominence the achievements in that domain, and especially those of his own master, Lyell, whom he places as the founder of inorganic evolution side by side with Darwin as the founder of organic evolution. With what feelings do we now read of the great struggle—rapidly passing into ancient history—between uniformitarianism and catastrophism, of the pitying contempt with which many of his contemporaries regarded "poor old Lyell's fads," and of the nervous caution which at that period was necessary in order to circumvent the *odium theologicum*. It may have been excusable in those days to regard the uniformitarianism of Lyell as synonymous with evolution. Yet it must not be forgotten that this inorganic evolution deals only with the geological record. Whether catastrophism in any form occurred during the period represented by that record is a matter of geological evidence, and it is with the geologists that the interpretation of the evidence rests. The old view of terrestrial catastrophism has certainly been slain; nevertheless, after the heat of the fray, are we not justified on calm consideration in rejecting the view that catastrophism and evolution are antagonistic and irreconcilable? The shedding of moons by planets, the outburst of temporary stars and other cosmical phenomena of castastrophic magnitude would appear to indicate that nature's operations are not always carried out by retail instalments. Evolution *per saltum*, so far as the geological record teaches, may be ruled out; nevertheless there was a period antecedent to that record, and catastrophic development must be reckoned with as part of the evolutionary machinery of the cosmos.

Thoughts of this kind and many other suggestive ideas will be prompted by the perusal of Prof. Judd's condensed history. There are many points upon which the various classes of readers to whom the book appeals could enlarge, and there is very little scope for criticism in the usual acceptation of the term. Prichard, who in some measure forestalled Galton and Weismann, did not spell his name Pritchard. The statement (p. 155) that "the inheritance of acquired characters and similar problems were constantly present to Darwin's ever-open mind" may be challenged, because—to our everlasting regret—this question did not take an acute form until after Darwin's death. There is only one passing allusion to the subject in the "Origin of Species" (sixth edition, p. 33), where it stated that such "'variations' are supposed not to be inherited," but Dr. Francis Darwin informed the writer some time ago, when the passage was brought under his notice, that he was unable to throw any light upon the source of his father's authority for the statement, nor has the present writer been able to ascertain by whom this view was held in Darwin's time. Perhaps some of the readers of this notice may be able to supply the necessary information.

But these are only small points. From what has been said concerning the volume as a whole it is evident that we are indebted to the author for a most readable and instructive summary, which appeals not only to the educated public for which it is intended, but which ought to be read, and read carefully, by students of natural science. Prof. Judd, upon whom many of the present generation of geologists can now look as their teacher, survives as a living witness of that great campaign, carried on in the arena of science, which resulted in the overthrow of the ancient cosmogony and the demolition of that narrow teleology which hampered scientific progress in every

direction down to the middle of the last century. It is well that he has given us this short epitome with the history of modern evolution still fresh in his mind, for the present-day student is apt to forget the services of the great masters who fought and won on his behalf that battle which swept away the barriers interposed in the path of scientific progress by prejudice and bigotry, and opened up illimitable fields for cultivation by later generations.

R. MELDOLA.

EDUCATION AND ENVIRONMENT.

Educational Aims and Efforts, 1880–1910. By Sir Philip Magnus, M.P. Pp. xii+288. (London: Longmans, Green and Co., 1910.) Price 7*s*. 6*d*. net.

IT has been recently pointed out by a distinguished educationist how the opening of each of the last four centuries has been associated with far-reaching educational reforms, and how the beginning of the present century has seen for the first time a determined effort to grapple with the whole problem of national education in England, in all its grades, as one thing. The present moment, therefore, seems a fitting opportunity for Sir Philip Magnus to have collected together some of his more important contributions to educational progress, which have been rendered the more interesting and the more valuable by a prefatory series of essays dealing with several branches of educational activity.

It is, of course, easy to be wise after the event, and especially is this true in the subject under consideration, which, if it is regulated as it presumably is, or should be, by certain fixed principles, yet the factors on which these principles depend, and the data on which they must be founded, are so vague, so changeable, and so difficult of definition, that possibly much may be said in mitigation of the blunders which people in high places have made in the past. None the less, it is difficult to put forward a national defence for the neglect of educational reform on broad scientific lines, and so long as this sphere of national activity is regarded as the shuttlecock of party politicians, it is hopeless to expect a well-defined policy which will be conformable to the changing conditions of changing times.

When the history of that great movement which was started by the Education Act of 1870, and vitalised and broadened by the Act of 1902, comes to be written, after its effects have been properly defined and the results can be assessed, it will be seen more clearly than can at present be done the extent to which the nation is indebted to the labours of a body of men, who were responsible in a far larger measure than is commonly appreciated for the essentials of the reforms, and among the names of these assiduous workers that of Sir Philip Magnus will occupy a distinguished place. In some way he has been connected with nearly every branch of educational work during the last thirty years, and although in the earlier days of what may be termed the forward movement, he was frequently in the minority, events have shown that the minority is not always wrong, and it is due largely to the zeal with which he and others, whose names are not less prominent, pleaded for the recognition of environment as one of the essential factors in determining the aims and ideals of any educational policy, that so many of the latter-day reforms are due. The characteristic, however, which distinguishes the author of "Educational Aims and Efforts" from some few of his fellow-reformers, is a sense of proportion, combined with a breadth of outlook, which gives to his utterances a value denied to others.

To attempt in the small space at our disposal to deal in any detail with the subjects comprised in the present volume is out of the question. To do so adequately would involve a survey of the educational history of thirty years. The important part which Sir Philip played in the advancement of technical education is too well known to require notice, but in these days when the cultivation of manual dexterity and the practice of scientific method are beginning to be regarded as within the scope of the ordinary elementary school, it is interesting to recall some of the earlier utterances of Sir Philip Magnus on those points, made in the days of payments by results. Secondary education and university reform are also indebted to him in a large measure, and the views which he put forward in 1888 as to girls' education "demanding full and careful consideration from the point of view of suitableness to woman's wants, woman's occupations, and woman's mission in life," in spite of the progress which has been made in this direction in the last decade, hold with equal force to-day.

To those who take a broad view of education as something that is inextricably bound up with the social fabric, the essay on "Social Changes and School Work" will be regarded as perhaps the most important in the whole volume, and one cannot but recognise, in spite of the controversial issues which it raises —the consideration of which would demand an essay in itself—that the great upheaval of late years in the social condition of our wage-earning classes "renders it necessary that we should reconsider by the light of these changes the foundations on which our present system of education is raised." From the point of view of teacher and administrator alike the problem is rapidly entering on a new phase; and although no one can predict with certainty what the next decade may bring forth, it seems clear that, in the clash of opposing tendencies, the attitude of uncompromising hostility to the larger and more complex requirements of modern conditions and civic responsibilities must give place to a spirit of scientific inquiry as to the most effective and economic method of coordinating educational aims with national ideals. Education is at present far from being an exact science; but there is no reason why it should remain an aimless experiment of misdirected zeal with the welfare of the rising generation.

We may perhaps be allowed to express the hope that the author will return to this problem at an early date, and in the meantime can only trust that the essay will receive that earnest consideration which it demands in view of the rapidly changing phases of social life and of the child's altered relation to the State.

F. H. N.

ENERGETICS AND MODERN PROBLEMS.

Die Forderung des Tages. By Wilhelm Ostwald. Pp. vi+603. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1910.)

IN Goethe's "Maximen und Reflexionen" there occurs the passage: "Versuche deine Pflicht zu tun, und du weisst sogleich was an dir ist. Was aber ist deine Pflicht? Die Forderung des Tages." The author of the present volume tells us that this passage expresses the spirit in which he has from time to time, particularly during the last few years, attempted the solution of problems quite outside the sphere of his original scientific activity. These problems cropped up in the course of the day's work, and, so far as the author was personally concerned, imperatively demanded a solution. The numerous articles and speeches here collected represent Prof. Ostwald's views on the most varied questions, such as personality, immortality, the relation of art and science, the theory of happiness, science and technology, duelling, international languages, and educational reform. These and many other topics are discussed in a highly stimulating manner, the originality of the author's argument being equalled only by the charm of his style and the wealth of illustration which he has at his disposal. If one accepts the definition of a professor as given by "Fliegende Blätter"—"der Professor ist ein Mann welcher anderer Meinung ist"—it may readily be granted that the author, with his refreshing novelty of view, has fully earned the title.

The point of view from which all problems are regarded is the one natural to the apostle of energetics, whose attitude towards the more general questions of philosophy and psychology has already been outlined in these columns (NATURE, 1902, vol. lxv., p. 265). As the years have passed, however, Prof. Ostwald has been led to study the bearing of energetics on questions which touch more closely the life of the modern community, and are certainly of greater interest to the ordinary student of science and scientific method.

If, with the author, we measure culture by the extent to which the various sources of energy are economically utilised for human purposes, then it is natural to test the claims of every custom, every social organisation, and every educational system by the inquiry, How far does it contribute to the economical utilisation of energy? It might be supposed that the mental attitude of one who applies this test to all human endeavour is hopelessly utilitarian. But this is not true of Prof. Ostwald, who is concerned to find a place in his scheme of things for the higher and less immediately practical forms of man's activity. In this connection the question of the utility of works of art is of great interest. Prof. Ostwald, it appears, makes a hobby of painting, and we may be sure that he would at once forbid himself this activity if he considered it to involve a waste of energy. What, then, is a work of art, say a great painting, from the point of view of energetics? According to the present volume, the social value of such a work of art depends on its catalytic action, on its effect in making us better and happier beings, and so contributing to the more efficient transformation of energy in our daily tasks. This point of view is greatly in advance of the ultra-materialistic one from which a great painting is merely so much canvas, so much oil, and so much pigment, but it is doubtful whether the comparison with catalysis is anything more than a mere analogy.

The prominence still given to the study of languages in schools is condemned in no measured terms, and the time devoted to Latin and Greek is described as a sacrifice to a superstition. It is quite truly pointed out that the learning of even a modern language, with its innumerable exceptions to rules, tends to destroy the child's natural sense of logic and to unfit it for any future scientific work. From this position it is but a step to the advocacy of an artificial international language, which shall be "synthesised" on a thoroughly logical plan, and shall obviate the necessity of learning foreign languages. It is the economy of energy to be secured in this way that has led Prof. Ostwald to take a prominent part in urging the adoption of Ido, a simplified form of Esperanto.

"Die Forderung des Tages" is pervaded by a genial optimism, based on the belief that the future of the race is in the hands of science alone. The optimism is welcome, although one might be inclined to argue about the grounds for it. It may be noted only in passing that Prof. Ostwald's belief leads him to the curious conclusion that the chauffeur belongs to a distinctly higher order of being than the "cabby."

Throughout the book there are scattered many delightful reminiscences of the author's experiences at home and abroad. These only add to the interest and charm of a volume which is well worth reading whatever one may think of energetics.

J. C. P.

THE INDUSTRIAL REVOLUTION.

Industrial England in the Middle of the Eighteenth Century. By Sir H. Trueman Wood. Pp. xii+197. (London: J. Murray, 1910.) Price 5*s.* net.

WE have in the volume before us an extremely interesting sketch, expanded from an address by the author given at a meeting of the Society of Arts, of the condition of British industries in the eighteenth century. Perhaps no two periods in the history of social evolution, which followed one another closely, present greater contrast than the beginning of the eighteenth and the beginning of the nineteenth centuries. Indeed, so enormous was the change involved that Sir Henry Wood considers it rather as an "industrial revolution" than a stage in a process of evolution.

The invention of machinery, then the discovery of power to work that machinery, entirely altered the character of the industries of this country, and thus so modified the lives of its inhabitants that it is no wonder that social equilibrium is still far from being attained. Before entering into a very able discussion of the state of the various branches of industry up to the middle of the century, Sir Henry gives us a vivid description of the social conditions then prevailing with regard to the means of intercommunication, and the knowledge of scientific applications for doing the work of the industrial world.

He then begins with an account of the various branches of the textile and other trades, deeply interesting, not only to those desiring a knowledge of their history, but to all students of the economic position at that time. One curious fact impresses itself on the mind of the reader, that is, how greatly the development of trade was hindered by the very means used to encourage certain particular trades which were protected by Government action. There was certainly no *laissez-faire* in those days.

The most important and most ancient of British manufactures was the woollen industry. It was in a state of great prosperity in the eighteenth century, and was even down to 1770 a domestic industry carried out in the homes of the farmers, who produced the wool, and carded, spun, and wove it into cloth by the help of their families and servants. Nearly all farmers depended on this industry to enable them to pay their rent. For its protection enactments were passed to prevent the export of the raw material; laws were also passed to prevent the mixture of cotton and wool or of linen and wool in weaving fabrics. It was to prevent competition with this valuable trade that one of the Parliaments of that period killed the Irish woollen trade, particularly its blanket trade, by putting an import duty on its goods. Sir Henry Wood does not mention this fact, but he states that the encouragement given to the Irish linen industry was to prevent that country entering into competition with England. In the eighteenth century, as now, Ireland and Scotland seem to have been the chief manufacturers of linen.

Probably it was owing to these repressive regulations that England was one of the last countries to adopt the manufacture of cotton. The skill of her spinners was only equal to producing very coarse cotton yarns. Beautiful muslins and calicoes were imported from India, and became so popular that in 1760 it was made "penal for any woman to wear a dress made of India calico." The wearing of French cambrics was also penal. One of the most fascinating sections of this volume contains the description of the gradual growth of the cotton industry as machinery was invented and perfected.

The making of linen and afterwards of cotton thread was first initiated in the west of Scotland by a woman named Christian Shaw; it rose to be an important trade, even in the eighteenth century, and its products were largely imported to England for purposes of lace making, then chiefly carried on in Devonshire and Bucks.

At the beginning of the century under discussion the manufacture of iron was at a very low ebb. Carried out since Roman times by the use of charcoal derived from wood, it had almost declined entirely owing to the destruction of the woods, and consequent legislative restrictions. The author traces the gradual development of the use of coal for smelting, beginning about 1735, at Coalbrookdale, first of all.

At this same place the method of casting iron was discovered and practised. Sheffield and Birmingham were already making a reputation for metal goods, including pewter, which was much used as a substitute for pottery. Until well into the middle of the century England was mainly dependent on France and Holland for the commonest kinds of earthenware.

Sir Henry Wood tells us that this period, until some time after the middle of the century, was not a happy one for science or for scientific development, and we therefore find that industries dependent on scientific knowledge, such as the making of glass and fine pottery, of brewing and other chemical processes, were in a backward state.

Enough has been said to show what a wealth of material has been skilfully put together, and this book forms a most trustworthy source of information when coming from one who is in such a position as the secretary of the Royal Society of Arts.

SPECTROSCOPY.

The Spectroscope and its Work. By Prof. H. F. Newall, F.R.S. Pp. 163+viii Plates. (London: Society for Promoting Christian Knowledge, 1910.) Price 2*s.* 6*d.*

ALTHOUGH classed as a manual of elementary science, this little volume will be found to cover a very wide range of the phenomena of spectroscopy. The opening chapters are occupied with the first principles of the undulatory theory, Newton's classic experiments, and the description of a simple spectroscopic outfit. In chapters iv. and v. the reader is introduced to the various types of emission spectra shown by radiations from various sources, and to the characteristics of absorption, including the solar fraunhoferic and chromospheric spectra. Chapter vi. deals very lucidly with the theoretical principles to be considered in the design of spectroscopic equipment, showing the relation between angular and linear dispersion, purity and resolving power of various dispersive media, &c. Coming next to the application of the spectroscope to definite branches of research, it is shown how, by the aid of large instruments of special design, the spectra of the stars may be studied, revealing their variation in chemical constitution. This naturally leads to the systems of classification which have been proposed to deal with the complex groupings. In describing the fluted structure of the third-type stars, such as α Orionis, it would have been more correct to speak of the maxima of absorption being nearest to the violet instead of saying that the brighter ends were towards the red, as it is usual to regard the heads of flutings as taken for reference to the positions of flutings. It is also perhaps unfortunate for the student that so much space should be given to the old, incomplete, and now little used classifications, while the more comprehensive and natural systems put forward of recent years are discussed in a few lines. The idea suggested on p. 81 that the maxima of the star Mira (*o* Ceti) are of the nature of a conflagration is scarcely to be recommended, especially when dealing with beginners, as the practically unchanging character of the spectrum of the star (apart from brilliancy) even at maxima precludes the probability of any such chemical changes as must accompany the production of flame.

Chapter viii. is occupied with the method and progress of determining the motions of approach or recession of celestial bodies by Doppler's principle of changes of wave-length.

The great field of solar observation is very efficiently summarised in chapters ix., x., and xi., including the new results obtained by the use of the spectroheliograph (a simple diagram such as is often used would have been of value in rendering the explanation of this instrument much easier); the phenomena of the prominences and reversing layer during a total solar eclipse; the sun's rotation and that of the various planets. In chapter xi. particular attention is given to the spectra of terrestrial atmospheric phenomena by the detection of special features in the solar spectrum at different altitudes.

Chapter xii. is devoted to a short outline of the methods of investigating long wave radiations. The inductive method of presenting the reasoning is very acceptable, and the beginner who has mastered the subject so far will be well equipped for entering on the more advanced branches of this intricate section of spectroscopy.

The concluding three chapters deal with the physical sections of spectroscopy. The various systems of harmonic laws found so closely to represent certain types of spectra are well described. Perhaps in the presentation of the diagrams to illustrate these it would have been preferable to adopt the same scheme of orientation for the spectra. Thus in Fig. 46 the red end is to the right, with all the lines of the series converging to the left or violet; while in Fig. 47 the red end is towards the left, and although the series lines really converge to the violet as before, it is confusing for a beginner to have to find that things are all turned the opposite way. This is all the more important from the fact that there are series actually converging in opposite directions. The phenomena of diffraction and general use of gratings for producing spectra are next given, though necessarily condensed. In a manual avowedly written to induce readers to repeat the experiments, mention might well have been made of the fact that excellent replicas of original Rowland gratings, both plane and concave, are now readily obtainable at a moderate price, as it is not often that an original grating is available for general experimental purposes.

It will have been noticed that the description of the application of the spectroscope has been almost confined to its astronomical aspects; it should not be forgotten that spectroscopic analysis is at present playing an important part in the chemical and metallurgical industries.

Eight plates are given at the end of the book, showing various representative spectra. There is also a large coloured plate as frontispiece showing certain elemental and other spectra.

It will be evident from this summary that the book under review should serve as a most useful introduction to the study of spectrum analysis. It appropriately fills a position between the elementary primer with little or no technical information and the more formidable complete treatises which are admittedly repellent to the beginner.

THE THEORY OF METALLOGRAPHY.

Metallography. By Dr. Cecil H. Desch. Pp. x+429. (London: Longmans, Green and Co., 1910.) Price 9*s*.

DR. DESCH has evidently been at great pains to compile a work that shall give a fair idea of the subject as a whole as it appeals to him, and he is, above all, a theorist. It is a difficult work for the writer to review, for two reasons: because it covers practically the whole range of this enormous subject and is therefore necessarily dogmatic on many matters that, if disagreeing with the author, it would need much space to discuss adequately; and, secondly, because he dismisses the whole Sheffield School thus:—"This (the Osmond) hypothesis has been generally accepted as the best expression of the known facts, in spite of strong opposition from a (the Sheffield) school of metallurgists . . ." although on pp. 363 and 364 we find rather contradictory opinions, such as "β-iron was originally described by Osmond as a hard variety of iron. It is more correct to say that it is capable of forming solid solutions with carbon, which become hard under certain conditions of cooling."

The "eutectic-times" method for fixing the eutectic composition was used by Arnold in his "Influence of Carbon on Iron" (Proc., Inst. C.E., 1895–6, part i.), although Tammann is credited with its first use in 1903 (p. 18).

The author might with profit study "The Diffusion of Elements in Iron," by Arnold and McWilliam, I.S.I., 1899, No. 1, instead of the preliminary announcement of 1898, which he quotes, and besides further details on diffusion would find that these authors used the quenching method then, in an endeavour to judge of the condition of the carbon, &c., at high temperatures. Also in connection with the method of changing structure from that showing Widmanstätten figures to granular, the author credits the discovery to Fraenkel and Tammann in 1908, whereas the fundamentals of the matter were first published by Arnold and McWilliam in NATURE, November 10, 1904, p. 32.

A good account is given of the diagram of thermal equilibrium, and on p. 32 it is pointed out that the intermetallic compounds do not conform to our ideas of valency.

The sixth chapter is a good one on practical pyrometry and thermal analysis, but actual work on the subject, and recent discussions have surely at last made it plain, that the author is entirely mistaken in his statement on p. 126 that "In accurate work on the transformations of solids, however, one or other of the difference methods is almost invariably adopted." As recently as the Buxton meeting of the Iron and Steel Institute, September, 1910, it was distinctly shown that in a 0·2 per cent. carbon steel the best workers by the difference method do not divide the Ar_2 point, whilst those working with the present modifications of Osmond's inverse-rate method divided the A_2 point with ease, absolutely proving the superiority of the latter method.

Chapters vii. to xiii. deal with the preparation of micro-sections; crystallisation of metals and alloys;

under-cooling and the metastable state; diffusion in the solid state; physical properties of alloys; and electromotive force and corrosion. In chapter xiv. the construction of the equilibrium diagram is clearly explained, and the remainder of the book deals with the condition of metals in alloys, plastic deformation, the metallography of iron and steel, and the metallography of industrial alloys.

The present writer has made many notes on points in these chapters, as p. 222, "white cast-iron, martensite and cementite," instead of pearlite and cementite. The author is good on the difficult subject of hardness. P. 276, aluminium alloys have "a lower hysteresis than the purest specimens of iron . . . probably due to . . . removing oxygen." This is more likely to be due to the larger crystals formed, and the author, in such a theoretical work, might use the term "crystal" occasionally instead of "crystal grain."

In the chapter on the metallography of iron and steel there is so much that is erroneous that it is impossible to deal with it properly, but as an example the statement on p. 374 that "A tool steel containing 1·6 per cent. carbon, quenched from 800° C. in ice-water, consists of pure martensite," is meaningless.

The work is, however, one that every student of metallography should possess, for although there are so many points in it with which one does not agree, the author has given on the whole a fair account of theoretical matters connected with metallography, has scoured the literature of the subject, even extending to Russian, and has given copious references which must prove useful to those investigating the problems of metallography, who desire with a minimum expenditure of time to find out what has been done on their particular branch. A. McWILLIAM.

PHYSIOLOGICAL CHEMISTRY.

Practical Physiological Chemistry. By Dr. R. H. Aders Plimmer. Pp. viii+270. (London: Longmans, Green and Co., 1910.) Price 6*s.* net.

