THURSDAY, JANUARY 6, 1910.

THE ETHER OF SPACE.

The Ether of Space. By Sir Oliver Lodge, F.R.S. Pp. xvi+156. (London: Harper and Bros., 1909.) Price 2*s.* 6*d.* net.

THIS book is a contribution to what the publishers describe as a "Library of Living Thought." In appealing to Sir Oliver Lodge for a book on the ether they could count on getting something which could certainly be called "thought," in the most exalted sense of the word, and would as certainly be alive. But, notwithstanding the many picturesque images with which the theme is illustrated, we must confess that we have found the book as a whole somewhat unsatisfactory. This is perhaps due to a certain indefiniteness of aim; some sections would seem to be addressed to the cultivated *dilettante*, and dwell at great length on very elementary matters, whilst others can hardly be appreciated except by the expert who is already conversant with the more abstruse parts of electrical and optical theory. Thus the primary notions of aberration are expounded very fully, whilst the theories of Michelson's experiments and of Fresnel's law of wave-velocity in a moving substance are treated with tantalising brevity. Again, the mechanical and optical details of the author's own experiments with the "ether machine" are given with a minuteness which in a work on the present scale rather tends to distract attention from the main point.

The ether has in its not very lengthy history undergone many transformations. The unsatisfactory elastic-solid medium of the last century, with its abundant provision for the explanation of non-existent phenomena, has at length gone, to the general relief. But the newer ether which is gradually being evolved in its place, with its ability to exercise force, and, at the same time, its utter indifference to forces exerted on itself, appears somewhat shadowy and mysterious. When the conceptions are resolved into their elements we are left with little more than what the mathematicians call a "vector-field." It might seem, indeed, that the physicist had only to take one step more, and hand over the whole medium, as a pure abstraction, to the mathematician, who, for his part, is disposed to welcome the gift with enthusiasm as affording, after a few improvements, an unexpected outlet for the theory of groups. His one regret is that he did not (as he confesses he ought to have done) invent the whole thing for himself.

Sir Oliver Lodge, like Lorentz, comes to the brink, but he will not take the plunge. The most interesting parts of this book are those in which he explains the lengths to which he is prepared to go in the effort to retain a mechanical basis for phenomena. He admits, indeed, that ordinary matter is an imposture, but he clings resolutely to something very real and very substantial in the background. He reproduces his recent arguments to show that if the inertia of the atoms of ordinary matter is merely the manifestation of that of a surrounding medium, the density which it is necessary to attribute to the latter is something like 10^{12} that of water. This seems at first sight like a nightmare, but it is in no sense incredible. Waiving details which can have no great influence on the result, it is, indeed, from the author's point of view, mathematically incontestable. He goes on to speculate on the origin of the forces which this medium can exert. Assuming a kinetic theory of force as the only one ultimately acceptable, he sums up his conclusions in a sort of anthem:—

"Every cubic millimetre of the universal ether of space must possess the equivalent of a thousand tons, and every part of it must be squirming internally with the velocity of light."

It will be seen that the book is in substance a restatement of the author's most recent speculations, in which, of course, he stands by no means alone. If it somehow fails to do full justice to these, and if in some respects the original papers in the *Philosophical Magazine* and elsewhere will probably be found by many to be really easier reading, the auspices under which it is brought out are no doubt partly accountable. The general reader, even if he is disposed to take most things on trust, and does not adopt the critical attitude which the author would himself welcome, will at all events learn to understand the admiration which the scientific world feels for the genius and unflagging spirit with which a most difficult as well as stupendous theme is repeatedly essayed.

H. L.

NEW METHODS OF WEATHER FORECASTING.

Nouvelle Méthode de Prévision du Temps. By Gabriel Guilbert. Pp. xxxviii+343. (Paris: Gauthier-Villars, 1909.)

MONSIEUR GABRIEL GUILBERT, the winner of the prize offered in 1905 by the Société belge d'Astronomie, de Météorologie et de Physique du Globe, for the most successful short-period forecasts of weather, has published in book-form a detailed exposition of the principles underlying his method. He introduces two new principles into the art of weather forecasting, which, so far as we are aware, have not been stated explicitly by any other writer on this subject. First, he invites us to compare the force of the wind at the surface as observed at the various stations contributing to our daily weather reports with the barometric gradient at sea-level. If in any region the observed wind forces are markedly in excess of the normal for the prevailing gradient, a surge of high pressure in the direction of the gradient may be looked for, and *vice versa*. His definition of the word "normal" is entirely conventional. It is based on comparisons made by Clement Ley, Sprung, Köppen, and others, and is that the number expressing the wind force on the Beaufort scale shall be twice that expressing the gradient in millimetres of mercury per degree (111 km.). It follows from this general principle that a depression which is surrounded on all sides by winds in excess of the normal will fill up, whereas a depression surrounded by winds in defect will grow deeper. If the defect is great, a depression of small intensity will develop into a violent storm

centre. A depression round which the distribution of wind force as compared with the prevailing gradient is unsymmetrical will move towards the region of "least resistance," *i.e.* the region where the winds are most conspicuously in defect. In identifying the region of least resistance the second principle is also used. It is based on the conception of "divergent" winds. Any wind which has a component directed away from a centre of low pressure is divergent for that centre, and as such marks a region of low resistance to its advance. Generally speaking, the greater the "divergence" the less the "resistance." Strong northerly or north-westerly winds to the eastward of a depression are looked upon as an extreme case of divergence, and as a sure sign of a rapid advance of the depression.

M. Guilbert proceeds to elaborate no fewer than twenty-five rules for forecasting which for the most part follow more or less directly from the two fundamental principles. Their application is illustrated by a large number of examples, taken mostly from cases when the forecasts issued by the Bureau at Paris proved incorrect.

So far as M. Guilbert is concerned, both principles must be looked upon as a direct result of the careful scrutiny of weather maps; they are entirely empirical, and no attempt is made to justify them from general dynamical considerations. Since the book has been in our hands, we have watched the charts published in the Daily Weather Report, and have noticed occasions on which the application of the first principle would apparently have been useful. On other occasions we have found difficulty in applying the rule. On many maps there are, within one and the same meteorological region, winds which are, some in excess, others in defect, of the normal. M. Guilbert gives no instructions as to how to proceed in such cases.

The principle of the "divergent" wind is not likely to be accepted without qualification in the form in which it is put forward. M. Guilbert insists very strongly that a single conspicuously divergent surface wind (observations on mountains or at high levels are expressly ruled out as not being comparable with the surface gradient) must be regarded as an almost infallible indication of the early advance of a depression. Objections based on the argument that surface winds are very liable to be influenced by local conditions are brushed aside. Among the examples quoted in the book there are many instances of surprisingly daring and successful predictions, some apparently *ex post facto*, others attested by stamped postcards as being genuine forecasts made before the event. We are, however, entitled to ask whether the rules might not lead to equally daring but unsuccessful forecasts? Nearly 100 examples are quoted; the number is large, but so is the number of charts from which the selection is made, and it is to be supposed that M. Guilbert, whose style often suggests counsel's address to the jury rather than the judge's summing up, has picked out the cases which best illustrate his points. No doubt he could produce many more instances if called upon to do so, but the multiplication of selected examples does not carry conviction. Before passing judgment we must hear counsel for the other side, who may be able to bring forward a similar number of cases at variance with the principles advanced. M. Guilbert has run up against the old difficulty of expressing his hypothesis in such a manner that it can be tested by an appeal to measurement. The relation between the observed wind velocity and the gradient should lend itself to numerical treatment, seeing that both quantities are the object of regular observation and measurement.

The book is accompanied by a preface by Prof. Bernard Brunhes, the director of the observatory on the Puy de Dôme, who acted as reporter on the occasion of the competition at Liége. In a supplement M. Brunhes points out that M. Guilbert's rules are consistent with the results deduced by Lord Kelvin and Bjerknes for the action of a steady current on a vortex, and describes some laboratory experiments of his own illustrating the phenomena.

MEDICAL EMBRYOLOGY.

Text-book of Embryology. By Dr. Frederick R. Bailey and Adam M. Miller. Pp. xvi+672. (London: J. and A. Churchill, 1909.) Price 21*s.* net.

THIS bulky volume is the third American text-book of embryology that has appeared in recent years. Like Prof. Heisler's work, of which a revised edition was published two years ago, it is addressed primarily to students of medicine and anatomy, being, in fact, based upon the course in embryology given at the medical school of Columbia University. Consequently it differs in its style of treatment from Prof. Lillie's "Development of the Chick," which is apparently intended for zoological students beginning embryology; and whereas Prof. Lillie confines his attention almost exclusively to a single type, and never passes outside the class Aves, the authors of the present volume, although dealing more particularly with human development, have aimed at treating the subject from a comparative standpoint, believing this to be the most efficient way of teaching it. With this opinion most teachers of biology must surely concur. It is satisfactory to note also that the physiology of the developmental processes is not entirely passed over. Thus, in an excellent chapter on the nervous system contributed to this volume by Dr. Oliver S. Strong, the author has been able to include much physiological matter which usually finds no place in a text-book of embryology.

In the second chapter a section is devoted to ovulation and menstruation and the relation which subsists between these processes, but it is to be regretted that the comparative method which is so successfully followed in other parts of the work is not extended to the problems dealt with here. That menstruation in the Primates is the physiological homologue of the proœstrum in the lower Mammalia, and that in the latter ovulation occurs normally during œstrus, are now generally accepted facts, the recognition of which has removed many apparent difficulties which used to perplex the older writers.

Messrs. Bailey and Miller quote Leopold's observations, but they omit to mention that the later investigations of Heape, Sobotta, and others have thrown a new light on the subject. In this connection reference may be made also to the recently published memoir by Bryce and Teacher, whose conclusions in regard to the usual time for ovulation in man are in general agreement with those arrived at by investigators of the sexual processes in the lower Mammalia.

The authors state that the discharged follicle "becomes organised by ingrowth of vessels from the theca to form the corpus hæmorrhagicum" (p. 32). The latter name is more correctly applied to the follicle when it contains a blood-clot, as happens frequently (but by no means invariably) after ovulation, and the term is used in this sense on a later page (p. 413). The cells of the membrana granulosa do not actively proliferate before becoming luteal cells, as stated here (pp. 32 and 413), but undergo a process of simple hypertrophy. Cell-division in this layer is extremely rare after ovulation has taken place.

The authors lay due stress on the fact that the ovaries are ductless glands, not only physiologically and anatomically, but also developmentally. On a later page (p. 437) they make the statement that congenital absence of the ovaries may occur without defects in the other generative organs. We do not know on what authority this observation is cited, and in view of the fact that the uterus undergoes atrophy after ovariotomy (or remains infantile if the operation is performed in early life), the statement seems on the face of it unlikely.

The question as to the determination of sex is discussed at some length, and the recent observations of Wilson, McClung, Morgan, and Correns are referred to. Some of the older experiments on feeding caterpillars, tadpoles, &c., are also described, but the authors do not mention that the evidence derived from these has been to a large extent invalidated by the recent work of Cuénot, Kellogg, and others.

The book is divided into two parts, the first dealing with general development, including the development of the external form of the body, while the second is devoted to organogenesis. The sections at the ends of the chapters, treating of the origin of malformations and developmental anomalies, are a special feature. Moreover, there is a final chapter on teratogenesis, in which the views of Beard, Mall, and others are duly referred to. Suggestions for practical work, with descriptions of the necessary technique, are also included.

There are a few minor errors. For example, on p. 115, "Fig. 107" is a misprint for "Fig. 108," and on p. 416 "Girou" is wrongly written "Giron."

Among the more noteworthy omissions are absence of reference to the "phylogenetic law" (commonly but erroneously called the law of von Baer), excepting for a passing mention on p. 387, Miss Lane Claypon's work on the origin of ova from ovarian interstitial cells during adult life, Herring's researches on the development of the pituitary, and Gaskell's work on "The Origin of Vertebrates," which, with all its wealth of detail and illustration, morphologists cannot afford to ignore. However, much valuable and important matter is included, and the volume as a whole forms a useful addition to the literature of medical embryology.

FRANCIS H. A. MARSHALL.

FUNDAMENTAL PROBLEMS OF PSYCHIATRY.

Modern Problems in Psychiatry. By Prof. E. Lugaro. Translated by Dr. David Orr and Dr. E. G. Rows. Pp. vii+305. (Manchester: University Press, 1909.) Price 7*s.* 6*d.* net.

THIS translation will be welcomed by those who are interested in the study of mental disease, but have been unable to read the original Italian work. The book is intended to pass in review the chief fundamental problems which present themselves to the student of psychiatry. As the author states in his preface, the latter must be a man of extensive knowledge, since his study carries him into the most difficult branches of anatomy, physiology, pathology, psychology, sociology and even criminology. The author also hints that one object of his book is to justify the claim of psychiatry to a place among the sciences and by the side of general medicine, and to remove from the public mind the existing prejudice against the study of mental disorders. The work is, however, surely too learned a disquisition to engage the attention of an ordinary layman. We regret to find that the author himself draws a distinction between physicians and "alienists" (p. 71), as if so-called "alienists" were not physicians; yet we understand that even in Italy psychiatry is a well-recognised branch of medicine.

While admitting that it is still necessary at the present day to define clearly one's position in relation to metaphysical doctrines, we consider that Prof. Lugaro is too respectful to effete hypotheses of the nature of mind in devoting so much space to dismissing them. His final attitude is that he accepts the external world as an existing reality independent of our experience of it; while consciousness he regards as coinciding, perhaps identical, with experience; whether the experience be that of the philosopher, peasant, child or brute. This mode of regarding consciousness he designates "primitive realism."

The book as a whole strikes one as the work of a pathologist and anatomist with but limited clinical experience. The chapters on anatomical, physiological and allied problems should claim the attention of every asylum physician; those on pathogenesis and etiology are not so strong, but they repay perusal.

In the anatomical section the researches of Ramon y Cajal, Nissl, Brodmann and Vogt on the histology of the cortex are passed in review, but we note with regret that the excellent work of Campbell is not even mentioned. Similarly, in the physiological section we regard it as an important omission that no reference is made to Sherrington's researches.

Prof. Lugaro is a believer in the utility of hypotheses. "If a hypothesis starts from assured facts and involves no errors of reasoning, it has as much value as the observation from which it takes origin," and "even the observations on which it is based

acquire greater force." Accordingly we are here and there treated to a useful hypothesis. For example, the fact that the first collaterals from the axon of a cortical projection neuron are directed back to the cortex means for Lugaro that neighbouring neurons are stimulated to participate in the action of the first neuron, and that the function of these particular collaterals is to diffuse stimuli.

The superficial layer of the cerebral cortex is regarded as associational in function, the middle layer as motor, and the deep layer as sensory. It appears that the very deepest layer of the cortex, the destruction of which gives rise to the remarkable syndrome known as dementia precox, is normally developed much more in man than in lower animals, even the highest apes. We note, by the way, that the author regards the neuroglia as an anti-toxic substance, since it reacts more than the true nervous tissue to toxic substances.

The author very properly decries, on the one hand, the superficial methods of examination of insane patients as practised in most asylums and, on the other, the systematic examination by a hundred or more tests employed by certain enthusiastic plodders. The first is desultory and can never advance the science of psychiatry one whit, while the second is unpractical. Kraepelin's methods meet with the professor's approval.

On p. 64 Lugaro expresses the view that the manifestations of insanity at times defy comparison with normal processes, but here we would accuse him of failing to see below the surface; a normal instinct may be compared with its distorted self in disease, and any normal mental function may fitly be compared with its absence where such absence constitutes a positive symptom.

The author's views respecting heredity are rather heterodox. He starts with the premiss that the tendency of heredity is to improve the race, and appears to conclude therefrom that heredity is an over-estimated factor in the causation of insanity. He has some difficulty in rejecting the possibility of acquired characteristics being transmitted but, after a long discussion of the matter, appears finally forced to do so.

Private asylums receive some severe criticism. These institutions in Italy are apparently in a parlous state; but many in England come well beneath the ban, and this part of the book should not be read in a pharisaical mood.

The work should be on the shelf of every pathologist and asylum physician; it is thoughtful, suggestive and well written. The translation also is excellent, but there are a few infinitives that might with advantage be unsplit when the next edition appears, as it undoubtedly will.

THE AUTOBIOGRAPHY OF N. S. SHALER.

The Autobiography of Nathaniel Southgate Shaler, with a Supplementary Memoir by his Wife. Pp. x+482. (Boston and New York: Houghton Mifflin Company, 1909.) Price 16*s.* net.

THE keynote of this book is to be found in its final lines, written to Mrs. Shaler by Prof. G. H. Palmer:—

"How large your companionship with him was your words in this volume, and elsewhere, show. Happy woman to have been so blest, and happy we who were allowed to know you both!"

The book is the outcome of a personal relationship, which pervades it, but which does not obtrude upon the reader. We are spared the emotional and sometimes spiteful passages which are supposed in so many biographies to add vitality to the story of a married life. We gather instead a sense of peace, such as comes from long-continued good work, jointly and perseveringly performed. But we do not get to know Shaler through these pages as generations of Harvard students knew him. Prof. W. H. Hobbs, indeed, wrote two years ago:—

"It would be necessary to secure a composite of the memory picture of literally thousands of students in order adequately to present the characteristics of this truly remarkable man to one who had never known him."

It was the man himself, a fighter from his youth, vigorous, virile, yet painstaking in a high degree, that established his claim on others, rather than the work he did. Hence his autobiography, which ends in 1861, and the modestly entitled "supplementary memoir," which covers the remaining forty-five years of his life, will be read with most pleasure by those to whom passage after passage will recall some familiar trait, some habit, perhaps some manner of speech, impossible to set down in print.

As an account of a life spent in transition times, when the easy-going, slave-tended society of the south was about to organise itself for a strife of heroes, the autobiography leaves us somewhat cold. We have useful glimpses, however, of Louis Agassiz, then dominating the natural science course at Harvard, and the anecdotes of his methods as a curator and an examiner (pp. 93–104, and 189–92) will please those called to similar duties. Young Shaler, studying fishes under his care, was left to describe what he could observe for himself, and was merely told when he was wrong; whereupon he would begin again, and so on, until his master found that the results tallied with his own. The impression made by Agassiz in denouncing the Darwin-Wallace school is well shown by the story of his pupil Stimpson (p. 129), who, when convinced that he had found intermediate links among molluscan species, ground "one of these vexatious shapes" to powder with his heel, remarking, "That's the proper way to serve a damned transitional form."

Shaler, of course, soon accepted the new views. He studied zoology practically, by dredging, fishing, and shooting, though he much disliked killing animals; and he was thus engaged, in his twentieth year, when the men of his native State, Kentucky, had to decide for or against the Union. The movement in the south was regarded as desultory; even if it continued, it was not going to reach Kentucky for some years; and Shaler set off with Hyatt in 1861 for a sail of several months about the mouth of the St. Lawrence. This peaceful campaign, with its scientific aims, involving a rough-and-tumble life on a small boat, prepared him for many a future struggle.

Shaler returned from it to find even neutral Kentucky divided within itself; and soon, though the chief actor tells us nothing of it, "Shaler's battery" became known upon the Union side.

Shaler married in 1862; but his wife refers us to his various writings on the war, and quotes very little from letters written to her from the field. The advance of Rosecrans on Nashville left Kentucky outside the crash of armies, and no echo reaches us of the bitter days round Chattanooga. It is of far more importance to Mrs. Shaler to record—and this was probably the feeling of all who knew her husband—that in 1864 Shaler was appointed assistant in palæontology in Harvard University. In 1869 he became professor of this subject, when only twenty-eight; then he was made professor of geology; and in 1891 he was chosen as Dean of the Lawrence Scientific School. Even his position from 1874 to 1880 as Director of the Geological Survey of Kentucky did not break his connection with the development of Harvard. For more than forty years, down to his death in 1906, he was one of the most familiar figures in the courts of the university.

Chapter xix., which deals with a visit to England, contains characteristic mention of Tyndall, and of several English geologists. Here, as in other places, some proper names have gone astray. The Rev. Mr. Simons of p. 256—have we not made the same rural journey to enjoy a meeting at his gate?—must surely be the late W. S. Symonds, the friend of all naturalists in the Midlands. Elsewhere we have "Renivier," "Guinitz," "Geoffrys" for Jeffreys, and "Marais," as we may presume, for "Marey." These slips result from copying out of diaries, where the incidents of the day have been set down. The incidents thus recorded, page after page, seem rarely of value in themselves; yet it is clear that we may end this notice much as we began. To those for whom the book is written, those whom Shaler had helped or stood by as a friend, nothing about Shaler will seem unworthy to be expressed. GRENVILLE A. J. COLE.

MATHEMATICAL TEXT-BOOKS.

(1) *Geometry for Beginners.* By C. Godfrey and A. W. Siddons. Pp. x+79. (Cambridge: University Press, 1909.) Price 1*s.*

(2) *The School Geometry.* Parts i. and ii. By W. P. Workman and A. G. Cracknell. Part i., pp. viii+248. Part ii., pp. viii+(233–383). (Cambridge: University Tutorial Press, Ltd., 1909.) Price 2*s.* each part.

(3) *Coordinate Geometry.* By H. B. Fine and H. D. Thompson. Pp. viii+300. (London: Macmillan and Co., Ltd., 1909.) Price 6*s.* 6*d.* net.

(4) *Exercise Papers in Elementary Algebra.* By the Rev. E. M. Radford. Pp. viii+112. (London: J. M. Dent and Co., 1909.)

