THURSDAY, MARCH 19, 1908.

COAL MINING.

Practical Coal Mining. By Leading Experts in Mining and Engineering. Edited by W. S. Boulton. Vol. ii., pp. vi+161–348; vol. iii., pp. viii+192; vol. iv., pp. viii+193–404. (London: The Gresham Publishing Company, 1907.) Price 6*s.* net each.

IN NATURE of May 23, 1907, a notice was published of the first instalment of this work, which, when completed in six volumes, is intended to cover the whole ground of modern coal-mining practice. Three further volumes have been received, containing the conclusion of Prof. H. Louis' section on shaft sinking, which broke off in the middle of a paragraph, and sections on breaking ground by Mr. H. F. Bulman, on methods of working and timbering by Mr. E. H. Robertson, on haulage by Prof. G. R. Thompson, on winding by Prof. C. Latham, on pumping by Mr. W. E. Lishman, on ventilation by Mr. H. W. G. Halbaum, and on transmission of power by Mr. W. E. Lishman. This division of responsibility among many contributors renders a certain want of harmony in the treatment of the subject-matter inevitable. The work will, however, certainly prove as a whole a valuable addition to coal-mining literature.

The concluding instalment of the section on shaft sinking by Prof. H. Louis is excellent. Recent German experience of shaft sinking in difficult cases recorded by Riemer and other Continental authorities is set forth in concise form; details of cost hitherto unpublished are given, and the accompanying sixty-five illustrations, unlike most of the others in the work, have in every case an indication of the scale to which they are drawn.

The fifth section, on breaking ground, covering fifty-nine pages, contains much practical information on driving stone drifts and on coal-cutting machines. The details relating to explosives do not, however, exceed a few words, and no description is given of the rock drills employed in driving stone-drifts.

The sixth section, on methods of working and timbering, the most important branch of mining, covers only fifty-four pages, and the illustrations are not very happily chosen. Altogether this section does not compare favourably with the treatment the subjects have received in the existing treatises by Hughes, Pamely, and others.

The seventh section, on haulage, which forms the commencement of vol. iii., covers seventy-four pages, and has been carefully compiled, the information given regarding tubs, rails, haulage, roads and systems of haulage being concise, accurate, and up to date. Interesting details are furnished of the recent application of mechanical conveyors in the road leading from each working face to the level beneath in steep seams. In regular seams, not seriously disturbed by faults, much is to be hoped from the application of conveyor systems; but there will always remain a large number of mines in disturbed areas where the natural conditions preclude such systematic working, and thus give scope to the ingenuity of the manager in arranging his system of secondary haulage.

The eighth section, on winding, covers ninety pages, and is adequate as far as it goes. Less hackneyed illustrations might have been selected with advantage, and more attention might usefully have been given to the great changes in winding that have taken place in recent years. The operating of main winding gears by electricity, for example, is dealt with in fifty lines. Winding by electricity is, it is true, little practised in Great Britain, although there is a large plant of 1500 horse-power in South Wales. In Germany, however, winding by electricity is making rapid progress. One firm alone has in hand about forty winding engines, some dealing with 2000 tons of coal per day and lifting from depths of 900 yards.

The ninth section, on pumping, covers 83 pages, and contains a concise summary of the recent literature on mine drainage, with well-selected illustrations of the principal types of pumps.

The tenth section, on ventilation, covers 80 pages, gives the princples on which the practice of mine-ventilation is based and discusses the theory of the centrifugal fan. The properties of mine gases and the instruments of measurement are also briefly dealt with.

The eleventh section, on transmission of power, deals first with electricity as the leading power agent, and then in turn with steam, compressed air, and hydraulic power. In this section various topics, such as winding, hauling, pumping, ventilation, and coal-cutting, are incidentally dealt with, the result being that there is a certain amount of clashing with previous sections. The Kaselowsky pump, for example, described on p. 403, is also described on p. 244 of the same volume.

The work is profusely illustrated, the three volumes containing 293 illustrations and twenty plates; and the type is large and clear. The ornate binding and the garish frontispieces are, perhaps, a little wanting in dignity for a comprehensive treatise on mining.

MALARIA AND NATIONAL DECAY.

Malaria. A Neglected Factor in the History of Greece and Rome. By W. H. S. Jones. With an introduction by Major R. Ross, C.B., F.R.S., and a concluding chapter by G. G. Ellett. Pp. vii+108. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

THE subject of the rise and decline of nations and of the causes to which they are due is of perennial interest. One of the problems which historians have striven to solve is the great change in the Greek character which occurred during the fourth century B.C. To quote from Mr. Jones's essay: —

"Home life took precedence of city-life. Patriotism decayed, and lofty aspirations almost ceased to stir the hearts of men. In art there appeared a tendency to sentimentalism; philosophy in many quarters became distinctly pessimistic. Some schools of thought actually took 'absence of feeling' or 'absence of care' as the highest goal of human endeavour. Dissatisfaction and querulousness are marked charac-

teristics of the age. By 300 B.C. the Greeks had lost much of their manly vigour and intellectual strength."

In seeking for a cause for so remarkable a change the pregnant suggestion was made by Major Ross that widespread disease—particularly those "endemic diseases, which when introduced oppress a country for ever"—may have had far-reaching effects in modifying and moulding a new national character. Thus, in many of the southern States of America, the ill-health produced by widespread infection with the hook-worm has been held by American parasitologists to be largely responsible for the sloth and want of enterprise exhibited by the inhabitants of those districts. Recent investigations into the prevalence of malaria in Greece by Major Ross and others suggest that this disease may have been introduced into the country during the period mentioned, and may have been the factor bringing about this remarkable alteration of national characteristics. For malaria has not necessarily always been endemic in the districts in which it is now found. For example, Mauritius was free from malaria up to 1866, in which year it was introduced, and has caused infinite injury to the island ever since.