THIS is really the second edition of Dr. Aders Plimmer's excellent manual. The first appearance of the book was privately printed for use in the practical classes of physiological chemistry at University College, London, but a good many copies were distributed to other teachers, and to the Press. A favourable notice of this preliminary edition appeared in the pages of NATURE at the time. The publication of the book for general sale is an indication of the way in which the teachers of the subject welcomed the new departure in the presentation of the subject. For it is a new departure; hitherto works on the subject have been written by physiologists; the present book is written by a chemist; it is physiological chemistry as opposed to chemical physiology.

The increasing exactitude of knowledge in the chemistry of those carbon compounds which are the constituents or products of living matter warrants the appearance of a book written to show that physiological chemistry is only a branch of organic chemistry, and Dr. Aders Plimmers has been successful in showing the connection of the two by the insertion of the appropriate and logical links which unite the introductory chapters on organic chemistry proper with its daughter science.

The main aim of the work is to make it a trustworthy practical guide, and no laboratory worker can afford to be without it. Its ideal is that every student shall work through all the exercises; these are set out with detail and in a clear manner, so that there is no reason why the student should fail to do so under his teachers, except that of time, and time is a very important factor for students of medicine, to whom the work is primarily addressed. In the medical curriculum, the number of subjects is growing every year, and each one of these is expanding and seeking to encroach more and more on the unfortunate student's already too-full day. Teachers are already seeking means to limit in particular certain preliminary subjects, and to exclude those portions which have but little direct bearing on his future practical life. There is no subject, however, which has such a direct bearing on medical practice as physiological chemistry; its relationships to pathology become clearer with every advance in knowledge; if there is one subject more than any other which should not be curtailed, that subject is physiological chemistry. W. D. H.

SYSTEMATIC BOTANY.

Das Pflanzenreich. Regni vegetabilis conspectus. Edited by A. Engler. Vol. iv., pt. 104. *Papaveraceae-Hypecoideae* et *Papaveraceae-Papaveroideae.* By Friedrich Fedde. Pp. 430. (Leipzig: W. Engelmann, 1909.) Price 21.60 marks.

THIS volume forms the fortieth part of the great series of monographs in course of publication under Dr. Engler's editorship. It comprises the family Papaveraceæ as understood in the restricted sense, that is, without the Fumariaceæ; the account of these will be issued subsequently as Papaveraceæ-Fumarioideæ. The special portion of the work, the systematic treatment of genera and species, is preceded by a general account of the family occupying eighty-three pages, in which Dr. Fedde discusses the morphology and anatomy of the vegetative organs, with special reference to the value for systematic purposes of the anatomical characters; the position of the laticiferous vessels and the character of the latex is found most helpful in this respect. The floral structure and its modifications are discussed at considerable length, and also the fruit, especially the various mechanisms of dehiscence. There is also a useful section on geographical distribution, a discussion of the affinities of the family, and an account of its economic uses.

The great value of these monographs lies, however, in the systematic portion, which should represent the results of the work of an expert student of the family on all the available material. Dr. Fedde is known as an authority on the Papaveraceæ, and we look to his monograph for a careful and considered systematic presentation of the family. It is somewhat surprising therefore to note the treatment of the earlier genera of Papaveroideæ which, as Platystemon and Eschscholtzia, are confined to Pacific North America. In

Bentham and Hooker's "Genera Plantarum," these genera are credited with one and four to five species respectively, and while we might expect some increase in the number of known species since the date of issue of that volume, it is with somewhat of a shock that we find Platystemon credited with fifty-five and Eschscholtzia with 123 species. In Platystemon forty-nine of the species are of Greene and six of Fedde, in Eschscholtzia 104 of Greene and twelve of Fedde. Prof. E. L. Greene, we believe, holds views as to the origin of species which do not accord with those generally accepted, and these views are no doubt responsible for the description of species based on characters which might otherwise be regarded as representing mere variants of a single species. Dr. Fedde has not only adopted Dr. Greene's estimate, but added to the number. He perhaps shrank from the difficult task of reducing the species to more workable proportions, and took the path of least resistance. The result is, however, an increase in the number of those genera, which, like Cratægus in America, and Rubus in the Old World, have been rendered hopelessly unworkable by any but the most devoted expert. This method of treatment of some of the genera leads to a want of uniformity in the work as a whole. Thus under the common poppy, *Papaver rhoeas*, are twenty-six varieties and subvarieties, which probably have as good claim to specific distinction as the "species" of Platystemon.

In dealing with the genera of Chelidonieæ, Dr. Fedde has followed the limitation of species accepted by Dr. Prain, though he does not adopt his reduction of several of the genera, Dicranostigma, Hylomecon, and others, to subgeneric rank under Chelidonium. On the whole, however, Dr. Fedde shows a disinclination to differ from authority which we do not expect from the expert who has exhaustively surveyed the entire field of a large natural order. Thus under Meconopsis, while accepting Dr. Prain's sections, he suggests with regard to two of these, Aculeatæ and Primulinæ, that the division is not a natural one.

As regards the presentation of genera and species, the descriptions are full, the synonymy and geographical distribution are carefully worked out, and collections and numbers are largely cited. The index is a good one, but would be improved by the repetition of the genus name at the head of each column, thus avoiding the necessity for turning back to find the genus to which the species names belong.

A. B. R.

OUR BOOK SHELF.

Woodcraft for Scouts and Others. By O. Jones and M. Woodward. Pp. 156. (London: C. Arthur Pearson, Ltd., 1910.) Price 2*s.* net.

THAT the present generation of country people do not study woodcraft and field-lore with the zest and thoroughness of their forefathers, is a regrettable fact too well known to all capable of forming an opinion on the subject. The nature-knowledge of the old-fashioned shepherd has been replaced by a superficial education of a different class, which is of little or no use to its possessor, and the intimate knowledge of the creatures of the forest, field, and stream owned by the professional poachers of a generation ago has to a considerable extent vanished with the diminution in the numbers of that class in many districts. Nor is this all, for ordinary country lads, in some counties at any rate, show a lamentable lack of knowledge of the names of wild plants and birds as compared with their grandfathers. That the scout movement, if properly conducted will do something to improve this state of affairs in the case of the rising generation is almost certain, for it is obvious that to orient one's position in a wood at night, to follow the trail of a suspect, or to escape the attentions of an enemy is impossible without a full knowledge of woodcraft in its widest sense.

As an aid to knowledge of this nature, the excellent little volume by Messrs. Jones and Woodward is very opportune, if only it reaches the class for which it is primarily intended. Both authors appear to have a thorough grasp of their subject, and the amount of information contained in their work is little less than marvellous. In the tenth chapter there is perhaps a little too much tendency to convert the young scout into a rabbit poacher, and the expression on p. 136, "to break the law of trespass," is an indication that the authors are not so well versed in the common law of their own country as they might be. In treating of the animals and plants of the countryside, the authors are just as much at home as when discussing old-fashioned country remedies, or the difference between wholesome and noxious funguses, and their work as a whole leaves little or nothing to desire in the matter of completeness and thoroughness.

R. L.

A School Course of Heat. By R. H. Scarlett. Pp. xvi+300. (London: Longmans, Green and Co., 1910.) Price 3*s.* 6*d.*

THIS book is intended for the use of students who have already passed through an elementary course in general physics. The author devotes the first thirty pages of the present volume to a recapitulation of the elementary portions of heat. The rest of the book deals with the more advanced parts of the subject and touches briefly upon some points which do not usually find a place in a school text-book.

The subject is developed throughout along the line of practical work in the laboratory, but we do not think the laboratory experiments are always well chosen. In dealing with the errors of mercury thermometers on p. 18, the author states that mercury is not quite uniform in its expansion, and near 50° C. on the scale, there will be a constant error amounting to almost a degree. This error, of course, will depend upon the glass, but one-tenth of a degree is nearer the average correction necessary from this cause. The method employed on p. 62 to obtain the relation between the density of a liquid at different temperatures and its coefficient of expansion will present difficulty to an elementary student, and it is certainly not sufficiently accurate for all experiments as performed in the laboratory. Thus, in the example given on pp. 64, 65, there is an error of 3 per cent. in the calculated coefficient due to the use of this approximate formula.

Similarly, in the treatment of coefficient of absolute expansion on p. 70, it is not made clear to the reader which column length is involved in the denominator of the expression obtained. The wrong one is measured in the illustrative example, making a 1½ per cent. error in the result. The hydrostatic method is a most unsuitable one to employ for the expansion coefficient of ether between 10° and 30°, as given on p. 66. On p. 191 we are told that the steam and hoarfrost lines intersect at 0° C. The chapter on thermal conductivity would have been improved by

the inclusion of some experiments within the range of possibility for the student. Forbes' method is entirely unsuitable for performance in a school laboratory.

Die praktischen Schulerarbeiten in der Physik. By Dr. W. Leick. Zweite Auflage. Pp. 49. (Leipzig: Quelle and Meyer, 1910.) Price 0.80 mark.

THIS pamphlet consists of two parts, of which the first and longer is a plea for the further introduction into German schools of laboratory work in practical physics, while the second gives a few selected examples of the kinds of work which the author regards as specially suited for schools. It appears that comparatively few of the German *Gymnasien* and *Realschulen* have as yet introduced practical physics into the school curriculum, although there is at the present time a vigorous movement in favour of its compulsory adoption in all higher schools. The author sets forth very clearly the advantages of individual practical work, and discusses at some length the objections that have been raised against laboratory work in schools.

It is interesting and refreshing to find a German author holding up English educational methods as a model for his countrymen. He is, however, severe on that method of teaching which induces the student, or professes to induce the student, on the strength of a few experiments (probably badly performed) to regard himself as the discoverer of natural laws. The examples in the second part of the pamphlet illustrate other and better methods of arousing the interest of the pupil, and show that Dr. Leick is a teacher who by his own originality will induce originality in his pupils. There is a fairly full bibliography.

H. E. S.

(1) *Who's Who*, 1911. Pp. xxvi+2246. (London: A. and C. Black.) Price 10*s.* net.

(2) *The Writers' and Artists' Year Book.* Pp. viii+132. (London: A. and C. Black.) Price 1*s.* net.

(3) *The Englishwoman's Year Book and Directory*, 1911. Edited by G. E. Mitton. Pp. xxxiv+386. (London: A. and C. Black). Price 2*s.* 6*d.* net.

THE new edition of "Who's Who" (1) shows another annual increase in size, containing eighty-four pages more than the last issue. Due prominence is given to the biographies of men of science, about whom the volume provides many interesting personal facts, as well as details of their professional careers. This work of reference is more than ever indispensable.

The "Writers' and Artists' Year Book" (2) is a very useful directory for writers, artists, and photographers. It gives just the information which these workers require. The new tables in the book include clubs for authors and artists, and there is an article this year on the law of copyright.

We agree with the editor of "The Englishwoman's Year Book" (3) that no woman who takes any part in public or social life can afford to be without this volume. The book is now for the first time divided into two parts: one including education, professions, and social life, and the other being mainly devoted to philanthropic effort. An especially valuable feature is the section giving particulars of scholarships offered to women by the different universities.

Notes on Physiology. By Dr. Henry Ashby. Eighth edition. Revised by Hugh T. Ashby. Pp. xxix+346. (London: Longmans, Green and Co., 1910.) Price 5*s.*

ALTHOUGH this little book has seen eight editions, and so has successfully catered for a certain class of students, that fact alone must not be taken as evidence that the book is a good one. There is little or no attempt made to keep pace with the advance of modern physiology. Old and incorrect statements are still retained, new work and new ideas are almost altogether omitted. The book may perchance still enable the lazy student to scrape through his examination on the minimum of pass marks, but it is only right to warn intending purchasers that to rely on Ashby's notes alone will be like leaning on a broken reed. A catalogue of the various faults, both of commission and omission, which adorn nearly every page, might be given, but it would be hardly fair to the readers of NATURE to use its columns in this way. These might more suitably appear in periodicals which are more widely read by the medical students for whom this book is intended.

W. D. H.

The Stars from Year to Year, with Charts for Every Month. By H. Periam Hawkins. Pp. 23. Price 1*s.* net.

The Star Calendar for 1911. By H. P. H. Price 1*s.* net.

The Star Almanac for 1911. By H. Periam Hawkins. (Bedford and London: *Beds. Times* Publishing Co., Ltd.; and London: Simpkin, Marshall and Co., Ltd., 1910.) Price 6*d.* net.

ONCE more we welcome the three annuals prepared by Mrs. H. Periam Hawkins as being among the most useful, low-priced aids to amateur astronomers. "The Stars from Year to Year" is practically the same as last year, and in some respects this is to be regretted. For example, turning to "Halley's Comet," we find the latest information is the statement that "according to the latest computations of Messrs. Cowell and Crommelin it will be nearest the sun on April 30, 1910." It seems a pity that in a book, apparently issued for 1911, some short *résumé* of the facts we learned from the re-apparition of so famous an object is not given.

In the "Star Calendar" the date calendar and the hour quotations have been changed, and we would suggest that in future issues the fastening at the centre of the planisphere should be strengthened. The addition of the equator and ecliptic, especially the latter, might also prove useful.

No handier almanac than the broadsheet prepared by Mrs. Hawkins can be hung in the sanctum or observatory of the amateur. Eclipses, meteor showers, the positions of the planets, &c., are tabulated, and reproductions of the lunar eclipse of April 30, 1905, and Ritchey's Orion nebula are also given.

W. E. R.

The Medical Directory. 1911. Pp. 2168. (London: J. and A. Churchill.) Price 14*s.* net.

IN addition to full information of the professional qualifications of recognised practitioners, this very complete directory contains all the facts a medical man is likely to expect in such a work of reference. Among the new features of the sixty-seventh issue may be mentioned new lists of coroners and Continental health resorts; a summary of the law as to cremations; information as to motor-car and petrol rebates; and a numerical summary showing the geographical distribution of the medical profession.

Philips' Nature Calendar, 1911. (London: G. Philip and Son, Ltd.) Price 6*d.* net.

NOTES are given on the characteristic animal and plant life of each month, and on garden operations. There are also notes on general aspects and problems of nature-study, intended to suggest subjects for lessons and observations. The calendar is intended to be hung upon a wall, and it should be of decided service in directing attention to the changing face of animate nature throughout the year.

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.]*

Observations of Mars.

IN NATURE of November 10, 1910, Mr. J. H. Worthington gives his interesting observations of the fine straight lines which he saw on Mars at Flagstaff, and expresses his belief that these "telegraph wires" are objective realities in the focal image. Although I have not seen Mr. Worthington's paper, yet I shall reply to it, basing myself on the accuracy of the abstract given of it in the Journal of the British Astronomical Association, vol. xxi., p. 130.

Now Mr. Worthington's very brief experience of the appearance of Mars during the few days spent at the Lowell Observatory is necessarily outweighed by that of an astronomer like Prof. A. E. Douglass, who spent several years in the planet's study at Flagstaff. But what was the conclusion of Prof. Douglass from his observations of the straight "canals," of which he saw more than anyone else? That they are optical "illusions" having "worked serious injury to our observations" (*Popular Science Monthly*, vol. lxx., May, 1907). It would be difficult to conceive a more decisive symptom of frailty in the "canal" question than this surrender to truth of its ablest exponent.

In discussing my work rather than the collective evidence of great telescopes (of which my results form an integral part), Mr. Worthington seems to show some misapprehension in the very object of his criticism, for my conclusions are identical with those arrived at at Lick, Yerkes, and Mount Wilson. Thus, in 1895, Prof. Barnard, summarising his evidence with the 36-inch at Mount Hamilton, said:—"No straight, hard, sharp lines were seen on the continents, such as have been shown in the average drawings of recent years" (Monthly Notices, R.A.S., vol. lvi., January, 1896, p. 166). On September 21, 1909, I state that "those geometrical spider's webs . . . do not exist" (Journal of the British Astronomical Association, vol. xx., p. 141). A fortnight later Prof. Frost telegraphs:—"Yerkes telescope too powerful for canals." Lastly, on January 3, 1910, Prof. Hale proclaims "the perfectly 'natural' appearance of the planet" in the 60-inch reflector, by far the most perfect and powerful instrument ever made, "and the total absence of straight lines" (Journal of the British Astronomical Association, vol. xx., p. 192).

It would thus appear that Mr. Worthington is perhaps attempting to revive the old controversy on the relative merits of large and small telescopes. But that question has been settled long ago, so that any attempt to renew it can no longer deserve serious consideration. The overwhelming superiority of large instruments has been often demonstrated on double stars, for the two discs seen in a great aperture will be blended, by increased diffraction, into a single mass of light with an 18-inch; and, as the smaller star is observed to revolve in perfect harmony with Newton's law, there can be no doubt whatever as to its objective existence. The same fundamental principle holds good for planetary detail. Two contiguous, irregular, bright spots on Mars in a 33-inch will appear as a single round spot in an 18-inch. Hence delicate objective markings, which are quite plain in large glasses, cannot be defined at all with inadequate instruments, and this well-known rigid demonstration establishes for ever the hopeless inferiority of small telescopes.

The advantage of great objectives I have further shown on Mars when stating (December 23, 1909) that the geometrical network vanished in perihelic opposition of the planet, while much more delicate detail was quite plain (Journal of the British Astronomical Society, vol. xx., p. 141). On September 20, 1909, under perfect seeing, I can discover no straight lines, but draw Lacus Mœris as a vast shading, and Deltoton Sinus triple (letter to Schiaparelli, dated September 21, 1909). A fortnight later the same region of Mars is photographed at Mount Wilson, and Lacus Mœris comes out likewise as a vast shading, while the triple structure of Deltoton Sinus is also confirmed. On November 3, 1909, at Flagstaff, the "lake" is missed (although covering fully one-sixth of the diameter of the planet), and Deltoton Sinus appears single, while a host of lines furrow the surface (Journal of the British Astronomical Association, vol. xx., pp. 376–7). But the fact that straight lines are drawn when more delicate detail, confirmed by photography, is missed, constitutes another proof, not only of the inadequacy of the 18-inch as compared with the 33-inch, but also of the inanity of the "telegraph wires."

Yet my position in the "canal" question should not be misunderstood. If by "canals" be meant straight lines, then I think the "canals" do not exist; if we mean irregular, more or less streaky markings, then the "canals" exist. Of course, it would be utterly illegitimate to speak of genuine canals on Mars. But in the positions of Schiaparelli's lines I often saw, with the large telescope, either (*a*) complex, irregular, knotted, or winding bands; or (*b*) jagged, isolated, dark spots; or (*c*) indented edges of differential shadings. Under good seeing, the irregularities of these objects were held steadily from five seconds to several minutes. From my experience of the "canals" since 1894, with various apertures, I am led to account for the single and double straight of lines of Schiaparelli as follows: over the objective substratum of irregular, sinuous corrugations diversifying the Martian surface, a tired eye will discover by flashes a geometrical appearance. Impressions of single lines will fleet now and then either over a narrow objective streak or over the jagged border of a half-tone, while double parallel lines will flash in the position of a broader band. But, as pointed out by Mr. Maunder, the straight lines (which, so far as my evidence goes, are usually glimpsed severally, and not collectively) are merely optical summations of groups of minute irregularities beyond the reach of the instrument used. Prof. Lowell may justly feel proud upon having succeeded where all his predecessors failed, and upon having photographed the irregular streaks of Mars by ingenious methods, devised at his observatory.

A new notion was recently introduced in science by the "born-good" and "born-bad" air of some localities; but the splendid results of Dawes, Lockyer, Burton, Green, Denning, and others in the British Isles (a country most unfavourable to telescopic work), prove that the difference between the best and worst observing stations is largely a difference of duration of good seeing. Transparency of air, which is indispensable in detecting faint stars or nebulæ, seems to be of little moment in planetary detail. When minute Martian irregularities, beyond the reach of an 18-inch at Flagstaff, are held steadily near Paris with a 33-inch; when such detail is corroborated by the unanswerable testimony of photography; and when the blue cap of Saturn is a most conspicuous feature at Meudon a whole year before the recent Solar Congress, we are bound to admit that *any* point on the earth's surface may give us short spells of perfect seeing.

E. M. ANTONIADI.

Paris, December 28, 1910.

Sir Ray Lankester's Book on the Okapi.

SIR HARRY JOHNSTON is wrong in suggesting (NATURE, December 15) that the incompleteness of my monograph of the okapi is due to the "financial control" (presumably he means the trustees of the British Museum) disliking the expense of publishing a volume of text. The full expenditure required was approved by the trustees when I was director of the museum. The absence of any further text than that which accompanies the plates and figures in the volume, as issued, is solely due to the fact that I have not provided such further text.

It would have been better to call the book "Contributions to a Knowledge of the Okapi" rather than a "monograph" of that animal, since although it is in the strict sense a monograph, it does not profess to give (as Sir Harry Johnston seems to think that word implies) a *résumé* of all that is known and has been written on

the subject. When my book was originally planned it was intended that it should be a monograph of the specimens of okapi contained in the national collection, and it thus became entered on our list as "the monograph on okapi."

More, no doubt, might be written about the specimens which I had under examination, and I should have, in some circumstances, been able to add to what the book contains; but the problems which arose in the course of my work could not, in many cases, be satisfactorily solved by the examination of the existing material.

We shall have to wait for new observations made upon fresh or living specimens for a solution of the question as to what are the characteristics of the male and female okapi respectively, what are their geographical variations, and whether there are distinct races or subspecies.

E. RAY LANKESTER.

29 Thurloe Place, South Kensington.

SIR E. RAY LANKESTER is correct in supposing that I was misled by the last paragraph of the preface to his work on the okapi into the belief that there had been or might be an additional volume of text to supplement the illustrations given in the volume under review. From private correspondence which passed between Sir E. Ray Lankester and myself about three years ago I was under the impression that the "text" alluded to was in existence, and perhaps I arrived too hastily at the conclusion that for reasons of economy it had been put aside because of the intervening publication of M. Jules Fraipont's work. The title "Monograph of the Okapi" to which Sir E. Ray Lankester refers as likely to mislead an appraiser of his work was not of my bestowal, but is the official title of this valuable and admirably produced volume. The illustrations are fully described; but I suppose what I missed, and what I hoped might still be forthcoming, were the deductions to be drawn from these illustrations as to the affinities and systematic position of Okapia: in short, a statement of Sir E. Ray Lankester's personal opinions. He is probably quite right to withhold these until something is known of the beast's musculature and intestines.

H. H. JOHNSTON.

The Dynamics of a Golf Ball.

WITH a view to reproduction in the forthcoming Life of the late Prof. Tait, I have just been editing his popular article on long driving, which appeared in the *Badminton Magazine* of March, 1896. On reading Sir J. J. Thomson's lecture, as published in NATURE of December 22, 1910, I was greatly struck with the strong resemblance between golf-ball paths worked out mathematically by Tait and the stream lines of the electrified particles in the ingenious experiment devised by Sir J. J. Thomson. A few of Tait's calculated curves were given in NATURE, vol. xlviii. (June 29, 1893); but better examples will be found in the second paper on the path of a rotating spherical projectile (Trans. R.S.E., vol. xxxix., or Scientific Papers, vol. ii., p. 386) and in the article on long driving already mentioned.