(5) *Problem Papers in Mathematics.* By R. C. Fawdry. Pp. vii+240. (London: Macmillan and Co., Ltd., 1909.) Price 4*s.* 6*d.*

(1) IN the light of the experience gained in the last eight years or more, it is now possible to estimate, with considerable accuracy, the effect of the numerous changes which have been made in the methods of teaching elementary geometry. The circular issued by the Board of Education last March contains a report on this subject which is well worth careful perusal. The central feature of the modern movement has been an attempt to familiarise the pupil with the fundamental concepts by experimental methods, before providing him with formal proofs. It is now suggested that this experimental stage, by being made more systematic, should *replace* the first part of the present deductive course. The properties of parallel lines and congruent triangles possess a characteristic which pertains to few, if any, of the later theorems. Once a pupil clearly apprehends their significance, which is possible only by experimental work, he is convinced with absolute assurance of their truth; and this very fact only serves to increase the difficulties which surround the formal proof. In the words of the circular,

"to commence the subject by proving what seems to need no proof is a safe way to make boys think that the whole subject is artificial and unreal. It is much better to begin Euclidean, that is, deductive proofs at the point where their necessity can be appreciated—that is after these fundamental propositions—and where, therefore, the proof is a natural process, not subject to arbitrary or artificial rules."

If then these base-theorems are incorporated in the experimental stage, and if at the end of this course those fundamental concepts, which have been thereby assimilated, are allowed to be assumed without formal proof, the course of deductive geometry will open with the properties of areas of triangles and parallelograms, and continue with theorems on the circle. In this way, at the end of his first year, a pupil will have covered as much ground as at present is covered, in the majority of cases, only after two or three years.

The present excellent little volume has been compiled to cover the complete experimental course outlined above, and it follows in every respect, save one, the suggestions made by the Board of Education. It is, however, advised in the circular that riders should be excluded entirely from the experimental stage; although in this way time may be saved and greater emphasis placed upon the fundamental theorems, yet simple riders so frequently serve to illustrate a theorem, and, moreover, form a valuable introduction to the future deductive course, that we are firmly convinced that the authors are right in inserting a large number of easy deductive examples in the text. We have developed these considerations at some length, because we consider that the change now advocated is likely to exert a profound influence on the teaching of geometry, and that the more it is considered in all its bearings, the more advantageous it will appear.

(2) This is an abridged edition of the authors' work, entitled "Geometry: Theoretical and Practical," published about two years ago. In the present book a certain amount of theory which may be fairly considered to be beyond the range of the average schoolboy has been omitted. The sequence adopted in the theoretical course is that of the Cambridge syllabus. Part i. contains the substance of Euclid books i., iii.; part ii. that of books ii., iv., vi., together with those

modern extensions, such as harmonic ranges and coaxal circles, which now form a customary part of the school course.

(3) In this treatise the elements of coordinate geometry are presented in a compact form. The first twelve chapters are devoted to the treatment of the line, circle, conic, and other curves, while the remaining six deal with the line in space and the surfaces of the second degree. The experience of the authors has led them to introduce a number of changes in the order of development of the subject. The equation of the straight line is given, before the customary work on lengths and areas; they advise the student to read the chapter on the parabola before that on the circle, thereby enabling him to see at an early stage how analytical methods may be used to obtain properties which are new to him. All mention of pole and polar properties is deferred until after the treatment of the general conic, and the application of Cartesian methods to the investigation of loci is postponed to the final chapter of the first part of the book.

The section on solid geometry, while omitting the more complicated analytical formulæ, is sufficiently thorough to enable the student to attack with success any problem on the geometry of the conicoid of a straightforward character. There are numerous exercises and diagrams. In every respect this book is admirably suited to meet the needs of those who are reading the subject for the first time.

(4) The range of work covered by Mr. Radford's useful book includes the binomial theorem and the exponential and logarithmic expansions. Quadratic equations and graphical solutions are introduced at the start, and logarithms appear at an early stage. There are also ten book-work papers.

(5) The papers set in recent examinations conducted by the Civil Service Commissioners have included a number of problems of a much more practical character than are to be found in the ordinary academic text-book. That this type of question is both stimulating and of real educational value is beyond question, but up to the present there has been no convenient collection of problems of this character. Mr. Fawdry's book now supplies exactly what is wanted. Primarily, it is intended for army candidates and students in technical colleges, but many of the papers contain practical questions of considerable intrinsic theoretical difficulty, and may therefore profitably be set to boys preparing for entrance college scholarships. A comprehensive set of revision papers adds materially to the utility of this first-rate book.

OUR BOOK SHELF.

Ant Communities and How they are Governed. A Study in Natural Civics. By Dr. H. C. McCook. Pp. xvii+321. (New York and London: Harper and Bros., 1909.) Price 7*s.* 6*d.* net.

FOR thirty-two years Dr. McCook has devoted much time and attention to the habits of American ants, and has published many popular works on the subject, in addition to the two large works on "The Agricultural Ants of Texas" and "The Honey Ants of the Garden of the Gods." In the present work, which is based chiefly on his own original observations, he discusses the conditions of ant-life from a popular standpoint; and his sixteen chapters deal with such subjects as fraternal confederacies, nesting architecture, engineering, feeding the commune, language, government, dependents, war, aliens, aphis herds, slave-making, sanitation, &c.

Britain is very deficient, both as regards number of species and number of individuals; but the American species are more numerous, and the size of nests and communities of many species is almost incredible. Thus Dr. McCook writes:—"The large conical nests of the mound-making ants of the Alleghanies, *Formica exsectoides* vary in size from newly-begun colonies a few inches high to mature hills, measuring thirty-seven feet in circumference at the base, though rarely more than three feet high. They occur in groups, and in one site near Hollidaysburg, Pennsylvania, within a space of fifty acres, the writer counted seventeen hundred well-developed mounds. At two other localities in these mountains, similar groups were observed even more thickly placed. At "Pine Hill," about thirty acres were occupied, of which five were found to contain two hundred and ninety-three mounds, an average of fifty-nine to the acre, or eighteen hundred for the whole section. At "Warrior's Mark," another large settlement of nearly two hundred hills was visited. Experiments made in the Hollidaysburg group proved that all therein formed substantially one community, in complete fellowship, although the individual mounds appeared to be conducted independently" (pp. 3–5).

Dr. Forel's comment on these observations is:—"These ant kingdoms have in all probability a population of two hundred to four hundred million inhabitants, all forming a single community, and living together in active and friendly intercourse" (quoted at p. 8).

Again, with reference to the cutting ants of Texas, we read:—"A planter, in order to get rid of the depredations of an immense commune near his residence, had set his men to dig it up and utterly root it out. In order to reach the central nest he had traced the ants from a tree inside his home premises, which they had stripped of leaves, to a point six hundred and sixty-nine feet distant. The nest occupied a space as large as a small cellar, the lowest and main cave being as large as a flour-barrel. In this central cavern were great numbers of winged males and females, and innumerable larvæ and workers. From this point radiated the various avenues over which the leaf-cutters marched on their raids" (p. 64).

We could quote equally interesting passages from almost every page of this fascinating volume; but before concluding, we may note that Dr. McCook attaches great importance to the sense of smell in ants.

The numerous text-illustrations are of unusual excellence.

Sextant Errors. By Thos. Y. Baker. Pp. 32. (London: J. Griffin and Co., 1909.) Price 1*s.* net.

MR. BAKER has supplied a very excellent shillingsworth for those who have occasion to use the sextant and wish to understand it properly. Every text-book gives the simple theory of the instrument, and the more ordinary adjustments and tests for errors are generally enough understood, but when the complete theory of an astronomical instrument, worked out on the supposition that no part is quite perfectly made, is required, then only such elaborate books as, for instance, Chauvenet may be turned to with confidence. It will be a great convenience to the sextant user to find in this little book complete demonstrations, free from the usual omission of steps, unnecessary for the writer of

the book, but sadly needed by the reader, of the important errors, with specially prepared tables to facilitate calculation.

The extreme importance of the collimation error and its surprising possible magnitude are pointed out, and a very neat way of ascertaining if the telescopic axis is perpendicular to the index mirror when the arm is suitably turned is described, but it is unfortunate that this is not available in all sextants as made.

One fault must be insisted on. The use of the signs ′ and ″ for feet and inches instead of the abbreviations ft. and in. is bad enough when used by engineers, but then it is rare that there is fear of confusion. The author, however, gratuitously causes confusion in a book which is bristling with the signs ′ and ″ in their proper meaning by using the symbol ″ for inches even in the same sentence with ″ in its proper meaning. It is to be hoped that this and one or two typographical errors will be corrected in a future edition. C. V. B.

The British Journal Photographic Almanac, 1910. Edited by George E. Brown. Pp. 1320. (London: Henry Greenwood and Co.) Price 1*s*.

THE present issue of this very useful volume is drawn up on the same lines as those of its immediate predecessor, and its contents are of the usual essence of photographic matter on all topics, which makes it such a valuable *aide mémoire* to the working photographer. Commencing with the usual calendar, which begins on p. 407, and not on p. 447 (as it is incorrectly indexed, by the way), there follows the useful directory of photographic societies and bodies. An interesting chapter on lens calculations by mental arithmetic, written by the editor, precedes the large section on the epitome of progress by the same authority. This latter portion is always one of the chief contributions to the volume. Then follows a description of the recent novelties in apparatus, which occupies nearly 100 pages. Formulæ for the principal photographic processes, the developing formulæ of the principal plate and paper makers, miscellaneous information, and the usual large number of valuable chemical, exposure, optical, and other tables, bring the volume to a conclusion.

Another feature of this publication, and one which is so often referred to by those who have the book in their possession, is the excellently indexed mass of advertisements in which the main text of the book is sandwiched.

The volume should find its usual place in every photographer's library.

Outlines of Bacteriology (*Technical and Agricultural*). By Dr. David Ellis. Pp. xii+262. (London: Longmans, Green and Co., 1909.) Price 7*s*. 6*d*. net.

THE general plan of this book is excellent, but we doubt if the various subjects are dealt with in sufficient detail to render the book of much practical utility to the student. To attempt to deal with disease-producing organisms and all the technical applications of bacteriology in 260 short pages is an impossible task if anything more than general principles is to be considered.

The contents of the book include the general morphology and biology of the bacteria, a subject to which the author has himself contributed, sterilisation, pathogenic bacteria, sulphur and iron bacteria, preservation of food products, nitrification, fermentation and ferments, and their industrial applications (*e.g.* beer, butter, cheese, tanning, tobacco, &c.), and sewage disposal.

Unfortunately, a number of errors disfigure the text. Thus on p. 109 a classification of proteids is given in which one class is termed "amyloids" and is stated to be insoluble in gastric juice, globulins are said to be soluble in dilute acids, and casein is given as an example of a derived albumin, and is said to be soluble in dilute acids. A number of mistakes also occur in the section dealing with pathogenic organisms. In the section on the preservation of food-stuffs by heat, while canning is mentioned, there is no reference to the sterilisation or the pasteurisation of milk. The names of plants yielding flax, hemp, jute, &c., are not correctly given, and on p. 245 a paragraph dealing with the *Bacillus enteritidis* of Gärtner is hopelessly wrong.

The book is clearly printed, and illustrated with a number of figures. Many of these are very diagrammatic and drawn to no scale, so that the reader sees the anthrax bacillus and influenza bacillus depicted about the same size, which is somewhat misleading. R. T. HEWLETT.

A Descriptive Catalogue of the Dobrée Collection of European Noctuae. Compiled by H. B. Browne. Hull Museum Publications, No. 63. Pp. xv+156. (Hull: A. Brown and Sons, Ltd., 1909.) Price 1*s*. net.

THE late Nicholas Frank Dobrée, of the New Walk, Beverley, who died in 1908, at the age of seventy-seven, formed a very valuable collection of Palæarctic Noctuæ between the years 1871 and 1888, which he subsequently presented to Hull Museum, on the understanding that a complete catalogue should be published. We presume that it will be preserved intact, for we are convinced that special collections of all kinds, whether literary or scientific, are of far greater permanent value whenever it is possible to preserve them thus, than when they are (sometimes unavoidably) dispersed, or even broken up to be incorporated with larger collections. The collection includes longer or shorter series of 654 species, more than 300 named varieties and aberrations, and 720 specimens of preserved larvæ. These are contained in forty-two cabinet drawers, and Mr. Browne has carefully noted the origin of every specimen according to Mr. Dobrée's note-books, and added short descriptions of a large number of aberrant specimens, named or otherwise. The work is of much importance to all students of the interesting group of moths of which it treats.

The Human Race: its Past, Present, and Probable Future. An essay by J. Samuelson. Pp. xii+192. (London: Swan Sonnenschein and Co., Ltd., 1910.) Price 3*s*. 6*d*. net.

IN part of this small volume is summarised the whole history of the human race—man's origin and material progress, the history of his vices and virtues, and of his mental, social, and political development. That such a summary must be very superficial is only to be expected, and the author claims very little for it, but hopes "that it will at least stimulate inquiry and serious study on the part of youths about entering life." Its chief fault appears to us to be that there is no clear distinction drawn between changes in man himself and changes in his surroundings. Thus, for example, under the heading "Man's Mental Progress" are catalogued a number of discoveries and inventions, such as the spectroscope and telephone, which are not evidence of mental progress at all if one takes the term to mean improvement of mental powers. It is also to be regretted that, although the author appears to be a believer in evolution, no mention is made of heredity as a factor possibly affecting the history of mankind. E. H. J. S.

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.*]

The Heat developed during the Absorption of Electricity by Metals.

IN 1901 (O. W. Richardson, Camb. Phil. Proc., vol. xi., p. 286) one of the present writers showed that the phenomena attending the emission of negative electricity by hot metals could be explained on the assumption that the electrons which, on the electron theory of metallic conduction, move freely inside the metal attain sufficient kinetic energy at high temperatures to enable them to overcome the forces tending to keep them inside the surface and so escape. From the way in which the thermionic current varied with the temperature of the metal it was shown that the difference in the value of the potential energy of an electron when outside and when inside a metal could be calculated. Somewhat later (O. W. Richardson, Phil. Trans., A, vol. cci., p. 497) it was shown that the existence of this difference in the potential energies would involve a loss of thermal energy by the substance when the electrons were being given off, and it was pointed out that this effect would increase very rapidly with the temperature, so that at sufficiently high temperatures the loss of energy due to this cause would be greater than that arising from thermal radiation. An effect of this character has recently been discovered by Wehnelt and Jentzsch (*Ann. der Physik*, iv., vol. xxviii., p. 537).

Another consequence of the existence of this difference of potential energy is that when electrons possessing negligible kinetic energy pass into a metal an amount of heat should be liberated which is equal in magnitude to the difference in the potential energy for each electron multiplied by the number of electrons entering the metal. Experiments which have been carried out by the writers show that this effect exists, and is of the expected order of magnitude.

The method adopted was to cause the electrons emitted by two hot osmium filaments to flow on to a grid of fine platinum wire, which acted as a bolometer, and was placed in one arm of a double Wheatstone's bridge. The double bridge arrangement enabled the galvanometer to be balanced for the thermionic current into the bolometer in each experiment. The change in the resistance of the bolometer per unit thermionic current was measured when different voltages were maintained between it and the negative ends of the filaments.

In order to standardise the bolometer a known variation of current through it was produced, and the resulting change of resistance due to heating measured. By making use of this datum the energy received by the bolometer per unit thermionic current can be expressed in terms of the fall of potential which the electrons would have to undergo in order to produce the observed effect. The value thus obtained may be denoted by the "effect in volts."

When the effect in volts E is plotted as ordinate against the negative potential of the negative end of the filaments V as abscissa, the relation between them appears to be a linear one. The line, however, which is obtained does not intersect the axis of ordinates at E=0, but in the neighbourhood of E=3 volts, showing that when the electrons fall through no difference of potential due to the field they are still able to produce a heating effect equivalent to that due to the energy they would have received in falling through a difference of potential of about 3 volts. Inasmuch as Richardson and Brown (*Phil. Mag.* [6], vol. xvi., p. 353) have shown that the natural kinetic energy with which the thermions are emitted corresponds to only about 1/30 volt, the conclusion is inevitable that there is a liberation of potential energy when the electrons enter the metal comparable with that which would be acquired by falling through a difference of potential of about 3 volts.

Experiments have, so far, been made with applied potentials varying from +2 to −9 volts, the potential drop along the filaments due to the heating current varying from 3 to 3·7 volts. Changes are now being made in the experimental arrangements which, it is believed, will lead to greater accuracy of measurement. It seems likely that, owing to certain defects in the present apparatus, the values which have so far been obtained are somewhat too low.

O. W. RICHARDSON.
H. L. COOKE.

Palmer Physical Laboratory, Princeton University,
Princeton, N.J., December 21, 1909.

Malaria and Ancient Greece.

IN his scholarly "Malaria and Ancient Greece," reviewed in NATURE of December 16, 1909, p. 192, Mr. Jones has apparently overlooked what seems to be, though modified for dramatic purposes, a description of an acute attack of ague, *i.e.* that given by Sophocles of the sufferings of Philoctetes in his play known by that name. Here, just as he is about to accompany Neoptolemus to the ships, Philoctetes is seized with a sudden attack (line 730). He recognises the prodromal symptoms of what he describes to Neoptolemus as a recurrent attack of his malady (ἥκει γὰρ αὕτη διὰ χρόνου, line 758). The attack appears to be ushered in with pain or discomfort (line 730) and shivering (735). The symptoms become increasingly acute (καί τι προσδοκῶ νέον, 784) until they become almost unendurable (790). Soon, however, from previous experience, Philoctetes can foretell that the worst is over (808), and that the attack will pass away during the sleep which always supervenes. λαμβάνει γὰρ οὖν ὕπνος μ', ὅταν περ τὸ κακὸν ἐξίῃ τόδε, 766.

Later on, as he is falling asleep, Neoptolemus directs the attention of the Chorus to the profuse perspiration which bathes his body (823). The periodicity, suddenness, and ingravescence of the symptoms, the sleep and sweating followed by a passing feebleness on waking (880), present a clinical picture the vividness and truth of which are not surpassed in any literature. The congeries of symptoms in this description must be based upon actual experience of disease. It will, of course, be urged that Sophocles makes all the symptoms dependent upon the uncured wound in the heel caused by the snake-bite at the shrine of Chryse. Here there need be, however, no difficulty in the acceptance of the ague theory, for this would be in full accord with the accepted pathology of the period. The Greek physicians were probably well acquainted with the characteristic results of non-fatal snake-bite—the pain, sloughing with foul discharge, and delayed healing.

Without attempting to labour the point further, from a strictly clinical point of view the imposition of a malarial infection upon a chronic condition such as that described would, without doubt, give rise to periodic exacerbations of the inflammatory conditions. This is probably the explanation of the statement of Hippocrates quoted by Arndt (*cp.* Jebb, *Philoctetes*, p. 241) that the "ulcers become especially inflamed on these alternate days."

The *Philoctetes* was performed in 409 B.C., just when, according to Mr. Jones's theory, malaria was becoming widely disseminated through Greece, and nothing would be more natural than that Sophocles, in his wish to draw the sympathies of his audience to his long-suffering hero, should represent him as wracked with all the horrors of the new and strange disease, which appeared to lend themselves peculiarly to his purpose. There can scarcely be a sight more pitiable than that of a person in an acute paroxysm of malaria.

It is much to be regretted that the loss of their respective plays prevents a comparison with the manner in which Æschylus and Euripides treated the subject. That Sophocles had a keen clinical grasp of the salient features of disease is noticeable in his description of the Acute Delusional Insanity of Ajax—a description of a form of mental aberration which is extraordinarily true to nature, and one which from a clinical standpoint far surpasses the delineations of madness by Shakespeare, as might indeed be expected from a consideration of the relative positions of medicine as a science at the times of the respective poets.

GEORGE A. AUDEN.

Birmingham.

An Example of Spurious Correlation.

IF I am not mistaken, the first method of forecasting the summer season proposed by Mr. A. B. MacDowall in NATURE of September 16, 1909 (vol. lxxxi., p. 335), is based upon a spurious correlation. If we take a series of departures from normal of a meteorological element and tabulate the sums of consecutive groups of thirty, there will always be a relationship between these sums, although the original departures may be entirely independent, and hence the relationship between the sums cannot be utilised for forecasting an individual term of the original series. That such sums of independent departures are not independent may be seen in the following way. If we denote the original independent departures by d_1, d_2, . . ., and the sum of thirty quantities beginning with d_p by s_p, the correlation coefficient between such quantities as s_p and s_{p+1}, as given by statistical methods, will be the mean value of a long series of products $s_p\ s_{p+1}$ divided by the product of the square roots of the mean values of s^2_p and of s^2_{p+1}. Now as d_p, d_q are independent the mean value of the product $d_p\ d_q$ will be zero; and it is easily seen that the correlation coefficient in question is the mean value of $(d^2_{p+1}+d^2_{p+2}+\ +d^2_{p+29})$ divided by the product of the square roots of the mean values of $(d^2_{p+}\ .\ .\ .\ +d^2_{p+29})$ and of $(d^2_{p+1}+\ +d^2_{p+30})$; if we denote the mean value of d^2_q by m^2, this becomes $29m^2/30m^2$, or 29/30. Thus the thirty-year sums of independent annual departures will tend to vary closely together, and the dots in a diagram like that of p. 335 would tend to lie on a straight line.

The relationship actually found by Mr. MacDowall between the sums does not appear, therefore, to afford a satisfactory basis for a forecast. GILBERT T. WALKER.