Mr. Jones has sought in the ancient authors for evidence which may serve to show when malaria was introduced into Greece, and what its effects may have been on the race, and has embodied the results of his researches in this interesting book. With two exceptions there seem to be no references in the classic writers to any disease which could be malaria before the middle of the fifth century B.C. It is in the "Wasps of Aristophanes" (422 B.C.) that the word πυρετός (used, generally in the plural, for malaria) first occurs in Greek literature (with a single exception in the "Iliad"). It is a singular coincidence that three years previously the Athenians were engaged on the island of Sphacteria, which is now one of the most malarial centres in the Mediterranean. The Peloponnesian war followed, large tracts of land were allowed to go out of cultivation, and it seems not unreasonable to conclude that the malaria parasites, introduced from Italy by Greek slaves or perhaps by the Carthaginians, then spread gradually over the country.

The word μελαγχολία and its cognates occur in Greek literature soon after the word πυρετός became common. Now the primary meaning of "melancholy" (derived from μέλαινα χολή, "black bile") seems to have been "excitable" or nervous. In the medical writers, tertian and quartan fevers were said to be derived from yellow and black bile respectively. Galen says that "large spleens are caused by 'melancholy humour'" (humour being used in the sense of a morbid fluid), and Hippocrates remarks that cases of "melancholy" occur in the autumn, which is the malarial season. It would therefore seem that the "melancholy" of these early writers is malarial cachexia. Mr. Jones arrives at the conclusion that "malaria was certainly prevalent in many parts of Greece, including Attica, during the fourth century B.C., though Greece was not 'highly infected,'" and that "the change which gradually came over the Greek character from 400 B.C. onwards, was one which would certainly have been aided, and was in all probability at least partially caused by the same disease."

In a similar manner the introduction of malaria into Italy is discussed, and it is inferred that this disease did not exist there much before 200 B.C., but was prevalent from 50 B.C. onwards. It seems plausible that it was introduced by Hannibal's Carthaginian mercenaries. As in Greece, so in Rome, it left its mark on the national character:—"Malaria made the Greek weak and inefficient; it turned the sterner Roman into a blood-thirsty brute—*atra bilis* made its victims mad."

Mr. G. Ellett contributes a final chapter, and among other points directs attention to the immunity from malaria enjoyed by progressive Japan contrasted with her stagnant neighbour China, where malaria is prevalent. Major Ross's foreword describes the manner in which malaria is disseminated by the mosquito, and some of the results of malarial infection, and serves as a fitting introduction to this interesting essay, particularly for the non-medical reader. Besides being interesting, the book has been issued with an object—to show how important it is to stamp out malaria wherever possible. R. T. H.

ELECTRICITY OLD AND NEW.

Cours d'Électricité. By H. Pellat. 3 vols. Vol. i., pp. vi+329; price 10 francs. Vol. ii., pp. 554; price 18 francs. Vol. iii., pp. vi+290; price 10 francs. (Paris: Gauthier-Villars, 1901, 1903, 1908.)

Les Découvertes modernes en Physique. By O. Manville. Pp. iii+186. (Paris: A. Hermann, 1908.) Price 5 francs.

M. PELLAT has published the courses of lectures which he gave from 1898 to 1907, covering the whole science of electricity. The first volume deals with electrostatics, the second with currents and magnetism, the third with the later developments of electrolysis and gaseous conduction. The course is intended and suited for somewhat advanced students, and no limitations are placed upon the use of mathematics; for the most part, little attention is given to experimental arrangements.

In the case of a work by a physicist so distinguished as M. Pellat it is unnecessary to criticise details; accuracy and soundness in all essentials may be assumed. The only remarks which a reviewer can offer concern the method of treatment; and it is in this respect that M. Pellat's volumes call for comment, for the order in which the subject-matter is introduced is entirely unconventional. The author believes that the usual development is illogical, and has endeavoured to correct this fault.

Thus he refuses to develop electrostatics from the basis of Coulomb's law on the ground that, if that law is taken as the starting-point, some hypothesis must be introduced, when media of different dielectric constant are considered. Accordingly he starts from experiments with a Faraday cylinder and an electrometer, and only introduces Gauss's theorem and the

law of the inverse square after he has established almost all the important propositions. But any given proposition can only be established validly by any process of argument from an irreducible number of primary propositions or assumptions. If the assumption of which M. Pellat speaks is necessary to the development of the subject, then, if his arguments are sound, that assumption or its equivalent must be introduced at some stage. The difference between M. Pellat's treatment and that adopted ordinarily is not that the former requires fewer primary propositions than the latter, but that in the former those propositions are introduced as the direct consequence of some experiment, while in the latter they are introduced as hypotheses verified subsequently by the agreement of deductions from them with experiment. Now we insist most strongly that it is the latter process which is the more logical, for it is the process by which experimental sciences are actually developed. It is perniciously misleading to attempt to apply to such sciences arguments of the kind used in pure mathematics, for it is impossible to deduce any mathematical conclusion whatever from any experiment without an hypothesis; there is always an error of experiment. In our opinion, there are only two methods by which a science may be developed logically, neither of which is adopted by M. Pellat. The first is to follow the historical development, pointing out the stages at which hypotheses are introduced; the second is to define at the outset the concepts used and the propositions relating them, and to show that these lead to conclusions in harmony with experiment.