By laborious arithmetical calculations, Tait and his assistant computer worked out a series of possible trajectories with various values for the transverse force due to the underspin, obtaining, among others, the kinked path which Tait had already demonstrated by undercutting a light rubber balloon. It is extremely interesting to see how the several types of curve figured by Tait for the same initial speed of projection, but varying degrees of underspin, are almost accurately reproduced by Sir J. J. Thomson's beautiful method of subjecting a stream of negatively charged particles to a suitable combination of electric and magnetic forces.

C. G. KNOTT.

Edinburgh University, January 2.

On the Simultaneity of Abruptly-beginning Magnetic Storms.

I WAS naturally much interested in Dr. Krogness's communication to NATURE of December 8, 1910 (p. 170), and wish to take this occasion to express my gratefulness to him for making known his criticisms on some of the results of my investigations on magnetic storms, as well as on those of Mr. Faris, where there is opportunity for reply. I am also glad that he has made his statements sufficiently direct, so as to admit of an equally direct answer.

Dr. Krogness first wishes to show that my conclusion, that even the sudden magnetic disturbances do not begin strictly at the same instant, but at measurably different times at various points on the earth, rests on insecure foundation; he would make it appear that it was based on but two cases, viz. the disturbance of May 8, 1902, and that of January 26, 1903. He will find a table (No. VIII.) in No. 2 of my researches (December, 1910, issue of *Terrestrial Magnetism and Atmospheric Electricity*) which summarises the data from thirty-eight abruptly-beginning disturbances between the years 1882 and 1909, thirty-four of which were available to me when the article was prepared which Dr. Krogness reviews (*loc. cit.*, pp. 19–20).

The table gives the date and approximate Greenwich mean civil time for each of these thirty-eight disturbances, next the number of observatories for which time data were available and the approximate portion of a complete circuit of the earth embraced by the contributing observatories. Then the value of x, or the time in minutes required by a disturbance to pass over one-fourth of a great circle, and in the following columns is given the approximate weight to be attached to any particular value of x, as determined from all circumstances involved, and the source from which the data have been obtained. A plus sign attached to x means that the disturbance progressed apparently in an eastwardly direction, as indicated by an increase in the Greenwich mean time of beginning at easterly stations over that at westerly ones. A minus value of x means, of course, the reverse. Nos. 35–38 were since added on the basis of data communicated by Mr. Faris (*loc. cit.*, pp. 213, 214).

Out of thirty-eight values of x, only ten, or about one-fourth, have the negative sign, so that three-fourths of the disturbances of the type here considered show an eastward progression at the times of beginning. In view of the greatly varying circumstances on which the figures are based—different observatories, different instruments, times scaled by different persons, different years, covering a period of two and a half times that of a sun-spot cycle—it is going to be difficult to explain the persistency of the plus sign by any such possible errors as Dr. Krogness points out, which, as a matter of fact, even he will hardly contend would be always in the same direction for *every* observatory, nor even necessarily always the same at the same station.

From this table the following results are derived:—

Weighted mean value of 28 plus values of x	$= +1{\cdot}65$ minutes
,, ,, 10 negative ,,	$= -1{\cdot}80$,,
Weighted mean without regard to sign ...	$= \pm 1{\cdot}69$,,
(Hence velocity of progression for average sudden disturbance, whether to the east or to the west, is	99 km./sec.)
Weighted mean with regard to sign	$= +0{\cdot}74$ minute
(Hence average *algebraic* velocity of eastwardly progression is	225 km./sec.)

We thus get a velocity for the progression of a sudden disturbance on the order of 100 to 200 kilometres per second; hence, if a sudden disturbance passed around the earth completely it would take approximately between seven and three minutes. We are here, then, dealing apparently with a velocity of a greatly subordinate order (1/3000 to 1/1500) to that of electromagnetic waves, which would require but a tenth of a second to pass round the earth, and of kathode rays which would take on the order of a half-second.

Another line of argument set forth in my papers is based on the harmonic analysis of the typical disturbance here under consideration, for which the effect, in general, is an increase in H (horizontal intensity) over the whole earth and a decrease in Z (vertical intensity) in the northern magnetic hemisphere and an increase in Z in the southern. It was found, for example, that the disturbance system of

May 8, 1902, was a two-fold one: first, the stronger, a set of electric currents which, if negative, circulate in the upper regions around the earth eastwardly (anti-clockwise) if one were looking down on the North Pole, and secondly, a weaker system, imbedded within the earth, possessing the characteristics of directly induced magnetism. It is a matter of interest that the harmonic analysis prescribes the same direction of progression around the earth for the upper negative electric currents as has been revealed by the generally eastwardly progression of the times of beginning; and it is natural, then, to inquire whether these overhead negative currents consist of negative ions moving at the rate of 100 to 200 kilometres per second, the resulting effect of which on our magnetic needles is merely an exhibition of the Rowland effect on a scale far transcending any laboratory experiment.

We have found that the speed of these negative charges must be on the order of about 1/500 that of kathode rays. My provisional calculation showed that if we are dealing here with moving ionic charges, then at the height of about 75 kilometres the rarefaction of the air and the other necessary conditions, so far as can be judged from surface experiments, would be such as give a velocity of the order required to satisfy the apparently slow propagation of magnetic effects over the earth. The lower the current gets down the slower the speed, and, if other things are equal, the greater the effect. Whether this is in accordance with actual observation is at present undergoing an examination.

Now let us look briefly at the matter in another way. Suppose a negative ion is set in motion at a given altitude and in an easterly direction; the deflecting effect of the earth's magnetic field on the eastwardly moving negative charge is to bring it down closer to the earth. But, as we have seen, the ionic velocity decreases with decrease of altitude, and hence the magnetic effect produced by the moving charge on a needle at the surface would begin later and later as the charge travelled eastward. If, on the other hand, the negative charge started westward around our planet, then the deflecting effect of the earth's magnetic field would be to make the charge move higher and higher or faster and faster. We might thus possibly have the following state of things: due to some cause, electric charges are set in motion in every direction from a given point overhead. Those with an easterly component of motion would have their velocities checked in the manner just described, whereas those having a westerly component would have them increased, so that for two stations, one east and one west, the magnetic effect might be recorded later at the east station than at the west one—as we have actually found to have been the case in the vast majority of the thirty-eight cases above treated.

Dr. Krogness next attempts to break down the testimony regarding non-simultaneity of commencements of sudden storms furnished by Mr. Faris (*loc. cit.*, pp. 93–105). Dr. Krogness notwithstanding, Mr. Faris *does* make a statement (p. 98) as to his method of time scalings and the various matters involved to secure the desired accuracy. It is the custom in the Coast and Geodetic Survey to take into account every possible source of error, and as the result Mr. Faris says:—"It would thus appear that with especial care the times could be scaled from the magnetic records within one-half minute in any individual case."[1] He furthermore states (p. 105):—"In closing, it seems proper to state that the scaling of the times of the beginnings of sudden impulses is not so difficult a matter as it is to ascertain the exact correspondences in the curves at different stations, for the form of the photographic record of the starting impulse is not always exactly the same at different places; that is to say, the fixing of the exact point of the beginning of the disturbance is sometimes more difficult than the reading of the time after the point is decided upon. This difficulty arises chiefly from the fact that the magnetic traces, except in tropical latitudes, are much of the time not smooth curves."

[1] In the December, 1910, issue (*loc. cit.*) Mr. Faris has two communications which will give further evidence on the matter of accuracy of his time scalings to which Dr. Krogness may be referred.

This matter of being sure of having precisely the same perturbation for all stations is one apparently insufficiently considered by Dr. Krogness. For example, he questions our time of beginning in the H disturbance for the storm of May 8, 1902, as recorded at Potsdam. I gave 12h. 0m., and he gets 11h. 58m.; I have had our scalings gone over once more, and have this to say: unless the Potsdam Observatory has revised the data furnished us (copy of magnetogram and accompanying time data), the time given by Dr. Krogness is wrong, and 12h. 0m. is correct. If our Potsdam data are correct, then Dr. Krogness has either made an error somewhere, *e.g.* may not have considered the fact that the middle of the hour breaks in the Potsdam curves is for local mean time, not for middle European time, or he has taken a small preliminary tremor observed at some of the stations, but of a different character than the particular perturbation considered. He should also remember we had before us the curves of twenty-five observatories, with the aid of which the identical characteristic point could be determined upon for each, so far as that is possible.

Another fundamental fact in terrestrial magnetism of which Dr. Krogness is not aware is this: the existence or non-existence of a terrestrial magnetic phenomenon cannot be proved by *one* magnetic observatory, no matter how excellent and superior its equipment may be—not even the whole European group, consisting of about twenty magnetic observatories, would in certain instances suffice. Since the publication of the papers criticised by Dr. Krogness, a prediction which I made has been found true. On p. 25, *loc. cit.*, I say:—

"In fact, I confidently expect, as soon as a complete analysis has been made of magnetic disturbances covering the greater portion of the earth, it will be found that the disturbance field, in general, presents all the same characteristics of the terrestrial, primary one—the disturbances will themselves reveal effects from terrestrial, continental, regional, and even local causes (earth currents, for example, whose path and intensity depend upon local character of soil, &c.)."

Mr. Faris has brought together for the March, 1911, issue (*loc. cit.*), the data from observatories all over the globe with respect to some peculiar magnetic disturbances which occurred between December 29 and 31, 1908. With his permission I will anticipate by saying that these disturbances, of which there were eight cases, occurred each time over restricted regions of the globe—*e.g.* in the United States and not in Europe, or *vice versa*, &c. The interval between the occurrence of the disturbance in the United States and Asia, or Asia and Europe, was not a matter of a few minutes, but a matter of many hours! Though this disturbance—whenever it occurred—never lasted much more than half an hour, and was during an otherwise magnetically calm day, nevertheless a number of observatory directors are on record as having recognised it and having characterised the day as disturbed (class 1). The interesting point is, however, that they did not all get it at the same absolute time, but at times differing by many hours! A discussion will be given in the March issue (*loc. cit.*).

Hence, by attempting to disprove a fact based on such extensive data as referred to above, with the aid of data at *one* observatory—Potsdam—Dr. Krogness has simply shown that he is unfamiliar with a fundamental fact regarding the *distribution* of magnetic phenomena. Every magnetic phenomenon known to me partakes of a most complex character, and to get a general result of value it is necessary to base an investigation, not simply upon one station or one part of the earth, but on as great a portion of the earth as possible—the greater the better.

Dr. Krogness next reverts to the disturbance of January 26, 1903, the times for which were scaled by Prof. Birkeland. He exhibits a rather interesting method of discrimination between the various stations, and appears to have overlooked where his own figures lead. He rejects *in toto* the three Coast and Geodetic Survey magnetic observatories, Honolulu, Baldwin, and Cheltenham—the latter two probably because Prof. Birkeland had found the identification of the point of beginning of the disturbance

difficult. But this Prof. Birkeland says was likewise true of Toronto, yet Dr. Krogness retains this station; why he rejects Honolulu Dr. Krogness does not say. Again, he overlooks the fact that when he corrects Birkeland's scaling for San Fernando he has improved the easterly progression—Prof. Birkeland's value was nearly two minutes too high. In view of the uncertainties in Prof. Birkeland's scalings revealed by Dr. Krogness, and as Prof. Birkeland fails to specify the particular element considered, not full weight could be attached to this disturbance in the above table. It should also be stated here that Prof. Birkeland considered, in all, six characteristic points of the disturbance curve, and my result was based on *all* the scalings—seventy-two in number—and not merely the half-dozen taken by Dr. Krogness. Did I myself consider such limited data as Dr. Krogness uses adequate for the purpose, I might point out that his own figures show an easterly progression of the times on the order of what is to be expected, which would have been still further accentuated had he not rejected Honolulu.

Just as I am preparing this reply, I am in receipt of a letter from Dr. Chree, dated December 6, 1910, accompanying a copy of the proof-sheets, which he kindly let me see, of his paper before the Physical Society, November 11; he had also given a paper on the same subject at the British Association meeting. He is not in agreement with my general deductions or with those of Mr. Faris. His criticisms are in part covered by the foregoing reply to Dr. Krogness, and in part by my article in the December (1910) issue (*loc. cit.*). I can only say here that I cannot agree with Dr. Chree in several of his own deductions, and especially with regard to the possible inaccuracy of Mr. Faris's time scalings: I beg to refer him to pp. 213–4 (*loc. cit.*). Nor can I enter here into a discussion with regard to his criticisms of my hypothesis of ionic currents, for it would seem that he has unintentionally put into his discussion ideas which are new to me. I will only remark that nowhere in my papers have I supposed such a simple overhead electric current in the plane of the geographical equator as postulated by him; this is best shown by my mathematical analysis.

In conclusion, I would like to state my position once more, viz. *even our most sudden magnetic storms begin at measurably different times for various stations distributed over the globe. The data thus far available would show that the Greenwich mean times of beginning increase more often in an eastward direction than in a westward one.*

Our explanations as to the cause may differ, but I believe what I have just stated to be an actual fact.

L. A. BAUER.

Washington, D.C.,
December 19, 1910.

Tribo Luminescence of Uranium.

MOISSAN first directed attention to the pyrophoric properties of metallic uranium. The luminosity shown on shaking a bottle containing metallic uranium is due to the oxidation of small particles of the metal. Uranium is a hard but brittle metal; when pieces of it rub together small particles are knocked off, and if these are neither too small nor too large the friction may be sufficient to heat them above 170° C., at which temperature uranium inflames in air. The presence of smaller particles, which do not inflame visibly in air, is shown by their incandescence in a gas flame lit by the "spark" from the metal. The luminosity obtained by rubbing metallic uranium is not the same class of phenomenon as the luminescence produced by shaking a tube containing uranium nitrate; the latter has been described as tribo luminescence (Wiedemann). If the tube containing metallic uranium is filled with hydrogen no luminosity is obtained, whereas the luminescence of the uranium nitrate is unabated in such an atmosphere. The sparks obtained from uranium are hot enough to kindle a gas flame or explode a mixture of hydrogen and oxygen; in fact, I have been able to work a petrol engine by igniting the gas charger by means of such sparks. The luminescence of the uranium nitrate crystals, on the other hand, is unaccompanied by any considerable rise in temperature. Pyrophoric properties similar to uranium are shown to a remarkable extent by Welsbach's alloys of rare earth metals and iron.

Tribo luminescence is shown by a large number of organic and inorganic compounds, *e.g.* arsenic trioxide, uranium nitrate, potassium sulphate, zinc sulphide, quinine valerate, aniline hydrochloride, benzoyl β-naphthylamine. Crystallo luminescence, or the luminosity produced during crystallisation, is practically the same phenomenon, being caused by the fracture of crystals after formation; it is well shown by mixtures of sodium and potassium sulphate. Tschugaeff found a connection between the optical activity and the tribo luminescence of organic substances, but Gernez has disputed the existence of any relation between them. Substances that phosphoresce readily under X-rays generally show tribo luminescence, and the connection between the two phenomena is accentuated by the observations of Karl, which show that quite pure inorganic substances do not show tribo luminescence. It is remarkable in view of the radio-activity of uranium that salts of this metal should show phosphorescence and tribo luminescence to such a degree; Karl has found, though, that quite "pure" uranyl acetate does not show tribo luminescence, while Tschugaeff mentions that the chloride and sulphate also do not exhibit this property, though they are all phosphorescent. The tribo luminescence of crystals may be likened—though analogies are dangerous guides to theories—to the bursting of an elastic band with a snap; when the cohesive forces between the molecules of the crystal are overcome the electrons are disturbed, and light waves result, while substances which easily phosphoresce or are radio-active would the more readily have their electrons disturbed.

Mr. Rudge mentions that the yellow oxide of uranium shows slight tribo luminescence; I could only obtain the effect by fairly vigorous rubbing in a mortar, and as the oxide changes to a dark colour with this treatment, the luminosity may be due to oxidation.

Mr. Rudge's letter directs attention to two interesting but distinct phenomena.

ALFRED C. G. EGERTON.

R.M.A., Woolwich.

The Clarification of Liquids by the Process of Tanking.

I SHALL be glad if any of your readers can give me information upon the following problem. In the clarification of liquids by the process of tanking, the settled clear liquid is drawn off from a tap situated on the side of the tank above the muddy layer. When the tap is turned on, does only the liquid above the tap run out or does some of the liquid below the tap run out also? In the special case of tanking oils, there is very little difference in specific gravity between the upper clear layer and the lower muddy layer. Further, how should the outlet be fitted so that on running out the upper layer the lower should remain least disturbed?

ROWLAND A. EARP.

Preston Brook, near Warrington,
December 22, 1910.

The Conduct and Song of Birds.

THIS morning, Thursday, is clear and frosty, but until now we have had constant rain. In spite of this the birds, for three or four days, have been singing as in early spring. The rooks have been visiting their old nests in the elms, and, our gardener assures me positively, have been carrying sticks and repairing their nests; this he has seen himself, and marked as exceptional. I suspect that this (unusual?) conduct and song herald a period of fine dry weather.

F. C. CONSTABLE.

Wick Court, near Bristol,
December 22, 1910.

P.S.—Fine weather here since December 22 until to-day, January 2!

THE NEW HAMBURG OBSERVATORY.

IN the United States the science of astronomy has enjoyed for many years the advantage of liberal financial support, and the erection of a new observatory on an imposing scale is no very uncommon occurrence. In Europe it is otherwise, and the establishment of a new observatory is a notable event. We welcome it as such, and watch its development with special interest.

The old observatory at Hamburg was founded in the year 1825. Its first director was C. Rümker, and the excellence of his services may be judged from the fact that the present staff is engaged upon a re-reduction of the catalogue which he formed. In 1906 it was decided to remove the observatory to a distance from the town, and the necessary funds were voted by the municipality for its equipment. The new site is at Bergedorf, about twelve miles south-east of the old observatory, and about 130 feet above the level of the Elbe. Work on the new institution has proceeded with great energy, and the observatory "Jahresbericht" for the year 1909 shows that the constructional part was practically complete at the end of that year. The report contains an excellent series of photographs of the several buildings in different stages of construction, and gives a good idea of what the observatory will be when it is in full working order.

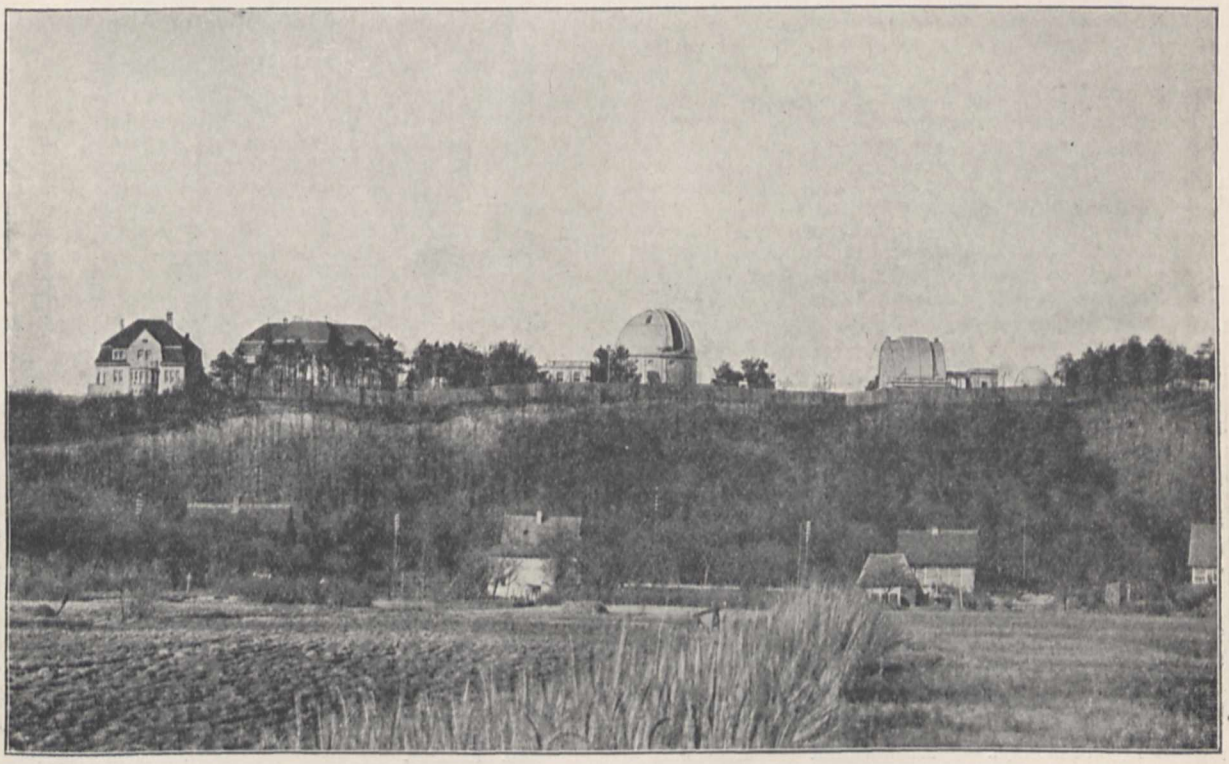


FIG. 1.—The New Hamburg Observatory at Bergedorf: View from the South.

The great feature in the plan of the new observatory is the complete isolation of the different instruments. Each has its own building, as shown in the illustration here reproduced. This is a principle to which we have long been tending, and here it is carried out with absolute and logical completeness. We are only too familiar with the old style of observatory building. Apart from separate structures, which are additions of a later date, it was usual to crowd the whole equipment—at least two equatorials, for instance, and a meridian circle—into one main building. The same building contained, under the same roof, the working rooms of the astronomers, and often—most objectionable feature of all—the residence of the director, and perhaps of an assistant as well. The new Hamburg Observatory carries modern ideas to their logical conclusion. The isolation of the instruments reduces mutual obstruction to a minimum, makes it possible to design each building solely to the advantage of the instrument it contains, and to a great extent removes the risk of fire, an ever-present danger in climates drier than our own.