India Meteorological Department, Simla,
December 16, 1909.

On Fluorescence Absorption.

IT is desirable to direct attention to Prof. R. W. Wood's most important paper in the *Philosophical Magazine* for December, 1908, on a method of showing fluorescent absorption directly if it exists; but it seems certain that he has, at the end, drawn a conclusion from his experiments the very opposite, as I venture to think, to that to which they really lead. He compares the light apparently transmitted by a fluorescent body when fluorescence is, and is not, taking place, and finds that there is no difference in the resultant effect. This, I think, is as it should be; but the inference he draws is that there is no difference in the absorption. For my part I must admit that it only confirms my results published in the Philosophical Transactions, vol. cxci., A, 1898, that there is such an absorption; for if there were none such the light *apparently* transmitted would be less when the body is not fluorescing, owing to the fact that the fluorescent light would increase the *apparent* transmission, and a flickering should ensue; but Wood's experiment demonstrates that this is not so. The inference I should draw, then, is that during fluorescence there is an increased absorption of the light transmitted.

Prof. Wood appears to assume, moreover, that the resultant effect on the retina of two successive flashes is equal to the sum of the two acting simultaneously, which is not the case, since the successive flashes act merely as an intermittent single flash would do.

Nichols and Merritt, who have fully confirmed my results spectroscopically, have shown that the absorption effect diminishes as the intensity of the transmitted light increases, so that when the intensity of the transmitted light is large in comparison with that of the fluorescent light there is no effect at all, owing to the fact that this transmitted light itself is sufficiently intense to excite fluorescence, and there is therefore no change of state in the two cases.

If uranium glass is used for the absorption—it was with uranium glass that I observed the effect—the source of the transmitted light should also be uranium glass. I may add that the best results were obtained by using the light from the spark between cadmium electrodes for exciting fluorescence. With a suitable Leyden jar in the circuit, the illumination is sufficiently steady, and any errors in this respect can be detected by the null method I have described. J. BUTLER BURKE.

December 18, 1909.

Adsorption.

"THE above effects, however, become of consequence in those frequent cases in which a muddy liquid is only partially filtered through a dry filter in order that some analytical estimation may be made in a given volume of the filtrate. *The first drops of the filtrate must therefore be discarded.*" The above quotation is from Ostwald's "Foundations of Analytical Chemistry" (English translation), the italics being in the text. Ostwald makes this a purely theoretical deduction, but the practice of discarding first drops does not, I think, originate with him. Doubtless many analysts neglect the precaution, but many use it.

Some experimental work on adsorption which I am at present carrying on seems to point to the practice being quite uncalled for in at least the majority of cases. I am not yet ready to speak definitely, but it seems to be as unnecessary as it would be to reduce weighings to a vacuum standard in everyday analytical work. Ostwald's extreme positiveness, however, makes me wonder whether I have overlooked some serious fault in my experimental methods, and I should be much indebted to anyone who would point out to me any references in the literature which give an *experimental* justification of the practice. The absence of any library facilities in this place makes a systematic search of the literature impossible to me.

ALFRED TINGLE.

Imperial Chinese Pei Yang Mint, Tientsin,
December 8, 1909.

The Terminal Velocity of Fall of Small Spheres in Air.

AT the Winnipeg meeting of the British Association Prof. Zeleny and Mr. McKeehan read a paper on the terminal velocities which they had found when Lycopodium and other small spores fall through air. The measured terminal velocities were only about half those calculated by Stokes's formula. The fall was steady, no Brownian motion or rotation being visible. The authors of the paper have since succeeded (see NATURE, December 9, 1909, p. 158) in making minute spheres of wax and mercury which do obey the theoretical law, but add that the reason for the deviations in the former cases is not clear.

May not the reason for these deviations be the roughness of the spore? The drops, through surface tension, are smooth and practically perfect spheres, whereas a spore of Lycopodium is very rough relative to its size. (Using a microscope objective with large aperture, and oblique illumination, Lycopodium spores of about 14 μ radius were seen to be coated with hair-like projections.) The spore would, from its roughness, leave a tail of small eddies behind it. The increased energy of this turbulence represents the increased resistance which the spore experiences on account of its roughness, as compared with that experienced by the smooth drop considered in the theoretical law, much as the speed of a ship is lessened when its bottom is foul.

As a suggested experimental test, an increase in the pressure of the air will not affect the viscosity, but will alter the energy in this tail of small eddies. So also would a moderate decrease in the pressure, while yet it would probably not bring the relative size of the spore and of the gaseous molecular free path too close for the theory to be applicable. Should this be the case, however, it would be shown by the appearance of Brownian motion. EDITH A. STONEY.

Positions of Birds' Nests in Hedges.

LIEUT.-COLONEL TULL WALSH'S observations as to the positions of nests (NATURE, December 16) are interesting, as they tally with the aspect of arboreal cryptogams, as already noted by me. South-west winds depositing sulphurous and nitrous products to leeward of towns cause lichens and mosses to flourish best on the eastern side of trees and hedges; and, moreover, this is general, for winds bearing spores from the south-west continually play on the trunks and blow away spores as they settle. If it were not for a kind of capillary attraction or rotary motion drawing the spores round the trunk to leeward, or east or north-east, they would never germinate. So the eastern side is the most productive, though often the western

aspect may exhibit a greater abundance of species, though less well developed, from the continuous play of spores—and rain—upon the trunk.

Of north and south positions the same may be said, *i.e.* the south is sheltered from fierce, cold north winds, yet open to warm, rain-depositing winds. Again, once established, cryptogams flourish on the southern aspect best owing to its sunny character. North winds blow when spores are not so abundant, and the same applies to boisterous east winds, though these are short-lived.

Apart from wind dispersal of spores, vegetative reproduction tends to favour the same situations, south or east, for south-west winds bring moisture, and, when not laden with poisonous substances, are beneficial; but long-continued wind tends to drive plants to the east side, and absence of sun from north to south.

The causes inducing birds to nest preferably on the eastern and southern sides of hedges (and trees, to some extent) are much the same, *i.e.* protection from wind and the greater safety of a leeward position and amount of sunlight; but in their case, also, there is light dispersal. There is a shadow on the leeward side of hedges for a great part of the day after the early dawn, and this enables birds safely to go in and out without being observed.

The western side presents fewer convenient nesting sites, the branches of hedges being generally bent over from west to east, as seen best on the west coast, affording a better arbour on the east. The south and east face early dawn longest, and this is the favourite season of the birds. At any rate, their song is richest between 4 and 8 a.m. The north and west are open to bright sun but during the *colder* part of the day.

As to the actual distribution of nests, the same positions noticed by Lieut.-Colonel Tull Walsh are favoured by birds in Leicestershire, Shropshire, Surrey, amongst other counties, and seem to be more or less general. The need for studying cryptogamic distribution in relation to wind in connection with the extinction of plants led me to formulate the conclusions noted. It is interesting to observe that they are directly analogous to the position of birds' nests in hedges. Hence the parallel drawn.

A. R. HORWOOD.

Leicester Corporation Museum, December 22.

Studies in Polychæt Larvæ.

MAY I make use of your columns to correct an error in my "Studies in Polychæt Larvæ" in a recent number of the *Q.J.M.S.*? The specimen there described as a young Odontosyllis sp. I have since found to be in reality a fully grown Exogone. I have been unable to identify it with any known species, but as dorsal natatory setæ are quite well known in specimens of Exogone of this size, the conclusions drawn from this specimen are of no value.

With regard to the last section of the same paper, it has lately come to my notice that de Saint-Joseph has shown Claparède and Mecznicow's so-called Spionid larva, in which there are no provisional setæ, to be the larva of the aberrant worm Saccocirrus, and not of one of the Spionidæ. There is, then, no known exception to the rule that free-swimming Spionid larvæ bear provisional setæ.

F. H. GRAVELY.

5 Silver Street, Wellingborough, December 27, 1909.

Cross-fertilisation of Sweet-peas.

I HAVE recently seen two further reiterations of the statement that the sweet-pea is invariably self-fertilised, a statement which I think is often based on an opinion of Charles Darwin's. It may therefore be worth while placing on record an observation made by me in 1907, when examining daily and closely a large quantity of sweet-peas. While *Apis mellifica* failed entirely to open the flower, it was done perpetually by *Megachile willughbiella*, and there was not the least doubt about the cross-fertilisation being effectively brought about by this bee. The point has probably been noted before, but it is worth recording once more in view of the repetition of statements as to the self-fertilisation of sweet-peas.

π.

A Supposed New Mineral.

WHEN we wrote recently (NATURE, October 28, 1909) about a supposed new mineral from Co. Antrim, we were led to believe that the specimen we had received was from the basalt—our information, in fact, was that "a very big pocket of it" had been found in that rock, but the exact locality could not be ascertained at that time, the finder having left home.

We now hear that this gentleman cannot remember where he got the specimen. It certainly cannot be traced to the basalt, and as its composition is unlike that of any known mineral, it seems highly probable that the substance is an artificial product.

RICHARD J. MOSS.
HENRY J. SEYMOUR.

Laboratory, Royal Dublin Society,
December 23, 1909.

THE HEART OF ANTARCTICA.[1]

IMMEDIATELY after the arrival of the British Antarctic Expedition of 1907–9 in New Zealand the attempt was made in NATURE (April 1, 1909, vol. lxxx., p. 130) to estimate its scientific results from the information received by cable. The full details now supplied show that the estimate then made in no way exaggerated the greatness of its achievements. The full story of the expedition, told in these most interesting and beautifully illustrated volumes, shows that its great success was due to careful and scientific foresight in equipment, to the determined and uttermost use of the equipment and staff, and to daring in the field, carried sometimes to the verge of recklessness, but saved from accidents by sound judgment and cool courage.

The main purpose of the expedition was to reach the South Pole, and as that object required an advance into the heart of Antarctica, no better route could have been selected. There can be little doubt that the expedition would have been completely successful and reached the Pole but for the accidents to the ponies. Four of them died in the winter quarters, one from eating some poisoned shavings, and three from eating sand—perhaps due to the craving of horses for salt, that may not have been adequately allowed for in their food. The most irreparable accident was the loss of the last pony during the southern sledge journey by its fall into a crevasse on the Beardmore Glacier. The sledge party was thus deprived of an important part of its reserve food, and the accident was especially annoying, as the pony was to have been killed that night. The horse meat was not a complete success, as it brought on dysentery. Sir Ernest Shackleton explains this somewhat unexpected result by the meat being poisoned by a toxin of exhaustion. As the symptoms of fatigue can be transmitted by inoculation from a tired to an untired dog, the suggestion sounds probable.

The work is prefaced by an admirable introduction by Dr. Mill on previous Antarctic work. The first volume describes the equipment, the vain attempt to land on the eastern side of the Great Ice Barrier, the establishment of headquarters on MacMurdo Sound, and the winter's work there. The motor car proved of great service around the station, but though it ran well on smooth sea ice, it would have been of no use on the soft surface of the Barrier.

The great sledge journey to the south was, therefore, dependent upon the ponies; and these did their work well. The sledging party consisted of Sir Ernest Shackleton, Adams, Wild, and Marshall, with

[1] "The Heart of the Antarctic. Being the Story of the British Antarctic Expedition, 1907–9." By Sir E. H. Shackleton, C.V.O. With an Introduction by Dr. Hugh Robert Mill. Vol. i., pp. xlviii+372; 132 plates. Vol. ii., pp. xvi+410; 141 plates, 3 maps. (London: W. Heinemann, 1909.) Price, 2 vols., 36s. net.

four sledges, each hauled by a pony. The explorers made a quick journey southward until the mountain wall which forms the western boundary of the Ross Sea and of the Great Ice Barrier curved eastward and lay across the route to the Pole. The mountain scarp is breached by a valley occupied by the Beardmore Glacier, which offered a difficult route to the plateau, and up it the explorers forced their way. After many narrow escapes from crevasses, the expedition attained the plateau and marched southward across it until the exhaustion of their food compelled them to turn back at a point only ninety-three miles from the South Pole. No scientific advantage would have been gained by traversing the remaining distance, and, considering the small reserve supply of food, the risks that had been accepted were, if anything, unduly high.

This magnificent sledge journey has practically demonstrated that the South Pole is on a high plateau, which is bounded to the north by a continuation of the mountain scarp of South Victoria Land, and that this scarp trends eastward towards Graham Land.

The second important achievement by the expedition was the daring sledge journey by Prof. David and Messrs. Mawson and Mackay to the South Magnetic Pole. This great feat was all the more remarkable as not one of the three members had any previous Arctic or Antarctic experience. Prof. David's party had to haul its own sledges, make double journeys over most of the way, and work on half rations almost from the first day. They successfully sledged along the coast of Victoria Land, and then up the Larsen Glacier and over the inland ice to the South Magnetic Pole. They ran great risks from crevasses, and had to incur the added danger of not being found by the *Nimrod* on their return to the coast. Had they been delayed a few days they must have missed the ship, and their only chance would then have been to wait until the sea again froze over and they could sledge back to winter quarters.

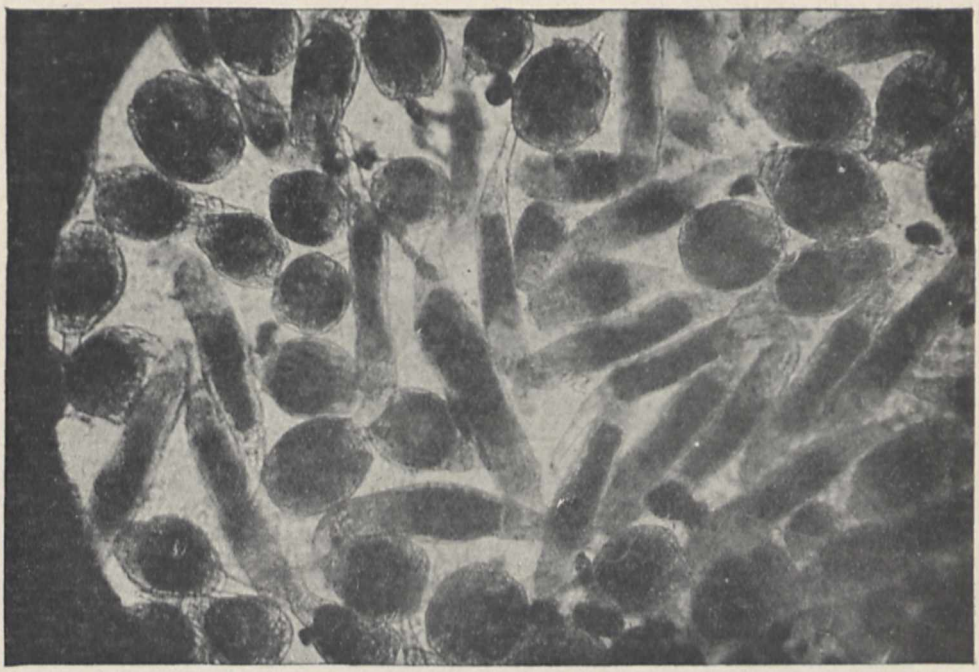

FIG. 1.—The Gregarious Rotifer, which forms blood-red patches in the lakes at Cape Royds. From "The Heart of the Antarctic."

The scientific results of the expedition are unquestionably of the highest importance. It found that, as was suggested in NATURE in 1901, the mountains of South Victoria Land curve eastward, so that the South Pole stands on a high plateau, of which the scarp facing the Pacific trends towards Graham Land. The structure of the mountains of Graham Land and of South Victoria Land is very different; hence we must expect either a continuation of the fold line of Graham Land between the great scarp of Antarctica and the South Pacific coast, or else that the eastward extension of the fold line of Graham Land has foundered beneath the sea, leaving the coast of Antarctica along the South Pacific of the secondary Pacific type.

The scientific problems raised in the second volume are of wide interest; though only preliminary statements are given, they show the wide range and high quality of the work. The accounts are most definite in regard to geology and biology, and they include appendices on the meteorology, magnetic observations, aurora australis, and on tides and currents. The expedition was fortunate in having such an expert geological staff as Prof. David, of Sydney, Mr. Priestley, of Bristol, and Mr. Mawson, of Adelaide, of whom the last acted also as the physicist to the expedition. The biologist, Mr. James Murray, is a well-known specialist on the smaller animals most likely to live on an Antarctic land. Among the most remarkable of the geological results was Sir E. Shackleton's discovery of several seams of coal and coaly material, and of a band of limestone in the southern continuation of the Beacon Sandstones. He was fortunate in collecting the only recognisable fossil (other than radiolaria) hitherto found in this quadrant of Antarctica; it has been determined by Mr. E. J. Goddard, of Sydney, as a piece of coniferous wood of Upper Devonian or Carboniferous age; it furnishes the only direct evidence of the age of the sandstones that are so important in the geology of South Victoria Land.

Mr. Priestley's excursion to the mainland opposite the winter quarters also yielded interesting results, which greatly reduce the thickness previously assigned to the Beacon Sandstone, and throw doubt on its invasion by a younger granite. Prof. David determined the geological history of Mount Erebus, as well as obtained most valuable results as to the structure of South Victoria Land.

One of the most instructive of the geological results is Prof. David's description of the Nordenskjöld and Drygalski Glaciers, which continue out to sea as great ice capes for sixteen and thirty miles from the coast. These projections appear to be certainly

floating, and, though fully exposed to the gales of this stormy sea, they have not been broken up into icebergs; moreover, solution by sea water appears to be very slow, as Prof. David describes the floating end of the Nordenskjöld Glacier as dwindling away from the failure of fresh supplies of ice from the snow-fields by which it was formerly fed. The Great Ice Barrier appears to be of quite a different origin. Shackleton records in his diary (vol. i., p. 293) that "The Barrier surface is still as level as a billiard table, with no sign of any undulation or rise." And with his keen geographical insight Shackleton discriminated (*e.g.* p. 305) between the Barrier ice and the glacier ice, which in places is thrust into it from the land.

FIG. 2.—One thousand feet below the active cone of Erebus. From "The Heart of the Antarctic."

It would be difficult to explain the striking uniformity in level of the Barrier if it were land ice flowing northward, the conclusion adopted by the staff of the *Discovery* expedition. This view was rejected in NATURE in the reviews, both of Captain Scott's narrative and of the volume on the geological results of the *Discovery* expedition, in favour of the origin of the ice "by the accumulation of layers of snow upon the surface more quickly than the ice was dissolved by the sea beneath" (NATURE, 1906, vol. lxxiii., p. 300). This explanation was then attended by the difficulty that the snowfall was said to be too low. The evidence, however, of the photographs brought back by the *Discovery* seemed so convincing that the writer concluded that the snowfall would be found much larger than was reported. The new observations show that the snowfall at the winter quarters was equivalent to a rainfall of 9½ inches a year, and that on the Barrier the average for the past four years has been 7½ inches. This amount of snow seems adequate for the formation of the Barrier ice from snowfall, and this explanation of its origin is now fully confirmed by Prof. David.

The meteorological results are still indefinite, but further light on the hypothetical South Polar anticyclone may be expected from the full records. The narrative shows that there was a less constant blizzard from the south in the southernmost district than was inferred from the cable report. There was a north wind, for example, behind the party during its ascent of the Beardmore Glacier. Nevertheless, the direction of the ice ridges on the polar plateau shows that its pre-

valent wind is from the south. The evidence available suggests that, if the South Polar anticyclone exist, it is either less extensive than was thought, or its centre is in the area between the South Pole and the southern Atlantic.

The appendix on the zoological results gives many interesting particulars as to the habits of the penguins and seals. Mr. Murray is an expert on the rotifers and tardigrades, of which he found a rich fauna in lakelets near the winter quarters. They are only thawed occasionally in the summer, and live in ice through most of the year. They were subjected to various experiments to test their resistance to low temperatures and ultra-saline waters, and they triumphantly survived. Mr. Murray discusses the geographical relations of this fauna, and concludes from the poverty in species, and their wide distribution, that it is due to modern immigration. Mr. Murray collected many marine animals from what he describes as the living carpet covering the sea-floor in McMurdo Sound.

The lakes also contain a rich growth of fungus, which Prof. David describes as giving rise to beds of peat. It is therefore possible that coaly material may be formed in the Antarctic area even under existing conditions. The fossil conifer found by Shackleton shows that Antarctica once had a milder climate than at present, a fact already established by the work of Swedish expeditions, and only natural as a correlative of the warmer conditions that once prevailed in Greenland and Spitsbergen.

J. W. GREGORY.

GAME PRESERVES IN BRITISH EAST AFRICA.[1]

COLONEL PATTERSON is already well known to the British reading public by his remarkably interesting book on his destruction of the man-eating lions which infested the eastern section of the Uganda Railway during its construction and first years of activity. He returned to East Africa in 1907, but whether as a Government servant or as a private traveller is not clearly stated in the book under review (which it may at once be said is exceedingly interesting to a wide circle of readers—those who love thrilling adventures, those whose chief interest is in sport, and to students of the East African mammalia). Whether he was all the time or not on Government business, he had not been long back in East Africa before he was requested to undertake an important mission to the little-known north of the Protectorate across the Guaso Nyiro, there to report on the most suitable frontier to be fixed as the eastern limit of the great Northern Game Reserve.