M. Pellat also prefers to develop electrodynamics directly from the mutual action of currents, introducing the concept of magnetism as a subsidiary function, and then applying it to the phenomena of magnetic substances. His reason for this unconventional procedure is that magnetism is a fictitious quantity which does not exist, but only behaves as if it existed—a distinction too subtle for our comprehension. But here surely the author is abandoning his logical principles. Magnetism is only introduced into the study of current actions because the properties of permanent magnets happened to be examined before those of currents; if the historical order had been reversed, there would have been no need for the conception. If the author is ready to brave all the inconveniences that attend the ignoration of the history of the subject for the sake of logic, surely consistency to his scheme should make him abandon a notion so purely historical as magnetism.

Remark should also be made on M. Pellat's strange neglect of Maxwell's theory of the electromagnetic field. A complete description is given of Hertz's experiments on electric waves, but the theory on which alone they are intelligible is relegated to a few pages in an appended note. Rowland's fundamental research, proving the identity of the electrostatic and electromagnetic conceptions of a current, is referred to in a brief phrase and attributed to Röntgen and Hertz. In some other places the work shows a lack of proportion in the space that is given to different subjects; twenty pages on electrostatic generators seems excessive, but on the other hand the chapter on dynamos and motors is excellent, and contains much that is too often excluded from physical text-books. The last volume is on a somewhat different plane from its predecessors; it is more advanced, and contains discussions of many controversial points. We welcome an excellent last chapter on the elements of gaseous conduction.

It must not be thought that our remarks imply any disparagement of the work as a treatise for students; criticism has only been directed where it is challenged. English students are not so well provided in this subject that they would not welcome a translation. There is only one really serious defect in the book in its present form—the absence of an index.

M. Manville's book may be regarded in some respects as an attempt to supplement that of M. Pellat. The author complains that his countrymen have not realised yet the importance of the latest physical research. He thinks that they may have been hindered by the absence of a suitable summary which renders unnecessary reference to original memoirs, and has set himself to supply the defect. In less than 200 pages he treats of kathode and Röntgen rays, ionisation of gases, radio-activity, and general electron theory. Two subjects are also introduced which can hardly be termed modern; we should have thought that his exposition of the simple facts of electrolysis might have made way for more valuable matter, but apparently he is right in assuming that Maxwell's work has not been assimilated by those for whom he writes.

M. Manville's project is admirable, but we fear that his powers are not equal to his intentions, for he himself has not mastered these subjects completely. There are several actual mistakes, but a still more serious fault is to be found in his failure to show the connection between many of the phenomena which he describes. Though the various methods by which a gas may be rendered a conductor are treated in some detail, the only reference to the modern theory of ionisation, by which these methods may be correlated, is contained in a brief and inadequate paragraph at the end of the chapter. The account of the kathode rays is satisfactory, but there is no reference to the mechanism of the electric discharge in which they have their origin, nor is any distinction made between the electron and the ion which it forms. The chapter on radio-activity is a list of unconnected facts, while the theory of Rutherford and Soddy is dismissed as insufficient for the strange reason that it gives no account of induced activity! If not more than six pages could be spared for the application of the electron theory to optics, conduction and chemistry, it would have been better to leave such matters unmentioned. In view of recent speculations on the density and rigidity of the æther, it is hardly judicious to describe that medium as "ultra-gaseux."

As an example of actual inaccuracy we may quote the statement that solid dielectrics are ionised by Röntgen rays in the same way as gases. Our confidence in the author's analysis is shaken severely by

a calculation on p. 67, where the maximum current obtainable between two electrodes of constant potential difference, but variable distance, is deduced from the condition that the differential coefficient of the current with respect to the *time* should be zero.

French books are apt to err in matters of typography, but such an abundance of misprints and misspellings cannot be left unnoticed; Prof. Townsend comes in for specially hard treatment. On the other hand, we are accustomed to expect French authors to redeem these deficiencies by a graceful literary style; but M. Manville's aberrations would be hardly tolerated in England. It is with great regret that we have to express our opinion that a design contemplated so wisely should remain still in need of successful execution. N. R. C.

OUR BOOK SHELF.

The Oceanic Languages: their Grammatical Structure, Vocabulary, and Origin. By Dr. D. Macdonald. Pp. xv+352. (London: Henry Frowde, 1907.) Price 10*s.* 6*d.* net.

In this volume, Dr. Macdonald sets forth the proposition that the Oceanic languages originated in the Arabian peninsula, and are thus cognate with the Semitic tongues. The primitive Oceanic he regards as a sister language of Arabic, Himyaritic, Ethiopic, Assyrian, Phœnician, Hebrew, and Aramaic, and Efate, Samoan, Malagasy, Malay, &c., as cousins of the modern Semitic dialects. He regards the people speaking the Oceanic languages in Madagascar, the Malay Archipelago, Melanesia, and Polynesia as one great, though diversified, race or people, and the languages themselves as constituting one great family. This unity of race is, however, negatived by the known ethnological data.

Although entitled "The Oceanic Languages," the work is mainly a dictionary of the Efate language of the New Hebrides, preceded by a discussion on the phonology, triliteralism, word-building, pronouns, and particles of the same language. These grammatical elements are compared with those of the Semitic languages taken collectively, so as to show a correspondence of forms. There is no attempt to give a comparative grammar of the Oceanic languages, though some few languages of the region, mainly Malagasy, Malay, other New Hebrides dialects, and Polynesian, are dealt with partially. In the absence of a comparative treatment of the Oceanic languages, some statements, such as those relating to the loss of gender in Oceanic pronouns (p. 75), the modern use of plural pronouns for singular, the representation of the Semitic nunation by final *na* or *n* in Malagasy and Malay (p. 92), are open to doubt, and cannot be accepted without some adequate proof being given.