The old-fashioned astronomer would expect a serious disadvantage in the weakening of central control. But this defect is avoided by a complete system of telephonic communication between the several buildings. The central offices of the observatory contain in a cellar six standard clocks. These are connected with a switchboard on one wall of a room in the basement. Close by is a chronograph by means of which all the clocks can be compared *inter se* and with all the observing clocks of the establishment. The Hamburg observatory is responsible for an elaborate public time service. The necessary electrical arrangements for this are placed on another wall of the same basement room. It is very natural that the installation of this complicated system of wiring has occupied much time, the underground cables alone running to a total length of about 1400 yards. When to the low-voltage system required for the telephones and time service is added the provision for distributing electric light and power, it can be judged to what extent the efficiency of a modern observatory depends on the technical application of electricity. Modern advances in astronomy are often attributed to the spectroscope and the photographic plate. This rather overlooks the help derived from electrical power,

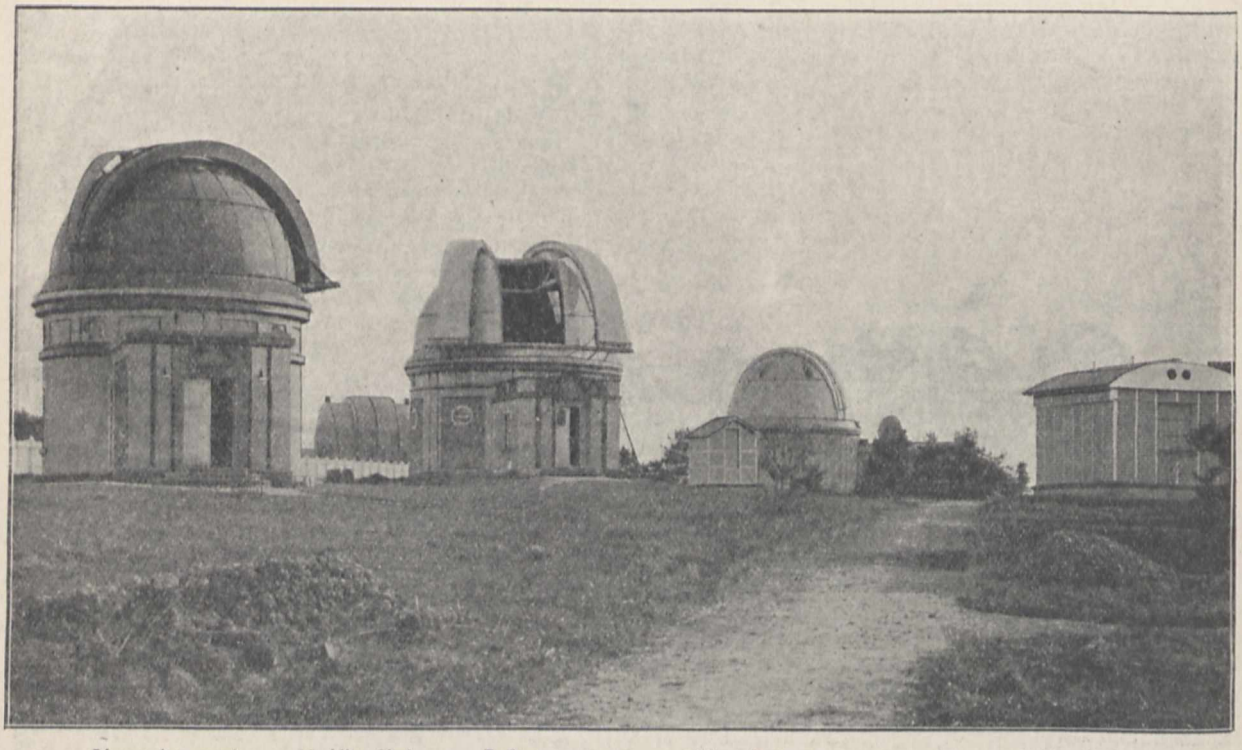
which has rendered the use of large-scale apparatus practically possible.

The new observatory will be powerfully equipped. The 10-inch Repsold-Merz equatorial has been moved from Hamburg, and is in working order. A 4-inch Repsold transit instrument remains for the present at Hamburg, and will be moved when the new institution is in a position to take over the time service. This will be the case when the installation of a new Repsold 7½-inch meridian circle is complete. The mounting of this fine instrument will embody the ideas of Sir David Gill. The roof is of iron and in the shape of a half-cylinder, the shutters rolling apart over the east and west ends. The whole is protected from the direct radiation of the sun by a louvred wooden covering. Special arrangements are made to control the instrumental errors. To the south is an adjustable horizontal collimator of the ordinary type; to the north is a lens focussed on the *mire*, which takes the form of a vertical collimator, as at the Cape Observatory. Still further to the north, on the same meridian, will be placed the 4-inch transit instrument, which will use the same *mire*. The two instruments are thus in line, and an independent check is possible by comparing them directly.

In addition, the observatory will possess a large refractor of 24-inch aperture, a reflector of 40-inch aperture and 10-feet focal length, and a photographic combination. The mounting of the refractor will be by Repsold, and the lens by Steinheil; some delay has been caused by the difficulty in obtaining the discs of suitable quality. The large mirror has been made by Zeiss. For the photographic combination the observatory is indebted to Herr Lippert. It will comprise a telescope of the normal astrographic type, and two short-focus photographic objectives of 12-inch aperture. This work has also been assigned to Zeiss.

Dr. R. Schorr, the director, has expressed some disappointment at delays, particularly in completing the optical work. But in an undertaking of this magnitude something of the kind is inevitable, and we can only express admiration of the lines on which Dr. Schorr has designed the new institution, and the energy which is apparent in the progress already made.

H. C. P.



Lippert Astrograph. Meridian Circle. Reflector. Mire. Refractor. Transit Instrument.

FIG. 2.—The Main Buildings of the New Hamburg Observatory.

THE ANCIENT INHABITANTS OF THE NILE VALLEY.[1]

SOME ten years ago, when Lord Cromer was building up a medical school in Cairo, the task of establishing the department of anatomy was entrusted to a junior fellow of St. John's College, Cambridge, Dr. Elliot Smith. The young professor reached Egypt at an interesting phase of the development of our knowledge of the ancient inhabitants of that country. It was then becoming clearly recognised, thanks to the labours of Prof. Flinders Petrie and those associated with him, that certain of the burials were older than the dynasties, and that it had become possible to study the Egyptians of a prehistoric or predynastic period.

With the human remains of this ancient period Prof. Elliot Smith was soon brought in contact; in 1901 he had the good fortune to examine the bodies excavated by the Hearst Egyptian exploration of the University of California from a predynastic cemetery at Noga-ed-Deir, in upper Egypt; material which was particularly valuable because of the accurate manner in which it had been dated by Dr. G. A. Reisner. During the following years, amidst the onerous duties

1 "The Archæological Survey of Nubia." Report for 1907–8. Vol. ii., Report on the Human Remains, by Drs. G. Elliot Smith, F.R.S., and F. Wood Jones. Pp. 378+vi plans. Plates to accompany Vol. ii., pp. 9+xlix plates. (Cairo: National Printing Dept., 1910.) Price 2 L.E.

of the medical school and the time absorbed by other lines of research, he found time to examine human remains which could be assigned to definite periods of a long period of Egyptian history, and thus lay the foundation of a knowledge of the physical history of the ancient inhabitants of the Nile valley.

In 1907, when it was resolved to heighten the Aswan dam, an opportunity occurred which allowed him to carry his researches among the ancient inhabitants of Nubia, and to compare them with their contemporaries in Egypt. Very wisely the Egyptian Government resolved to make a complete exploration of the ground which would become submerged when the dam was raised, and it was especially fortunate in the men selected for the task. Captain H. G. Lyons, F.R.S., was director, Dr. G. A. Reisner, archæologist, Prof. Elliot Smith, anthropologist. The work of exploration was commenced immediately above the dam, and by the month of October, 1907,

FIG. 1.—Grave 231. Burial assigned to the late Predynastic Period.

the remains of more than 2000 individuals, each with its full archæological history, waited the attention of the anthropologist. With his school duties in Cairo it was clearly impossible for Prof. Elliot Smith to undertake the task of examining these single-handed. By good fortune Dr. Wood-Jones, who had just returned from studying coral formation in the Cocos-Keeling Islands, was appointed to assist Prof. Elliot Smith and carry out observations in the field. During the winter 1907–8 forty-eight cemeteries were explored on both banks of the Nile, extending some eighteen miles above the Aswan dam. At the end of the winter the anthropological staff had made observations on about 6000 individuals, belonging to various periods, dating from predynastic to early Christian times—random samples of a local population through a period of 5000 years. The opportunity was unique; it may never occur again, and it is only just to add that Prof. Elliot Smith and Dr. Wood-Jones have availed themselves of it to the full. Their splendid records have now been published by the Egyptian Government in a form which deserves warm acknowledgment from archæologists and anatomists throughout the world. Ever since men began to inquire into the origin of the human species they have turned for light to the valley of the Nile.

In a remarkable opening chapter, Prof. Elliot Smith deals with the living thread of humanity that stretches along the Nile valley and links the negroid population of equatorial Africa with the fairer-skinned millions of Asia and Europe. During the last 6000 years that thread has changed remarkably little in character; at least when the curtain rises on it in predynastic times its composition is altogether modern in type and composed of a comparatively highly civilised community. It is true that in later times the head of the inhabitants becomes broader and the stature taller. Some have regarded the change in physique of the Egyptians as the result of civilisation. Prof. Elliot Smith does not deny that the environment of a higher civilisation may not have had its effect, but is inclined, from the evidence he has been able to adduce, to infer that the changes are to be sought rather (1) from an infiltration of a Levantine race, which entered lower Egypt at an early period and spread up the valley, and (2) from an infiltration of a negro element which entered the valley from the south. This at least is clear that there is a long period of Egyptian

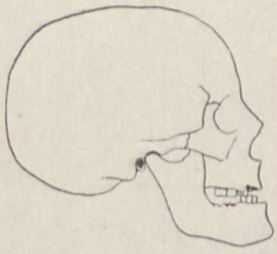


FIG. 2.—Skull of a man showing feminine characters.

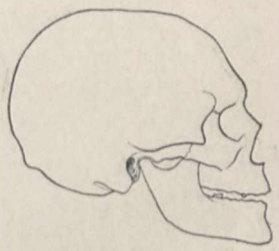


FIG. 3.—Skull of a woman showing masculine characters.

history beyond that which is now termed predynastic. The modern type of man is more than 6000 years old.

Some of the speculations regarding the racial constitution of the ancient Egyptians may prove to have only a passing value, yet the contributions made by Prof. Elliot Smith and Dr. Wood-Jones to certain problems which closely concern anthropologists are certainly of an abiding worth. It seems a comparatively easy thing to distinguish a man from a woman, but when it comes to the sexual and to the age distinction of the skeleton, and especially of the skull, the problem becomes a very difficult one. Dr. Wood-Jones gives accurate tracings of two crania (Figs. 2 and 3); one skull possesses all the characters of a male, but is really that of a woman; the other is that of a man, but has distinct female features. The pelvis, as one would expect, affords the best criteria of sex, and even it may show a certain degree of sexual mixture. Prof. Elliot Smith found by experiment that crania which were "sexed" according to their apparent characters were grouped wrongly to such an extent that the measurements made from such groups gave misleading data. It is very unfortunate that elaborate statistical tables have been prepared from crania which were thus classified. We are glad to note, too, that Prof. Elliot Smith thinks there is a future for anatomical as well as statistical observation in anthropology.

The account given by Dr. Wood-Jones of the physical characters, deformities, and abnormalities of

the ancient Nubians is full, accurate, and interesting, and provides a wealth of data which is quite new. His observations on their diseases and injuries opens a fresh chapter in pathology; for the first time we have a precise knowledge of the ailments and diseases of ancient races. No certain evidence of syphilis was found in Nubia, tuberculosis was extremely uncommon, rickets was unknown, but that chronic disease of joints, rheumatoid arthritis, was extremely common, especially in the predynastic inhabitants. Stone in the bladder and kidney occurred but seldom, but appendicitis evidently occurred, for in the illustration reproduced in Fig. 4, a band of adhesion—signifying a former inflammation of the appendix—is seen to pass across the pelvis of a young woman found in a cemetery of the Byzantine period. Gout was also known; and a sketch by Dr. Wood-Jones shows the basal joint of the big toe of a man loaded with "chalk" stones. Caries of the teeth, so prevalent now amongst European races, was unknown amongst the predynastic Egyptians, but in lower Egypt, it had appeared in the wealthier class by the time of the earlier dynasties. It did not become common until early Christian times in Egypt.

FIG. 4.—Pelvic viscera, showing an adhesive band attached to the appendix from a young woman of the Byzantine period.

There cannot be two opinions of the scientific value of the report prepared by Prof. Elliot Smith and Dr. Wood-Jones; they have made a contribution to our knowledge of racial anatomy and disease, of which the Egyptian Government and English anatomists may well be proud. But it is also clear that this contribution is only a first instalment to a very large and important subject, which must be studied now, otherwise the opportunity will have gone for ever. Both authors have returned to England, and it is greatly to be desired that the Egyptian Government will see that the work they have begun so well will be continued.

THE GERMAN EXCAVATIONS AT BABYLON.

OF all the societies that are engaged in the enormously important scientific work of disinterring the remains of ancient civilisation in the countries of the Near East, probably the most successful, in proportion to the length of time it has been in existence, is the "Deutsch Orient-Gesellschaft." Here, as in other matters, the German has come late upon the scene, but he has made up for his late appearance, not only by the amount of work he has done, but also by the way he has done it. Armed with ample funds derived from private subscribers, and made conspicuous by the special patronage of the German Emperor, the "Deutsch Orient-Gesellschaft" has carried on, or helped to carry on, excavations in Egypt, Palestine, Mesopotamia, and Asia Minor, which have produced results of the highest importance to the archæologist and to the historian of early civilisation. The excavations of the pyramids of Abusir, in Egypt, which date to the time of the Fifth Dynasty, have given us an entirely new idea of the art and religion of Egypt under the "Old Kingdom"; the disinterment of the ancient ruins of Jericho and Megiddo have made us realise better than before what the Canaanite civilisation was like; the discoveries of Dr. Winckler at Boghaz Kyöi have revealed to us a previously unknown period of the history of the Hittites, and those of Dr. Koldewey and Dr. Andrae at Babylon and Kala'at Shergat (Assur) have enabled us to study the actual ruins of the greatest city of the ancient world and of the oldest capital of Assyria.

The work at Babylon was the first undertaken by the society after its foundation eleven years ago. In March, 1899, work was begun on the Kasr, the "citadel" of Babylon, where are the ruins of Nebuchadnezzar's palace, and where he constructed the famous "Hanging Gardens" to please his Median queen, and make her fancy herself once more among the mountains, trees, and forests of her native land. Here was found an important monument in the shape of a *stela* of a Hittite king, which had been carried off by some Babylonian conqueror, probably from Carchemish. The great walls of the citadel, Imgur-Bel and Nimitti-Bel, have been uncovered, and the long "Processional Way of Marduk," between the two walls of Nimitti-Bel, have been revealed. Near by is the great mound, now called Tell 'Amrân ibn-'Ali, which covers E-sagila, the chief temple of Babylon's chief god, Marduk. And between this and the citadel is a space called *es-Sahn*, "the plate," in which stood a great *ziggurrat*-temple called Etemenanki. This building, E-sagila, and the neighbouring temple of Borsippa, compete for the honour of being the legendary "Tower of Babel." Dr. Koldewey seems to pronounce for the claims of E-sagila and Etemenanki against Borsippa, and has lately announced in an article in the *Berliner Tageblatt* that the excavation of the Tower of Babel "we now aspire to and expect." Whether E-sagila or Etemenanki, or the two together, are the basis of the legendary tower we do not know, but in any case the work will be of the highest interest. The excavations have also uncovered a temple of the god Ninib, E-patutila, and many streets; while the great palace buildings of the citadel, where Belshazzar's feast took place and Alexander died, have been shown to cover up on the river-side the remains of the quay walls built by Sargon and Nabopolassar.

Babylonian architecture was not beautiful, and in this, as in its use of enormous and imposing brick-masses, it reminds us strongly of the architecture of imperial Rome. As the brick at Rome was covered up by marble veneer, so at Babylon the brick wall-faces were often varied by coloured relief brickwork or hidden by coloured glazed bricks arranged in ornamental designs. The Gate of Ishtar at Babylon, discovered by Dr. Koldewey, has splendid decoration of both kinds, showing bulls guarding the gate. The

style of decoration with glazed bricks was borrowed by the Persians, and we see it in the splendid decoration from Persepolis now in the Louvre at Paris.

It is to be hoped that Dr. Koldewey has still more important discoveries in store. H. R. HALL.

THE NEGLECT OF GROUP-THEORY.

THE volume of "Proceedings of the London Mathematical Society," second series, vol. vii., contains twenty-six papers by such well-known mathematicians as Bateman, Bromwich, Burnside, Dickson, Dixon (A. C., and A. L.), Hardy, Harrison, Hobson, Lamb, Littlewood, Macdonald, Pidduck, Sommerville, and Young. While these are mainly of too technical a character to admit of discussion in this notice, attention should be directed to some remarks in Prof. Burnside's address on the "Theory of Groups of Finite Order," as affording an object-lesson on the important question of "England's neglect of mathematics." Prof. Burnside states:—

"It is undoubtedly the fact that the theory of groups of finite order has failed, so far, to arouse the interests of any but a very small number of English mathematicians; and this want of interest in England, compared with the amount of attention devoted to the subject both on the Continent and in America, appears to me very remarkable." "So far as I have been able to learn, no course of lectures has ever been delivered either at Oxford or Cambridge on the theory of groups of finite order." "In fact, so far as the teaching of the subject in England is concerned, one may say that it does not exist."

It appears that during the twenty-one years of the now, alas! defunct "Part II." of the Mathematical Tripos, questions on finite groups have only appeared four times, and that it is doubtful whether four candidates have seriously studied the subject.

On the other side we have the following statement:

"In Paris M. Jordan gives a course on the theory of groups of finite order at the Collège de France at regular intervals to an average class of six students, while the Galois theory of equations is lectured on at the Sorbonne and the École normal, as well as at one or two of the provincial universities.

"In most German universities, the regular course of lectures on algebra, attended by large classes of students, contains an exposition of the more elementary parts of the theory of groups of permutations. In addition to this there are, in all the larger universities, special courses devoted to groups of finite order and to discontinuous groups, which attract a considerable number of students. For instance, such special courses last year were attended at Göttingen by thirty students, and at Freiburg by twelve.

"In the United States all the leading universities offer regular courses in the theory of groups of finite order, with the exception of Harvard, where a course is given on the Galois theory of equations. In some cases the course is a yearly one, and in the others it is biennial. These courses attract from two or three up to ten or twelve students, who in general have already taken the B.A. degree."

Prof. Burnside offers some explanations for this neglect, but probably the reason is a very simple one. If any English mathematician specialises in the theory of groups (and at least one instance is known to the reviewer) no university will offer him adequate remuneration for a course of lectures on the subject; on the other hand, the mathematical departments of English institutions of university rank are deplorably understaffed in comparison with those in foreign countries, and their teachers are far too overburdened with elementary work to be able to start courses or a subject like "groups," in addition to meeting the necessary requirements of their examination syllabuses. Prof. Burnside suggests that the cause may partly be a lack of demand for instruction in the subject on the part of senior university students. But is it not the fact that such students are induced to give up advanced mathematical study and to take to experimental science in order to qualify for "research studentships?" If they persist in specialising in higher mathematics of any kind, they not infrequently do so at the risk of injuring their future prospects of obtaining appointments.

NOTES.

POLITICAL services and commercial prosperity appear to be the claims to distinction of most of the people whose names are to be found in the list of New Year Honours. The list includes the names of few men of eminence in the intellectual world—whether of science, art, or literature. One Fellow of the Royal Society—Dr. David Ferrier—has been knighted; and among the twenty-four other new knights are Dr. H. B. Donkin, Mr. G. Laurence Gomme, and Dr. G. Newman. Even in these cases, however, the honour appears to have been conferred for public services rather than in recognition of scientific work. The list has been received with the usual chorus of congratulation by the daily papers, but it can in no way be regarded as truly representative of the men who are rendering the best services to the nation.

THE Oceanographical Institute provided by the Prince of Monaco at Paris will be inaugurated on Monday, January 23.

IT is announced that an association for the promotion of science, to be called the "Kaiser Wilhelm Gesellschaft," will shortly be formed in Germany. The first meeting of the association is to be held within the next week or two under the presidency of Prof. Emil Fischer, and the German Emperor proposes to be present.

THE Paris Academy of Sciences, at a meeting on December 29, 1910, discussed the question of the election of women as members of the Institute of France. We learn from the *Times* that the academy eventually came to the conclusion that each section of the institute has complete independence with regard to the election of members, and that each academy has the right to decide the question of the election of women to its membership. The subject is being discussed at a general meeting of the academies as we go to press.

WE regret to see the announcement of the death of one of the best known supporters of amateur astronomy in Germany, Dr. M. Wilhelm Meyer, who died recently at Meran, at the comparatively early age of fifty-eight. Dr. Meyer's astronomical career began at Geneva, of which observatory he was for a short time director. He signalised his connection with that observatory by an attempt to determine the density of the material near the nucleus of a comet by observing the displacement of stars over which the comet passed; but he is better known from his relations with the Urania Gesellschaft in Berlin and his efforts to encourage astronomical studies in those who frequented the observatory. He was successful in attracting those who were capable of using the equipment provided wisely and well. Among his pupils or followers may be mentioned Herr Witt, who discovered the planet Eros in the Urania Observatory. Many of his popular works have had a wide circulation, among which may be mentioned "Das Weltgebäude," a work addressed to those who were capable of following the detailed explanation of the more difficult problems in astronomy, and the

"Spaziergänge durch das Reich der Sterne." He also wrote on comets and meteors in a way to attract attention and stimulate enthusiasm.

THE Meteorological Office has, with the commencement of the present year, introduced considerable improvement in its Daily Weather Report. Dover has been discontinued as a reporting station, and Newquay has been added. The London observations are now taken at Kew, and not in St. James's Park as for some years past. The London area is, however, well served by supplementary observations given for Greenwich Observatory, City (Bunhill Row), Westminster (St. James's Park), and Hampstead. The graphic representations are greatly improved, and the area covered by the charts has been extended, so that the incorporation of the observations from the Atlantic Ocean received by radio-telegraphy will be much clearer.