Seeing the risky and important nature of this journey, the need to avoid any unnecessary responsibility and cause for anxiety, and, if need be, to travel light and with swiftness, it was (as the author half admits) unwise to have allowed two friends (an English sportsman and his wife) to accompany him into such a remote and possibly dangerous part. However, they went; the friend was killed by a revolver accident, and the author of the book was faced with the dilemma as to whether he should immediately escort the widow back to civilisation, some three hundred miles away, or complete his survey (another fifty miles) and then return. He very sensibly adopted the last course. It should be mentioned that the lady with whom circumstances obliged him to travel showed herself a brave woman and an excellent rifle shot. She faced elephants, lions, rhinoceroses and buffalo, sickness of herself and others, mutinous followers, with equal courage and coolness. But it is, of course, a commonplace by now to point out that in the hardships of exploration and the dangers of big-game shooting, British women, some Americans, and a few French and German women, are quite on a par with the men of their race.

One can admire their pluck, but at the same time regret that it should be thrown away on often unnecessary dangers in attacking wild animals far too interesting to be killed. But apparently the men and women of the Caucasian subspecies will not rest content until every big beast and every bird of remarkable plumage is exterminated.

Colonel Patterson does not tell us (so far as we can gather) what recommendation he made as to the definition of the eastern boundaries of this Northern Game Reserve; he hints, however, in one place, that its area is unwieldy (which is quite true), and that as it stands it is far too large to be properly supervised. The whole question, it is to be feared, is purely academic in the British Empire. Large or small as the game reserve may be, the native peasant or the nomad hunter *takes* leave, the Royal or distinguished visitor is *granted* leave, and somehow the shooting goes on. Abyssinians, Somalis, Arabs, and even Goanese traders, adventurers, or bandits, enter this Northern Game Reserve and defy the law to stop them or punish them, and it is said the Boer settlers of the western part of the Protectorate are doing the same.

FIG. 1.—Camels crossing the Kaisoot Desert. From "In the Grip of the Nyika."

The history of the East Africa Protectorate will, no doubt, be very like the history of Cape Colony and the Orange State: the big game will be nearly all killed out, not within the next ten, but certainly within the next fifty years. For it occupies land which in many parts is really well adapted for human occupation (with all the appliances we now possess for turning the tropics to account). The only way to preserve the game to a reasonable degree in selected parts of Africa will be to convince ourselves that these "useless" beasts *are* worth preserving for their

[1] "In the Grip of the Nyika: Further Adventures in British East Africa." By Lieut.-Col. J. H. Patterson, D.S.O. Pp. xv+389. (London: Macmillan and Co., Ltd., 1909.) Price 7*s*. 6*d*. net.

beauty or their interest; secondly, to impress that principle in their childhood's education on the rising generation of the white race; and, thirdly, to spend time and money to impart this doctrine to the natives of Africa, making it well worth their while to cooperate with us.

Of course the Northern Game Reserve is far too large. Colonel Patterson alludes to its history. It was jointly instituted by two commissioners of East Africa and Uganda—Sir Arthur Hardinge and the writer of this review—as a temporary means of arresting the devastations of Europeans, Somalis, Goanese, &c., until the question of game preservation could be more deliberately dealt with in legislation. The time has now come (since the entire reserve of 38,000 miles lies within the limits of the East Africa Protectorate) to cut up this area into (say) three "national parks" of, perhaps, five thousand square miles each, and provide each park with a sufficient staff of game wardens. The remainder of the country would then be allotted to the expansion of native tribes, or be prudently held in reserve for future foreign settlement, if at present without human inhabitants. Disappointing as this reduction might seem, it would be better for the preservation of rare animals to set aside three or four areas each about the size of Yorkshire, in which *no one*, millionaire or prince, soldier or civilian, was to be allowed to shoot, than to mark on the map a reserve as large as Scotland, Wales, and the Isle of Man put together, and to be quite unable to control within its limits either natives or Europeans.

These reserves might be specially selected for the preservation of the more important beasts; thus one could be marked out where rhinoceroses were most abundant; another to save and multiply the handsome Beisa oryx; a third for elephants, and a fourth for the giraffe; and the game wardens must be *civilians* and *biologists*, men of the stamp of the Indian forestry officers.

Colonel Patterson's book reveals the existence of very fine specimens of eland in British East Africa, on which the Government of that Protectorate should keep an eye. It gives new information about the course of the still mysterious Guaso Nyiro river, and contains interesting particulars concerning the Samburu negroids in the northern part of British East Africa. It suggests, indirectly, how much of interest to the student of Africa awaits discovery and explanation in the semi-desert regions that stretch between the Guaso Nyiro and the middle Juba.

H. H. JOHNSTON.

FIG. 2.—A Masai Manyatta. From "In the Grip of the Nyika."

PROBLEMS OF SCIENCE TEACHING IN SCHOOLS.[1]

A DEFECT of intellectual character, national in its incidence, is revealed at conferences of teachers and in the reports issued by associations of schoolmasters and others concerned in educating English boys and girls. In this country the teacher, like the man in the street, is too narrowly "practical"; he regards the discussion of fundamental principles as unprofitable. Thus it is that we find details concerning exposition (*e.g.* of calorimetry) receiving the careful attention of the physics teachers of our leading schools before anyone has sought to answer the question, "Why teach physics?"

We admit that there is some virtue in the insularity of mind which produces this illogical treatment of class-room problems. The schoolmaster says that the aim of teaching chemistry is *to teach chemistry*, and concentrates his attention upon making each lesson effective, with the result that boys are made to do some definite work. Yet it can hardly be denied that neglect of the wider questions infallibly narrows the teacher's outlook, and that this narrowing sooner or

[1] The American Federation of Teachers of the Mathematical and the Natural Sciences. Bulletin No. 2, November, 1909. (Secretary, C. R. Mann, University of Chicago.)

later eliminates from his teaching all the vitalising enthusiasm for knowledge which a man who *believes* in his teaching can inspire in his boys. The best results are obtainable only when the teacher and the boys believe that the work which the class is doing is really worth while. How can a teacher hold such a belief steadfastly through the disillusions of experience unless he has thought out, to some extent, the why and whereunto of his work?

Another objection to the scrappy manner of approaching problems of class-room and laboratory is that such procedure is unscientific because unorganised. An analysis of the recommendations which have been published by societies of teachers in England will be fairly certain to reveal example after example of statements which you can neither accept nor deny until you have settled the *aim* which justifies inclusion of science in the curriculum. Nor is it to be imagined that a realisation of the educational functions of the various subjects is of import only to persons placed in authority—to the high priests of our educational hierarchy. Such a realisation (or the absence of it) affects every minute of every lesson given by the humblest practitioner of the teacher's craft. In all teaching, the objective dictates the method.

Granted that the fundamental problem of science teaching is the determination of the aim of such teaching, how far is it possible to generalise? How far will the aim depend upon the sex, range of age, previous preparation, and probable after-life of the majority of the pupils? It is easy to enunciate a few general truths, but it is clear that each school has its own special problem. Every subject worthy of a place in the school course does at least two things—(1) it enriches the mental content with valuable knowledge; (2) it develops mental power through the process of acquiring the knowledge. The former is too often under-rated by the schoolmaster, the latter by his lay critic, *e.g.* the business man. We must promote the fitness of the boy for his particular *rôle* in life, and at the same time give him as intelligent an understanding as possible of his fellow-men and their work. The boy should acquire some sense of his inheritance in the round world and all that therein is. Properly taught, science will have a humanistic value; the teachers of literary subjects must be made to feel, by the demonstrated effect of the science teaching in evolving many-sided interest in the boy, that they have not the sole title to "the humanities." But beyond such broad generalities there are no rules to be laid down, and the individual teacher must study his own case. In this task he might derive much assistance from debate with colleagues and in educational conferences.

Teachers in the United States have organised large federations of associations in order to discuss the broad problems of teaching. The concluding paper of a "Symposium on the Purpose and Organisation of Physics Teaching in Secondary Schools" appeared last March, and now we find in "Bulletin Number Two" papers on "The Problems of Science Teaching," written by President Ira Remsen (chemistry), Messrs. G. F. Stradling (physics), J. M. Coulter (botany), W. T. Campbell (mathematics), and N. M. Fenneman (physical geography). We abstract from the paper which deals with botanical instruction. The first problem, writes Prof. Coulter, is the prepared teacher, a problem not peculiar to botany, but peculiarly conspicuous. The prepared teacher means one who, in addition to good laboratory and field experience, has a clear conception of the purpose of botany in secondary schools, as distinct from its purpose in higher institutions. To inject into these schools miniature duplicates of college and university courses is to defeat their purpose. There is no ideal method of first attack; the most natural one is the one nearest to the pupils. It would be very unfortunate for any committee to assume to determine that some one method of approach is the best. A current problem is the place of the economic aspects of botany. The older educational theory emphasised mental discipline to the exclusion of useful things, so that sometimes no useful plants were included in the course. In these days there is a tendency to the other extreme, and it is proposed to substitute agriculture for botany—a short-sighted change, because the most practical thing in the world is the foundation of pure science upon which applied science rests. The fundamentals of botany can be obtained from useful plants; but there should never be a straining after such plants at the expense of a clear illustration of the principle to be established. Referring to the proposal to include botany in general biology, using plants and animals indiscriminately for giving knowledge of biological principles, the author finds that this method is inappropriate to immature students, as the perspective is far too large to be grasped by their limited experience; but he suggests that the question be settled in conference. Finally, Prof. Coulter asks for a clear statement of the real value of botany from the point of view of the pupil—a serious attempt to answer the honest question, "What is it good for?"

Our only comment is that the "prepared teacher" who has answered the last question for his own school is in a fair way to solve the other problems propounded. We welcome this series of papers, for unless the teachers of science study their work with scientific method, *quis custodiet?*

G. F. DANIELL.

MAGNETIC SURVEY OF SOUTH AFRICA.[1]

THE Cambridge University Press has published for the Royal Society a work giving an account of the results of the magnetic survey of South Africa carried out by Prof. Beattie, of Cape Town, with the aid of grants from the Royal Society, the British Association, and the Governments of the Crown Colonies in South Africa. The author, in the preface, acknowledges help from a number of scientific gentlemen in South Africa, and he has been fortunate in securing for the final presentation of the work the help and acute judgment of Dr. Charles Chree. The observations were made at some 400 stations in British South Africa, and extend over the period from 1898 to 1906, and the region is bounded roughly by latitudes 18° to 34° S., and by longitudes 20° to 36° E. The epoch to which the results have been reduced is July 1, 1903.

The amount of observational work required is very great and of a peculiarly monotonous type. The reduction of the results must have been a still more arduous task. It is difficult for anyone looking at the final results to realise the amount of sheer labour involved.

A work of this kind appeals in the main to professional magneticians, and for this reason the first part of chapter i. strikes us as a little out of place. It was hardly necessary to define the magnetic elements, but if the author thought it well to do so, he might have made them strictly scientific, instead of giving the kind of descriptive definitions which are suitable for a popular lecture. Similarly, a very "rough" method of finding declination is given. It looks trifling in a work of professional character.

Not the least difficulty in making a magnetic survey

[1] Report of a Magnetic Survey of South Africa. By Prof. J. C. Beattie. Pp. x+235. (Cambridge: University Press, 1909.) Price 21*s.* net.

is the fact that the magnetic elements are constantly changing. The only satisfactory way of eliminating this trouble is by reference to a recording magnetic station within reasonable distance of the point at which the absolute observations are taken. Unfortunately, there is no such station in South Africa, and thus Prof. Beattie has been severely at a disadvantage. He has attempted by other means to eliminate the effects of periodic and secular change, but after giving an account of his attempts he concludes that the result is somewhat illusory, and probably most impartial readers will agree with him. This naturally sets a limit to the general accuracy, and unfortunately it is a case in which the excellent maxim of considering the pennies does not ensure that the pounds will behave with their reputed propriety.

A statement of the reduced results and tables for the purpose of drawing charts of equal values of any element naturally occupies a considerable proportion of the book.

The problem of drawing equivalent curves from observations at discrete points calls for great experience and discrimination on the part of the operator. As regards the main features, no question can arise. The results agree well with the known geological formation, of which an excellent map is given. Moreover, the localisation of magnetic districts is fairly definite and must prove of value to geological and mining science; but some of the minor fluctuations may as well be due to local magnetic matter as to incidental error, from which, under the conditions, the observations cannot be quite free. The manner of presentation of the results will, we feel sure, meet with general approval. We trust that the author will not accuse us of unduly exceeding the limits of reasonable criticism if we suggest that the phrasing "with one instrument first, then with the other, and finally with the one again," is not the most elegant way of describing the operation of comparing instruments. Further, X, Y, Z, T so naturally represent the northerly, westerly, vertical components and total force that we deprecate the use of Z for total force and T for the northerly component.

In appendices which really occupy more than half the volume, a statement of the method of reduction and of the station observations is given. That the observations should occupy so large a space is only right, for we trust that future generations will desire to examine the record of this important work. In Appendix D the author gives a typical example of reduction of the determinations of horizontal force. We observe that Prof. Beattie estimates times in the vibration experiment to one-twentieth of a second. While several magneticians adopt this practice, we have some doubt whether, by counting chronometer ticks, one can always be certain of one-tenth of a second. Even with an electric chronograph it is not customary to estimate a single transit to nearer than one-tenth of a second.

In the determination of horizontal force a number of points arise. One's object being the value at a definite instant, we require a vibration and deflection experiment. In taking a vibration experiment, both before and after the deflection experiment, Prof. Beattie is well advised, but we are unable to follow the logic of his elaborate system of taking means. If the change in horizontal force during the experiments is linear and small, it will not make the least difference whether we take the average of the first and second vibration experiments or adopt Prof. Beattie's more elaborate procedure; while if the question enters on squares and non-linear change, we would point out that this has not been examined fully on the theoretical side. Again, we notice that the practice of reversing the magnet at a given distance was followed. A really better average is got by changing the distance on each reversal of the magnet according to the Kew practice. Whatever the elaborate way of combining the results may mean, it does not eliminate the frequent possibility of the value of H during the deflection experiment being different from the average value during the two vibration experiments, nor the fact that H may differ for the 30-cm. and the 40-cm. distances in the deflection experiment. These are, however, criticisms of detail, and do not affect the general accuracy of the final result, and the record of the first South African survey will remain a memorial to the industry and conscientious work of its director.

G. W. W.

M. BOUQUET DE LA GRYE.

AMONG French men of science, few have been more respected or have worked more indefatigably than M. Bouquet de la Grye, whose death, at the advanced age of eighty-two, was recently announced. His official work was more immediately connected with engineering and hydrography, but his scientific interests were wide, and he was equally well known as an astronomer and geodesist. As marking his qualities as a hydrographer, it is sufficient to recall that at an early age, shortly after leaving the École Polytechnique, he took a prominent part in charting the parts of the Mediterranean adjacent to the coasts of Italy and the Island of Elba. To estimate correctly the importance of this work, we must remember that in the early 'fifties, methods of surveying were not so systematised as they have since become, and mechanical routine had not displaced opportunities for original treatment. Subsequently, he was engaged in correcting the charts of the French Atlantic coast, and in the course of this work he assisted in improving the navigation of the River Loire and contributed greatly to the establishment of the successful port of Nantes. His work on river navigation, and his appreciation of the facilities for traffic which inland waterways offered, seem to have inspired him with the hope of converting Paris into a seaport, utilising the Seine, which he proposed to deepen for the purpose, and avoiding its irregular bends by the construction of canals. A system of docks and the whole machinery of a seaport were to be constructed at Saint Denis. Needless to say that this project, which demonstrates the extent of the imagination and enterprise of the regretted man of science, has not met with public favour. It seems to be the fate of canals either to be rendered useless by the increasing growth in the tonnage of steamers, or to involve such gigantic expenditure in construction that their commercial success is jeopardised at the outset.

In his astronomical work, M. Bouquet de la Grye will be remembered in connection with his loyal and long continued efforts to render the observations of the transit of Venus available for the determination of the solar parallax. In 1874, and again in 1882, he took active part in the preparations and in the actual observations, on the first occasion visiting Campbell Island, and on the second, Mexico. This method of determining the sun's distance may now be discredited. Improved technique and greater knowledge have permitted the use of methods of greater accuracy, providing results less difficult of interpretation; but it would be ungenerous to undervalue the devotion of astronomers of a past generation, who have been actuated by a sincere desire to benefit science and have exhibited both ingenuity and energy in the pur-

suit. It would be scarcely too much to say that for the last thirty years this subject occupied the attention of the deceased astronomer. The care and elaboration M. de la Grye bestowed on the reduction of the observations, sometimes devising ingenious experiments to remove photographic difficulties, at others undertaking new determinations of longitude in order to improve the data, are beyond all praise.

M. de la Grye's attention to geodesy supplied him with another outlet to his energy, and perhaps a relaxation. As a member of the Bureau des Longitudes, he interested himself in all questions which involved the figure of the earth, tidal movements, the variation of gravity or of latitude. He was a regular attendant at all geodetic congresses, reporting their proceedings and upholding their objects. The proposed scheme for the re-measurement of an arc of meridian in Peru had his hearty support. In the details he took the greatest interest, and his suggestions were appreciated by the commission. The encouraging support he was ever ready to extend to others, and his long experience, always at the command of those who sought his counsel, will be long missed by his colleagues, who well know how irreparable is their loss.

PROF. J. S. H. PELLAT.

IT is with deep regret that we see the announcement of the death, after a very short illness, of M. Pellat, professor of physics at the Sorbonne (Paris). Joseph Solange Henry Pellat was born at Grenoble on July 27, 1850, and he died on the December 18 last. After leaving the École normale supérieure, he started work as meteorologist in the Paris Observatory. His stay there was not long, however, for he was soon appointed as professor in the Collège Rollin, and then at the Lycée Louis-le-Grand. In 1885 he was appointed a lecturer in the faculty of science at the Sorbonne, and was ultimately given a chair, which was created specially for him. He occupied many distinguished positions. He was for many years general secretary of the French Physical Society, and also occupied the presidential chair. He was vice-president in 1896 of the Société des Électriciens, and was president of the same society at the time of his death.

Prof. Pellat was one of a brilliant group of pupils of Prof. Jamin, whose laboratory at the Seine was a focus for physical studies. His scientific work covers nearly the whole range of physics. Of practical importance we may single out his construction of an electrodynamometer, in which the force is measured by which one coil is pulled inside another when a current flows through each. Measurements of the electrochemical equivalent of silver and experiments on the cadmium cell fall within the same category. It was, however, for questions having a theoretical bearing that he had the greatest interest. Some of his early work consisted in measuring the differences of potential of contact between two metals; and throughout his life, in common with practically all French physicists, he adhered to the views then held as to the existence and origin of these potential-differences. In a paper in the *Journal de Physique* for March, 1908, he combated the theory of Nernst in regard to the performance of a voltaic cell, and considered that his experiments proved that a metal immersed in a solution of one of its salts is sensibly at the same potential as the latter, at any rate when the solution is not too dilute.

Prof. Pellat was greatly interested in the properties of dielectrics; he constructed apparatus for measuring dielectric constants, and also (in 1899) for measuring their rate of change with temperature. The latter data were required to illustrate the application of a theorem deduced by him thermodynamically, according to which the increase of the energy of a condenser on being charged is only partly represented in general by the electrical energy, an intake (positive or negative) of heat occurring at the same time whenever the dielectric constant varies with temperature. In 1895 he promulgated a new method of dealing with electrostatic phenomena in the general case of heterogeneous dielectrics, in which Coulomb's law is dispensed with, and use is made of three experimental principles in conjunction with the two laws of thermodynamics. In an early paper on the influence of a metal on the nature of the surface of another metal placed a small distance away from it, he anticipated one of the modern phenomena of rays by showing that lead emits something capable of affecting a neighbouring photographic plate in the dark.

Of his devotion, zeal, and enthusiasm, M. Bouty speaks in the funeral oration (*Revue scientifique* for January 1), from which we have gleaned many of the above facts. He lived as in a beautiful dream. The taste for experimenting he had contracted as a youth. His experimental ingenuity was never at fault. He had furnished his laboratory with apparatus of his own invention. His lectures swarmed with original experiments. "Pellat had inherited a name rightly celebrated in juridical science. He transmits it to his widow and children shining with an added light."

DUKE KARL THEODORE OF BAVARIA.

THE subjoined extract from the official gazette of the Principality of Monaco, referring to the death of Duke Karl Theodore of Bavaria, is worthy of being put on record as an appreciation of one great personage of high rank by another, and an acknowledgment that the nobility of station which commands the greatest respect is that which carries with it personal service to the community.

Son Altesse Royale Charles-Théodore, Duc en Bavière, qui vient de mourir dans Sa résidence de Bad Kreuth, était le beau-père de Son Altesse le Duc d'Urach et Sa disparition atteint profondément le Prince Albert dans Ses affections les plus chères.

L'alliance entre la Famille des Ducs en Bavière et celle des Princes de Monaco n'avait pas, seule, rapproché les deux Princes; il existait aussi entre Eux une sympathie étroite basée sur la communauté de Leurs goûts pour le travail scientifique et le progrès des idées.

Le Duc Charles-Théodore, après avoir fait de brillantes études médicales, S'était spécialisé dans l'oculistique et pratiqua avec une habileté qui Lui attira une clientèle considérable: non pas celle qui apporte à l'opérateur une fortune, mais celle qui, au contraire, sort de chez lui moins pauvre qu'elle n'y était entrée.