The work is well printed, but it would have been better to print all the Semitic words in Roman character instead of occasionally using the Ethiopic, Syriac, Arabic, or Hebrew characters without transcription. In the preliminary (grammatical) part of the book there is a large amount of cross-reference, by which the illustration of some statement has to be sought in hundreds of places in the body of the book. In the dictionary, comparison of the Efate words is more fully made with the Semitic than with the Oceanic tongues, and here there are also numerous cross-references.

In conclusion, it may be said that the similarity of form in words and particles which Dr. Macdonald has shown in Efate and Semitic is no proof that they were originally the same, and exactly the same method has been employed to affirm the relationship of the Oceanic languages to Aryan, Australian, and American. The history of the Oceanic languages, as a whole, must be traced out before the apparent affinities of one of them can be held to establish a relationship of the whole group to some other linguistic group. S. H. R.

Searchlights: their Theory, Construction, and Application. By F. Nerz. Translated by Charles Rogers. Pp. vii+137. (London: Archibald Constable and Co., Ltd., 1907.) Price 7*s.* 6*d.* net.

The use of searchlights has rapidly extended during recent years, with the result that the want of a good treatise, dealing with their principles of construction and the methods of using them, has made itself acutely felt. The volume at present under review is a translation of the treatise on searchlights in Prof. Voit's "Sammlung elektrotechnische Vorträge," but much new matter has been added, so that it now forms an epitome of the latest practice. After dealing with the optical principles utilised in the construction of searchlights, special attention being paid to parabolic mirrors, the performance of searchlights and the methods of testing their mirrors are discussed. The applications of searchlights in the field, in land fortresses, for coast defence, and on battleships then receive attention. For field purposes a light equipment is now obtainable, consisting of a waggon carrying a petrol motor and a dynamo, coupled to another waggon which carries the searchlight and a transportable tower for elevating it. Searchlight equipments for fortresses may be either fixed, partially movable, or wholly movable; each type receives adequate consideration.

For coast defence, special arrangements, such as dispersers, are sometimes required, and these, in their turn, necessitate special protecting devices. Searchlights are indispensable to a battleship; without their aid a night attack of torpedo boats could not be repelled, hence the application of searchlights to naval purposes receives very careful consideration. The details of construction are then described and illustrated, attention being paid to the different forms of arc lamp, their method of control, and the various optical accessories which form part of a complete equipment. The scientific principles utilised are so carefully and lucidly explained that they will be readily understood by one who has previously had little acquaintance with them. Various forms of transportable power supply are described and illustrated in the last chapter, and the book ends with an appendix which briefly describes the physical units used in photometry. No book could meet the want which led to its compilation better than this one does. E. E.

Beyond Good and Evil. Prelude to a Philosophy of the Future. By Friedrich Nietzsche. Authorised translation by Helen Zimmern. Pp. xv+268. (Edinburgh and London: T. N. Foulis, 1907.) Price 5*s.* net.

"All prudent, worldly wise men follow more or less approximately the practice which Nietzsche teaches, notwithstanding the opposite principles which they perhaps profess to hold," says Mr. Thomas Common in an introduction to this translation, and it will interest and instruct those who are unfamiliar with Nietzsche's philosophy to read what the philosopher has to say here on the natural history of morals and other subjects. No reader will complain that there are not questions enough for thought raised.

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 Habitability of Mars.

INASMUCH as Dr. Wallace has sent me his book through his publishers, as I gather from the wrapper—though it is not so expressed—I suppose it is incumbent on me to acknowledge it, since he clearly expects some sort of reply. The effect of its perusal is to show me again how cogent is the argument for the habitability of Mars, for only by many misstatements of fact, wholly unintentional, of course, can Dr. Wallace make out even a seeming case upon the other side. A physicist will not need to have these errors pointed out to him, but as most readers are unable to correct them for themselves it may be wise to instance a few to show how his house of cards tumbles down in consequence.

On p. 22 he quotes from Miss Clerke to prove that the cap could only supply 2 inches of water over the irrigated districts. Let us assume her own estimate of snow deposited, and merely correct her mathematical and topographic mistakes. She states the maximum area which the cap covers to be 2,400,000 square miles. Now the south cap comes down to 36°·5 latitude on the average, and an easy calculation shows this to occupy 11,330,000 square miles, or to be more than four times as great. Next, she supposes the natural dark areas of the planet to be irrigated, which they are not, mistaking them for the canal system, which, instead of 17,000,000 square miles, covers, oases and all, only about 4,750,000 according to our measures, remembering that the whole of it is not watered from one cap. By combining these two corrections we find, not 2 inches of water for each bit of ground, but 2½ feet, and this according to her own estimate, which there is no reason to suppose not to be two or three times too small. So that it is the argument of Dr. Wallace, and not the cap, that fails to hold water.

An equally fatal flaw affects Dr. Wallace's argument for temperature. Here he bases his deduction on a misstatement of Prof. Poynting. Prof. Poynting states that in my paper on the mean temperature of Mars I took no due account of the blanketing effect of air. Not only did I expressly take it into account, but I did so in the only way it can correctly be taken, not by hypothesis, but by direct appeal to what takes place on earth under a clear and under a cloudy sky by night; and I am glad to know that in a paper he has sent to the *Phil. Mag.* on the subject Prof. Very, the bolometric authority on matters of temperature to-day, agrees with both my method and my conclusion for Mars, and points out where Prof. Poynting's calculations are fallacious.

Another omission is no less telling. Dr. Wallace apparently is unaware that Prof. Very's bolometric determination of the moon's heat, which for delicacy surpasses any previous ones, makes the temperature on the moon during the lunar day reach 356° F. above Fahrenheit zero.