THE summary of the weather for the year just issued by the Meteorological Office with its Weekly Weather Report shows that the mean temperature for the several districts of the United Kingdom was nowhere very different from the average. The absolutely highest temperature reported in the British Isles was 83°, which occurred both in the east of England and in the Midland counties, and the lowest was minus 10°, in the east of Scotland. The rainfall for the year was in excess of the average, except in the north and west of Scotland. The greatest excess was 9·12 inches, in the Channel Islands, and this was followed by an excess of 6·83 inches, in the south-west of England. The heaviest aggregate measurement was 49·74 inches, in the north of Scotland, and the least 25·24 inches, in the north-east of England. The largest number of rainy days during the year in any district was 257, in the south of Ireland, the least 194, in the north-east of England, and 195, in the south-east of England. The duration of bright sunshine varied considerably in different districts, but there was a general deficiency except in some of the northern districts. In the north of Scotland there was an excess of 74 hours, and in the north-west of England an excess of 62 hours, whilst in the Channel Islands there was a deficiency of 159 hours and in the east of England a deficiency of 103 hours. A discussion of the Greenwich observations shows that the mean temperature for the year was 50·4°, which is 0·3° in excess of the average. The highest monthly mean was 62·2°, in August, the lowest 38·7°, in November. In November the mean temperature for the month was 4·7° below the average of sixty years, and in July it was 4° below the average. In December the mean was 5° in excess of the average, and in October it was 3·5° in excess. The absolutely highest temperature was 82°, in June, the lowest 20°, in January. The greatest range in any month was 48°, in May. There were only two warm days with the temperature above the average in July, and only three in November, but there were about twenty-six warm days both in October and December. November had as many as fifteen frosty nights. The aggregate rainfall was 28 inches, which is 4 inches more than the average, and, with the exception of 1903, it was the heaviest rainfall for thirty years. July was the wettest month, with 3·55 inches, and September the driest, with 0·72 inch. The duration of bright sunshine was about 115 hours' deficient for the year. May was the sunniest month, with 219 hours, and December the least sunny, with about 30 hours.

SEVERAL earthquake shocks have been recorded during the past week. According to Reuter messages, continuous shocks were experienced in the province of Elis, Greece, on December 29, 1910. On December 31 a distinct earth tremor, lasting several seconds, was felt at San Francisco at 4.41 a.m.; and on January 1 a strong shock was felt at Brusa, in Asiatic Turkey.

A TELEGRAPHIC message from the ss. *Cedric* to the Marconi Wireless Telegraph Company on December 29, 1910, published in the *Times* of the following day, stated that the ship had been in communication with the English and French coasts at 1250 miles distance, and with Flores Island on three successive days. The ship was in communication with the European and American coast every day of the passage, and was at the time of telegraphing 1140 miles from New York.

THE Elizabeth Thompson Science Fund was established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense." The income from this fund is now available, and the trustees desire to receive applications for appropriations in aid of scientific work. The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding 60*l.* will be made only in very exceptional circumstances. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points:—(1) precise amount required; (2) exact nature of the investigation proposed; (3) conditions under which the research is to be prosecuted; (4) manner in which the appropriation asked for is to be expended. All applications should reach, before February 1, the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A.

MR. F. C. SELOUS has been commissioned by the trustees of the British Museum to undertake an expedition to the southern district of the Bahr-el-Ghazal or Lado for the purpose of procuring the head and skin of an adult male of the Sudani race of Lord Derby's eland (*Taurotragus derbianus gigas*). As these antelopes appear to be of a wandering disposition, it is by no means easy to know where to light upon them, and even when found it is somewhat difficult to decide whether to select, for museum purposes, a comparatively young bull with long, unworn horns and a short frontal "brush," or an older animal with shorter horns but a fully developed brush. At present this eland is represented in the exhibition galleries of the natural history branch of the museum by the mounted head of a female and a male skull and horns. Mr. Selous, who has our best wishes for success, starts, we believe, almost immediately.

A CORRESPONDENT of the *Times* of December 28, 1910, records the discovery of what may be called an Arabic Pompeii in the neighbourhood of Cordova. The discovery of this pleasure-resort of the great Khalif Abderrahman III., who erected it between 936 and 961, has been jealously concealed by the Spanish archæologists, and came to light accidentally through the examination of certain fragments of Arabic sculpture of the tenth century recently deposited in the Museum of Cordova. The remains may be assigned to the Egyptian or Copto-Arabic school, and among them the most remarkable are the specimens of glass work with a silver sheen, the secret of which has long been lost, and the painted and glazed pottery made out of calcined clay. So far, the excavations

appear to have been most inefficiently conducted, and much valuable material has been destroyed. It may be hoped that the Spanish Government will now arrange for the scientific examination of a site which is likely to supply much information on a little known chapter of the history of Moorish art.

MR. D. CARRUTHERS, in conjunction with Mr. J. H. Miller and Mr. M. P. Price, left England in March last with the object of exploring zoologically, botanically, and, so far as possible, geographically, the upper part of the basin of the Yenesei and the western frontier of Mongolia. The expedition started in May from Minusinsk, on the Yenesei, up to which point that river is navigable, and finally reached Kuldja on November 14, in the Ili valley in the Tian-shan range, having successfully accomplished the journey along western Mongolia. A preliminary account was given in the *Times* of December 30, 1910, from which it appears that the expedition had first to traverse a belt of virgin forest, which extends in this region from the Yenesei to the Baikal lake, and then passed over a range 5000 to 7000 feet high into an upper basin of the Yenisei. This basin was inhabited thinly by tribes of Finno-Tartar stock, who reside partly in the forest and partly on the more open country of larch groves and pasture land. The forest people are occupied in hunting and herding their domesticated reindeer, of which two breeds were met with. Wild reindeer were also found to occur on the higher parts of the hill ranges above the forests. The western part of the basin was found to be more arid than the forest-clad eastern portion, and in it the inhabitants lived in felt tents. Everywhere signs abounded of former settlements and of an earlier and more advanced civilisation, and evidence seemed to point to an increasing desiccation of the region having been the principal cause of its desiccation here as in other parts of Central Asia. In passing south to Kuldja on the approach of the winter season across the basin of the Upper Irtish, vast deposits of fine mud now being eroded by the hill-streams were met with, and it is suggested that these were deposited in comparatively recent times, when there existed a vast inland sea covering all the river basins of this region, and of which the lakes Balkash, Ala-Kul, Ebi-Nor, &c., are the vestiges. The route for next season may be eastwards along the Tian-shan range to the western margin of the Gobi desert.

IT has been long known that there is a considerable bed of low-grade iron ore in the Jurassic rocks of some of the western isles of Scotland, and especially in Raasay. The deposit there has been described by Mr. H. B. Woodward in the Memoirs of the Geological Survey, and analyses published by him showed that the ore agrees in general character, as well as in geological horizon, with the Cleveland ores of Yorkshire. The deposit in Raasay, an island off the north-eastern coast of Skye, covers an area of some 28 square miles. Prospecting work on the deposit has been conducted for some time past by Messrs. Wm. Baird and Co., of Glasgow, and it is now announced that they have secured an option for the purchase of the island, and that they propose to erect blast furnaces there for the smelting of the ore. The extension of the ore bed in Skye has also been examined, but with less promising results. The Raasay ore is of low grade, but its position allows of inexpensive mining. The ore will be used for the production of foundry pig iron.

SOME particulars of the proposed work of the German Antarctic Expedition are given by the Berlin correspondent of the *Times* in the issue for January 4. We learn from this source that the Antarctic expedition, under the command of Lieut. Filchner, will leave Germany early this year for Buenos Aires, and will proceed from there at the beginning of October *via* South Georgia and the Sandwich Islands to the Weddell Sea. On arrival in the Weddell Sea it is proposed to establish a base station on the eastern coast so far south as possible, with the necessary equipment for a year's research. A party of ten men will be landed, of whom six—a geologist, a meteorologist, an astronomer, a doctor who is also a biologist, a cook, and a sailor—will stay in the station, while the remaining four will undertake a long sledge expedition into the interior of the South Polar continent. Meanwhile the ship will return to the Atlantic Ocean to carry out coastal observations and oceanographical work. At a meeting held on January 3 in the building of the General Staff, with Prince Henry of Prussia in the chair, the treasurer of the committee which is arranging for the expedition announced that a sum of about 41,250*l.* is in hand. The cost of the vessel and equipment have amounted to 14,500*l.*, and the total cost of the expedition is estimated at 70,000*l.* A lottery has been authorised by the Federal Council, and is expected to produce not less than 27,000*l.*

THE expedition of the British Ornithologists' Union to Netherlands New Guinea, continues to labour under extreme difficulties, and the experiences of its members confirms the opinion that New Guinea is one of the most difficult places in which to travel. The jungle which the expedition has encountered is almost impenetrable, and is described as "dismal, dark, dripping," abounding with noxious insects and leeches. The strain and illness have so told on Mr. Goodfellow, the leader, that he has had to return home. Earlier accounts stated that very short people had been met with; the last account describes a true pygmy race inhabiting "the foot-hills of the mountains. These shy and treacherous pygmies, who average 4 feet 6 inches to 4 feet 8 inches in height, wander over the heavy jungle-clad hills and mountains, subsisting on roots and jungle produce, hunting the wallaby, pig, and cassowary, and fishing in the mountain torrents. They dwell in the rudest kind of lean-to huts made of branches and fan palms, with no regular villages, but moving from district to district in search of food. The only metal tool they possessed was a small wedge-shaped piece of iron, 1 inch by 2 inches, inserted into a wooden handle, and answering the purpose of an axe, and with this a whole 20-acre clearing had been made. None but those who have worked and toiled in this dense jungle can really appreciate the perseverance and patience necessary to accomplish this, for many of the trees are from 12 to 15 feet in circumference. This piece of iron was traded up from the coast natives."

ON Tuesday, December 20, 1910, in a paper read before the Royal Colonial Institute on the birds of our colonies and their protection, Mr. James Buckland brought a further heavy indictment against the plume-hunter and his trade in our colonies and dependencies, and a powerful appeal in favour of the prohibition of the import of trade feathers. In Australia, New Guinea, New Zealand, India, and the West Indies, the most beautiful members of their avifauna are apparently being so ruthlessly destroyed as to make it no difficult matter to predict their comparatively early extinction. As an example of the havoc wrought by these hunters, Mr. Buckland instances, among many other battues, the slaughter on the island of Losiansky, near Lysan, one of the bird-reservations

established in the Pacific by the United States, of 300,000 sea birds before the descent of the Government cutter put a sudden stop to their proceedings. The author of the paper emphasises the enormous value of birds in our tropical and subtropical colonies from an economic point of view, and pictures what would result from the extinction of such species as the straw-necked ibis, which saves the Australian paddocks in their periodical ravages by grasshoppers, of which twenty-five tons can be devoured in a single day by 200,000 of these useful insect eaters. Protection of colonial birds, he pleads, is called for also in the interests of sentiment and hereditary association. "Which is it to be," he asks, "the bird, alive, filling the land with song and beauty and labouring unceasingly for the good of millions of our kinsmen, or the bird, dead, and irreparably lost to our colonies, that a few individuals, whose number is composed largely of the foreign element, may put money in their pockets?"

MR. HAMEL SMITH forwards us, in reference to the review of his book, "Aigrettes and Bird Skins," in NATURE of December 15, 1910 (p. 207), a number of extracts—unfortunately too long for our limited space—from various notices dealing with the book in the colonial and Indian Press, many of them supporting "a fair hearing for both sides prior to the passing of enactments," and reminds us that his book "suggests the establishment of a close season generally and total prohibition of shooting at any centre where the birds show serious signs of diminishing." In reply to this communication our reviewer repeats that the difficulties and expense of effectively maintaining a close season are prohibitive. The plume-hunter, moreover, apparently devoid of conscience, ignores all laws, regulations, and enactments. The nuptial period is his only harvest time; if stopped in that season his occupation would be gone. The facts already sufficiently established prove that the trade is conducted with the utmost cruelty, that the extermination of many economically valuable species is imminent, and that no close season will effectively stop the slaughter of ornate birds so long as such great emporia as London and other Continental cities remain open. In centres where extermination is imminent, even if proclaimed, the plume-hunter will carry on his trade by stealth when he cannot openly, and will ship away his harvest as "cow-hair," "horse-hair," or under any other specious designation likely to pass the custom house.

IN a lengthy letter to the *Times* of December 26, 1910, Dr. Bulloch makes an earnest appeal for the adequate endowment of medical education and research. He points out that the better educated the medical man, the greater the gain to society in general who requires his services. Medical education at present is so expensive that the cost is less than half covered by the fees of the students. We have hospitals unrivalled in the world, but it has been decreed that the generous contributions of those who support them must not be applied to medical education. The public demands the greatest efficiency, yet with few exceptions fails to provide the institutes which are necessary for the training. The donations of generous donors for medical research, such as those of city companies and of Mr. Carnegie and the Beit scholarships, to some extent miss their aim. In the main they go to the researchers, but neglect to provide these with laboratories and training for their work. The teachers who have to train them are overworked and inadequately remunerated; they themselves might, had they the time and opportunity, form the mainstay of medical research in this country. But the research scholarships are usually awarded to relatively young men, and their teachers obtain no help, financial or otherwise.

THE *Psychological Review* for November (1910) contains a paper by Mr. T. V. Moore on the influence of temperature and the electric current on the sensibility of the skin. The author finds that the minimum threshold for touch and for spatial threshold is reached when the temperature of the skin is about 36° C., above and below which point the threshold rises. He also concludes that Pflüger's law for the irritability of motor nerves and muscles holds for cutaneous sensibility, which is accordingly decreased at the anode and increased at the kathode pole. Mr. Moore finds that, immediately after the subjection of a skin area to the induced electric current, the sensibility of the touch spots and of the pain spots is lowered considerably, and he believes that under these conditions a touch spot may function as a pain spot.

ACCORDING to an article by Mr. L. E. Hope, the curator, published in the *Museums Journal* for December, 1910, a local natural history record bureau has been established at the Carlisle Museum. The area of observation includes a radius of fifty miles from the city, and it is to be hoped that an increase in the local fauna list will be the result of the movement. The scheme has been in operation since 1902, and during the last few years the annual number of notes has been between 200 and 300 annually. The idea may be commended to other local museums.

ACCORDING to an article in the *Times* of December 23, 1910, the relatives of the late Mr. Boyd Alexander are about to present, in accordance with the wishes of the deceased, his large collection of African birds to the British Museum. The specimens are about 4000 in number, and include several species (whether the types is not stated) discovered by the late explorer, among the most interesting of these being Willcocks' honey-guide (*Indicator willcocksi*) and the long-tailed tree-warbler (*Urolais mariae*), the latter representing a generic type of its own. The first portion of the collection was made in the Cape Verdes, a second portion during the Kumasi relief expedition, a third when Mr. Alexander led a column to Gambaga, a fourth in the course of the Alexander-Gosling expedition from the Nile to the Niger, and the last in the islands of the Gulf of Guinea and the Cameruns.

MUCH interest attaches to a note, by Mr. E. Bidwell, in the October (1910) number of the *Ibis* (ser. 9, vol. iv., p. 759), on fragments of the egg of an ostrich obtained some years ago in a nalla on the Kain River, in the Banda district of the United Provinces of India. Structurally the shell is almost identical with that of the Somali *Struthio molybdophanes*, but the thickness is somewhat greater. The name *S. indicus* is proposed for the species represented by the Banda egg-fragments. It may be mentioned that in ancient literature there are references to the occurrence of large birds in Central Asia, not improbably inclusive of Baluchistan, which could scarcely have been other than ostriches, while in old Chinese works there is mention of ostrich-eggs sent as presents to the emperors. The Assyrian sculptures show, moreover, that ostriches formerly inhabited Mesopotamia. Sub-fossil egg-shells indicate the occurrence of a species (*S. chersonensis*) in the Government of Cherson, in south Russia, while in the Pliocene we have remains of *S. karatheodori* from Samos and of *S. asiaticus* from northern India.

THE nature of the colouring of the kingfisher is discussed by Mr. F. J. Stubbs in the *Zoologist* for December, 1910. According to the angle of vision and the position

of the spectator with regard to the light, the colour of the feathers on the back of the bird ranges from ultramarine and cobalt, through green, to straw-yellow. The outer layers of the feathers are transparent, and may be removed without interfering with the underlying colour, which is not due to pigment. Beneath the outer layer is a pavement-like arrangement of polyhedral cells, the tops of which are the source of the blue colour. These caps are slightly convex, and when seen by reflected light are blue on both sides. In the author's opinion the origin of the colour may be explained by "the theory of the production of blue by the reflection of light from small particles, and of orange or red by the transmission of light through small particles." It is, in fact, precisely analogous to the colour of the air, the full blue appearing when the feathers are seen by diffused reflected light, while at a low angle, when the light is in part transmitted, the straw-yellow results.

A MONTHLY journal entitled *Peru To-day* is published to give an account of Peruvian development, and from it we learn that the principal cotton-producing districts are near the coast, and are usually vast desert-like valleys irrigated from the rivers flowing from the Andes to the Pacific. Canal irrigation is adopted, and the growers have acquired considerable skill in management. The sugar cultivation is being improved by the introduction of labour-saving devices and more modern machinery; attention is also being paid to drainage. The yield on well-managed estates is very considerably above the average of the country, a fact which indicates that there is still considerable scope for development. An experiment station has been established at Lima for working out agricultural problems.

THE interesting little booklet entitled "West Indies in Canada," that has been drawn up for the Canadian Exhibitions at Toronto and St. John's to give information about the resources of the West Indies and British Guiana, will appeal to a much wider audience than such publications usually find. It contains a map of the West Indies and tables showing their chief exports and imports; then follows an account of each island, including a short history and general description, an account of the climate and sanitary conditions, and of the industries. Unfamiliar crops and operations such as planting bananas are illustrated. A list of books dealing with the West Indies is included, and finally an alphabetical list is drawn up of the products, with a sufficient account of each.

THE Proceedings of the University of Durham Philosophical Society is always an interesting volume, and the current number (part v., vol. iii.) fully maintains the standard set by its predecessors. Mr. Gray reports a severe attack by a furniture pest, *Glycyphagus domesticus*, de Geer, on the contents of the dining and drawing rooms of a new house in Newcastle, which did so much damage that all the infested furniture was destroyed. Prof. Potter describes experiments showing the difference of potential set up by the activity of micro-organisms in culture solutions, and Mr. Horne and Miss Coull give an account of their work on the absorption of water by the seeds of *Vicia Faba*. Engineering subjects are represented by Mr. Eden's paper on the endurance of metals under alternating stresses, and Mr. Dixon's paper on torsional vibrations of massive loaded shafts.

THE Board of Agriculture issues each month an excellent Journal containing papers on technical subjects of importance to farmers, market gardeners, and others, as well as shorter articles and notes on crops, markets, &c. Recent issues contain an article by Mr. K. J. J. Mackenzie, in which he develops his well-known studies of the "points" of livestock, showing how they may to some extent be reduced to actual measurement, and thus become susceptible to exact treatment. Mr. Sawyer gives an account of the sugar beet grown for export in Norfolk, but considers that the price offered—17*s.* 6*d.* per ton—was barely sufficient; he thinks that 20*s.* would have to be offered by factories starting in England. Dr. Russell gives some new analyses of seaweed, and shows that it contains notable quantities of fertilising material; unfortunately, no economical method has yet been discovered of working it up into a saleable manure.

IN the Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 13, 1910, M. I. P. Tolmachef reports the changes made in the map of the coast between the rivers Khatanga and Anabar by his expedition in 1905. Cape Preobrazhenie is removed more than half a degree to the south. The east coast of the Khatanga Gulf was found to be very irregular, jutting out into three large peninsulas separated by deep inlets, and the St. Nicholas Island does not exist. The entrance to Nordvik Bay faces north, not west. The actual coast-line is marked in red on a cutting from the 100-verst map of Asiatic Russia.

THE Memoir of the Imperial Russian Geographical Society (Statistical Section, vol. x., No. 2) consists of an essay by M. Semionof-of-Tian Shan, on the towns and villages of Russia and their distribution in relation to physical conditions and historical events. The country is divided into three main divisions: the centre and north-west, where agriculture thrives on the watersheds; the northern, where the climate is severe and rural industries (fishing, lumbering, &c.) are pursued on the rivers and lakes; and the black soil of the south, exclusively agricultural, where the population is concentrated in the valleys. The towns are divided into groups according to population and regions, and are treated in connection with the non-rural industries (mining, manufacture, trade, &c.) to which they chiefly owe their origin. Fifty per cent. of the urban population is concentrated on the shores of the Baltic. The article is accompanied by a general map and many sketch-maps illustrating especial subjects.

As the irrigation system in Egypt is continuously being developed, the margin within which improvements may be made becomes narrower, and factors which at first were of minor importance have now to be studied. In the November (1910) number of the *Cairo Scientific Journal* Mr. J. Murray contributes a study of the seepage and evaporation loss from the Ibrahimia canal, which waters the greater part of Middle Egypt. A reach of 132·5 kilometres is investigated, having a width of from 38 to 55 metres between Deirut and Maghagha, and is treated in four sections; in these the loss is found to be 3·9, 2·8, 2·0, and 0·8 metres per second in proceeding from Deirut down stream, and a formula is proposed for reckoning the loss in similar canals in Egypt.

IN the *Cairo Scientific Journal* for November (1910) Mr. H. E. Hurst describes a visit made to some of the oases in the Libyan desert when extending the magnetic survey of the Nile valley to the westward. Traces of the old Egyptian practice of astronomical observation were found in Dakhla oasis in the method of dividing up the day into periods for supplying the water from the flowing wells, and in utilising the rising or setting of certain stars for distributing the water to the land of different shareholders in the water of the spring. The same custom prevails in Baharia oasis, and also in Nubia, where the water is raised from the Nile by water-wheels worked by

cattle, and then distributed on the land of each owner in turn.

AT the meeting of the research department of the Royal Geographical Society on December 15, 1910, papers were read by Miss M. Pallis and Mr. R. Gurney on the saline water of that portion of the Norfolk Broads which is drained by the rivers Thurne and Bure. Evidence was brought forward to show that such salinity was only directly due to the tidal water of the sea in the case of the Bure, but in the basin of the Thurne salinity increases inland, and is greatest in Horsey Mere, which is fed by a layer of salt water which percolates from the sea coast and extends to some height above low tide-level. Similar conditions were cited from Holland, where much attention has been given to the mapping of such salt-water table.

AN article relating to the decrease, in recent years, in the frequency and intensity of London fog appeared in the *Times* of December 27, 1910. The statistics given, based on information published by the Meteorological Office, are illustrated by two diagrams, in which the prevalence of fog and bright sunshine in London are shown, in triennial means, by curves. These diagrams are supplemented by the following table:—

	Days with fog	Hours of bright sunshine
1st nine winters, 1883–4 to 1891–2 ...	29·9 ...	55·6
2nd ,, ,, 1892–3 ,, 1900–1 ...	20·7 ...	70·1
3rd ,, ,, 1901–2 ,, 1909–10 ...	10·6 ...	93·5

The curve relating to fog shows an increase in frequency during the first nine years, a decline subsequently, rapid at first, afterwards gradual. The curve of bright sunshine, although irregular, exhibits a tendency for an increase during the twenty-seven years; since the winter of 1901–2, only one season had fewer than the normal record. Reference is made to a discussion on the subject which took place six years ago at a meeting of the Royal Meteorological Society, when the respective speakers attributed different causes to the improvement in the air of London. The opinion favoured by the writer of the article is that the improvement is due to the more vigorous enforcement of the smoke-prevention clauses of the Public Health Act, the use of gas fires for heating and cooking, and improved methods of lighting. As regards the quality of London fog, these are probably the true reasons; fog, however, usually occurs when an approximation to uniformity of pressure gives rise to a state of stagnation in the atmosphere, and is frequently, though not necessarily, associated with anticyclonic conditions; moreover, the geographical position of London favours the occurrence of fog.