Charles-Théodore fonda des cliniques, et ce Prince qui, dès sa jeunesse, avait senti qu'une couronne royale impose avant tout la pratique du bien, y fit des opérations très nombreuses. Dans cette tâche que Sa haute intelligence se donnait, il était secondé par Sa femme dont le cœur formait le digne pendant du Sien. Et le couple exemplaire vivait ainsi depuis trente-quatre ans sans être séparé un seul jour, si ce n'est quand l'Empereur Guillaume, blessé à l'œil, demanda les soins du Duc. Sa résidence de Kreuth, située au milieu des Alpes Bavaroises, loin des élégances mondaines, devenait vers le mois d'octobre le lieu de réunion d'une nombreuse famille que plusieurs amis, des confrères ou des professeurs, rejoignaient toujours avec joie. Alors se succédaient les chasses au cerf ou au chamois, celles qui se font dans les conditions vigoureuses, séduisantes pour des chasseurs de race: et le Prince Albert y trouvait régulièrement, depuis seize ans, la compensation de Sa vie laborieuse.

Il faut pleurer avec tout son cœur la disparition du

Duc Charles-Théodore, car Son existence était une leçon pour les hommes d'un rang élevé qui se contentent de vivre et de jouir; elle en était une également pour les humbles en leur apprenant de quelle façon il faut comprendre la vraie fraternité. Mais elle enseignait aussi à la jeunesse moderne, si rarement soucieuse de sa propre dignité, comment on traverse la vie dans toute la fière simplicité qui ne veut rien devoir à personne.

Et pour terminer cette existence admirable, le Duc Charles-Théodore, par l'expression formelle d'une dernière volonté, a maintenu jusqu'à l'ensevelissement de Sa dépouille, la simplicité de toute Sa vie: le concours des personnalités impériales et royales déjà accourues à Munich, celui de l'armée auquel Sa qualité royale lui donnait droit, celui des municipalités de la Bavière où sans doute il n'existe pas un village qui ne Lui ait envoyé des malades, celui de six mille opérés qui Lui doivent la vue, toutes les manifestations capables de flatter la vanité humaine furent écartées doucement; et jeudi dernier Son cercueil descendit, en présence de la famille seule, dans le caveau princier.

Cependant jamais funérailles ne furent plus grandioses, car tout un peuple était consterné devant la perte irréparable qu'il venait de faire.

NOTES.

We learn from the *Times* of January 3 that the will of the late Dr. Ludwig Mond directs his trustees, on the death of Mrs. Mond, to set aside two sums of 50,000*l.* each, free of duty, one to be payable to the Royal Society and the other to the University of Heidelberg. The will provides that the income of the 50,000*l.* bequeathed to the Royal Society "is to be employed in the endowment of research in natural science, more particularly, but not exclusively, in chemistry and physics, by providing rewards for new discoveries and pecuniary assistance (including scholarships) to persons pursuing scientific investigations, and in supplying apparatus and appliances for laboratories and observatories, and, so far as consistent with the Mortmain and Charitable Uses Act, 1888, or other similar provisions, in improving existing or in erecting new laboratories and observatories, and in such other manner as the Royal Society shall decide to be best calculated to promote scientific research, and also in providing, so far and in such amounts as the council of the Royal Society shall from time to time determine, for the publication and circulation of the reports and papers communicated to the said society, and for the preparation and publication of catalogues and indexes of scientific literature which the Royal Society may have undertaken or may in future undertake." Similar conditions govern the bequest to the University of Heidelberg. Dr. Mond also left three sums, each of 20,000*l.*, one for the authorities of the Akademie der bildenden Kunste at Munich, to be applied for the promotion of the arts of sculpture and painting; a second for providing pensions or occasional pecuniary assistance to aged or disabled workmen of Messrs. Brunner, Mond and Co., Ltd., or their successors, in the works at Northwich, Sandbach, and elsewhere; the third for the municipal authorities of Cassel.

Sir James Dewar, F.R.S., has been elected a foreign member of the Reale Accademia dei Lincei (Academy of Sciences) of Rome, in the section of physical, mathematical, and natural sciences. The King of Italy has signified his approval of this election.

M. Émile Picard, vice-president of the Paris Academy of Sciences, has been elected president for 1910, and is succeeded by M. Armand Gautier as vice-president.

The death is announced of Mr. W. Earl Hodgson, author of books on "Trout-fishing," "Salmon-fishing," and other works on fishing and popular natural history.

We notice with regret the death, on January 1, of Sir Edward L. Williams, in his eighty-second year. Sir Edward Williams was well known as the designer of the Manchester Ship Canal, which took twelve years to construct. He acted as chief engineer during the work of construction and on the completion of the canal in 1894 was knighted by Queen Victoria.

The annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Westminster, on Tuesday and Wednesday, January 18 and 19. The new president of the institute, Sir Gerald Muntz, Bart., will deliver his presidential address on the former day.

It was announced by the president of the Chemical Society at the last meeting that in view of the completion of fifty years' fellowship by the past presidents Sir Henry Roscoe, Sir William Crookes, Dr. Hugo Müller, and Dr. A. Vernon Harcourt, the council has resolved to entertain these fellows as guests of the society at a dinner to be held some time at the end of May or beginning of June.

The following appointments have been made to the Indian Agricultural Service:—imperial agricultural bacteriologist, Mr. C. M. Hutchinson; supernumerary mycologist, Mr. F. J. F. Shaw; supernumerary agriculturist, Mr. G. R. Hilson. The two posts of assistant superintendent recently vacant in the natural history section of the Indian Museum, Calcutta, have been filled by the selection of Mr. Stanley W. Kemp and Mr. F. H. Gravely.

We offer our congratulations to the *Chemical News*, which has just completed the fiftieth year of its existence and its hundredth volume. The Chemists' Club of New York and the American Chemical Society have sent Sir William Crookes messages of congratulation on the jubilee anniversary of his editorship of the journal, and the former institution has elected him an honorary member in recognition of his services to the science of chemistry.

The Geneva correspondent of the *Times* states that the Swiss Federal Government has decided to send a scientific expedition into the unexplored parts of Bolivia under the leadership of Prof. O. Fuhrmann, of the University of Neuchâtel. The explorers will leave Switzerland for South America on July 1, and their object will be to study the fauna, flora, and climate of the country. It is stated that several English and American men of science are to join the expedition at their expense.

On Tuesday, January 18, Prof. W. A. Herdman, F.R.S., will commence a course of three lectures at the Royal Institution on "The Cultivation of the Sea," and on Thursday, January 20, the Rev. C. H. W. Johns will deliver the first of two lectures on "Assyriology." The Friday evening discourse on January 21 will be delivered by Sir James Dewar, F.R.S., on "Light Reactions at Low Temperatures," and on February 4 by Prof. W. Bateson, F.R.S., on "The Heredity of Sex."

The death is announced, in his sixty-eighth year, of Dr. Charles B. Dudley. For a short time after his graduation at Yale he was an assistant in the department of physics at the University of Pennsylvania. Since 1875 he had been the chief chemist to the Pennsylvania Railroad Company, in which capacity he made important investigations relating to the composition of steel rails and of the lubricating oils used on railways. He was president of the American Chemical Society from 1896 to 1898. From 1902 to 1908 he was president of the American Society for

Testing Materials, and was recently elected president of the international society of a similar name.

THROUGH the kindness of Mr. and Mrs. Wickham Boynton, the collection of birds formed by the late Sir Henry Boynton, which for many years has been exhibited in the large room at Burton Agnes Hall, has been placed in the Municipal Museum at Hull. As all ornithologists are aware, Sir Henry's collection of birds, principally obtained by his own gun, was one of unusual interest and importance, and contains many great rarities. There are above 200 cases in all, and besides being valuable by reason of the scarcity of the specimens, the collection is interesting from the fact that in many cases both sexes of birds are represented, and in some instances there are also the young. Each case has been exceedingly well set up, and the whole forms a collection such as is rarely seen together. In addition to this, the Hull Museum has also recently acquired the collection of birds (about seventy cases) formed by Mr. Riley Fortune. This collection consists principally of Yorkshire specimens, and fortunately serves well to fill in the gaps in Sir Henry Boynton's collection. These, together with the Pease collection already in the museum, will enable the authorities at Hull to have a display of birds such as will be difficult to surpass in any northern museum.

THE President of the Local Government Board has appointed Dr. Eastwood, one of the pathologists of the Royal Commission on Tuberculosis, an additional medical inspector of the Board, with the special view of his undertaking pathological investigations. Provision also has been made for the necessary assistance and laboratories. The immediate object will be to apply to public health work the important results obtained by the Royal Commission on Tuberculosis, and thereby to ensure the freedom of important foods from the infection of this disease. It is intended also to investigate the similar problems which are constantly arising in connection with other infectious diseases. These investigations will be concerned chiefly with current doubtful points in regard to disease. The new work thus inaugurated by Mr. Burns will include inquiry as to the pathological methods of diagnosis of disease already utilised in the public health work of many sanitary authorities. It is expected that by interchange of information good work will be encouraged and extended, and that coordination and standardisation of the bacteriological methods of diagnosis of disease will be secured.

THE weekly returns of the Registrar-General show that in 1909, taking the returns for the fifty-two weeks ending with Christmas Day, the total deaths in London were 70,988. This is 3883 fewer deaths than the average for the previous five years, but it is 2353 more than in 1908, which, so far, is the healthiest year on record; the year which has just closed is, however, the second healthiest on record. The deaths in London for the respective quarters were 23,761, 16,917, 13,727, and 16,583; the rates per annum for every 1000 persons living were, for the respective quarters, 19·7, 14·0, 11·4, and 13·8. For the urban districts represented by the seventy-six great towns of England and Wales, the death-rates for the several quarters were 18·8, 14·5, 11·9, and 14·1.

WE have received a copy of a paper by Messrs. H. B. Torrey and F. L. Kleeberger, issued in the zoological series of the University of California Publications, on three new species of the actinarian genus Cerianthus from southern California.

WE have to acknowledge the receipt of a copy of the report of the Clifton College Scientific Society for 1908–9, this being the first printed report issued by that body for the last two-and-twenty years. The resumption of the issue will, it is hoped, enable members to keep more readily in touch with the work of sections other than those in which they are specially interested.

TO the first part of *Sitzungsberichte der Niederrhein. Ges. f. Natur- und Heilkunde in Bonn* for 1909, Prof. G. Steinmann contributes an illustrated paper on the problem of ammonite-phylogeny, as exemplified, in this instance, by the genus Heterotissotia. It is concluded that, in place of being a member of the "Circumnodosi" group, Heterotissotia is really related to the Triassic Ceratites, of which it is to be regarded as the Cretaceous descendant. Accordingly, the original view of von Buchs as to the existence of Cretaceous as well as Triassic Ceratites is maintained by the author to be valid.

IN *Prometheus* of December 8, 1909, Drs. P. and E. von Hass, in the course of an article on the origin of the upright posture in man, assert that the ancestors of the human race used their canines for tearing the hide and flesh of the animals on which they fed (how these animals were killed is not explained), but that when they learnt to employ mussel-shells or flint-flakes for this purpose, their tusks, as being no longer necessary, rapidly degenerated. On the other hand, in a recent article in the *Daily Telegraph*, Sir E. R. Lankester has expressly stated that ancestral man never used his tusks for rending flesh. Whom are we to believe?

IN the issue of the *Yorkshire Weekly Post* for December 18, 1909, the natural history correspondent refers again to the killing of birds for the sake of ascertaining whether they have been ringed, quoting as instances a heron shot in Cheshire and a black-headed gull in Lancashire. The heron, he remarks, is protected in Cheshire, as in most other counties, so that the slaughter was illegal as well as unnecessary. In the case of a robin ringed at Glasgow, and picked up dead at the same place a few months later, he asks if there is any use in the ringing of such birds.

FROM the evidence of actual specimens and information obtained by Mr. Rothschild from his agents in California, Mr. Lydekker announces in the *Field* of December 25, 1909, that the so-called Californian elephant-seal to which Gill applied the name *Macrorhinus angustirostris* appears to be identical with *M. leoninus*, as typified by the specimens obtained by Lord Anson on Juan Fernandez, and named by Linnæus. The seals formerly inhabiting Guadalupe Island and the Californian coast are stated to migrate southwards after the breeding-season, and probably cross the equator. *M. leoninus* is characterised by the comparatively long snout of the old bulls, whereas in the Falkland, Crozet, and Macquarie sea-elephants, hitherto identified with *leoninus*, this appendage is shorter. These southern sea-elephants should be known as *Macrorhinus falclandicus* or *patagonicus*, unless the earlier Morunga, or its original and still more barbarous form Mirounga, be preferred.

THE vascular anatomy of mammals forms the subject of the two articles in the November (1909) issue of the *Anatomical Record*, Messrs. Schulte and Tilney discussing in the first the means by which the venous blood is returned to the heart, with especial reference to the iliac veins, while in the second Mr. C. B. Coulter describes the early stages in the development of the aortic arches in the cat, more particularly with regard to the existence of a fifth arch.

The existence in mammals of such a fifth arch, lying between the seismic and pulmonic arches, has recently formed the subject of several papers. This fifth arch appears to be a vessel rising from the aortic bulb and discharging into the pulmonic arch near its junction with the dorsal aorta. It attains fullest development in man and the mole, in both of which it is generally complete, but in the cat and the pig the full arch is rarely formed, while in the rabbit its condition is still more rudimentary.

A LARGE portion of vol. iii., part ii., of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle is taken up by papers on polypod Arthropoda, Canon Norman and Prof. Brady furnishing a synopsis of the local crustaceans, while Dr. A. R. Jackson comments on rare arachnids obtained in 1908, and the Rev. J. E. Hull contributes notes on spiders. Special interest attaches, however, to the description, by Mr. E. L. Gill, of a new Carboniferous arachnid from the Tyne Valley. This valuable specimen, which was obtained from the Coal-measures of Crawcrook, is evidently related to *Anthracosiro woodwardi*; the two forms agreeing in the general structure of the abdominal region. Whereas, however, the typical species has limbs of a normal type, those of the Crawcrook specimen are curiously expanded and flattened—so much so, indeed, that, unless this peculiar contour admits of some other explanation, it is evident that we have to do with a new species. It has accordingly been named *Anthracosiro latipes*, with the proviso that it may eventually be found advisable to change the generic title.

WRITING in the December (1909) number of the *Zoologist*, Mr. H. St. J. K. Donisthorpe claims to be the fourth naturalist who has witnessed in this country a slave-raid on the part of a colony of *Formica sanguinea*. The incident occurred at Bewdley, and the colony raided belonged to *F. fusca*. At the nest of the latter, the narrator states that "Many workers [of *sanguinea*], laden with pupæ, were streaming off in the direction of their home. . . . Others were attacking and killing solitary *fusca* workers. Several *fusca* workers were observed up the grass-stems, &c., holding pupæ, and endeavouring to escape from the slave-raiders. I watched these proceedings for a considerable time, and accompanied some of the ants with pupæ back to their nest, quite a distance off, though they covered the ground very quickly." In the same nest Mr. Donisthorpe took two "gyandromorph" *sanguiniae*, the one being, both in colour and structure, male on the right side and worker on the left, and the other male on the left and female on the right. Only two other specimens of such abnormal ants, neither referable to *sanguinea*, appear to have been previously observed in Great Britain.

As a large portion of the December (1909) issue of the *Journal of Economic Biology* is taken up by a list of literature and the proceedings of the Association of Economic Biologists, the articles are reduced to two. One of these, by Mr. S. A. Neave, who has recently returned from a prolonged tour in northern Rhodesia, Katanga, and the Congo Free State, relates to the distribution of the species of tsetse known as *Glossina palpalis*. The author remarks that the great Congo-Zambezi watershed forms a delimitation between two quite distinct faunas. On descending from this plateau into the Zambezi basin a fauna of the southern type is encountered, whereas at the same elevation on the Congo declivity the area of the western tropical fauna is entered. Now, so far as is known, *G. palpalis* occurs only on the Congo side, and its distribution coincides with that of the tropical fauna generally. Further, the extent of the range of the species within the tropical area is dependent upon station, the insect first meeting the traveller as he descends from the plateau in the well-wooded, damp gorges cut by the rivers and streams.

CIRCULAR No. 112 of the Bureau of Entomology of the United States describes very fully the Mediterranean flour-moth, and the damage and loss it causes to the milling industry. The pest was first noticed in 1892 infesting several Californian flour-mills, and since then it has gradually spread until at the present day it occurs in practically all the principal milling centres and in most of the States. On attaining full growth the caterpillar forms a new web, which becomes a cocoon wherein it undergoes transformation to pupa, and it is in this stage that the insect does most damage. The infested flour becomes caked, clogging the machinery and necessitating frequent and prolonged stoppage resulting in some cases in the loss of thousands of dollars. The remedy suggested is treatment with hydrocyanic acid; the methods of carrying out this rather delicate and dangerous fumigation, and the subsequent cleaning of the mill, are fully given.

THE Imperial Department of the West Indies has issued a pamphlet on the grafting of cacao, by Mr. Joseph Jones, curator of the Botanic Station, Dominica. It is shown that propagation by grafting gives better results than propagation by seed, inasmuch as the desirable characters of any particular tree, such as character of bean, prolific bearing, early bearing, and resistance to disease, &c., can be reproduced with tolerable certainty. Indeed, in no other way can the planter ensure absolute uniformity of bean, one of the most important features in the improvement of the quality of the crop. Grafted trees always develop into a low, spreading form, and this is of special advantage in picking the pods and also in affording protection from the wind. Full instructions for grafting are given, and the process is shown to be neither difficult nor expensive. Another pamphlet explains how to erect and work cotton gins, and is intended for workmen in regular charge of ginneries and for those who have to erect gins without any previous experience with this class of machinery.

THE "cotton-boll weevil"—a beetle of the genus Anthonomus, to which our own "apple-blossom weevil" belongs—causes in the United States an annual loss estimated at 25 millions of dollars. A vast economic literature has grown up around this insect, the latest contribution being an exhaustive account, by W. E. Hinds and W. W. Yothers, of its methods of hibernation (Entom. Bull., No. 77, U.S. Dept. Agric., 1909). The species is carried over the winter by adult beetles sheltering in various situations—many in old bolls that remain on the cotton-stalks. Only a small proportion of the individuals that commence to hibernate survive until the spring, so that the wintering period affords the most vulnerable stage in the insect's life-history, and detailed information respecting it cannot fail to be of value to the planters who seek some practicable means for destroying the weevils.

THE Year-book of the United States Department of Agriculture for 1908 contains some interesting short articles on the economic importance of vertebrates, written by naturalists attached to the Biological Survey. Mr. F. E. L. Beal discusses the relations between birds and insects, and argues that insectivorous birds are beneficial even though they destroy a large number of predaceous and parasitic insects, since the vegetable-eating insects that are present in any year in abnormally large numbers

must form the larger proportion of the birds' food. Mr. A. K. Fisher writes on the economic value of predaceous birds and mammals. He believes that coyotes, foxes, weasels, and skunks are, on the whole, beneficial, and that the most dangerous enemies to poultry are domestic cats. Mr. D. E. Lantz describes the various poisons used for destroying noxious mammals such as wolves, gophers, and prairie marmots, and recommends strychnia-sulphate for general use. This poison is also advocated for campaigns on a large scale against voles by Mr. S. E. Piper, who contributes a paper on "mouse plagues," voles being usually known as "meadow-mice" or "short-tailed field-mice" by American farmers and naturalists.

THE Indian peasant, says the *Pioneer Mail*, usually looks with suspicion upon any scientific innovation which the Government may introduce for his benefit, and it speaks much for the efficacy of the expedient if it eventually overcomes his stubborn prejudices. Such success has attended the inoculation of cattle with rinderpest anti-serum prepared at the bacteriological laboratory of the Civil Veterinary Department. At first great opposition was experienced to the use of the serum, but since it has curtailed outbreaks of a malady which probably creates more havoc than any other cattle disease in India, and has prevented heavy mortality amongst animals, it has been much in demand, and it is now common for cattle owners in infected localities to pay for inoculators to be sent. It is expected that the demand for the serum will increase each year, and the Ceylon Government and many native States desire to be provided with it. The supply is, however, limited. During the year 1908–9 every endeavour was made at the bacteriological laboratory to prepare as large an amount as possible, but about eighty thousand more doses were required than were manufactured.

THE Selborne Society has just issued a new illustrated leaflet entitled "How to Attract Wild Birds." It is a reprint of an article written by the honorary secretary, Mr. Wilfred Mark Webb, for the *Country Home*, and deals with the methods employed in the Brent Valley Bird Sanctuary. A number of photographs which have been used to embellish it were taken in the Bird Sanctuary, and show the construction of the nesting-boxes, the ways of fixing them, the heights at which they should be placed, as well as the open trays which have also been successfully introduced.

IN *Travel and Exploration* for January Mr. P. L. Faulkner gives an account of the Khasia Hills, "a little-known district of the Indian Empire." His description is popular and interesting, but it is curious that he seems to be unacquainted with the valuable official monograph on the Khasi tribe by Major P. R. Gurdon, published by the Government of Eastern Bengal in 1907. By its aid he would have been able to explain the fact, to him mysterious, why a flat stone is placed before the trilithons which the Khasis erect in honour of deceased persons held in respect by the tribe.

IN the December (1909) issue of *Man* Major P. M. Sykes describes the system of tattooing in vogue in Persia. Until the last generation the practice was universal. Now it is rare among persons of rank, and is confined to the lower classes, especially in southern Persia. It seems to be partly ornamental, partly prophylactic. Women use it to avert the evil eye, to hide a scar or other blemish, or to cure disease. As usual, the trade is in the hands of Gypsy women; and though it prevails in Arabia, among the better-class Mussulmans in Persia it is now regarded as a relic of barbarism.