Many more such misunderstandings might be mentioned occurring throughout the book, such as where, from not giving its context, he makes me appear to say that water-vapour is one of the heavier gases, which, of course, I did not.

Again, his theory, taken from Chamberlin, that the interior of Mars can have completely lost its heat in the very process of contraction, and yet later have suffered a meteoric bombardment sufficient to give it a heated outer layer, is mechanically whimsical, not to say impossible. For it can be shown that Mars could not have captured any meteoric swarms not substantially travelling in its own orbit when it coalesced into a planetary mass, and any meteors subsequently encountered could only have fallen on it as it passed through a swarm, yielding a relatively insignificant amount of matter. Any such effect would be even more pronounced on the earth, of the occurrence of which there is no evidence.

Misstatements cannot be too carefully avoided in science, especially when a man, however eminent in one branch, is wandering into another not his own. Dr. Wallace, whose intentions are of the highest, will appreciate this. Indeed, if criticism were confined, as common-sense counsels, to those versed in the phenomena, we should hear very little about the inhabitability of Mars.

Boston, March 6. PERCIVAL LOWELL.

DR. J. W. EVANS'S letter in NATURE of February 27 seems to invite notice from me in respect to three of the subjects with which it deals.

(1) As regards temperature. In most physical problems temperature may be regarded as a single definite measurement, which I understand to be Dr. Evans's point of view; but this ceases to be legitimate in molecular physics whenever the behaviour of an individual molecule comes under consideration. Temperature has then to be recognised as not one, but many, measurements, chiefly of two groups of activities, one group associated with the events that go on *within* the molecule and are in touch with the activities of the æther, and the other group mainly concerned with the journeys of the molecule through space and with one section of the events that occur during each of the encounters to which it may have to submit. Dr. Evans will find this subject referred to, and partly dealt with, at p. 76 of the *Astrophysical Journal* for July, 1904, or in the *Phil. Mag.* of the preceding month. On the other hand, in molar physics (as also in the kinetic theory of gas as usually treated) we have no occasion to deal with individuals; we are only concerned with swarms of molecules acting on one another and changing their behaviour so frequently that the activities of or within the molecules come into operation in too rapid succession to be distinguishable. All that we can then detect is that these numberless activities furnish an average outcome of energy which fortunately is (except in certain critical instances) sufficiently steady to admit of measurement, and is then what we call the temperature. But this jumbling together of unlike activities is not admissible when the question is about individual molecules—as when our object is to learn the conditions under which the lightest gaseous molecules of an atmosphere, which are those most violently tossed about, can occasionally and *one by one* drift away from their atmosphere.

(2) The question whether we can know that Mars is unable to prevent the escape of water is in effect almost the same question as whether we may trust the evidence that helium is in process of escaping from the earth, inasmuch as the dynamical conditions in these two problems are nearly identical. The evidence in the case of helium, so far as it was known eight years ago, Dr. Evans will find on pp. 369, &c., of the *Astrophysical Journal* for June, 1900. It should be added that the discoveries since that date about helium have materially strengthened the evidence then available.

(3) Dr. Evans bases an argument on the early state of the earth, which he thinks could not have been followed by the presence of water in modern times if some molecules can now escape from a planet in the way I have supposed. This, I believe, is a mistake. In the remote past the potential of attraction of the dilated earth of those days may have been, as supposed by Dr. Evans, so much less than now that multitudes of molecules now on the earth were not then upon it. So much may be conceded. But then, as now, these molecules were under the influence of the sun's attraction, and did not range beyond a ring round the sun, in which the earth also travelled—like the rings of Saturn or the asteroids of the solar system. Afterwards, when the earth shrank and the potential of its attraction rose to near its present amount, such of these molecules as encountered the earth were unable to escape again, and we now find them upon the earth. There is therefore no such conflict as Dr. Evans supposed between this possible past and the argument I have based upon observed facts, viz. upon the absence of all the gases of its atmosphere from the moon, and on the escape from the earth of molecules of hydrogen and helium which is still going on.

The more deductive method of investigating the escape of gases from atmospheres, without the premisses from

observation of which I have latterly made use—which deductive method I attempted in former times, and upon which others have relied since—will, I am persuaded, continue to be incompetent to deal with this real problem of nature unless man's knowledge of molecular physics receive such unhoped-for accessions as will enable him to trace the history of single molecules. Meanwhile, what I advocate is that we avail ourselves of the mixed method, which introduces data established by observation to supplement the deductive method at the point where the deductive method fails. G. JOHNSTONE STONEY.

30 Chepstow Crescent, W., March 6.

Postscript, added March 13.—NATURE of yesterday's date announces the last supposed spectroscopic detection of water vapour upon Mars by one of Prof. Lowell's assistants. Observations of a like kind had been recorded by Sir Wm. Huggins and Prof. Vogel, and the wave-lengths of three of the lines observed were measured by Vogel, two of which may possibly be water lines recorded by Rowland, but not the third.

On the other hand, Campbell and Keeler in a better climate did not see them. Now, however, they seem to have appeared again. This would be the behaviour of a very variable coloured vapour like NO_2; and what I should desire is that an adequate study be made of the absorption spectra of the several such vapours which are unable to maintain themselves in our atmosphere on account of the presence of water, but are presumably to be found on Mars if water does not exist on Mars, and which if present will account for the orange colour of large tracts upon that planet, and for the variations of its colour at different seasons which are conspicuous.

It is to be regretted that the observers to whom we owe so much—from Schiaparelli to Lowell—have kept in view only one of the competing views as to the state of things on Mars instead of at each step considering them both, especially as the one they have preferred is that which some physicists have felt to be the least probable.