THE present position of Antarctic meteorology is the subject of an interesting and instructive article, by Mr. R. C. Mossman, in the Quarterly Journal of the Royal Meteorological Society for October last. He points out that our knowledge of Antarctic climate, as relating to a continental surface, depends on sledge journeys, the fixed observing stations being largely affected by oceanic influences. One of the most striking features shown by the records at the stations is the low summer temperature to the north of the Antarctic circle, due to pack-ice and to the frequency of fog in low latitudes. The useful tables accompanying the work show that the lowest of the annual mean temperatures was −1·3°, observed by the *Discovery*, being 8·4° lower than that at Cape Adare, some 400 miles to the north. The absolute minimum, observed by the same ship, was −58·5°, but considerably lower readings were recorded on sledge journeys. Precipitation is most difficult to estimate, owing to drifting snow; in the Victoria Land region the Shackleton expedition found an annual fall equal to about 9½ inches of rain. The author estimates the annual amount for the land surface of Antarctica at about 12 inches. The winds are from an easterly direction, but at heights exceeding 15,000 feet the air moves polewards. The Shackleton expedition recognised two high-level currents, the upper from a northerly and the middle from a southerly quarter. The author observes that the subject requires further study, and that after the Pole is reached there will be little inducement for enterprises of a record-breaking character, and then some solid scheme of purely scientific research could be set on foot with some prospect of success.

THE *résumé* of the meeting of the Société française de Physique on December 2, 1910, contains a short account of M. Perot's paper on the luminescence of the mercury arc *in vacuo*. The observations were made on arcs formed in a spherical vessel 10 cm. diameter, the current flowing along a diameter. At very low pressures the discharge fills the whole of the vessel, and has a white appearance. As air is allowed to enter, the discharge concentrates itself and becomes a rose-coloured column not unlike the positive column in a vacuum tube. Mercury is transported from the anode to the kathode. Water vapour destroys the luminescence. An examination of the green line of the spectrum shows that while the principal component is reversed and displaced towards the red as the pressure is increased, the principal satellite is unaffected by pressure. When observed in light emitted in the direction in which the current is flowing and in the reverse direction, respectively, it shows that the luminous centres are travelling with the current with velocities of 30 to 350 metres per second, according to the pressure. M. Perot concludes that the light emission is due to the mercury atoms set in vibration by the impact of electrons, that these atoms encounter inert atoms which they set in motion without rendering luminous, and at each encounter the phase, but not the energy, of the vibration is changed.

A NOTE in the *Builder* for December 31, 1910, gives account of a contradiction to the generally accepted idea that asphalt paving or lining is a barrier to vegetation. The courtyard at the Bank of Italy, in Rome, includes a small garden planted with shrubs, and particularly with Dracæna and Chamærops. Beneath the court is a basement covered by masonry arches, the extrados of which is protected by a layer of asphalt seven-eighths of an inch thick, with the object of preventing the percolation of moisture into the chamber where documents are stored. Some little time ago it was noticed that damp patches had appeared on the ceiling, and that the size of these increased rapidly. On removing the earth from above the masonry it was found that several roots of Chamærops had penetrated right through the asphalt, the holes being of about 0·25 inch in diameter, and almost as clean as if bored by a tool. Being unable to pierce the masonry, the roots had forced their way between it and the asphalt, and, some of them having perished, left holes, through which water passed freely.

COMMENTING on the accident on the Midland Railway at Hawes Junction, the *Engineer* for December 30, 1910, considers that the question of safeguards against fire in trains after collision is not very easily settled. The substitution of electric light for gas is a recommendation which does not meet the whole case. Live coals ejected from the fire-box by the collision have been responsible for starting fires; it is on record that an electrically lighted coach was so destroyed in the Grantham accident; again, the two coaches which first caught fire at Cudworth were so illuminated. The small inverted incandes-

cent gas mantles now employed give an excellent light much appreciated by passengers, and gas commends itself to the companies on account of but little skilled attention being required. Points which might be considered are a more generous use of steel in the body of the coach, and the adoption of fire-proof paint, as on the District Railway. Extinguishers and a few fireman's tools might be provided in every guard's van. Lastly, it might be asked whether it is not possible to reduce the chances of telescoping? It is only natural that the two front coaches of the train in question should be crushed; they were situated between two engines and a sleeping-car weighing about 40 tons. A uniform weight for passenger-carrying vehicles would appear to be a point worthy of attention.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF AN EIGHTH-MAGNITUDE NOVA.—A telegram from the Kiel Centralstelle announces that a new star was discovered by Mr. Espin, at Tow-Law, on December 30, 1910. Measurements were made at 7h. 35·9m. G.M.T., and the position of the nova is given as

R.A. = 22h. 32m. 9·5s., dec. = 52° 15′ 21″ N.

This is just circumpolar in our latitudes, and, as the object is at present of the eighth magnitude, numerous observations should be possible, weather permitting.

This object will be known as Nova Lacertæ, as it lies in that constellation, forming the apex—to the north-east—of an approximately equilateral triangle, of which the base is the line joining α and β Lacertæ; it lies in the southern border of the Milky Way in that region. As Lacerta transits during the afternoon, observations should be possible during the greater part of the evening, and as Mr. Espin records "bright lines," spectroscopic observations are desirable wherever possible.

Later reports state that the star is red, and that bright helium and hydrogen lines have been seen in the spectrum. Photographs of the nova were taken at Greenwich on December 31, and the magnitude was reported as 7·5.

METCALF'S COMET, 1910*b*.—A continuation of Dr. Ebell's ephemeris for comet 1910*b* appears in No. 4462 of the *Astronomische Nachrichten*. The present position of the comet lies in Corona at 15h. 52m., +36° 45·4′, and is moving northwards and slightly towards the west; the magnitude is nearly constant at 12·0. Although not very favourably placed for observation, the comet may still be observed during the hours of the early morning.

ELEMENTS FOR FAYE'S COMET, 1910*e*.—From observations made on November 11, 18, and 25, Prof. Ristenpart and Dr. Prager have calculated new elements for comet 1910*e*, and now publish them in No. 4462 of the *Astronomische Nachrichten*. These elements confirm the identity of the comet with Faye's comet, and give the time of perihelion passage as 1910 October 30·04 G.M.T.; the eccentricity of the orbit is given as 0·5169, and the comet's period as 5·96 years.

A set of elliptic elements, calculated by Mr. Meyer and Miss Levy, of the Berkeley Astronomical Department, and published in No. 186 of the Lick Observatory Bulletins, gives the time of perihelion passage as 1910 November 12·413 G.M.T., the eccentricity as 0·5459, and the period as 6·926 years.

A NEW MAP OF THE MOON.—A map of the moon, prepared by Mr. Goodacre, was exhibited during last session at the Royal Astronomical Society, and was enthusiastically received by the selenographers present. Mr. Goodacre now proposes to have the map reproduced on such a scale that the lunar diameter will be 60 inches, and to issue it in the form of twenty-five separate charts, each 13 inches square. If 200 subscribers are forthcoming this can be done at the price of 22*s*. 6*d*. per set. The map shows all the known lunar features, their accurate delineation depending upon the positions of 1433 points given in Mr. Saunder's memoir (the *Observatory*, No. 429).

THE TOTAL ECLIPSE OF THE MOON, NOVEMBER 16, 1910.—Reports of the observations made at a number of Continental observatories during the total lunar eclipse which took place on November 16 appear in No. 4460 of the *Astronomische Nachrichten*.

Dr. Max Wolf gives the times of entry and exit of various features as recorded by a number of observers at Heidelberg; detailed observations of the various colorations of different features are also reported.

Father Fenyi, at Kalocsa, also records colours and remarks on the general brightness of the eclipsed surface; at 12h. 33m. 12·37s. G.M.T. he observed the occultation of the star B.D. + 18° 489.

Occultations and colour variations are also recorded by Herr Mündler, Prof. Küstner, and Dr. Courvoisier.

NINETEEN STARS WITH NEWLY DISCOVERED VARIABLE RADIAL VELOCITIES.—In a paper appearing in vol. xxxii., No. 4, of the *Astrophysical Journal*, Mr. O. J. Lee gives the measures of the spectra of nineteen stars which have recently proved to be spectroscopic binaries. The spectra were photographed at the Yerkes Observatory, the dispersion of one prism being usually employed. The stars are σ Andromedæ, ι Cassiopeiæ, ρ Tauri, ν and ϕ Geminorum, 42 Camelopardalis, γ Cancri, θ Hydræ, σ Leonis, 23 Comæ Berenices, η and γ Coronæ, ι and π Serpentis, γ Ophiuchi, ϕ Sagittarii, 13 Vulpeculæ, 16 Lacertæ, and α Pegasi.

The multiple character of some of these stars was announced by Prof. Frost and Mr. Lee at the Cambridge meeting of the Astronomical and Astrophysical Society in August, but ι Cassiopeiæ, γ Ophiuchi, and α Pegasi are now included for the first time. Some of these binaries are members of visual multiple systems, and in others the examination of the H and K lines suggests that the stars may belong to that class of binaries in which the calcium lines appear to have a constant velocity.

OBSERVATIONS OF PLANETS.—The December (1910) number of the *Bulletin de la Société astronomique de France* contains some interesting notes, by M. J. Halley, on observations of Venus made at Roubaix during 1909–10.

M. Halley used a Secretan refractor of 135 mm. aperture, and was favoured with excellent atmospheric conditions. He records, in addition to the bright polar areas, several markings which persisted during his observations; the chief of these is a pair of dark streaks, divided by a bright lane, running from the terminator towards the south; a dark patch, which appeared to lengthen, in the northern hemisphere near the bright limb; and a dark area bordering the bright area at the north pole.

Several of the photographs of Saturn exhibited by Prof. Lowell are reproduced to illustrate a paper on planetary photography which appears in the November (1910) number of the Bulletin.

COLOUR CONTRAST IN PHOTOMICROGRAPHY.

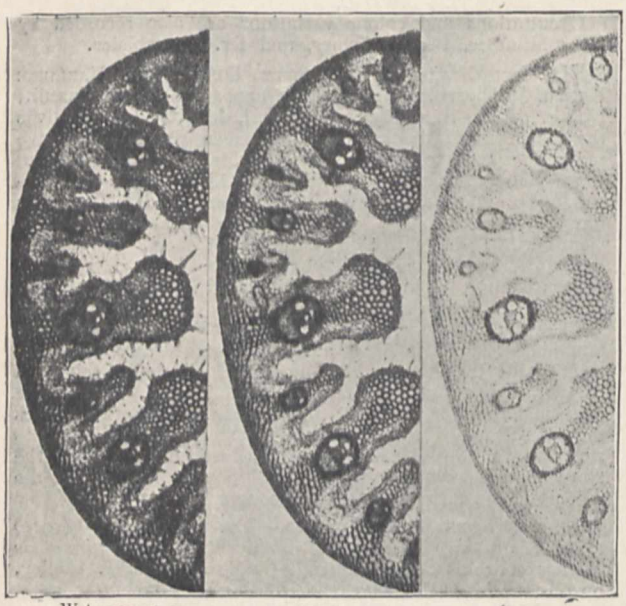
THE latest of the series of booklets issued from the laboratory of Messrs. Wratten and Wainwright, Ltd., Croydon, deals with photomicrography. This booklet differs from most of the more pretentious works dealing with photomicrography in that but little attention is paid to the instrumental side of the subject, which is dismissed with only a few words of practical advice, attention being concentrated upon the relation between colour and contrast, especially from the point of view of the photography of stained sections.

A perusal of most books on photomicrography indicates that the more difficult parts of the subject technically, such as the high-power photography of diatoms or minute bacteria, receive a somewhat undue amount of attention compared with their importance to the average worker in science, the difficulties which less expert workers find in obtaining really first-rate photographs of sections or preparations being somewhat apt to be overlooked. The greatest difficulty found is usually that the contrast between the structure to be examined and the background is insufficient, and the main control of contrast is supplied by the colour of the light used for illumination.

A coloured object is, of course, coloured by virtue of the property which it possesses of absorbing some of the constituents from white light; if the light reflected from

such a coloured object be examined by means of a spectroscope, it will be found that a portion of the spectrum is partly or completely missing. This missing portion appears as a black band, which is generally known as the absorption band of the colour. If a particular object absorbs most of the constituents from white light, so that only a small portion of the spectrum is transmitted, then that portion may be referred to as the transmission band.

Since the light which is not absorbed falls upon the eye, the sensation of colour produced is the reverse, or

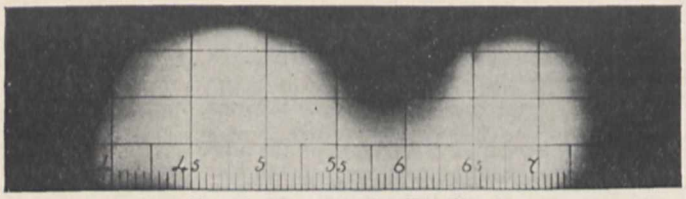


W.L. 5000 to 5400 5700 6400

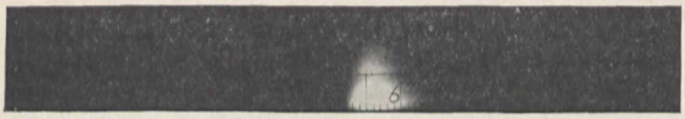
Photomicrographs of an Eosine stained section.

complementary, to the colour which is absorbed, so that a light-blue object has an absorption band in the red of the spectrum, a magenta in the green, an orange in the blue-green, and a yellow in the blue-violet. Now this consideration shows that if a colour is to be rendered as black as possible, then it must be viewed or photographed by light which is completely absorbed by the colour, that is, by light of the wave-lengths comprised within its absorption band.

A useful example is given by the photomicrographs of



Absorption Spectrum of Aniline Blue.



Transmission Spectrum of Wratten B and E Screens.

a section stained with eosine; this section appears pink, eosine absorbing green and blue-green light from λλ 4700 to 5400. If the section is photographed by green light of wave-lengths 5000 to 5400, completely absorbed by eosine, the section is entirely black, the maximum amount of contrast being obtained, and, owing to an excess of contrast, the detail of the section is blocked up. Photographing at λ 5700, on the border of an absorption band, a greatly lessened contrast is obtained, which for this particular section will give the best result. If we photograph by red light of wave-length 6400, which is completely transmitted by the section, the contrast disappears and the results are flat and useless.

This section thus demonstrates the close connection between the colour of the illuminating light and the contrast produced. A different procedure is required if contrast is to be obtained, not against the background, but within the object itself.

A good case of this is the photography of an unstained section of whalebone; this is of a yellow colour, and shows ample detail to the eye, but it completely absorbs blue-violet light, and if it is photographed on an ordinary plate sensitive only to blue-violet light, then it shows far too much contrast, appearing as a black detailless mass against the background, and presenting an exaggerated example of the loss of detail which has already been noted in the eosine section photographed by light which it completely absorbs.

The proper procedure in this case is to photograph the object by the light which it transmits. The whalebone section, for instance, photographed by red light, gives perfectly satisfactory results, showing ample detail in structure.

The best method of determining the contrast required by any object is to examine the object visually under the microscope first by means of a combination of screens transmitting light absorbed as completely as possible, and then by other screens transmitting light less completely absorbed, until the degree of contrast obtained is satisfactory to the eye.

In the booklet on photomicrography, Messrs. Wratten and Wainwright, Ltd., publish a list of the chief microscopical stains, giving their absorption bands. By the help of a special set of screens a section stained with any of these colours can be illuminated in such a way as to produce any required degree of contrast.

The accompanying illustration shows the absorption spectrum of aniline blue, and the transmission band of the filters chosen to produce the maximum degree of contrast.

In order to estimate exposure, tables are given showing the various factors involved, and including a table giving the multiplying factors of the screens used singly and in pairs, the light sources given ranging from the oil lamp to the open arc.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual public meeting of the academy, held on December 19, the prizes awarded for the year 1910 were announced as follows:—

Geometry.—The grand prize of the mathematical sciences was not awarded, no memoir having been presented on the stated problem; Emile Lemoine receives the Francœur prize, and M. Riquier the Poncelet prize.

Mechanics.—A Montyon prize is awarded to Jules Gaultier, for his inventions in connection with surveying instruments; the Fourneyron prize was postponed to 1912.

Navigation.—The extraordinary navy prize was divided between G. Hilleret (3000 francs), J. L. H. Lafrogne (1500 francs), and J. Lecompte (1500 francs); the Plumey prize was not awarded.

Astronomy.—The Pierre Guzman prize was not awarded, but the interest accrued was attributed to the late Maurice Lœwy, for the whole of his scientific work; the Lalande prize to P. H. Cowell and A. Crommelin, for their researches in connection with Halley's comet; the Valz prize to Stéphane Javelle, for his work on nebulæ and periodic comets; the Janssen medal to W. W. Campbell, for his researches in stellar spectroscopy.

Geography.—The Tchihatchef prize is divided between Dr. Verbeek (2000 francs), for his geological explorations in Borneo, Sumatra, and Java, and Louis Vaillant, for his explorations in Central Asia; the Gay prize is not awarded, but Carlos Porter receives a mention for his work on the fauna and flora of Chili; the Binoux prize is divided between Emmanuel de Martonne (1000 francs), for his work in physical geography, A. Bellot (500 francs),

for his monograph on the island of Delos, and Crépin-Bourdier de Beauregard (500 francs), for his guide to the geographical explorer; the Delalande-Guérineau prize to the Marquis de Segonzac, for his work in Morocco.

Physics.—The Hébert prize is awarded to M. Barbillion for his works on the technical applications of electricity; the Hughes prize to Alexandre Dufour, for his researches in spectroscopy; the Kastner-Boursault prize to M. Magunna, for his inventions in connection with multiplex telegraphy; the Victor Raulin prize to Gabriel Guilbert, for his meteorological researches in connection with weather forecasts.

Chemistry.—The Jecker prize is divided equally between A. Guyot and J. Bougault, for their researches in organic chemistry; the Cahours prize between MM. Brunel, Guillemard, and Jolibois; a Montyon prize is awarded to M. Taffanel, for his researches on explosives used in mining, and a mention (1500 francs) is divided between his assistants, MM. Fenzy, Le Floch, and Durr; the Alhumbert prize to Witold Broniewski, for his experimental studies on the electrical properties of the metallic alloys.

Botany.—No award was made of the Desmazières prize; Georges Bainier receives the Montagne prize, for his studies of the moulds; Hippolyte Coste, the de Coincy prize, for his book on French flora; Maurice Bouly de Lesdain the de la Fons-Mélicocq prize, for his memoir on the lichens in the neighbourhood of Dunkerque; G. Chauveaud the Bordin prize, for his memoir on the development and disappearance of the transitory tissues of plants.

Anatomy and Zoology.—The Savigny prize is awarded to Emile Brumpt, for his studies of African parasitic diseases; the Thore prize to Emile Massonnat, for his entomological studies.

Medicine and Surgery.—Montyon prizes (2500 francs) were awarded to G. Martin, Lebœuf, and Roubaud, for their report on the expedition for the study of sleeping sickness in the French Congo; to J. Déjerine and André Thomas, for their book on diseases of the spinal column; and to E. Perroncito, for his researches on the causes of pernicious anæmia in miners. Mentions (1500 francs) were awarded to Ch. Mantoux, for his memoir on the intra-dermo reaction with tuberculin; to P. Emile Weill, for his researches on the treatment of subjects with non-coaguling blood; and to MM. Moussu and Monvoisin, for their memoir on the milk of tuberculous cows. MM. Aynaud, Léon Bérard, and Jules Milhit receive citations. The Barbier prize is divided between A. Thiroux, for his memoir on sleeping sickness and the animal trypanosomiases in Senegal, and H. Bierry, for his work in experimental physiology; the interest on the Bréant prize is divided between Jules Bordet (3500 francs), for his work on immunity and studies on the serum of vaccinated animals, toxins, and antitoxins, and A. Taurelli Salimbeni (1500 francs), for his work in connection with cholera; the Godard prize is awarded to L. Ambard and E. Papin, for their study on urinary concentrations, very honourable mentions being accorded to MM. Carle, Hans von Winiwarter, and G. Sainmont; the Baron Larrey prize is divided between M. Chavigny, for his studies in military psychiatry, and Miramond de Laroquette, for his memoir on the scapular ring; the Bellion prize is divided between M. Imbeaux, for his work entitled "Statistical and Descriptive Annual of the Distribution of Water" (in collaboration with MM. Hoc, Devos, van Lint, Peter, Bétant, and Klein), and MM. Frois and Sartory; the Mége prize is not awarded, the interest being divided between Mlle. J. Joteyko and Mlle. Stefanowska; Séverin Icard receives the Dusgate prize, for his memoir on the signs of real death in the absence of a doctor.

Physiology.—A Montyon prize is divided between Ch. Livon, for the whole of his work in experimental physiology, and Marin Molliard, for his memoirs on the organic nutrition of the higher plants in its relations with morphology; the Philipeaux prize is awarded to Maurice Arthus, for his work on anaphylaxy; the Martin-Damourette prize to E. Laguesse, for his researches on the structure of the pancreas and their application to a rational treatment of various forms of diabetes; the Lallemand prize is divided between René Legendre and Aldo Perroncito, the former for his contributions to the knowledge of the nerve cell, and the latter his researches on the regeneration of the nerve cell. No memoir having been received on the question suggested for the Pourat prize, this has not been awarded, and is postponed until 1913.

Statistics.—MM. de Chabert and Gallois receive a Montyon prize (1000 francs) for their general atlas of Indo-China, with statistical tables, mentions of 250 francs being accorded to MM. E. Blin and Perrier.

History of Science.—The Binoux prize is awarded to Ernest Lebon, for the whole of his historical work, and especially his history of astronomy.

General Prizes.—Berthelot medals are awarded to MM. Barbillion, A. Dufour, Magunna, Gabriel Guilbert, Guyot, J. Bougault, Guillemard, Taffanel, and Broniewski; the interest of the Lannelongue foundation is divided between Mme. Cusco and Mme. Rück; Charles Fremont receives the Trémont prize; Arthur Robert Hinks the interest on the Leconte prize (2500 francs), for his researches on the solar parallax; Fabry and Perot a Wilde prize (3000 francs), for their researches on new interference methods in spectroscopy; Harel de la Noë the Caméré prize, for his improvements in bridge construction. The Lonchampt prize is divided between Albert Frouin (2000 francs), for his work on the use of calcium and magnesium salts after of orchids, F. Monier, F. Chesney, and E. Roux (1000 francs), for his researches on the influence of mineral salts in the therapeutics of fractures, and M. Fleig (1000 francs), for his studies on the intravenous injection of mineral solutions; the Saintour prize between Noël Bernard (3000 francs), for his researches on the biology of orchids, F. Monier, F. Chesney, and E. Roux (1000 francs), for their book on adulteration, and E. Kayser (500 francs), for his work as a whole. The Jérome Ponti prize is given to Henri Andoyer, an encouragement of 500 francs being accorded to M. Kimpflin. The Houllevigue prize is awarded to the late Bernard Brunhes, and an additional prize from the same foundation to Emile Gérards. M. Audibert receives the prize founded by Mme. the Marquise de Laplace, and MM. Audibert and Henry Weill the prize founded by M. Félix Rivot.