IN *Man* for December (1909) Mr. W. J. Lewis Abbott discusses the so-called "Pygmy" flint weapons. He gives a graphic sketch of the race which erected the Kitchen Middens at Hastings, and is disposed to associate the habit of making these implements with the Continental troglodytes who, he supposes, migrated north to Britain and southwards to the Mediterranean, Egypt, and India. This theory of primitive race migrations obviously involves many difficulties, and it is quite within the bounds of probability that this type of implement may have been independently evolved from more than one centre of origin. The geological evidence collected by Dr. Colley March in Lancashire is believed to show that they belong to an age far more remote than any deposit in which polished stone implements have been hitherto found.

IN the Journal of the Royal Society of Arts for December 17, 1909 (vol. lviii., pp. 101–29), Mr. Hugh Pearson gives a popular account of the diamond fields of Brazil, including the history of the industry since the first discovery of diamonds in 1729, brief descriptions of the geology of the different areas, and the methods of working the deposits. Details are furnished of the curious process of burning out the surface flaws by means of potassium nitrate. The loss in weight is about 8 per cent. There is an excellent general map showing the relative positions of the diamond fields, as well as local maps on a larger scale.

THE constant σ of Stefan's law—the energy radiated by a black body at temperature T° absolute$=\sigma T^4$—has generally been assumed to have the value $5{\cdot}32\times10^{-12}$, as deduced by Dr. Kurlbaum from his observations. M. Féry's recent observations give, however, $6{\cdot}3\times10^{-12}$. Owing to this disagreement MM. Bauer and Moulin have made a re-determination of the constant by heating a platinum strip *in vacuo* until the radiation from it was equal in amount to that from a perfectly black body at the melting point of gold (1064°). The electrical energy given to the strip was then measured. They deduce as the value of σ to within 1 per cent. $6{\cdot}0\times10^{-12}$, and are disposed to question the accuracy of Prof. Planck's expression for the energy of each wave-length sent out by a black body at any temperature. An account of the work is contained in the *résumé* of communications made to the Société française de Physique at the meeting on December 3, 1909.

THE *Physical Review* for December (1909) contains an abstract of a paper on a new modification of the cloud method of measuring the elementary electrical charge, and the most probable value of that charge, read by Prof. R. A. Millikan to the American Physical Society at its Princeton meeting in October. He observes single isolated drops having multiple charges, first when gravity is balanced by a vertical electric field and the drops are stationary, then when the drops fall under gravity, the field having been withdrawn. The mean value deduced from observations of drops composed of water and of alcohol, and having from two to six elementary charges, is $4{\cdot}65\times10^{-10}$, with a possible error of 2 per cent. This number is in close agreement with the values obtained by Prof. Planck and by Prof. Rutherford and Dr. Geiger by other methods, but differs widely from those obtained previously by Sir J. J. Thomson, Prof. Townsend, and Prof. H. A. Wilson.

IN the U.S. Geological Survey's Bulletin No. 401, 1909, Mr. George F. Becker discusses the origin of petroleum and other natural hydrocarbons, with numerous references to authorities. He considers it proved that some oils are

of organic, others of inorganic, origin. So far, however, as any direct evidence goes, "the great petroleum pools . . . may have been derived from carbonaceous matter of vegetable or animal origin . . . (or) from carbides of iron or other metals." The possibility of the latter origin led Mr. Becker to consult Dr. L. A. Bauer's map of magnetic declination in the United States. This he reproduces, marking on it where petroleum exists, and concludes:—"What the map does prove is that petroleum is intimately associated with magnetic disturbances similar to those arising from the neighbourhood of minerals possessing sensible magnetic attraction. . . . Henceforth no geological theory of petroleum will be acceptable which does not explain this association." Mr. Becker's conclusions, if confirmed, promise a new and important sphere of usefulness for magnetic surveys.

THE Patents and Designs Act, 1907, forms the subject of an article, by Mr. George Schuster, in the December (1909) number of the *Economic Journal*. Mr. Schuster deals mainly with the effect which the Act has had upon the practice pursued by some foreigners of taking out British patents for the purpose, not of working them in the United Kingdom, but of preventing them being worked there. He states that there has not been any petition for revocation under Sec. 27 in which the revocation would have led to the establishment of an important industry in the United Kingdom, and points out that this fact, when considered in conjunction with the other evidence, affords conclusive proof that the original evil was greatly exaggerated, and accordingly that the hopes of benefits to be felt on its removal could not in any case have been realised. This conclusion justifies the note of warning given in NATURE for July 23, 1908, immediately before Sec. 27 came into operation, in the following words:—"Much has been written lately as to the benefits to this country likely to be produced by this section, and in some cases there has been considerable exaggeration of the probable effects."

PROF. R. H. SMITH contributes an article on a new formula for the total heat of steam in the *Engineer* for December 24, 1909. Prof. Smith has been led to analyse the law of total heat algebraically in consequence of the publication of a new set of tables compiled by Prof. L. S. Marks and Mr. H. N. Davis, of Harvard University. These tables are consistent between their different columns, and also seem to give data really trustworthy for comparatively strict accuracy. The formula, which represents with complete accuracy the figures of the new table throughout the whole range from 70° F. to 500° F., is as follows:—

Total heat from 32° F. of saturated steam:

$$H = 1826 + t - \frac{1{,}250{,}000}{1620 - t}.$$

The author gives an abbreviated table for comparison of the tabular numbers given by Marks with the results as calculated by the new formula; the comparison shows very close agreement, excepting for temperatures below 60° F. and above 500° F. It will, of course, be remembered that it is very difficult to make accurate heat experiments on very low-pressure steam, and also that no trustworthy experimental data as yet exists for temperatures above 400° F., the tabular numbers given by Marks having been extrapolated.

IN the note on Mr. Knocker's address on the arrangement of ethnological collections in provincial museums in NATURE of December 16, 1909 (p. 198), the word *geographical* should have been *non-geographical*.

MESSRS. WILLIAMS AND NORGATE will publish almost immediately "Beet-sugar Making and its Chemical Control," by Mr. Y. Nikaido. The author has endeavoured to explain, not only the practical operations of sugar-house stations, but also the fundamental principles involved in the various processes of the sugar house and in the methods for analysis of various sugar-house products.

MESSRS. W. AND G. FOYLE, 135 Charing Cross Road, London, W.C., have just issued a new edition of a classified catalogue of scientific and technical books. The catalogue contains a selection of books which can be supplied both new and second-hand, and, so far as it goes, it should prove of service to students seeking books on particular subjects.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY:—

Jan. 7. 5h. Venus at greatest brilliancy.
,, 9h. Saturn at quadrature to the Sun.
8. 14h. Neptune at opposition to the Sun.
10. 1h. Mercury at greatest elongation, 19° 2′ E. of the Sun.
11. 0h. 14m. Uranus in conjunction with the Moon (Uranus 3° 9′ N.).
,, 18h. Uranus in conjunction with the Sun.
12. 9h. 12m. Mercury in conjunction with the Moon (Mercury 4° 33′ N.).
13. 15h. 22m. Venus in conjunction with the Moon (Venus 7° 43′ N.).
16. 12h. Mercury stationary.
17. 3h. 45m. Saturn in conjunction with the Moon (Saturn 1° 34′ N.).
,, 16h. Mars at quadrature to the Sun.
,, 19h. 19m. Mars in conjunction with the Moon (Mars 4° 25′ N.).
20. 2h. Venus stationary.
23. 16h. 5m. Neptune in conjunction with the Moon (Neptune 4° 5′ S.).
29. 21h. Jupiter stationary.
30. 12h. 5m. Jupiter in conjunction with the Moon (Jupiter 2° 45′ S.).

HALLEY'S COMET.—The following is an extract from the corrected ephemeris for Halley's comet published by Mr. Crommelin in No. 4379 of the *Astronomische Nachrichten*:—

Ephemeris for Greenwich Noon.

1910	R.A. h. m.	Decl. ° ′	log *r*	log Δ
Jan. 5	2 4·6	+10 56	0·2984	0·1568
10	1 49·4	+10 15	—	0·1704
15	1 36·2	+ 9 39	0·2664	0·1851
20	1 24·7	+ 9 9	—	0·2001
25	1 14 9	+ 8 45	0·2310	0·2147
30	1 6·4	+ 8 27	—	0·2284

Thus we see the comet is about to pass from Aries into Pisces, and may be observed, with a sufficiently powerful instrument, at any time during the evening before midnight.

Observations made at Utrecht on November 8, 13, 17, 19, and 21, 1909, by Drs. Nijland and J. v. d. Bilt, indicated the increase of brightness shown by the following magnitudes:—13·5, 13·0, 12·8, 12·8, and 12·7.

ELEMENTS AND EPHEMERIS FOR DANIEL'S COMET, 1909e.—In No. 4379 of the *Astronomische Nachrichten* Dr. Ebell gives a set of new elements and an ephemeris for Daniel's comet, 1909e. From these we learn that perihelion passage occurred on 1909 November 27·6694 (M.T. Berlin), and that the comet is now but little more than half as bright as it was at the time of discovery. Its position for

January 6 is $\alpha = 6h.\ 18{\cdot}5m.$, $\delta = +53^\circ\ 48{\cdot}1'$, and it is still moving northward slowly.

SOLAR ACTIVITY AND MAGNETIC STORMS.—No. 1, vol. lxx., of the Monthly Notices (November, 1909) contains three papers on the connection between solar activity and magnetic storms.

In the first, Dr. W. J. S. Lockyer discusses a series of spectroheliograms taken at the Solar Physics Observatory, South Kensington, and shows that the enormous magnetic disturbance of September 25, 1909, was preceded by an abnormal outburst in connection with a spot then on the sun. One of these photographs shows that at about 10 a.m., September 24, the calcium flocculus surrounding the spot was so disturbed as to obliterate the very fine nuclei seen on the preceding photographs; these nuclei reappeared on a negative taken at 11h. 11m. the same morning.

The time of the maximum magnetic disturbance appears to have been 4h. 30m. p.m. on September 25, showing a "lag," after the solar disturbance, of about 30·5 hours. In a similar case, in 1892, Prof. Hale found that the "lag" was about 25·3 hours.

In the second paper, Father Cortie deals generally with the recent solar and magnetic disturbances, and points out that this spot was not accompanied by any abnormal, visual, spectroscopic outburst commensurable in intensity with the magnetic disturbance.

In the last paper Mr. Michie Smith shows, from the evidence of the spectroheliograms and magnetograms secured at the Kodaikánal Observatory, that a great eruption about a spot photographed on September 28, 1909, was accompanied by a magnetic disturbance.

STAR SWARMS.—In an article which appears in the current *Fortnightly Review* (p. 140), Prof. Turner gives a very interesting and lucid popular account of "Migrating Stars."

The difficulties and results of Prof. Boss's work in showing that a number of stars in Taurus are moving together, apparently to a convergent but really along parallel paths, are clearly explained and illustrated by some attractive analogies. This cluster is now some 120 light-years from us, and occupies a space on the celestial globe comparable with that occupied by India on the terrestrial; but in about 65 million years it will have receded so far as to appear merely as a star cluster, occupying an area, using the same analogy, about equal to Anglesea.

The researches of Dr. Ludendorff on the related stars of Ursa Major, and of Dr. Hertzsprung, who has added Sirius, α Coronæ, and other stars to it, are also described.

In No. 4366 of the *Astronomische Nachrichten*, Herr Kostinsky directs attention to two swarms of stars in the neighbourhood of the star clusters χ and h Persei, the individual members of which appear to partake of motions in a common direction.

A LARGE NEBULA IN CETUS.—On a plate taken in the autumn by Herr Lorenz, Prof. Wolf found traces of a large patch of nebulous matter in the constellation Cetus, and has recently succeeded in photographing it with the Waltz reflector. The negative obtained, with two hours' exposure, shows that the object is a long streak running in the N. and S. direction, its length being 15′; at the broadest part, E. and W., its breadth is 3′. The position of the central part of the nebula is $\alpha = 23h.\ 54{\cdot}6m.$, $\delta = -16^\circ\ 15'$ (1855·0), and the whole is seen to be a conglomeration of smaller nebulæ (*Astronomische Nachrichten*, No. 4380, December 28, 1909, p. 187).

ANNUAIRE ASTRONOMIQUE ET MÉTÉOROLOGIQUE, 1910.—For the amateur observer conversant with French, there are few more useful volumes than M. Flammarion's "Annuaire." This year's issue is very similar to its predecessors, but contains a useful *résumé*, with many drawings, of the observations of Mars during the recent opposition. Solar observers, wishing to chart sun-spots, will find the "Disques Moreux," figured on p. 67, a useful adjunct to their outfit. The climatology of 1908 is reviewed, and at the end of the volume there are some useful instructions on the use of instruments for people commencing astronomical observation.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual public meeting of the Academy of Sciences, the president, M. Ch. Bouchard, delivered the annual address, dealing with the population question in France, and announced that the prizes for the year 1909 had been awarded as follows:—

Geometry.—The Francœur prize to Émile Lemoine, for the whole of his works; the Bordin prize to G. Bagnera and Michele de Franchis, for their memoir on the number p of M. Picard for hyperelliptic surfaces.

Mechanics.—A Montyon prize to M. Lecornu, for his book on applied dynamics; the Poncelet prize to M. de Sparre, for the whole of his works; the Boileau prize to M. Boulanger, for his treatise on hydraulics. No satisfactory memoirs having been received on the subject proposed for the Vaillant prize, this has been postponed until 1911.

Navigation.—The Prix Extraordinaire de la Marine divided between M. Marbec, for his memoir on the theory of the equilibrium of an elastic plate submitted to a uniform pressure; M. Doyère, for his work on submarines; M. L. J. H. Lecoq, for work on the stability of submarines; MM. Victor Colin and Jeance, for their work on wireless telephony; M. Tissot, for work on wireless telegraphy; and M. E. Fromaget, for his river survey work in eastern French Africa. The Plumey prize between M. Routin, for his work on the regulation of electrogenic groups, and M. Henry Caralp, for his book on boilers and engines in warships.

Astronomy.—The Lalande prize to M. Borrelly, for his work as a whole; the Valz prize to M. de la Baume-Pluvinel, for his work on solar eclipses and the constitution of comets; the G. de Pontécoulant prize to Prof. E. W. Brown, of Yale, for his work on the theory of the moon. The Pierre Guzman prize was not awarded, and the Damoiseau prize postponed until 1911, no memoirs having been received on the subject proposed.

Geography.—The Tchihatchef prize was not awarded, but M. Henry de Bouillane de Lacoste receives a very honourable mention (2000 francs); the Gay prize to M. L. Joubin, for his researches on the distribution of marine plants in the Roscoff region.

Physics.—The Hébert prize to M. Paul Janet, for his book on general electrotechnics; the Hughes prize to M. Meslin, for his researches in physical optics, magneto-optics, and physical astronomy; the Gaston Planté prize to M. Jean Perrin, for his researches on the kathode rays and on the Brownian movement; the La Caze prize to M. Léon Teisserenc de Bort, for his contributions to meteorology and physics of the globe.

Chemistry.—The La Caze prize between M. G. Blanc, for his researches on the derivatives of camphor, and M. Marcel Guerbet, for his contributions to organic chemistry; the Cahours prize between MM. Carré, Jolibois, and Brunel; Montyon prize (unhealthy trades) to MM. Émile Lefranc, Paul Letellier, and Maurice Perrot; the La Caze prize to M. Recoura, for his work on chromium compounds.

Mineralogy and Geology.—The Grand prize of the physical sciences to M. A. Thévenin, for his memoir on the stages of evolution of the most ancient quadrupeds found in France; the Delesse prize to M. Ph. Glangeaud, for his contributions to the geology of the Auvergne; the Victor Raulin prize (1908) to M. Léon Bertrand, for his contribution to the stratigraphical and tectonic history of the eastern and central Pyrenees, and (1909) to M. Ferdinand Gonnard, for his mineralogical researches; the Joseph Labbé prize to M. Georges Rolland, for his geological studies relating to the mine basin of Meurthe-et-Moselle.

Botany.—The Desmazières prize to M. l'Abbé Hue, for his researches on lichens; Montagne prizes to MM. H. and M. Peragallo, for their work on French marine diatoms, and M. Guilliermond, for his researches on the structure of the Cyanophyceæ and bacteria; the de Coincy prize to M. René Viguier, for his work on the Araliaceæ; the Thore prize to M. Paul Bergon, for his researches on the structure and development of diatoms.

Anatomy and Zoology.—The Savigny prize to M. Robert du Buysson, for his entomological studies in Egypt; the

da Gama Machado prize to MM. J. Pantel and R. de Sinéty, for their studies in spermatogenesis; the Cuvier prize to M. Charles Janet, for his anatomical and embryological researches on ants.

Medicine and Surgery.—Montyon prizes to MM. Neumann, Ch. Nicolle, Bergonié, and Tribondeau, mentions being accorded to MM. Moussu, H. Truc and P. Chavernac, Ch. Porcher and Ch. Hervieux, and a citation to MM. Henri Claude and Jean Camus. The Barbier prize between M. L. Launoy, for his researches on the conditions of activity of glandular cells, and M. J. Lesage, for his experimental studies on maté (*Yerba maté*). The Breant prize was not claimed, but from the interest of the fund a prize of 4000 francs was awarded to W. M. Haffkine, for his work on vaccination against cholera and plague, and a mention of 1000 francs to M. Louis Rénon, for his memoir on the practical treatment of pulmonary tuberculosis; the Godard prize to M. A. Pousson, for his work on the surgery of nephritis, and a very honourable mention to M. J. L. Chirié, for his studies on arterial hypertension; the Baron-Larrey prize to M. Niclot, for his researches on the relations between the numbers of Anopheles and cases of malaria in the Oran district, and a very honourable mention to MM. Dupard and Lepourcelet, for their contribution to the study of meat in the army; the Bellion prize to M. Ch. Nicolas, for his work on public and private hygiene in the Loyalty Islands; the Mège prize (interest) to M. S. J. Metalnikoff, for his researches on *Galleria mellonella*; the Parkin prize to M. Ad. Cartaz, for his therapeutical studies on carbon dioxide as applied to diseases of the nose and throat.

Physiology.—Montyon prizes to M. Charles Dhéré, for his spectrographic researches on the absorption of the ultra-violet rays by albumenoids, proteids, and their derivatives, and to M. E. Pozerski, for his contribution to the physiological study of papaine; the Philipeaux prize to MM. J. E. Abelous and E. Bardier, for their discovery of urohypertensine; the Lallemand prize between M. August Pettit and Gustave Roussy; the La Caze prize to M. C. Delezenne, for the whole of his researches in physiology. The Pourat prize was not awarded, and is postponed to 1911.

Statistics.—A Montyon prize to M. Louis de Goy, for his financial studies, M. Ausset receiving an honourable mention.

History of Science.—Binoux prizes to M. P. Duhem, for the whole of his works relating to the history of science, and M. J. B. de Toni, for his historical studies on the life and work of Italian philosophers of the fifteenth and sixteenth centuries.

General Prizes.—Berthelot medals to MM. G. Blanc, Marcel Guerbet, Jolibois, Brunel, Émile Lefranc, Paul Letellier, Maurice Perrot; the Gegner prize to M. J. H. Fabre; the Lannelongue prize to Mme. Cusco and Mme. de Nabias; the Trémont prize to M. Charles Frémont; the Wilde prize to M. Joseph Vallot, for his work on Mt. Blanc; the Longchampt prize to M. Claudius Roux, for his work on the chlorosis of plants; the Saintour prize to MM. E. F. Gautier and R. Chudeau, for their scientific studies in the Sahara; the Jean Jacques Berger prize between MM. Bienvenue (3000 francs), Biette (1000 francs), Locherer (1000 francs), Thomas (1000 francs), Faillié (750 francs), Hervieu (750 francs), Chagnaud (750 francs), Daydé and Pillé (750 francs), and Calmette (6000 francs). The Petit d'Ormoy prizes were not awarded. M. E. Mercadier receives the Pierson-Périn prize for his physical researches; M. Ritz and M. Lebeuf, 2000 francs each from the Leconte fund; M. Vaucheret, the prize founded by the Marquise de Laplace; and MM. Vaucheret, Hentschel, Messiah, and Courtaigne the prize founded by M. Felix Rivot.

The Bonaparte Fund.—The committee proposes the following grants from this fund for the year 1909:—M. Cayeux, 4000 francs, to enable him to follow up in the United States his researches on oolitic iron-ore deposits, already commenced in France; M. Chevalier, 4000 francs, to assist his explorations in tropical Africa; M. Pérez, 4000 francs, to assist in the publication of a memoir entitled "Recherches histologiques sur les Métamorphoses des Muscides"; M. Houard, 3000 francs, to enable him to travel in Corsica, Algeria, and Tunis for the purpose of collecting material; M. Berget, 2000 francs, for the construction of a special form of pendulum for studying the variations of gravity; M. Bernard, 2000 francs, to assist him in his photometric studies of the variations of solar radiation; M. Blaringhem, 2000 francs, to enable him to continue his experimental researches on the variation of species; M. Estanave, 2000 francs, to permit him to continue his researches on stereoscopic vision, stereoradiography, and autostereoscopy; M. Mathias, 2000 francs, to enable him to continue his researches at the Leyden cryogenic laboratory on the rectilinear diameter of liquids and on the law of corresponding states at very low temperatures.