G. JOHNSTONE STONEY.

The Isothermal Layer of the Atmosphere.

LIKE Dr. Chree (p. 437) I have had experience of the vagaries of self-recording instruments, but I have generally been able to trace them to some remediable defect in the instrument or to the ignorance or carelessness of those who use them. I fancy that the man who constantly uses a certain instrument, and uses it intelligently and not by mere rule-of-thumb, has a fairly correct notion of the magnitude of the errors to which it is liable. If not, what reliance are we to place on any instrumental observations?

It is quite natural, however, to doubt the observations, and when this investigation first commenced I confess that I did the same. Now that hundreds of ascents have been made with different instruments, in different countries and in widely different circumstances, and all the results obtained are in striking agreement, such a view seems to me to be quite untenable. It is true that different instruments sent up with the same balloon have given widely different temperatures, but the results have been published, not concealed, and the instruments improved. I ascribe these discrepancies, which are the exception, not the rule, to solar insolation, which we avoid in England by making our observations after sunset.

With regard to the general question, the difficulties of registering a true temperature are two:—(1) stagnant and unmixed air which may be at different temperatures in different parts of the same garden; (2) the proximity of bodies of large thermal capacity, which by radiation and convection mask the true air temperature. Kites and balloons when they have left the earth are free from these errors, excepting that No. 1 applies to a balloon which does not burst when swimming at its highest point. Since, however, stagnant air does not matter provided sufficient time is allowed, and in this case time is allowed, I do not see what source of error there can be save solar insolation.

My belief in the accuracy of the thermometric results obtained in England is based on inference from the following facts. If a good trace, together with the constants of the instrument, is given to two persons, they, working quite independently of each other, will get practically identical results. If the trace and instrument only be given to two persons, they, each calibrating the instrument for himself, will obtain similar results for temperature within the limits stated, but the agreement for height may differ by a kilometre or more in the higher parts. Hence I believe in the accuracy of the temperatures, but do not claim any great accuracy for the heights.

Now with reference to Dr. Chree's questions.

(1) Each station is held responsible for the accuracy of its own results, and I am not acquainted with the routine pursued at each individual station, but the general practice certainly is to test each instrument in spirit cooled by solid CO_2 both before and after each ascent.

(2) Answered above.

(3) No. The instruments used on the Continent are expensive, and being heavier require a more expensive balloon, and we have no funds with which to meet the expense, especially when it is remembered that balloons and instruments in England are lost about three times out of ten. We hope that this will be done on the Continent before long. W. H. DINES.

Classification of Secondary X-Radiators.

IN NATURE of February 13 there is a letter by Dr. C. G. Barkla and Mr. C. A. Sadler in which the authors divide the elements—according to the qualities of the secondary X-rays emitted by them—into four groups founded upon the atomic weights, without consideration of any other quality of the element. It may be of interest to mention that practically the same classification was given by me as early as 1896 in the *Naturwissenschaftliche Rundschau* (vol. xi., p. 485), and that this classification was also dealt with in a treatise published by Prof. Voller and myself in the *Annalen der Physik und Chemie* (vol. lxi., p. 88, 1897). To this treatise there is added a table printed directly by the secondary rays of a great number of elements, and this shows not only the great difference between the elements of the different groups, but also the agreement in the behaviour of the various elements of the same group. B. WALTER.

Hamburg, Physikalisches Staatslaboratorium,
March 2.

Gods and Godlings.

LEST some readers should infer from your obituary note on Sir Denzil Ibbetson (March 12, p. 443) that this distinguished anthropologist invented the word "godlings" for the rural deities of India, it is worth noting that "godling" was good English in the sixteenth century, and has never been allowed to drop. The Philological Society's "New English Dictionary" quotes Lambarde's "Perambulation of Kent" (1570–6) on raising altars "to this our newe found Godlyng"; and examples from Drummond of Hawthornden, Dryden, and Peter Pindar show the convenience of the word. Coleridge preferred "godkin" for a minor deity with masculine attributes, but sanctioned "goddessling." Charles Colton in 1675 permitted a certain cult of "little Goddikins"; Coventry Patmore regarded "godlet" as the more dignified appellative. Anthropologists have therefore had a fairly ample choice; but it should be added that in some of the above examples, at least, Dr. Murray and his coadjutors suspected a "jocular" intention.

DAVID PATRICK.

Edinburgh, March 14.

Tabulated Values of Certain Integrals.

IN NATURE, October 24, 1907 (p. 639), the integrals $x=\frac{k}{2}\int\cos u^2du$ and $y=\frac{k}{2}\int\sin u^2du$ are given. I shall be grateful if any of your readers can inform me where I can obtain tables of the numerical values of these integrals, or any other tables that will reduce the labour of the numerical calculation of them. C. E. ADAMS.

9 Telford Terrace, Oriental Bay, Wellington,
New Zealand, January 18.

CANADIAN GLACIERS.[1]