The Bonaparte Fund.

Thirty-four applications for grants out of this fund were received by the committee for the year 1910; after reducing the number to eleven, the total amount required still exceeded the amount available. Under these conditions, Prince Roland Bonaparte placed an additional sum of 5000 francs, making 30,000 francs in all, for the current year, out of which the committee recommend the following grants:—

5000 francs to M. Hartmann, for the experimental study of the distribution and development of elastic forces in bodies deformed by external stresses.

5000 francs to M. Urbain, for the extraction on the large scale of germanium, indium, and gallium from blende.

3000 francs to MM. Bauer and Moulin, for the construction of an electric furnace in platinum or iridium, to be applied to the determination of Stefan's constant and the distribution of the energy in the spectrum.

2500 francs to M. Blaringhem, to enable him to continue his researches on hereditary variations in plants, to prepare a complete collection of the plants studied during the last four years, and to purchase a suitable microscope.

2500 francs to M. Nicolardot, to enable him to pursue his studies on columbium and tantalum, especially for the purchase of the necessary platinum vessels.

2000 francs to M. Jules Baillaud, to enable him to complete his researches on atmospheric absorption, the amount to be applied to the construction of a special photometer.

2000 francs to M. Chevalier, to enable him to carry on his studies on the vegetation of French tropical Africa.

2000 francs to M. Eberhardt, for the extension of his exploratory studies on the economic botany of French Indo-China, and to complete the installation of his laboratory at Hué.

2000 francs to M. Gaillot, for the completion of the

calculations necessary to the revision of Le Verrier's tables of Jupiter.

2000 francs to M. Bordmann, for the completion of his stellar photometer.

2000 francs to M. Quidor, for assistance in the publication of his memoir on the external morphology of the parasitic copepods.

SEX RELATIONSHIP.

PERHAPS one of the most subtle and interesting problems of life is the numerical relationship of sex and its influence on the body politic.

It has always been something of a puzzle why the proportion of each kind, apparently with little or no underlying reason, is produced in the right numbers. The argument that if such were not the case the particular species would not survive does not reveal to us the methods by which this object has been achieved by nature. That some mechanism must exist by means of which, within certain limits, the number of males and females born is regulated, is proved by the facts of history, where we have numerous examples of wars and other social upheavals where males have largely suffered, and yet within an apparently short period of time, as measured by such events, a balance has been again re-established. The sex equilibrium may be compared to that of a gyroscope, where the greater the disturbance of position the greater is the force tending to re-establish its natural stand whilst in motion. Nature in her methods never does anything exactly, but approaches an object by establishing lateral control, which guides her on her way, should any deviation occur. Thus she does not proceed along a straight line, but is continually oscillating to either side. Her progress may very well be likened to that of an inebriated person in search of his dwelling. All that can be said is that he has a tendency homewards.

The facts regulating sex must be something of the same type, and are such that the greater the oscillation in any one direction the greater must be the restraining force invoked to curb or neutralise the movement. All such movements have an inertia, and consequently, like a pendulum, pass the middle line and establish a negative phase. The history of any race in its sex composition would show us that such oscillations have occurred throughout time, modified, no doubt, in their regular sequence by such factors as wars and famine. These oscillations of sex balance have brought with them certain changes and movements in the people themselves; an excess of males would naturally tend to produce war, either civil or foreign, whilst a superfluity of females is easily associated with upheavals in the domestic polity of the community. There is no doubt that, could we trace the history of the world, or any section of it, we should see that man simply reacts to certain variations which are inevitable sequences in the establishment of this balance. Are there at present any indications of the methods upon which, or factors by which, this state is maintained? As is usually found, "truth is simple," and so the workings of nature, when once discovered, are easily understood. The sex constitution of our population, upon which such mighty issues depend, appears to obtain its regulating force from a very simple factor, and apparently is correlated with age only.

At the present time the sex balance is as follows:—At birth the ratio of males to females is about 1030 to 1000; at the fifth year, owing to deaths amongst the males, the balance is equal; from the fifth to the fifteenth year the mortality amongst the females is slightly higher than amongst the males, but from that time onwards the females relatively increase. If we take the male as a few years older than the female for the purpose of mating, then the balance is disturbed further still. The result of this is to produce in a community a section of women who cannot possibly perform that function for which they were fashioned. Their energies are naturally directed into other spheres, as evidence of which we see the revival of the movement for political recognition. The agitation is no new one, and apparently is dependent for its strength and virility on the position of the sex pendulum. If the present female oscillation has not yet reached its zenith the agitation will continue; if the reverse is happening, as there is reason to believe to be the case, then the present movement, after certain bursts of rejuvenescence, should slowly subside, to be again resurrected at some future epoch in the history of the world.

The following table gives the relationship of the age of the mother to the sex of the child:—

(*Taken from an Inquiry into Birth Conditions in the Town of Middlesbrough.*)

	Total number of births		Males born per 1000 females
	Males	Females	
All births up to 19th year ...	29	44	659
,, ,, 24th ,, ...	226	264	856
,, ,, 29th ,, ...	437	455	960
,, ,, 34th ,, ...	617	617	1000
,, ,, 39th ,, ...	720	715	1007
All births	772	750	1030
England and Wales (1910) ...	—	—	1033

If taken between the stated ages the figures are as follows:—

	Total number in each period		Males born per 1000 females in each period
	Males	Females	
Up to 19th year	29	44	659
From 20th to 24th year inclusive	197	220	895
,, 25th ,, 29th ,, ,,	211	191	1105
,, 30th ,, 34th ,, ,,	180	162	1111
34th year and over	155	133	1165

It is seen that, as a matter of fact, the tendency to produce females over males is present in young mothers; at more mature ages there is an excess of males. We can easily see how a self-regulating balance is established, depending upon this fact. In a state of society in which females are scarce they naturally, owing to demand, mate early in life, and tend thereby to reproduce an excess of their own kind (females), thus neutralising the state which recently existed. On the other hand, should the males be in the minority, the females will mate at more mature ages, at any rate at ages of twenty-five and above as is at present, in which circumstance an excess of males is produced. We see, therefore, that the natural tendency at the present time is to neutralise the female excess. We may possibly look upon ourselves at the present moment as being at the zenith of a female oscillation, and as time progresses, helped probably by a saving of infantile life, a more numerical equality of sex will be established.

The relationship of the age of the father to the sex of the child is much the same as the mother, and where disparity in age occurs the influences may neutralise each other, so that with a mother of about twenty years and a father of about thirty years the chance of a boy or a girl should be about as equal as nature can make such a problem. Education is attempting to teach the inhibition of self, and thus delaying the age of marriage, so that the preponderance of male births should go on increasing. If the present rate of progress is maintained, and allowing for the greater mortality of the male infant over the female, an average marriage rate of between twenty-seven and twenty-eight years should produce a population in which the males are at all periods in excess of the females.

R. J. EWART.

AVIATORS AND SQUALLS.

ON looking through the now formidable list of fatalities which mark the progress, and the dangers, of aviation, the reader is often struck by the number of accidents where the reason for the capsize of the machine is not apparent. "Holes in the air" is the explanation frequently tendered, but it seems more than probable that sudden gusts, or squalls, at critical moments may be the real factors causing the trouble. For this reason an article by M. Durand-Gréville in the December (1910) number of the *Bulletin de la Société astronomique de France* is of interest.

M. Durand-Gréville proposes a system of warnings of

grains and *coups de vent* which would inform the airman of the approach of grave risks should he attempt an ascent until the squall has passed. So far back as 1892 M. Durand-Gréville made the suggestion to meteorologists in a memoir entitled "Les Grains et les Orages," which appeared in the *Annales du Bureau central meteorologique de France*. This memoir showed that the isochronic lines marking the commencement of storms corresponded with much longer *isochrones* of squalls. The name *ruban de grain* was attached to a more or less sinuous band extending from near the centre to the circumference of a depression. This band is often 1000–1500 km. (625–940 miles) long, and in its interior the wind is very strong, and often accompanied by precipitation. The advent of the squall is generally marked by a gentle south-west wind veering with startling suddenness and violence to the north-west, masses of cloud come up rapidly from the west, and frequently heavy thunder is heard. All these phenomena occur suddenly and practically simultaneously, so that the passing of the squall is easily and definitely observed.

M. Durand-Gréville's proposal is that from those stations first passed over, telegraphic warnings should be immediately dispatched to centres lying eastwards in the subsequent path of the disturbance. Numerous experiments have demonstrated the feasibility and utility of the scheme. Stations west of Paris have sent messages announcing squalls which have subsequently passed over that city at the predicted time.

On the occasion of the great Aëronautical Congress at Frankfort during 1909, the plan was tried by M. Linke, director of the meteorological station there. Fifty-five observers within a radius of 150 km. were asked to notify the director of any squall which passed over their separate stations, and M. Durand-Gréville states that, "save in one or two cases, all the storms which visited Frankfort during this period were known to M. Linke *more than an hour in advance*."

M. Durand-Gréville points out that the expense to any body which undertook the organisation of the warnings would be almost negligible as compared with the money expended in prizes awarded to aviators, not to mention the much greater cost of machines, &c., and the lamentable sacrifice of human life which might, at least to some extent, be obviated. The ordinary forecasts and warnings issued by the various national meteorological offices are far too general to be of use in this regard, but special services might be instituted, as a trial, by some of the societies especially interested in aëronautical matters.

TEMPERATURE OF THE UPPER AIR.

M. M. RYKACHEF has worked out the results of balloon ascents at Pavlovsk, Kuchino near Moscow, and Nizhni Olchedaief. There were sixty-three flights at Pavlovsk, thirty-two at Kuchino, and twelve at Olchedaief, some of which attained a height of 12 kilometres. With regard to the yearly means, the temperature at Pavlovsk was up to 9 km. lower than at Kuchino, the differences increasing up to 3 to 3·5 km., and then diminishing. At 9 km. they change sign, increasing up to a maximum of about 4° C. between 10·5 and 12 km. The difference of temperature between Pavlovsk and Nizhni Olchedaief is much greater, diminishes up to 10 km., where it changes sign, and attains a maximum of 1° between 11 and 12 km. A marked diminution in the fall of temperature takes place at a lower height in Pavlovsk than in Kuchino, and at Kuchino than at Olchedaief, the heights being 9·5, 9·8, and 10·8 km. respectively. The temperature of the isothermic layers is highest at Pavlovsk and lowest at Kuchino. These variations may be explained by the differences of latitude, Pavlovsk being situated at about 60°, Kuchino 56°, and Nizhni Olchedaief 48°, while Pavlovsk is more exposed to the mild influence of a sea climate than the other two places.

At Nizhni Olchedaief the ascents were too few to deduce any satisfactory conclusions with regard to seasonal variations. At Pavlovsk the temperature at all seasons from the ground up to 8·5 to 9 km. was lower than at Kurchino, except that in winter the temperature up to 500 metres was higher, which result accords with the readings taken on the ground for a series of years. The difference of temperature in winter, spring, and autumn shows a marked increase at about 2·5 to 3 km., changes sign at 8·5 to 9 km., and rapidly increases to the isothermic layers, where the temperature is lower at Kuchino than at Pavlovsk. In summer the difference decreases continually up to 9·5 km., and then changes sign and increases. The height where the fall in the temperature becomes insignificant is lower in all seasons at Pavlovsk than at Kuchino, except in spring, when it is about 10 km. at both stations.

The temperature of the isothermal region is markedly lower at Kuchino. In the curve of monthly means is seen a retardation of the maximum in the higher layers of air. In the lower atmosphere the maximum occurs in July both at Pavlovsk and Kuchino, but at greater heights it occurs in August, the change taking place at a height of 2·5 km. at Kuchino and at 4·5 km. at Pavlovsk. At 9 km. the maximum returns to July. The minimum exhibits somewhat similar variations. Amplitudes and gradients, mean changes of temperature with elevation in cyclones and anticyclones, &c., are also discussed, with numerous tables and diagrams, in an article published in the Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 7, 1910.

THE INCENSE-ALTAR OF APHRODITE AT PAPHOS.

AN interesting article by Dr. Max Ohnefalsch-Richter appears in *Globus* of November 17 (xcviii., pp. 293–7), in which he brings forward data to prove his earlier supposition that the first site of Paphos was in the neighbourhood of Randi, in Cyprus. Certain inscriptions from this vicinity showed that Aphrodite, "the unconquerable," sender of Spring, was worshipped, and that an ancient incense-altar had existed there. The block containing the most important inscription is held by Prof. Richard Meister, of Leipzig, to belong to an incense-altar, and he adds that the incense-altar of Aphrodite at Paphos (Homer, VIII., 362; Homeric Hymns, IV., 59) was famous from earliest times.

Last August Dr. Ohnefalsch-Richter was able to identify a semi-subterranean side-chamber in the rock connected with this altar, whence had come the inscribed incense-bowls which Prof. Meister has been deciphering. Dr. Zahn's excavations in the chamber have brought to light some half-dozen further inscriptions in the Paphian script, and he has made a number of valuable discoveries on the hill-side below, among them phalli which again played an important part in the Paphian Aphrodite-worship. The cult carried on on the hill consisted in making incense offerings, as described by Homer; in Dr. Zahn's opinion images were not used originally. A clay statue of about life-size was, however, found in the middle of the altar-chamber, the style indicating a date about 600 B.C. The article concludes:—"We must wait to see what Prof. Meister will make of the hundred and more inscriptions discovered. As yet everything supports my surmise that on the hill of the incense-altar at Randi, not only *an* incense-altar of Aphrodite Paphia stood, but *the* most famous, the Homeric, incense-altar of Aphrodite of Paphos."

Early in the article the writer refers to ten inscribed stones from Randi "from secret, prohibited excavations," which were fortunately purchased by someone who generously presented them to the Cyprus Museum. This is additional evidence, if such be required, of the urgent necessity for strong measures by the Government for the repression of illicit traffic in objects of archæological interest in this island and elsewhere. A. C. H.

AIMS OF ASTRONOMY OF PRECISION.[1]

THE science of precise physical measurement is one which does not readily appeal to those not immediately concerned, either with the methods or results. An authoritative statement that the sun's distance from the earth is 92,880,000 miles may excite wonder, but scarcely more than will the statement that it is approximately

[1] From the presidential address delivered before the Royal Society f South Africa on April 20, 1910, by S. S. Hough, F.R.S. Published in t h Transactions of the Society, vol. ii., part i.

93,000,000, except in the minds of those who are in some measure acquainted with the laborious processes by which the two extra figures are derived. In fact, I have not infrequently heard the methods of observation used described by some such epithet as "hair-splitting." For this reason I think I cannot do better to-night than to describe to you, without entering into technical details of the methods employed, some of the aims and objects to which modern astronomy of precision is devoted, and which render essential none but the highest refinements that human ingenuity can devise.

Perhaps the primary reason why astronomy appeals to the popular imagination in a higher degree than other sciences is that astronomy is *par excellence* the science of prediction. True, the days are now past when an astronomer is regarded, except by the most ignorant, as gifted with supernatural powers and capable of predicting events that can have no conceivable relationship with the objects of his researches, or when an unscrupulous astronomer could utilise his powers of prediction for imposing on the world at large in the face of the criticisms of fellow-workers in collateral branches of science. Nevertheless, it is only necessary to point to any of the leading almanacs to establish the undoubted claim of astronomy to a considerable predictive capacity in its own legitimate sphere. These almanacs, prepared in advance, give from day to day the positions of the sun and moon, the phenomena of eclipses, and various other data with an accuracy which can only be called in question by the most refined tests available to astronomers.

How, then, has astronomy acquired this faculty? The answer to this question is—at least primarily—by continuous and patient observation, using always the most refined methods of physical measurement available.

A well-devised scheme of observation is sooner or later bound to lead to the detection of laws governing physical phenomena if such laws exist. Thus it was the planetary observations of Tycho Brahe which led to the detection of the laws of planetary motion associated with the name of Kepler.

Once such laws have been established and the necessary initial data secured, the science of astronomical prediction would for the future devolve on the mathematician rather than the astronomer, were it not for two sources of uncertainty with which the astronomer must continue to concern himself. It is evident, on one hand, that we cannot infuse into our predicted phenomena greater precision than that derived from the initial data, themselves dependent on imperfect observations. However well the laws governing planetary motions may be understood, the predicted position of a planet to-day depends on its observed positions at some earlier epoch or epochs; and the fallibility of the observations made at these earlier epochs will not only pervade all future predictions, but will inevitably increase in amount as the epoch of prediction recedes from the epoch of observation. For this reason, if the standard of accuracy of prediction is merely to be maintained—and the growing requirements of science will scarcely rest contented with this—continuous observation must be maintained and the data on which predictions are based revised from time to time.

I have dealt so far only with the effects of the unavoidable inaccuracies of observations, even when pushed to their utmost refinement, as influencing results of prediction. A second consideration of even greater importance is the validity of the laws associating the predicted with the observed phenomena. I may illustrate my point again by reference to the laws of Kepler. It is now well known that these laws are only rough approximations to the actual truth, and that though they might serve as a useful basis for prediction over a short interval, a few years at most would suffice, by showing a rapidly increasing departure between the observed and predicted positions of the planets, to indicate that these laws require amendment.

That the direction this amendment should take followed so soon on the original discovery of Kepler's laws was due to the genius of Newton, who showed that the theory of universal gravitation propounded by him not only adequately accounted for the laws enunciated by Kepler, and pointed to their imperfections, but served to coordinate as due to a single cause even more recondite phenomena, such as the leading inequalities in the motion of the moon, the precessional motion of the earth, and the phenomena of the tides. This theory further reduced to order those astronomical vagaries the comets, showing that, so long at least as they remained within the precincts of the solar system, their motions were governed by it, while observations of double stars have established beyond question that even remote parts of the universe are still subject to the same laws.

The dynamical laws propounded by Newton, which to-day virtually form the basis of all astronomical prediction, enable us to trace back as well as to trace forward the history of the solar system, and to confront modern observations with historical records. Needless to say, in but rare instances do these records possess the necessary elements of precision to strengthen the existing data required by the astronomer; but there are important exceptions. For instance, a very small uncertainty in the "elements," which in conjunction with Newton's laws govern the motion of the moon, will produce by lapse of time a large change in the comparatively small area of the earth's surface over which a total eclipse of the sun is visible as such. Thus a record that a particular eclipse was seen as total in a given locality becomes an observation of precision, provided only the chronological date at which the eclipse occurred can be traced with sufficient certainty to ensure the identification of the eclipse concerned.

The confrontation of modern with historical observations of such a character has served to establish beyond question the high degree of accuracy with which the laws of Newton represent the motions within the solar system, and their trustworthiness as a basis of prediction for years, perhaps for centuries, to come. It is, however, on various grounds quite certain that these laws in themselves are not absolute, far-reaching though they are, and that they in turn, like those of Kepler, must be superseded by laws still more exact.

Until such laws are discovered there will always remain an element of uncertainty, apart from that due to the initial data affecting all predicted phenomena—an uncertainty which can only be removed when the phenomena cease to be prospective, and when they can be confronted with later as well as with earlier observations.

The fact, however, that the laws of gravitation yield such a close representation of the observed motions within the solar system throughout historic time renders the detection of a departure from these laws a question of extreme delicacy, but none the less essential, if prediction is to be secured for long periods in advance.

I have selected my illustrations largely from the solar system chiefly on the grounds that, thanks to the Newtonian laws, it is here that, in spite of the immense mathematical difficulties which have had to be faced, astronomical prediction has attained its greatest triumphs. I wish now to divert attention to the stars. In so far as these form the fiducial points to which the motions of the planets and other members of the solar system are referred, it is essential that the positions of a limited number, at least, should be determined with the highest possible accuracy. Any uncertainty in their positions will undoubtedly be reflected in the positions of the planets, and will constitute one of those sources of error so liable to increase with time, and render efforts at prediction, if not entirely nugatory, at least partially ineffective.

The universe of so-called "fixed stars" is not invariable in aspect, though its changes, for the most part, are of so minute a character that they can only be surely detected either by the most delicate measurements or by their cumulative effect over long intervals of time. It is chiefly through a study of these changes that our knowledge of the stellar universe has been acquired in the past, and it is largely to similar means that we look for an extension of this knowledge.

Among changes which lend themselves to observation for this purpose we may enumerate:—

(1) Changes of the intensity of the light of the stars. The origin of these changes, except in a few instances, remains obscure. In certain cases, however, notably in the case of variable stars of the Algol type, a satisfactory explanation of the observed phenomena has been found in the motions of a system, governed by laws similar to those

operating in our solar system, of which the visible star forms a constituent member.

(2) Changes of position due to orbital motion in binary or multiple stars. Where both components of a binary star are visible, these changes readily admit of direct measurement. In other cases the existence of a companion is inferred to account for regular periodic changes of position of the visible component, though this companion cannot be seen either on account of intrinsic want of light or on account of its close proximity to the primary, and the consequent incapacity of our telescope to render the two visually distinct.

These changes are of interest as affording evidence of the validity of the Newtonian laws in systems other than the solar system.

The changes to which I have so far referred are changes which affect isolated stars or groups of stars, but which do not occur, at least to a sensible extent, in the generality of stars.

I come now to the changes of position due to the earth's orbital motion which, on the other hand, may be expected to influence all stars in common. Even where, as in the cases I have already spoken of, their influence is obscured by orbital motion within the system, when once this orbital motion has been thoroughly examined, its laws deduced, and due allowance made for it by computation, we might expect to find the effects of the earth's motion still apparent.

The earth in its orbit round the sun approximately describes a circle of 186,000,000 miles in diameter, and its successive positions in space at intervals of six months are separated from one another by this extent. But experience has shown that recurring changes in the relative positions of the stars, as viewed at intervals of six months—that is to say, from two different points of the universe separated by this vast distance—can only be detected in the case of a limited number of stars, and then only by the application of the most delicate methods of measurement specially designed to bring these changes to light.