The academy, taking advantage of the freedom accorded it under the terms of the Petit d'Ormoy foundation, has decided this year not to give this prize in the usual form, but to strike medals commemorative of the progress made in flying. Gold medals have accordingly been awarded to Louis Blériot, Commandant Bouttieaux, Captain Crocco, Henri Farman, Captain Ferber, Henri Juilliot, Charles de Lambert, Hubert Latham, Léon Levavasseur, Col. Charles Renard and Commandant Paul Renard (one medal), Alberto Santos-Dumont, Rodolphe Soreau, Édouard Turcouf and Henri Kapferer (one medal), Léon Teisserenc de Bort, Henry de La Vaulx, Gabriel Voisin, Commandant Jules Voyer, Orville Wright, Wilbur Wright and Count de Zeppelin. Also silver-gilt medals to Gustave Hermite and Georges Besançon, Louis Breguet, Léon Delagrange, Robert Esnault-Pelterie, L. Marchis, Louis Paulhan, Henri Rougier, and Victor Tatin.

CLIMATOLOGICAL REPORTS.

THE director of the meteorological observatory at Chemulpo has issued the results of the observations made at the Japanese meteorological stations in Korea for each of the months January–December, 1908. The instruments and the method of observation are the same as those at the meteorological stations in Japan, and the readings, taken six times a day, are expressed in metric and centigrade measures, with monthly means and extremes. These form an important contribution to the meteorology of the Far East; their value would be much enhanced by the addition of annual summaries.

The report on rainfall registration in Mysore for 1908 shows that, except in the Shimoga (north-west) district, the amount was deficient in all parts of that important province, reaching 43 per cent. in Kolar (east). The deficiency of the fall during both monsoons was detrimental to the cultivation of ragi, which is the staple dry crop of the province. The tables for monthly, seasonal, and yearly periods have been carefully prepared by Mr. Iyengar, as before, with diagrams and maps showing (1) the annual rainfall for 1908, and (2) the average for 1870–1908. The mean amount for the whole province in 1908 was 29·94 inches, the average for the thirty-nine years' period being 36·79 inches. Among the heavy daily falls we note 11·22 inches in Shimoga district, and 10·90 inches in Kadur district, both in the month of July.

An important memoir on the climate of Tripoli is published in the Annals of the Italian Central Meteorological Office (vol. xxx., part i.), containing the results of observations made during the years 1893–1907, at an observatory established by the Italian Foreign Office and the Meteorological Service, and situated in lat. 32° 54′ N., long. 13° 11′ E. The mean monthly values of atmospheric pressure exhibit the greatest variability during the winter season, when the barometer is highest; the lowest readings occur during spring. The mean monthly temperatures do not show much variation from one year to another. The means of the daily maxima are 60·0° in January and 86·2° in August, and of the minima 46·1° in January and 72·9° in August. The absolute maxima and minima were 109·0° in July and 34·5° in January. The mean annual rainfall is 17·29 inches, most of which falls between October and February (14·85 inches); from June to August inclusive little or no rain falls. The memoir has been carefully prepared in considerable detail by Profs. Martinuzzi and Eredia, and is especially valuable, as comparatively little has hitherto been published on the climatology of that country.

In the annual summary of the *India Weather Review* for 1908 the observations included in monthly issues are discussed in detail, and the departures of the monthly and annual means from the normal values are calculated for each element. Dr. Walker states that, on the whole, 1908 was cooler than usual, although in April and June, both of which were dry months, the temperature was in decided excess of the normal. Excluding the hill stations, 1908 was a year of average rainfall; of the four seasons, the cold weather and south-west monsoon were more rainy than usual, while the other two periods were markedly dry. With respect to the monsoon rainfall, the character was opposite to that prevailing in the previous seven years, all of which were in defect. The most striking feature of the year was the heavy rainfall in the dry zone of north-west India, due to the strong monsoon currents in July and August.

The report of the Transvaal Meteorological Department, containing observations and results in the usual form for the year ended June 30, 1908, has been received. The number of rainfall stations has greatly increased, and includes those which formerly reported to the Irrigation Department. The rainfall was below the average generally; at Pretoria the deficiency amounted to 31 per cent., and at Johannesburg to 10 per cent. Farmers suffered from want of water, but, among the compensating factors, remarkable freedom from locusts and little damage from hailstorms are mentioned. In connection with this report we may refer to interesting contributions by Mr. Innes (director) and Mr. Wood (chief assistant) to the climatology of the Transvaal in the current number of the Journal of the Scottish Meteorological Society. Mr. Innes remarks that it is one of the sunniest climates inhabited by civilised races, the average cloudiness being about 30 per cent., and the relative humidity low. Speaking of the High Veld generally, which is at an elevation of about 4000 feet, it is warm by day and cool at night. The rainfall averages 25 to 30 inches, the number of days with rain being only about eighty-five. At places like Johannesburg (5750 feet) the cold during winter is considerable, owing more to the cold wind than to actual temperature. Over the latter (Witwatersrand) district Mr. Wood shows that the mean monthly rainfall increases with great regularity from July (0·11 inch) to January (5·80 inches), and then diminishes to June (0·09 inch). The probability of heavy rainfalls (1 inch and above) is entirely confined to the months October–March inclusive.

The Department of Agriculture, Nairobi, has issued its fifth annual report of meteorological records in British East Africa, containing monthly rainfall values for fifty-six stations during 1908, and averages for ten years (1899–1908) and under at twenty-five stations. The latter show that the mean annual rainfall varied from about 16 inches at Kismayu to 72 inches at Mumias. Meteorological summaries for 1908 are given for ten stations; so far as these show, the absolute extremes of temperature were 99° at Nandi (6000 feet above sea) in February, and 35° at Elmenteita (height not stated) in January.

The Weekly Weather Report issued by the Meteorological Office, London, for the period ending January 1 contains a summary of temperature, rainfall, and bright sunshine for the year 1909. From this it is seen that for the fifty-two weeks ending January 1 the temperature was below the average over the entire kingdom. The rainfall was in excess of the average in all the English districts except in the south-west, but it was generally deficient in Scotland and Ireland. The largest aggregate measurement of rain is 47·12 inches, in the west of Scotland; the least amount for the year is 26·04 inches, in the east of England. The greatest excess of rain is 5·21 inches, in the south-east of England, and the greatest deficiency 6·91 inches, in the north of Scotland, whilst in the north of Ireland the aggregate measurement was 5·53 inches deficient. The rainy days were in excess of the average over the entire country, except in the west of Scotland and in the English Channel. The greatest excess was twenty-two days, in the east of England. The greatest number of rainy days was 250, in the north of Scotland, and the least 186, in the south-east of England. The duration of bright sunshine for the year was in excess of the average over the whole of the British Isles, except in the north-east of England, where there was a deficiency of forty-three hours. The greatest excess was 146 hours, in the south-east of England. The longest duration of bright sunshine was 1975 hours, in the Channel Islands, and this was followed by 1743 hours in the south-east of England. The least duration was 1157 hours, in the north of Scotland, which, however, is forty-eight hours more than the average. The mean temperature at Greenwich for 1909 is 48·9°, which is 1·2° below the average of the past sixty years. The highest monthly mean is 62·7°, in August, the lowest 37·2°, in February. The temperature was below the mean in every month except in January, April, October, and December. The absolutely highest temperature was 86°, in August, the lowest 14°, in March, which gives a range of 72° in the year. The temperature was above the average on 144 days, and frost occurred on sixty-five nights, fifty-two of which occurred in January, February, March, and December. The total rainfall for the year was 25·71 inches, which is 1·58 inches more than the average of the last sixty years. The wettest months were June, July, and March, in each of which the total fall exceeded 3 inches. In all, rain fell on 186 days, December having as many as twenty-three wet days and March twenty-two. There were during the year 1637 hours of bright sunshine at Greenwich, which is 138 hours more than the average. The sunniest month was May, with a record excess of 140 hours. Snow fell on twenty-four days and fog occurred on forty-three days during the year.

EDUCATIONAL TENDENCIES IN THE UNITED STATES.

THE first volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1909, has now been published, and is consequently available at an earlier date after the conclusion of the year with which it deals than any previous report. The second and concluding volume of the report is to be issued early in March next.

The present instalment, which runs to 598 pages, is prefaced by an introduction by the Commissioner, Dr. E. E. Brown, which gives a brief *résumé* of the more important subjects dealt with at length in the succeeding chapters. It is possible here to refer to a few only of the numerous subjects of interest discussed in the volume.

Industrial education has commanded attention in all parts of the States during the past year. The report points out that it has become increasingly evident that one of the vital elements of the problem, so far as the United States are concerned, is the question of the relation of school training to shop practice or apprenticeship. Accounts are given of several experiments which are being tried in various States. The special combination of shop practice with regular scholastic training, which was introduced two or three years ago by the University of Cincinnati, is receiving much attention, and a modification of this plan has been carried into effect in the public schools of Fitchburg, Mass. Model and practice schools have been provided for the teaching of manual arts in connection with the State normal school in Fitchburg. A cooperative course in preparation for the metal trades has been introduced into the Lewis Institute, in Chicago, for boys from sixteen to twenty years of age. Each boy in each of the two years of this course spends twenty-six weeks in the shop and twenty-four weeks in school, receiving from his employer the school tuition fee of 10*l.* a year and 1*l.* a week for the time he works in the shop. The report emphasises the fact that many diverse and often opposing interests are concerned in the effort to work out an American system of industrial education. All these interests are to be given full and fair consideration, and it is being borne in mind that, to render such a system stable and altogether American, it must be made genuinely educational.

Agricultural education has been stimulated during the year by the inquiries and the report of the Commission on Country Life, appointed by President Roosevelt. The establishment of agricultural high schools in different parts of the country goes forward steadily. Mississippi and Arkansas have made important beginnings in the establishment of such schools during the year, and Minnesota has

provided for agricultural departments in the graded schools of the State.

Referring to American colleges and universities, Dr. Brown gives it as his opinion that among the leaders of American university education there is a growing and surprisingly unanimous conviction regarding the directions in which improvement should be made in higher education in the States. It is to be rendered more coherent, vital, and democratic. As President Butler has remarked:—"The American college is under fire, no doubt. Well-directed intelligent firing will do it good. It is far from perfect, but it knows its job, and is working at it with the skill born of long and successful experience." The democratic movement in higher education has been emphasised during the year by the effort to organise in Massachusetts an institution which shall bring courses of college instruction home to all communities in the State in which it may be desired—a project which has been referred by the Legislature to the new State Board of Education for an opinion as to its advisability; by the step taken by Cornell University in the direction of the State university form of organisation, and by the beginnings at the University of Wisconsin of a more comprehensive and widely diffused system of university extension.

Within the year the University of Wisconsin has been a centre of public interest in a variety of ways, not the least important of which is the Vilas bequest, which is expected to amount to 400,000*l.*, and to be administered so that it shall eventually reach a total of 4,000,000*l.* The fact that the available income of this fund is to be devoted largely to research renders it an epoch-making endowment.

In addition to its treatment of the problems of American education, the volume provides an admirable series of summaries of educational progress in European and other countries. Separate chapters are devoted to educational problems in Hawaii, the Philippines, Porto Rico, the Argentine Republic and Chile, Great Britain and Ireland, France and Central Europe. Educational reform in China and current educational topics in foreign countries each receive special treatment.

These educational reports from Washington have often been praised in these columns, and it will suffice to say that the latest report fully maintains the excellence of its predecessors.

OLE RÖMER AND THE THERMOMETER.[1]

THE first thermometers of which the indications were independent of atmospheric pressure appeared in the latter half of the seventeenth century, but Fahrenheit was the first one to succeed, in 1710, in solving the problem of furnishing these thermometers with such scales that their indications agreed; these thermometers were much admired, and represented great progress. It may therefore be of interest to show that Ole Römer solved this problem before Fahrenheit, and that it was from him that Fahrenheit obtained his method.

From some stray remarks which I happened to come across in scientific literature of the eighteenth century, I saw that Ole Römer probably occupied himself with the construction of thermometers, and that some connection existed between him and Fahrenheit. These statements had the effect of inducing me to look for traces of Römer's work in the libraries and archives here in Copenhagen. In the university library I found what I was looking for—a work by Römer called "Adversaria," a volume of written papers in folio bound in a brown cover.[2]

The book contains a whole section about the thermometer, besides some scattered statements about temperature measurements, which I shall return to later. The arrangement of Römer's thermometer seems to me to be of considerable interest. Römer appears to have been the first to construct thermometers with the two fixed points, the temperature of melting snow—"Nix sine gelu et calore"—and the boiling point of water, and with the cubic contents of the tube divided into equal parts. Both Römer and Horrebow's remarks seem to indicate that this took place about the year 1702. The first part of this section is mathematical, and deals chiefly with the problem of dividing the cubic contents of a conical glass tube into equal parts. Römer finds a general method of making such a division, and calculates approximate formulas by the aid of which he may carry out more easily his calculations; he employs these formulas in dividing the cubic contents of a conical tube 8 inches long, intended for his "original thermometer," into four equal parts, and he gives the length of these parts when he determines that the scale of the thermometer is to have sixty divisions, and these are to be arranged in such a way as to read "boiling 60, snow without cold or warmth $7\frac{1}{2}$." After these preliminary investigations Römer gives complete instructions in four paragraphs for "the construction of an original[1] thermometer."

"(1) By means of a drop of mercury investigate whether the cavity of the tube, be it cylindrical or conical, is regular before the ball is blown out. Irregular forms are to be rejected; the cylindrical form may be employed without further investigation. With regard to the conical forms, proceed as follows:—

"(2) From the middle of the tube towards the outer points take the lengths of the drop of mercury.

"(3) When by means of this experiment the divisions have been divided into two equal parts, each of these parts is in turn divided into two equal parts proportionally by increase or diminution, and the whole tube will thus be divided into four equal parts.

"(4) When the thermometer is completed, filled and closed, fix by means of snow or crushed ice the point of division $7\frac{1}{2}$, by means of boiling the point 60."

After these instructions there are remarks written in Horrebow's hand and with his signature which are supplementary, and show also that Römer's thermometer existed after his death (1710):—". . . In 1739, Römer's widow sent me five glasses for thermometers which Römer himself had filled and divided with two points in accordance with his own rules given above. The alcohol in them is rather pale, although Römer coloured it with saffron in the usual manner. . . . After this was written, I asked Römer's widow if she knew whether Römer, after I had left his observatories, had made any change in his thermometer. She said that she did not know, but she gave me Römer's *vade mecum*, in which I found a loose sheet, which is pasted in here after the next sheet. On that I read that Römer fixed upon 8 as the dividing-point for snow, and thus, so far as we know, the alcohol never sinks below 0 in Copenhagen, and it is to be remarked that January 7, 1709, the alcohol only sank to $7\frac{6}{10}$."

The loose sheet which Horrebow mentions contains a table of temperatures which gives the temperature for every day from December 26, 1708, to April 1, 1709.

The two following pages contain a sort of table of corrections for the four divisions.

After this short account of the contents of the eleven folio pages which Römer devoted to the construction of his "new" thermometer, it will be appropriate here to give a short explanation of his method and to point out what is new in it.

The chief feature of the method is this: to base the division of the thermometer on two fixed points, the melting point of thawing snow and the temperature of boiling water, and to find the length of the degree by dividing the cubic contents of the thermometer tube between these two points into equal parts, taking into consideration whether the tube is cylindrical or not. The size of the degree is obtained on the basis of the fact that there must be between the freezing point and the boiling point 52·5 degrees of equal cubic content. If the tube is cylindrical the whole length between the two fixed points is divided into $52\frac{1}{2}$ equal parts, and 7·5 similar parts are added

[1] v. Kirstine Meyer: Temperaturbegrebets Udvikling gennem Tiderne og dets Forhold til vekslende Anskuelser om Varmens Natur. Gjellerups Boghandel. Inaugural Dissertation. (Copenhagen, 1909.)

[2] The language in "Adversaria" is chiefly Latin: the book will be published in 1910 under the auspices of the Kgl. danske Videnskabernes Selskab.

[1] Some weights which are still in existence from Römer's time, and probably are those that he constructed as standards for the new system of weights and measures introduced by the Act of May 1, 1683, bear the inscription "original weight." From this it may be inferred that "original thermometer" means "standard thermometer," and that it was Römer's purpose to introduce a standard for thermometers as for other units of measure.

below the freezing point, zero being thus determined. If the tube is not cylindrical, but conical, an investigation of the dimensions of the tube is made according to the method described in the introduction, the result obtained being the relation between the length of that part of the tube enclosing the seven-eighths of the cubic contents nearest the boiling point and the whole length which is to be employed for the 60°; in the example which Römer takes the conditions are such that the length of the tube between the boiling point and the freezing point must be divided into 52·2 equal parts, 7·8 parts to be added below the freezing point, zero thus being obtained. In using such a thermometer with a conical tube, it is necessary to have a table giving the readings in terms of degrees; thus the reading 7·8 on the length of the tube meant, in terms of Römer's thermometer, 7·5°, 15·563 meant 15°, &c.

Three questions naturally arise when we see that Römer used so much of his limited time in constructing on "original" thermometer:—(1) Is this interest in any way connected with the rest of his scientific or practical work? (2) Did he use the thermometers thus constructed for systematic measurements? (3) Have his new ideas in this line contributed anything to the improved construction of thermometers on the whole? In "Adversaria" there are indubitable indications that the first two questions are to be answered in the affirmative; he gives very excellent results of experiments on "the change of length in metals caused by cold and heat," and, furthermore, there is a sketch of an apparatus for comparative measurements of the expansion of gases and liquids when exposed to heat, and some good results of these measurements. There is also, as already mentioned, a series of measurements made with the new thermometer of the temperature of the air in Copenhagen during the winter of 1709. These measurements are of special interest, and are mentioned several times in the literature of foreign countries. The winter of 1709 was very severe. In an article in Phil. Trans., No. 324, 1709, W. Derham writes, in "The History of the Great Frost in the last Winter," about the conditions in Denmark:—"Dr. Woodward tells me, that in a lettre, he received from the learned Mr. Otto Sperling from Copenhagen, dated April 6, 1709, he calleth it Hyems Atrocissima. And I find it noted in the Minutes of the Royal Society of May 4, 1709. That Dr. Judichar said the ice was frozen in the harbour of Copenhagen 27 inches, and that April 9 N.S. people had gone over between Schone and Denmark on the ice. Which accounts give me a better opinion of some papers I have by me which were shew'd to the Society, concerning the frost at Copenhagen pretended to be taken from the observations of Mr. Römer. I should not entertain any the least distrust of the accuracy either of the instruments or observations of that eminent person were I sure they were his. But there are some passages and hints in those papers that lessened others as well as my opinion about them. 'Tis said there 'That such a frost hath not been known in the memory of man of these countries and *that*[1] *the frost on January 7 and February 23, 170⅝, did very nearly approach the Point of Artificial Freezing.*'" If we now look at the table of Römer's temperature observations from 1708–9 which is found in "Adversaria," it will be seen that it begins December 26, 1708, and continues until April 9, 1709, only that after April 1 there are not observations for every day, and this is no doubt due to the fact that the table is only calculated to show temperatures under 8°. The remarks along the margin are written in Horrebow's hand. The first remark is:—"So Römer had changed his first plan." The meaning of this is, as may be seen from Horrebow's other remarks in "Adversaria," that he thinks that Römer had placed 8 at the melting point instead of 7½ as earlier.

Now the table shows that on February 23, exactly the date which Derham especially mentions, the thermometer went down to about Römer's zero. It is important to note the exact wording of Derham's remark, "that the frost, February 23, 170⅝, came near the temperature for artificial freezing." So it is evidently taken for granted here that *Römer's zero was the temperature of a freezing mixture*, a fact which Derham must have obtained from the report sent from Denmark, since he was not acquainted with Römer's scale. This remark is of special importance for the question as to whether, and if so through what channels, Römer's thermometer has had any widespread influence. The answer is in the affirmative, and the way in which Römer exercised a wide influence was through his influence on Fahrenheit. I shall now proceed to prove that such an influence was exercised by Römer.

In the first place, there are some direct statements about this matter. The most important is by Boerhaave, who, in writing about Fahrenheit's thermometer, says:—"Now it is said that the eminent mathematician Römer in the year 9 of this century observed in Danzig a winter-cold down to the first degree of *this same* thermoscope, of which he himself was the first inventor. Then he increased it with 32° below the freezing-point."

So here it is stated quite distinctly that Römer was the first inventor of Fahrenheit's thermometer; and importance is to be attached to Boerhaave's words about this matter, because he was closely connected with Fahrenheit, who had constructed his thermometers, and whose skill as an instrument-maker and experimenter he often speaks of in terms of praise. That Römer should have made measurements in Danzig in 1709 must be a mistake, which can easily be accounted for by the fact that there are accounts of measurements made in Danzig the same winter with a similar thermometer. At least, I have not been able to find any indications that Römer was in a foreign country at the time mentioned, and his many official duties, his delicate health, and that very list of temperatures for Copenhagen which was sent to the Royal Society make it improbable that he was away from home.

On the other hand, it is related in a biography[1] of Fahrenheit, written four years after his death, that after 1706 he made many difficult journeys by sea and by land, and conferred with the most famous mathematicians in Denmark and Sweden; it is probable that Ole Römer was one of the famous men whom he visited, and then Fahrenheit must have visited him just at the time when the "original thermometer" was used; if Boerhaave's statement is correct, it must be possible to trace Römer's influence on Fahrenheit's thermometers. What Fahrenheit could learn from Römer was chiefly the principle of the two fixed points as a basis for the thermometer scale. According to Fahrenheit's own brief account[2] of his method in the construction of his thermometers, he does, in fact, use fixed points as a basis for his scale, but he mentions three: the temperature of the freezing point, the temperature of a cold mixture, and the temperature of the healthy human body; the last, however, is apparently only used as a sort of check, because Fahrenheit does not wholly rely on the constancy of the temperature of the cold mixture. Now Fahrenheit probably took the two fixed points from Römer, since the zero of Römer's scale, as was evident from Derham's account, was identified with the temperature of a cold mixture, and it appears that the scales of several of the oldest of Fahrenheit's thermometers have the same numeration as Römer's. These thermometers are mentioned in various places; Grischow[3] especially has a full comparison of the somewhat varying scales which Fahrenheit used at different times.