IN Dr. Sherzer's elaborate memoir on five glaciers in the Canadian Cordillera, we have a contribution to the study of ice-streams not less important than that recently undertaken by the Indian Geological Survey, which was recently noticed in these columns (p. 201). Easy of access, and thus well adapted for study, these Canadian glaciers lie between the 51st and 52nd parallel, that is to say, very nearly on the latitude of London; two of them, the Victoria and the Wenkchemna, being east of the continental divide, the third, the Yoho, west of it, while the Illecillewaet and the Asulkan glaciers are in the Selkirks. The peaks of each range often vary from ten to eleven thousand feet in elevation, rarely exceeding the latter, and though they form rather more continuous walls and exhibit less contorted strata, remind us of the Swiss Oberland, west of the Kanderthal. The ranges, in fact, are carved out of stratified rocks, the deposition of which began quite early in the Cambrian period (the crystalline Archæan floor being invisible in this region) and continued through Palæozoic and Mesozoic ages until the end of the Laramie. Then this enormous mass of sediment, supposed to measure from ten to twelve miles in thickness, was slowly bent up into a very broad and flattened arch—designated, inappropriately as we think, by the modern mongrel term, a peneplain—which was duly carved into peak and valley by the ordinary forces of subaërial erosion. Through Cenozoic (*sic*) ages until the beginning of the Pleistocene (why the diphthong should be abolished in one name and retained in the other we fail to understand) rain and rivers were the chief sculpturing agents, but with the latter, ice began to make its mark on the rocks. There was, in fact, a Glacial epoch here as well as in the European Alps, and Dr. Sherzer tells us that signs are found of two, and one case of three, advances of the ice, followed by retreats. We should have welcomed a rather more precise description of the materials deposited on these occasions than is conveyed by the terms "till" and "ground moraine," because the identification of the latter is often, as we know from experience, a function of the writer's imagination, but we infer that in this case the deposits alter in character as the distance from the present ends of the glaciers increases, much as they do in the Alps of Europe.

Photo. *Notman and Son, Montreal.*

FIG. 1.—Illecillewaet Glacier in 1888.

In the case of each glacier, very careful observations have been made on the present position of its end, the signs of advance or retreat, the nature and quantity of moraine, and the structure and other physical properties of the ice. No one of them is really large, the Victoria, of which the fullest description is given, not exceeding more than about three miles in length. Starting at Abbot's Pass (about 9500 feet) on the divide, its ice emerges from beneath the snow about 2000 feet lower down, and melts away after descending about 1500 feet more. According to the description, it exhibits all the features usual in an Alpine glacier—crevasses, moulins, stratification, blue bands, shear planes, a granular structure, and sometimes even the disputed capillary tubes. Observations were made to determine the rate of movement, which, if

FIG. 2.—Illecillewaet Glacier in 1905, from approximately the same view-point as Fig. 1.

[1] "Glaciers of the Canadian Rockies and Selkirks (Smithsonian Expedition of 1904)." By Dr. William Hittell Sherzer. Pp. xii+135. (Washington: Smithsonian Institution, 1907.)

these be confirmed, is unusually slow, a maximum of 65 feet a year.

The Wenkchemna receives the name of a Piedmont glacier, rather on the Bottom's dream principle, for, though formed by the lateral union of several short ice-streams (called "commensal" because they are fed from different sources), they come to an end high up in a mountain valley. The Yoho glacier, on the west side of the divide, is split into two by a rocky rib at its lower end, and is unusually free from surface débris. The Illecillewaet glacier, best known of those in the Selkirks, with its steep cascade of shattered *séracs*, forms an imposing feature in the landscape, but, as a comparison of the accompanying figures plainly shows, retreated considerably between 1888 and 1905. The Asulkan glacier is the smallest and most southern of the five, but is nevertheless a fine object.

Lakets, moraines, and other "leavings" of the ice show that all these glaciers have retreated in comparatively recent times, but more facts must be gathered before the periodicity of their movements can be ascertained. It is, however, as Dr. Sherzer points out, not unlikely to agree with the approximate thirty-five and a half years already inferred for other districts, and we may notice in passing that in these mountains the "Chinook" wind is a substitute for the Alpine "Föhn." He claims for glaciers a certain amount of erosive action—the scooping out of small lake-basins in favourable circumstances, and the conversion of valleys in their lower parts from V-shaped into U-shaped. The latter may be; but we cannot help remarking that in the Alps, where the ice at equal distances can hardly have been less in quantity, it seems to have been singularly incapable of effacing any pre-existent feature of importance. Dr. Sherzer also claims that ice can exercise a plucking action, but apparently only when passing over a much-jointed quartzite. Obviously, this would be the worst possible material for making *roches moutonnées*, but even here we should like a little more proof that the glacier has mastered the "art of pluck."

The so-called "bear den" moraines—piles of coarse broken rock without the usual infilling of fine material—seem to be one of the more exceptional features of this region. Dr. Sherzer regards them as records of "landslides" upon the ice from the higher peaks. That would explain their structure, but we doubt whether an earthquake is needed to start a "berg fall." Not to mention earlier instances, those near Elm in the Sernfthal and from Turtle mountain in Alberta occurred without any seismic disturbance. The prismatic structure in "ice dykes" is also remarkable, and recalls that exhibited in *glacières* and pond-ice—a subject once much discussed, among other places, in the first and second volumes of NATURE. On the whole, though sometimes, perhaps, a little too diffuse in describing the well-known, Dr. Sherzer has made a valuable and remarkably well-illustrated contribution to the literature of glaciers.

T. G. BONNEY.

THE FORTHCOMING MATHEMATICAL CONGRESS AT ROME.