To the Cape Observatory and its former director, Henderson (1832–4), belongs the credit of first producing trustworthy evidence of the existence of any fixed star, for which these changes could be unmistakably detected, and which, therefore, was not too remote from the solar system to permit of its distance being at least roughly determined in comparison with the diameter of the earth's orbit. Henderson's discovery has since been fully confirmed by later observers, and other stars likely to yield tangible results have now been examined. As illustrative, however, of the evasiveness of the quantities sought, and the excessive labour by which only they can be derived, though the problem of stellar distance has always been in the forefront of astronomical interest, and has attracted the attention of several able observers, the number of stars for which well-determined parallaxes have been published up to the present day does not exceed some 400. This number is quite insignificant in comparison even with the number of stars visible to the naked eye without telescopic aid. Moreover, the stars investigated have been, in general, selected on the grounds of some *a priori* probability of their possessing a measurable parallax, either on account of apparent brightness or on account of their large apparent motion, and for this reason they can scarcely be regarded as typical of the generality of stars.

In order, then, to gauge the depths of the visible universe it would appear imperative that our base-line must in some manner be extended. The distance of 186,000,000 miles through which we are carried in the course of a single half-year by the orbital motion of our planet round the sun is so small in comparison with interstellar distances as to give rise to changes in the apparent relative positions of stars which, except in the most pronounced instances, are so insignificant in amount as to defy detection even by the most refined processes of measurement we possess.

How, then, can such an extension of our base-line be attained? I have already pointed out that the so-called "fixed stars" are not truly "fixed," but that on close observation it is found that each star has an apparent motion either peculiar to itself or shared by other neighbouring stars which, with it, constitute an independent system. I refer primarily to the visible motion transverse to the line of sight.

If then our sun, as we may reasonably suppose, is itself a member of the stellar universe, it may be anticipated that it too will not be at rest, but will be moving forward in space, and the visible motions will be those due to the combined effects of the motion of the sun and stars.

That the apparent motions of the stars were not entirely fortuitous, but that they could, at least partially, be co-ordinated throughout the sky as the visible manifestations of a single phenomenon, viz. a translatory motion of the sun with its system of planets through interstellar space, was first pointed out by Sir William Herschel, who further indicated that the point of space to which this motion was directed was situated in the constellation "Hercules."

Before proceeding to the further consideration of this solar motion, I wish first to point out to you how its existence at once suggests a means of "extending our base-line" for the purpose of gauging these interstellar depths. I have refrained from any numerical estimates of the amount of this motion, as this involves philosophical questions into which I do not desire to enter to-night; but in order to fix our ideas it is necessary for me to give you some notion, at least, of the order of magnitude. It is now possible to state with some certainty that the speed of the sun's motion relatively to the stars as a whole amounts to about 20 kilometres per second, and that the space traversed in a single day therefore amounts to rather more than 1,000,000 miles, that in a year to about 400,000,000 miles. Thus the stars, as seen on two occasions a year apart, may be considered as viewed from two points in space separated by this length, and it only requires lapse of time in order to increase the length to an almost indefinite extent.

The great scheme for the photographic mapping of the heavens at present being carried out on an extensive scale by means of the cooperative efforts of the leading observatories of the world will shortly furnish a highly accurate delineation of the skies as seen at the commencement of the twentieth century. This alone has called for concentrated effort extending over some twelve years at least, while it would even now scarcely be safe to say that another ten years will see its completion. An immediate repetition is scarcely to be contemplated, though a subsequent repetition at some future epoch, which may be agreed on by astronomers, forms an essential part of the programme as originally introduced.

When this scheme is completed in its entirety very ample data will be available for the discussion of stellar distribution by the methods I have suggested to you.

In the meantime, however, in such tentative attempts as have been made to fathom the secrets of the universe by means of the study of stellar proper motion, it has been necessary to rely on early recorded exact observations. It will be clear from what I have already explained to you that it is the earliest trustworthy records in comparison with the most up-to-date available which will yield the greatest length of base-line, and consequently the most trustworthy results. For this reason the majority of the discussions hitherto attempted have been based on the catalogue of Bradley, dependent on observations made by him at Greenwich between the years 1750–62. This catalogue contains the places of some 3000 stars observed with a precision far surpassing any similar previous observations, and comparing favourably with the best modern catalogues. The stars selected by Bradley are fairly uniformly distributed over the portions of the sky accessible to him, viz. from the North Pole to 30° south of the equator.

Unfortunately no early catalogue of stars of even approximately similar precision exists for the remaining region of the sky between 30° S. dec. and the South Pole, and the absence of exact knowledge of these regions for the earlier epochs has always hampered these discussions.

The discussions I refer to have generally had as their immediate objective:—

(1) The determination of the precessional constant, *i.e.* the annual amount by which the earth's axis of rotation changes its position in space, and

(2) The determination of the speed of the solar motion and the position of the solar apex, *i.e.* the point in the heavens towards which the sun's motion is directed.

The discrepancies in these quantities found by different investigators, either starting with different data or utilising different methods for the combination and discussion of the same material, had long been a puzzle to astronomers. The key to the situation was at length furnished by Prof. Kapteyn, of Groningen, who, in an epoch-making paper read before the British Association in Cape Town, first pointed out that the apparent motions of the stars indicated, not merely the existence of a single solar apex, but that there were two separate regions of the sky towards which a preference was shown by the directions of motion of the Bradley stars.

This was a phenomenon which could not be explained by a simple motion of translation of the sun, as evidently the sun's motion could not be directed to two different points simultaneously, and the only feasible explanation was that the stars consisted of two groups, and that the motion of the sun relatively to one of these groups differed from its motion relatively to the other, or that, though the stars appeared intermingled in space, they possessed an independent relative motion, which might be regarded as located in one group or in the other, but which was shared by all the stars peculiar to the group.

The theory of the existence of two streams or drifts of stars thus put forward by Kapteyn has since received full confirmation by other investigators, notably by Eddington, who based his examination on the early observations of Groombridge, and by Dyson, who limited his discussion to a selected list of stars possessing considerable proper motions.

Recent investigations at the Cape have led us to examine in somewhat more minute detail the proper motions of the Bradley stars, with the result that, though the phenomena first noticed by Kapteyn stand out as the most prominent feature, certain subsidiary features of no less importance have been brought to light.

I have concerned myself hitherto only with the visible motions of the stars transverse to the line of sight, as derived by the older methods of measurement. The introduction of the spectroscope into astronomical research has opened up vast new fields into which, so far as they relate to the chemical and physical constitution of the sun and stars, it is not my purpose to enter to-night. What I wish rather to emphasise is the value of this instrument as a supplement to the older methods in relation to the geometrical astronomy of position.

In accordance with the principle laid down by Doppler, the wave-length of light received from a source which is either receding from or approaching a receiver will appear to be modified by an amount dependent in a known manner on the velocity of approach or recession. If the receiver takes the form of a spectroscope which permits by any means, direct or indirect, of the measurement of the wave-lengths, and the normal wave-lengths of the lines under examination are independently determined by laboratory investigations, the difference between the observed and the normal wave-lengths will thus afford a means of measuring the velocity of approach or recession of the source of light.

Of the precautions necessary to ensure precision it is not my purpose to speak to-night. The large spectroscope of the Cape Observatory, which we owe to the munificence of the late Mr. Frank McClean, was from the outset constructed with due regard to these precautions, so far as they could be foreseen, for the purpose of determining with the greatest accuracy attainable the radial velocities of stars. The instrument has been already successfully used, and its capabilities have been established in an investigation of the aberration constant of light as depending on the apparent variations in the radial velocities of stars resulting from the earth's orbital motion.

From a relatively short series of observations discussed by my colleague Dr. Halm, this constant has been derived with a precision not inferior to that attained by the best series of older observations, and the capabilities of the method are yet far from exhausted.

At the present time the instrument is being devoted to a series of observations of all such stars as are accessible in the southern skies, the spectra of which present sufficiently pronounced features to admit of measurement, primarily with the view of ascertaining what evidence can be derived from a study of the radial velocities in regard to the systematic structure of the universe.

A year or two must elapse before the present observing programme is completed, but a preliminary discussion of the observations already secured in combination with the published results derived from similar observations in the northern hemisphere has revealed the existence of anomalies similar to those found from the study of the transverse motions—anomalies which can only be reconciled with the two-drift hypothesis put forward by Kapteyn by the further hypothesis that though both drifts pervade the whole sky, they are not similarly distributed throughout it.

At present, through scantiness of material, from a study of the radial velocities we have been able to do little more than discriminate between the two halves of the sky, which contain, respectively, the greatest and the least proportion of second drift stars. It is, however, a fact of some significance that the former corresponds very closely with that hemisphere which contains the Milky Way, suggesting the phenomenon that Kapteyn's second drift might be identified with the galaxy. It was with the view of examining this suggestion in the light of the evidence which could be secured from the transverse motions of the Bradley stars that the discussions I have sketched to you to-night were undertaken by Dr. Halm.

While they have established almost beyond question the rough features of distribution demanded to reconcile the radial-velocity determinations, they further point to an even more detailed correspondence between the distribution of galactic stars and the distribution of stars of the second drift, leaving but little doubt as to the identity of this second drift with the galaxy. It is this second drift which exhibits evidence of structural unity. As regards the Milky Way, the mere appearance on any fine night affords evidence of a similar character, and it is on this account that we have been able to identify the Milky Way with the second drift rather than with the first.

The significance and origin of this structure are as yet obscure, but the more its details are elucidated and the essential features established the nearer are we to an answer to the question, What is the Milky Way?

To revert to my original text, I have endeavoured to point out to you the methods of research by which an answer is sought to this and similar questions, and to explain to you the reasons why the highest precision attainable is a *sine quâ non* in the conduct of such research. Thus it is that the study of the large-scale phenomena of the universe resolves itself frequently into a study of the minute detail of instrumental appliances, on which must be brought to bear all the knowledge that can be derived from other branches of scientific work. The geologist helps us in the selection of stable foundations on which the engineer may erect our large instruments. Chemistry and physics in our photography, our optical and electrical appliances, are of daily application, while one of the most valued accessories in almost all methods of precise measurement is the spider's web we derive from zoology.

Astronomy, in its turn, has done much in the past, and in the future will doubtless do more, to assist the development of collateral sciences. Thus the geologist cannot afford to ignore, even if he does not accept as conclusive, the evidence furnished by astronomy as to the nature of the earth's crust. Exact measurements of space and time as conducted in physical laboratories are for the most part conducted by methods first designed to suit the requirements of astronomical precision, while in the sun and stars chemical phenomena, which may be studied with the aid of the spectroscope, are taking place on a scale far surpassing anything that can be produced in the laboratory.

The value of free intercourse between workers in the various branches of science is certainly indisputable, and I wish to close my address by reference to the opportunities which our society can afford in this respect. Devotees even of applied, and still more of pure, science in a young country are necessarily few in number and scattered. A large proportion of these will in the early stages of their career have been in close association with one or the other great centres of scientific activity of the world, and to such a feeling of scientific isolation almost amounting to

exile, and consequent lack of stimulus, is almost inevitable. Important as are our publications, it is even more through our monthly meetings and the promotion of personal intercourse that the society can help in its primary duty of the advancement of natural knowledge in South Africa.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE discussions at a conference of teachers in rural schools, held in London on December 28, 1910, under the auspices of the National Union of Teachers, showed that teachers are recognising more fully the desirability of making the education in elementary schools in country districts so far as possible of a practical kind, which will train the children for agricultural and other country avocations in later life. A resolution was adopted unanimously urging that, wherever possible, some teaching in handicraft and housecraft should be given to children in rural schools, and that, where necessary and practicable, centres for instruction in these subjects should be formed. It was suggested during the discussion that central school farms might be established, where practical work on the land could be carried on by boys drafted from neighbouring schools. It was recognised, also, that actual work in a garden abounds in opportunities for the best lessons in observation, attention to detail, never putting off until to-morrow what ought to be done to-day, as well as the cultivation of the virtues more commonly associated with the moral instruction lesson. Another resolution, unanimously carried, deplored the continuance of the partial exemption system, and declared that the time has arrived when no child shall be either partially or totally exempt from attendance at school before fourteen years of age. A discussion on continuation schools in rural districts revealed some diversity of opinion, but the meeting eventually decided that, having regard to the impossibility of satisfactorily organising and coordinating continuation work in rural districts, where children are at present allowed to secure partial exemption from school attendance at the early age of eleven or twelve for the purpose of employment, no exemption, either partial or whole-time, from day-school attendance should be granted until the age of fourteen years is attained, all wage-earning child labour out of school hours under the age of fourteen should be forbidden by law, and these conditions having been secured, a system of compulsory attendance at continuation schools or other suitable educational institutions from the age of fourteen to eighteen, accompanied by provisions which should safeguard young people against undue physical or mental overstrain, should be an integral part of a national system of education.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 20, 1910.—Mr. R. Lloyd Praeger in the chair.—Dr. J. H. **Pollok**: The vacuum-tube spectra of the vapours of some metals and metallic chlorides (part i.). By the use of a new form of vacuum tube, made entirely of quartz, which the author has recently devised, he can readily obtain photographs of the whole of the vacuum-tube spectra of the vapours of metals and metallic chlorides. In the present paper the author gives a description of the quartz vacuum tube and photographs of the spectra of the vapours of mercury, zinc, cadmium, arsenic, and antimony, together with photographs of the spectra of their chlorides, under varying conditions. The vapours of the metals and their compounds, so far examined, show substantially the same line spectrum in the vacuum tube that they do when metallic electrodes are sparked in air. When a condenser is introduced in the circuit, the metal and its compound show precisely the same change of spectrum, which would seem to indicate that the changes take place in the vibrating atom. If a large amount of vapour of the chloride is present without a condenser, bands are seen in addition to the line spectrum of the metal, and these appear to be due to the particular compound present, and must therefore be connected with the vibrations of the molecule.—Dr. G. H. **Pethybridge**: Considerations and experiments on the infection of potato plants with the blight-fungus (*Phytophthora infestans*) by means of mycelium derived direct from the planted tubers. The theory recently advocated by Massee, that the potato crop becomes attacked with the "blight," not by means of the "spores" of *P. infestans*, but by means of the mycelium of this fungus, which, after lying dormant for a long period, passes from the planted tubers into the nearly full-grown stalks, is criticised, and it is pointed out how difficult it is to reconcile this mode of infection with the well-known facts of the disease. It is shown that, owing to the absence of controls, the experimental evidence on which the theory is based is quite worthless. A repetition of the experiments, carried out by the author with the necessary controls, gave results exactly the opposite to those on which the theory is based.—Rev. H. C. **Browne**: Some suggested improvement in epicyclic variable gears. The improvement applies specially to the modern bicycle, and consists in effecting the complete separation of the epicyclic train from all the moving parts on the middle speed, so that the friction is reduced to the same amount as if the machine were a single-geared machine, *i.e.* so that there is no movement except that of the ball races at each end of the axle. The high and low speeds are also improved by getting rid of all friction due to over-running pawls or the unnecessary rubbing of parts. The middle speed is produced directly by the engagement of the driving member with the hub, the epicyclic train being completely detached and in no contact with any of the moving parts. The linking up of the gear train with the drive for the high and low speeds is effected in a simple manner by the use of spring trigger pawls. Some care has been given to the construction of the epicyclic train so that it may be a proper mechanical unit in itself instead of being a somewhat loose assemblage of wheels. With this object, the wheels of the train are provided with friction discs reaching to the pitch lines, and the friction between the elements of the train is thereby reduced to rolling friction.

PARIS.

Academy of Sciences, December 27, 1910.—M. Émile Picard in the chair.—A. **Gaillot**: The analytical theory and tables of motion of Jupiter, by Le Verrier. Additions and rectifications. These tables represent with sufficient exactitude the observations made between 1750 and 1869. From 1870, the comparison of the observed and calculated positions shows increasing discrepancies. The tables for Jupiter have now been recalculated, and the results compared with observations for the period 1750 to 1906–7.—Paul **Sabatier**: A method for causing two substances to react in the electric arc. The method described by M. Salmon in a recent note (December 5) was anticipated by the author in 1899.—W. **Kilian** and M. **Gignoux**: An attempt to coordinate the levels of the pebble beds and terraces of the Bas-Dauphiné.—The perpetual secretary announced the death of Armand Sabatier, correspondant for the section of anatomy and zoology.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1910. Observations were possible on sixty-four days during the quarter. Three tables of the results are given, showing number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Maurice **Servant**: The transformations of surfaces applicable to surfaces of the second degree.—T. **Lalesco**: Left-handed symmetrical nuclei.—G. **Kowalewski**: The formulæ of Frenet in functional space.—L. **Zoretti**: The equations of motion of a viscous fluid.—G. **de Proszynski**: The application of the gyroscope and of compressed air to taking kinematographic views. The gyroscope is driven by compressed air, and is attached to the camera in such a manner as to suppress or deaden small vibrations.—Jean **Becquerel**: The positive magneto-optic effect presented by the phosphorescence bands of rubies and emeralds, and the relations between emission and absorption in a magnetic field.—J. **Thovert**: Photometry and the utilisation of coloured sources of light. A description of a new empirical spectrophotometric method.—Daniel **Berthelot** and Henry **Gaudechon**: The principal types of photolysis of organic compounds by the ultra-violet rays. The photolysis of

primary alcohols is characterised by the predominance of hydrogen and absence of carbon dioxide; with secondary and tertiary alcohols the proportion of hydrogen is reduced, being replaced by methane and its homologues. Aldehydes give a gas containing carbon monoxide as the chief constituent, whilst carbon dioxide predominates for the fatty acids.—M. **Nanty**: The equilibria between potassium bicarbonate and hydrated magnesium carbonate.—Georges **Denigès**: A new reaction for cupreine. The reagent used is a mixture of water, copper sulphate, ammonia, and hydrogen peroxide. Cupreine gives a deep emerald-green coloration after adding some alcohol.—M. **Hanriot**: Brown gold. This name is applied to the gold left after treating a gold-silver alloy (20 per cent. gold) with nitric acid. This is not pure gold, but contains traces of silver, copper and lead, and also of nitric acid, even although the washings with water are free from acid. This gold undergoes changes in colour and volume on heating, a description of these being given in detail.—F. **Bodroux**: The action of some esters on the monosodium derivative of benzyl cyanide. In a preceding paper it has been shown that the sodium derivative $C_6H_5.CH.Na.CN$ reacts with the esters of the fatty acids, giving compounds of the type $C_6H_5.CH.(CN).CO.R$, and in the present note the reaction is extended to esters of the monobasic aromatic acids.—M. **Lespieau**: The condensation of acrolein bromide with malonic acid. The saturated acid $CH_2Br.(CHBr)_2.CH_2.CO_2H$ is obtained instead of the unsaturated acid expected.—L. **Tchougaeff** and E. **Serbin**: The complex salts of certain amino-acids. An account of the preparation and properties of some chromium salts of glycine and its homologues.—P. **Pierron**: A method of preparation of the aromatic acylguanidines.—L. H. **Philippe**: The glucodeconic acids.—Pierre **Breteau**: The addition of hydrogen in presence of palladium: application to phenanthrene. Palladium was used in the form of sponge, block, and precipitated metal, phenanthrene tetrahydride being formed.—MM. **Achalme** and **Bresson**: A method for determining the presence of one or several diastases in a liquid.—W. **Vernadsky** and Mlle. E. **Révoutsky**: The chemical distinction between orthose and microcline. Lithium and rubidium have been found in various microclines; this is opposed to the rule for distinguishing orthose from microcline, based on the absence of lithium and rubidium in the latter.—Auguste **Chevalier**: New evidence on *Voandzeia Poissoni*.—L. **Matruchot**: The new culture of an edible mushroom, *Pleurotus cornucopioides*.—G. **André**: The conservation of saline matters during the growth of an annual plant.—Henri **Agulhon**: The acquirement by maize of immunity with respect to boron compounds.—P. **Mazé**: Induced ripening of seeds. The antigerminative action of acetaldehyde.—P. A. **Dangeard**: The action of light upon chlorophyll.—P. **Ammann**: The existence of a perennial rice in Senegal.—P. **Bouin** and P. **Ancel**: The lipoid nature of an active substance secreted by the yellow body in mammals.—Louis **Lapicque**: The relation of the encephalic weight to the retinal surface in some orders of mammals. A new set of experimental results confirming the views announced in a previous paper.—C. **Houard**: The mode of action of Asterolecanium, external parasites of stems.—Auguste **Michel**: The structure of the elytra of *Halosydna gelatinosa*.—Fabre **Domergue** and R. **Legendre**: A method of detecting *Bacterium coli* in anaërobic cultures in waters and oysters. The development is carried out in the absence of air; this modification of the usual methods removes some ambiguities from the reaction.—E. **Doumer**: Epilepsy and constipation. Cases are cited in which the epilepsy was directly connected with constipation; electrical treatment of the abdomen, resulting in the removal of the constipation, completely suppressed the attacks of epilepsy.—M. **Godfroy**: Some results of the study of the Antarctic tides observed in the course of the French expedition to the South Pole. The results of the analysis of the observed data are not in accord with the views of Whewell or the more recent hypothesis of R. A. Harris, and show that the tides in this region are very complex.—Georges **Hervé**: The instructions given by the National Institute (first and second class) to Captain Baudin for his voyage of discovery in the Antarctic (1800–4).

DIARY OF SOCIETIES.

THURSDAY, JANUARY 5.

RÖNTGEN SOCIETY, at 8.15.—The Radioactivity of Thorium: Prof. Rutherford.

FRIDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 8.—A History of Species-making; as illustrated by some Carboniferous Corals: by Dr. A. Wilmore.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Measurement of Boiler Deformations: G. F. Davidson.

TUESDAY, JANUARY 10.

INSTITUTION OF CIVIL ENGINEERS, at 8.—(1) The Strengthening of the Roof of New Street Station, Birmingham; (2) The Reconstruction and Widening of Arpley Bridge, Warrington: W. Dawson.

WEDNESDAY, JANUARY 11.

GEOLOGICAL SOCIETY, at 8.—The Zonal Classification of the Salopian Rocks of Cautley and Ravenstonedale: Miss G. R. Watney and Miss E. G. Welch.—On a Collection of Insect-remains from the South Wales Coalfield: H. Botton.

THURSDAY, JANUARY 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Absolute Expansion of Mercury: Prof. H. L. Callendar, F.R.S., and H. Moss.—The Density of Niton (Radium Emanations) and the Disintegration Theory: Dr. R. W. Gray and Sir W. Ramsay, K.C.B., F.R.S.—The Charges on Ions in Gases, and some Effects that Influence the Motion of Negative Ions: Prof. J. S. Townsend, F.R.S.—The Distribution of Electric Force in the Crookes Dark Space: F. W. Aston.—The Measurement of End Standards of Length: Dr. P. E. Shaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

MATHEMATICAL SOCIETY, at 5.30.—A Property of the Number 7: T. C. Lewis.—A Mode of Representation of an Electromagnetic Field as due to Singularities Distributed over a Surface: Prof. H. M. Macdonald.—On the Fundamental Theorem in the Theory of Functions of a Complex Variable: Dr. W. H. Young.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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