According to Grischow[4] and others,[5] Fahrenheit is said to have confided to his tutor in mathematics, Barnsdorf (from Rostock), the secret of the method of division used on his thermometer, which he maintained was such that anyone who knew it could construct thermometers which agreed. Grischow writes that this happened "circiter 1712 and 1713 nise jam ante." Shortly after that Fahrenheit travelled to Halle and Leipzig, and then Barnsdorf, in conjunction with a colleague named Lange, tried to construct thermometers after the instructions. The scale on these was somewhat different from that on the thermometers which were generally known later as Fahrenheit's, and we read about Barnsdorf that he probably retained "the older or oldest Fahrenheit division." Now from the table it appears that Barnsdorf's thermometers have 7½ at

[1] Emphasised by K. M.

[1] Altpreuss. Monatsschrift, ii., 1874, contains a fragment edited by E. Strehlek.

[2] Phil. Trans. London, vol. xxxiii., 1724, pp. 78–84.

[3] Miscell. Berolienses, t. vi. (printed 1737).

[4] *Loc. cit.*, p. 271.

[5] Cotte, "Traité de Météorologie," 1774, p. 129.

the freezing point and 22½ at the temperature of the human body, and these larger degrees are again divided into smaller ones, namely, each degree into eight. At all events, this idea of placing 7½ at the freezing point, together with all the other facts that have been mentioned, seems pretty certainly to prove Römer's influence, since it is highly improbable that two persons independently would both think of placing 7½ at the freezing point. Barnsdorf's zero is somewhat higher than that of the later Fahrenheit thermometers.

There is other evidence that Fahrenheit used 7½ at the freezing point and had his original zero a little higher than the later one. In 1737 Prof. Dn. Kirch described [1] a thermometer which he had received from Fahrenheit more than twenty years before. He states there that his thermometer has 7½ at the freezing point, and that his zero lies somewhat higher than that on the later Fahrenheit thermometers.

One more thermometer—perhaps the very oldest—seems based upon a division with fixed points and a scale like Barnsdorf's, although the division, apparently, is quite different. Grischow writes in 1740 that a large thermometer which Fahrenheit had constructed thirty years before for the Royal Society in Berlin, and consequently constructed with the greatest care, still agrees completely with the little thermometers which Fahrenheit had sent a short time before from Amsterdam to Berlin. These small thermometers were graded with the help of two or three fixed points, and are throughout like those we use now. So the first thermometer was also constructed according to fixed principles, for such agreement cannot be due to mere chance; a similar thermometer, which had been used for observations in 1709, and which certainly is one of the first Fahrenheit thermometers constructed, was found in Danzig in 1740.

This thermometer was apparently divided after the manner of the Florentine thermometer: 90 at the temperature of the body, 0 at about summer heat, 90 at the lowest degree of heat (which accordingly corresponded to zero on a Fahrenheit thermometer), and 30 at the freezing point. From the lowest to the highest degree of heat, then, there are 180°=8·22½, from the lowest degree of heat to the freezing point 60°=8·7½, accordingly like Barnsdorf's.

In 1714 Fahrenheit constructed two thermometers for Chr. von Wolf, Chancellor of the University of Halle, who was very enthusiastic about them, and has given a description of them.[2] The scale had 26 degrees; the second degree on the scale was marked "greatest cold," so that from this point to the top of the scale there were 24 degrees; the eighth degree was marked "cold." It reminds us perfectly of a scale which Grischow gives for the older Fahrenheit thermometers with the fixed points 0, 8, 24, which later were changed to 0, 32, 96. So here Fahrenheit hesitated—just as, perhaps, Römer did, according to Horrebow's opinion—and he took 8 instead of 7½. However, taken all in all, there are strong indications that it is Ole Römer's strange number for the freezing point which is the origin of the 32° Fahrenheit now used for this point.

Now, perhaps the objection may be made that if Römer's scale were to be traced in Fahrenheit's, we should find 4·60=240 at the boiling point, and not 212; but there is an explanation for this. According to those descriptions of the oldest thermometers which are given above, it appears that the zero in the later thermometers is placed lower than in the earlier ones. Now if the zero in the earlier ones coincided with that of Römer's, the degrees on them must have been shorter than on the later ones, since there must be the same number of degrees within a shorter limit. In the later thermometers the number for the boiling point was found by dividing the space between zero (chiefly determined by means of a cold mixture) and the freezing point into thirty-two equal parts, and marking equal parts off above the freezing point; since these degrees are longer than the older ones, there must be fewer within the same limit, therefore 212, and not 240, at the fixed point, the boiling point.

KIRSTINE MEYER.

[1] Misc. Berol., t. v., 1737, p. 120. [2] Acta Eruditorum, 1714, p. 381.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Board of Studies in Ethnology will be designated in future the "Board of Studies in Anthropology."

Mrs. Norman-Robinson has offered to found a scholarship in craniology and anthropometry, tenable at University College, in memory of the late Dr. R. C. Benington.

The principal of the University (Dr. H. A. Miers) has been elected chairman of the University Press Committee of the Senate.

In addition to the post-graduate course of lectures at University College, London, by Prof. J. A. Fleming, on "The Theory of the Propagation of Electric Currents in Telegraph and Telephone Cables and in Electric Conductors," two other post-graduate courses have been arranged, namely:—(1) "The Ideal Arch, Metal and Masonry, Theory and Design," by Prof. Karl Pearson; (2) "Steam Turbines," by Messrs. W. J. Goudie and E. G. Izod, both beginning on January 21.

Among the advanced courses of scientific lectures for the coming term arranged in connection with the University we notice the following. The lectures are intended for advanced students of the University and others interested in science, and admission to them will be free. A course of ten lectures on the "Evolutionary Aspects of Palæobotany" will be given by Mr. E. A. Newell Arber at University College, at 4.30 p.m., on dates which are published in the *London University Gazette*. Three lectures on "The Geology and Physiography of Arctic Europe" will be given by Prof. E. J. Garwood at University College on Thursdays, at 5 p.m., beginning on February 24. Dr. W. N. Shaw, F.R.S., will give a course of lectures on "Dynamical Meteorology, with Special Reference to the Forecasting of Weather," at the London School of Economics on Fridays, at 5 p.m., beginning on January 21. A course of eight lectures on "The Rate and Conditions of Chemical Change" will be given in the physiological laboratory of the University by Dr. V. H. Veley, F.R.S., on Fridays, at 5 p.m., beginning on January 21. A course of fourteen lectures on "Protozoan Parasites, with Special Reference to those of Man," will be given at the Lister Institute of Preventive Medicine, Chelsea, by Prof. E. A. Minchin, on Mondays and Thursdays, beginning on January 17, at 5 p.m. A course of three lectures on "The Marsipobranchii," by Mr. F. J. Cole, will be given at University College on Mondays, beginning on January 24, at 5 p.m. A course of three lectures on "Amphioxus," by Prof. E. W. MacBride, F.R.S., will be given at the Imperial College of Science and Technology on Mondays, beginning on February 14, at 5 p.m.

ACCORDING to the Chicago newspapers, plans are in contemplation for giving the University of Chicago the finest physical laboratory in the United States, if not in the world. It is said that before the building is complete it will have cost 200,000*l*. All the money is to be furnished by Mr. Martin Ryerson, president of the board of trustees of the University, who was also the donor of the present Ryerson Laboratory at Chicago University.

A COMMITTEE, with Mr. C. P. Trevelyan, M.P., Parliamentary Secretary to the Board of Education, as chairman, and Mr. W. R. Barker, of the Board of Education, as secretary, has been appointed by the President of the Board of Education to inquire into the administration of elementary education endowments. The terms of reference are "to inquire into the administration of (*a*) endowments, the income of which is applicable or is applied to or in connection with elementary education, and (*b*) small educational endowments other than the above in rural areas, the application of which to their proper purposes presents special difficulties; and to consider how far under the existing law it is possible to utilise them to the best advantage; and whether any, and, if so, what, changes in the law are desirable in the direction of conferring upon county and other local authorities some powers in respect of such educational endowments or otherwise."

IN an article on "Some Problems of Secondary Education," in the current issue of *The School World*, Mr.

W. A. Brockington, director of education for Leicestershire, raises several questions which deserve the earnest consideration of all who desire a complete and duly correlated national system of education. In the first place, there is the problem connected with the differentiation of secondary schools and the differentiation of the curricula in these schools. Then the question as to how to secure an adequate supply of trained teachers in secondary schools is discussed. "It is of no use," says Mr. Brockington, "to palter with the problem of the training of secondary-school teachers." Thirdly, there is the problem as to the length of the secondary-school life. "Public opinion has still to be educated into the general acceptance of the axiom that secondary education begins at the age of ten or eleven, and must be continued until at least the age of sixteen or seventeen; and that, accordingly, the privilege of free secondary education imposes a real obligation of self-sacrifice upon the parent." Commenting upon what should be the character of secondary education in the future, Mr. Brockington maintains that we should preserve what is good in traditional knowledge, and, keeping our schools in living touch with the changing needs of society, make the curriculum of secondary schools an epitome of the experience of the race. All sorts of teaching, if properly imparted, represent culture—science, theoretical and applied, the construction of engines, and manual work.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 21, 1909.—Dr. J. M. Purser in the chair.—Prof. W. **Brown**: Permanent steel magnets. With a given quality of steel the dimension-ratio can be found which gives the most effective magnet with a minimum weight of material. Also the results of six months' tests of fourteen different steels show that magnets made of chrome and tungsten steels are the most permanent.—Major F. **Eassie**: Some variations in the skeleton of the domestic horse and their significance. The author states that in whole races of the domestic horse the skeleton gives proof of deterioration from the type of the wild species, and that to a great extent this deterioration exists in horses in every country, and that it is easily recognisable in the living animal. It is due originally to unsuitable environment and breeding from deteriorated stock. As the result of observations of a large series of horses of different races, the author found three main variations in the skeleton, viz. in the relative length of the segments of the head and spine, of the arm, and of the thigh. That the short spine is a primitive character he considers proved by the remains of horses found in recent formations in the valley of the Nerbudda. In the evolution of the horse from its remotest ancestors in the Lower Eocene the arm and the thigh have gradually been shortened, and this shortening has determined its speed. The author also suggests that the short spine, arm, and thigh, respectively, were dominant characters as regards heredity, and that deterioration from the type of the wild species was probably recessive.

PARIS.

Academy of Sciences, December 27.—M. Bouchard in the chair.—The president announced the death of M. Bouquet de la Grye, past-president of the academy, and of M. Lortet.—Émile **Picard**: A class of developments in series of fundamental functions connected with certain functional equations.—M. **de Forcrand**: The hydrates of rubidium and cæsium. Particulars are given of the isolation of $RbOH+H_2O$, $RbOH+2H_2O$, $CsOH+H_2O$. The melting points of these compounds and heats of solution are given.—R. Jarry **Desloges**: The gradual retreat of the southern polar cap of Mars. A reproduction is given of sixteen photographs of the polar cap of Mars at dates between June 23 and October 19.—M. **Coggia**: Observations of comets made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Data are given for Daniel's and Halley's comets on December 11 and 16.—M. **Borrelly**: Observations of Daniel's comet, 1909*e*, made at the Observatory of Marseilles with the 16-cm. finder. Data given for December 9, 10, and 11. The comet is round, with a nucleus placed eccentrically.—P. **Chofardet**: Observations of the new Daniel's comet, 1909*e*, made at the Observatory of Besançon with the bent equatorial. Data given for December 14, 16, and 18. Comet appeared as a round nebulosity, 30″ to 40″ diameter, with a slight condensation at its centre. Brightness, as a whole, about the twelfth magnitude.—MM. **Montangerand** and **Rossard**: Observations of Halley's comet made at the Observatory of Toulouse with the Brunner-Henry equatorial. Data given for December 4, 8, 14, and 16.—J. **Haag**: Families of Lamé composed of surfaces admitting a plane of variable symmetry.—D. **Pompéiu**: The representation of analytical functions by definite integrals.—Charles **Reignier**: The calculation of the fly-wheels of rolling mills.—L. **Lecornu**: The fly-wheel of motors for flying machines.—E. **Jouguet**: The velocity of waves of shock and of combustion.—Jean **Becquerel**: The influence of a magnetic field on the damping of light vibrations. A discussion of the absorption bands produced in a magnetic field by xenotime and tysonite at the temperature of liquid (−253° C.) and solid hydrogen (−259° C.).—V. **Bournay**: The adsorption of ions.—L. **Houllevigue**: The preparation of thin films by volatilisation in a vacuum. A platinum wire is coated with a layer of the metal to be deposited, and heated to the necessary temperature in a high vacuum. The film is formed on a glass plate kept in rotation near the hot wire. The method has been successfully applied to the production of thin films of platinum, gold, silver, iron, copper, cadmium, zinc, and tin.—G. A. **Hemsalech** and C. **de Watteville**: The yellow, orange, and red regions of the high-temperature flame spectrum of calcium. Measurements are given for the calcium lines produced in the oxy-acetylene flame; it is shown that the spectrum is very similar to that observed by King in the electric furnace at a temperature of about 2800° C.—E. **Briner** and A. **Wroczynski**: Chemical reactions in gases submitted to very high pressures. The decomposition of nitric oxide and the formation of nitrosyl chloride. Pure NO at pressures greater than 250 atmospheres is decomposed into N_2O_3 and N_2. This corresponds to the observed production of nitrosyl chloride by the compression of a mixture of nitric oxide and hydrochloric acid.—L. **Brüninghaus**: The law of maximum phosphorescence: an attempt at a theory.—R. **Boulouch**: A demonstration of the phase rule. A reply to remarks by M. Müller on the same subject.—H. **Baubigny**: The necessity for the exact study of reactions. Reply to a criticism of M. Colson.—Em. **Vigouroux**: The alloys of nickel and copper. A study of the electromotive forces of these alloys does not point to the existence of any definite compounds of these two elements.—Em. **Pozzi-Escot**: The estimation of nitric nitrogen by reduction with amalgamated aluminium. It is claimed for the process described that it possesses advantages both in speed and accuracy over those commonly employed.—Georges **Dupont**: The stereochemical isomerides of hexine-3-diol 2·5, $CH_3.CH(OH).C\equiv C—CH(OH)—CH_3$. The two isomers were separated by means of the properties of the dibromides.—M. **Danaila**: The synthesis of 5 : 7 : 5′ : 7′-tetrabromo-indigo and 5 : 7 : 5′ : 7′-tetrachloro-indigo.—Gabriel **Bertrand** and M. **Holderer**: Bellase and the diastatic splitting up of cellose.—L. **Cayeux**: The mineralogical evolution of the primary oolitic iron minerals of France.—J. **Dumont**: The chemical decomposition of rocks. Rocks of different types were submitted to the action of pure water, carbonic acid, dilute hydrochloric acid, and solution of calcium chloride. The rocks were slowly attacked in all these solutions, the amount of material finally coming into solution being very small, and depending upon the state of division of the rock.—Em. **Perrot** and M. **Leprince**: *Adenium Hongkel*, the ordeal poison of the French Soudan. This plant is called *Kidi-Saramé* by the natives. From the aqueous alcoholic extract of the flowers a highly toxic active principle was isolated of the constitution $C_{26}H_{31}O_8$. It was definitely proved to be neither an alkaloid nor a glucoside, and its true nature still remains undetermined.—J. E. **Abelous** and E. **Bardier**: The general physiological effects of urohypotensine. Experimental studies on rabbits and dogs.—A. **Contamin**: The X-rays and cancerous mice. The action of the X-rays is more efficacious when the tissue of the

tumour is young; the resorption of a large tumour causes the death of the animal, probably by poisoning.—Cl. **Regaud** and Th. **Nogier**: The complete and definitive sterilisation of the testicles of the rat, without any lesion of the skin, by a single application of X-rays filtered through aluminium.—Fred **Viès**: The value of muscular striæ from the spectrographic point of view.—Jules **Auclair** and Paul **Braun**: Two cases of Maltese fever probably contracted at Paris. Both cases, which were definitely proved to be true Maltese fever, were probably contracted from handling sheep skins.—M. **Ledentu**: Vascular tumours and aneurisms of the bones.—P. **Bonnier**: The bulbar centres and intestinal diaphylaxy.—B. **Collin**: Some remarks on two new species, *Dendrosomides paguri* and *Podophrya fixa*.—Gabriel **Arthaud**: The salivary spirochætes.—J. **Savornin**: The palæogeographical evolution of Cape Bon and the direction of the folds of the Atlas, considered as the result of two orthogonal orogenic actions.—Em. **de Martonne**: The unequal distribution of glacial erosion in the bed of Alpine glaciers.—E. **Noël**: Tunisian hydrogeology.—Henryk **Arctowski**: The dynamics of climatic variations.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iii., for 1909, contains the following memoirs communicated to the society:—

July 17.—H. **Bohr**: The summability of Dirichlet series.—D. **Hilbert**: The theory of conformal representation.—D. **Hilbert**: The form of a surface of the fourth order.

July 31.—A. **Coehn** and U. **Raydt**: The quantitative validity of the law of distribution of charge between dielectrics in contact.—C. **Runge**: The determination of position in balloons.—P. **Koebe**: The uniformisation of given analytic curves (iv.).

DIARY OF SOCIETIES.

THURSDAY, JANUARY 6.

RÖNTGEN SOCIETY, at 8.15.—(1) A Comparison between the Skotographic and Electroscopic Effects of certain Animal Substances with the same Effects of Uranium, Thorium, &c.; (2) Retardation of Electroscopic Leak by Means of Recognised Radio-active and other Substances; (3) Masked Radio-activity; (4) Influence of Radio-active and certain other Substances upon the Division of Animal Cells: Dr. W. S. Lazarus-Barlow.

FRIDAY, JANUARY 7.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Application of the Pitot Tube to the Testing of Impulse Water-wheels: W. R. Eckart.—An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls: C. W. Jordan.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Oil Fuel: D. S. Richardson.

MONDAY, JANUARY 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels of a Naturalist in South-west Africa: Prof. H. H. W. Pearson.

VICTORIA INSTITUTE, at 4.30.—Modern Conceptions of the Universe: G. F. C. Searle, F.R.S.

TUESDAY, JANUARY 11.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Glare, its Causes and Effects: Dr. J. H. Parsons.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of Rolling Stock for Smooth-rail Working on Heavy Gradients: F. W. Bach.

WEDNESDAY, JANUARY 12.

GEOLOGICAL SOCIETY, at 8.—The Igneous and Associated Sedimentary Rocks of the Glensaul District (County Galway): C. I. Gardiner and Prof. S. H. Reynolds. With Palæontological Notes by F. R. C. Reed.—The Gneisses and Altered Dacites of the Dandenong District (Victoria), and their Relations to the Dacites and to the Grano-Diorites of the Area: Prof. E. W. Skeats.—Recent Improvements in Rock-section Cutting Apparatus: H. J. Grayson.

THURSDAY, JANUARY 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Atomic Weight of Strontium: Sir Edward Thorpe, C.B., F.R.S., and A. G. Francis.—On the Approximate Arithmetical Solution by Finite Differences of Physical Problems involving Differential Equations, with an Application to the Stresses in a Masonry Dam: L. F. Richardson.—On a Method of Determining the Viscosity of Gases, especially those available only in Small Quantities: A. O. Rankine.—Recombination of Ions at Different Temperatures: P. Phillips.—On the Electricity of Rain and Snow: Dr. G. C. Simpson.—On the Polarisation of X-Rays compared with their Power of Exciting High Velocity Kathode Rays: L. Vegard.

MATHEMATICAL SOCIETY, at 5.30.—The Transformations of Coordinates which can be used to transform One Physical Problem into Another: H. Bateman.—On Homogeneous Oscillation: Dr. W. H. Young.—On the Determination of a Semi-continuous Function from a Countable Set of Values: Dr. W. H. and Mrs. Young.—Note on a Former Paper on the Theory of Divergent Series: G. H. Hardy.—On the Expression of a Certain Function by Means of a Series of Polynomials: Dr. H. F. Baker.—On the Double Sixers of a Cubic Surface: Dr. H. F. Baker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Lord Kelvin's Work in Telegraphy and Navigation (*Second Kelvin Lecture*): Prof. J. A. Ewing, C.B., F.R.S.

FRIDAY, JANUARY 14.

MALACOLOGICAL SOCIETY, at 8.—Note on *Helix desertorum*: Mrs. G. B. Longstaff.—Description of *Thersites* (*Glyptorhagada*) *Hillieri*, n.sp., from Central South Australia: E. A. Smith.—Note on *Athoracophorus Schauinslandi*: Henry Suter.—The Ampullaridæ of the Eastern Hemisphere. Description of New Species of Donovania, Scutellina, Fissurella, and Pisania: G. B. Sowerby.—Marine Mollusca from the Kermadec Islands. Notes on Polyplacophora, chiefly Australasian: T. E. Iredale.—Helicoids from New Guinea and Description of a New Species of Papuina: G. K. Gude.

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