AS was announced in NATURE for February 6, the fourth International Congress of Mathematicians will be held at Rome in the week before Easter. The congress meets once every four years, the previous places of meeting being Zürich, Paris, and Heidelberg. On this occasion the order of proceedings will be as follows:—

Sunday, April 5; Reception at the Aula Magna by the principal of the University, at 9.30 p.m. Monday, April 6: Inaugural meeting at 10 a.m. at the Capitol, at which Prof. Volterra will read a discourse on Italian mathematics in the last half of the nineteenth century. At 3 p.m. a general meeting will be held at the Reale Accademia dei Lincei for the election of a president and for the award of the Guccia medal, followed by two lectures. From Tuesday, April 7, to Saturday, April 11, the congress will meet in four sections every morning at 9 a.m., the subjects of the sections being (1) arithmetic, algebra, and analysis; (2) geometry; (3) applied mathematics; (4) philosophy, history, and teaching of mathematics. In the section of applied mathematics the subject of actuarial mathematics will be introduced by Prof. Toja for the first time at these congresses. On each of the afternoons of April 7, 8, and 10, two lectures will be given, commencing at 3.30 p.m. Thursday, April 9: Visit to the Palatine by invitation of the Minister of Public Instruction, at 3 p.m. Saturday, April 11: Concluding general meeting; arrangements for date and place of next congress. Ninth and tenth lectures. Sunday, April 12: Visit to Hadrian's villa and lunch at Tivoli.

In addition, a reception will be given by the municipality in the museum of the Capitol on some evening during the week.

The lectures arranged are as follows:—Darboux (infinitesimal geometry), Forsyth (partial differential equations of the second order), Hilbert (method of infinite number of independent variables), Klein (the "Mathematical Encyclopædia"), Lorentz (partition of energy between matter and ether), Mittag-Leffler (representation of functions of a complex variable), Newcomb (lunar theory), Picard (analysis and mathematical physics), Poincaré (subject to be announced), Veronese (non-archimedean geometry).

From March 25 to May 5 the Italian State railways will issue tickets at reduced fares to those attending the congress from the frontier stations, as well as for ten separate journeys in any part of Italy. In addition, all members are granted free admission to the principal museums and galleries in Rome between April 1 and April 12. The subscription is fixed at 25 lire (*il.*) for members, or 15 lire for those belonging to the family of a member who desire to enjoy the same privileges; but to obtain railway vouchers for the outward journey subscriptions have to be received before March 25 by the treasurer, Prof. Vincenzo Reina, 5 Piazza S. Pietro in Vincoli, Rome.

From the point of view of the English mathematician, the time fixed for the congress this year is somewhat inconvenient, as those who attend will doubtless wish to see something of Rome at the same time, and not only are our Easter vacations, as a rule, very short, but in many cases they do not even cover the period fixed for the congress. These difficulties could have been obviated by holding the congress at its more usual time in the summer vacation, and had this been done no inconvenience would probably have been experienced from the heat, though some people might have been deterred from attending owing to fears in this respect. In view of the fact that only seven Englishmen attended the last congress, it is important that everyone who can attend should do so this time, even if this involves an extension of their holiday beyond the ordinary limits of the school or college vacation. It would be a great pity if anyone were debarred from attending these gatherings merely for the sake of a week's teaching to a class of elementary pupils, and it is to be hoped that the governing bodies of our schools and colleges will not allow such small obstacles to stand in the way of their mathematical representa-

tives being present on such occasions. Otherwise there is a danger of their mathematical teaching running into a narrow groove. In regard to future meeting-places of the congress, this matter is, of course, decided at the final meeting in April, but it may not be out of place to express the hope that the congress of 1912 will be held somewhere within the British Isles. G. H. BRYAN.

PREHISTORIC CHEMISTRY.

ANCIENT Egypt always exercises an intense fascination for the student of the past, particularly as its written records are amplified by its "human documents" in the shape of mummies. This interest has, during the past few years, been intensified by the valuable series of anatomical studies on mummified remains which have issued from the Government School of Medicine at Cairo under the auspices of Prof. Elliot Smith. Not the least important of these is from the pen of Mr. W. A. Schmidt,[1] who has investigated mummified material of different epochs from the chemical and biological point of view. Some of the mummies he worked with carry us back to prehistoric periods, 6000 years ago, before the art of embalming as practised in later times was known to the inhabitants of the Nile valley.

It is remarkable that, in spite of this lapse of time, organic materials, which of all others are liable to decay, should still manifest in the test-tube their characteristic reactions. The presence of solid and volatile fatty acids, proteins, and cholesterin, with traces of intact fat, was demonstrable. The high percentage of fatty acids leads the author to the conclusion that they originate, not wholly from fat, but mainly from the body proteins. The formation of adipocere in the muscles of corpses left in water or buried in damp soil was adduced by the French observers in their work at the Morgue in Paris as evidence of the possible conversion of protein into fatty material. At the present time, however, the doctrine of the metabolic change of protein into fat is regarded with scepticism by most physiologists, in spite of the large amount of fatty acid radicals in the protein molecule.

The mummy protein, although it retains the general characters of albuminous material, has lost those specific properties which enable us to distinguish that of human origin from that which is found in other parts of the animal kingdom. In other words, it no longer gives what is termed the "biological reaction." This is disappointing, although it was doubtless expected. Mr. Schmidt also found that he could no longer detect hæmoglobin, and the substance regarded as blood by previous observers was doubtless composed of coloured gum and resin employed in embalming. In reference to the process of embalming itself, he was unable to find any soda; the so-called natrium bath really consisted of a solution of common salt. The old Egyptians simply pickled their corpses in brine, and the various balsams used were mere accessories which could have exerted no real influence on the process of mummification. The real agent at work here was undoubtedly the extraordinarily dry climate of Egypt, and it is this also which has acted as a preservative of the organic material which can still be identified.

The research reminds me of a small piece of work which was carried out by Dr. Otto Rosenheim[2] in my laboratory a few years ago. Small pieces of the carapace of a fossil Eurypterid were placed at his disposal by Sir E. Ray Lankester and Mr. Bather, of the Natural History Museum, and he was able to demonstrate in them the presence of chitin, their organic substratum. In this case one was dealing with prehistoric material compared with which an Egyptian mummy is quite recent. This kind of work appeals to the imagination, and one can only hope that if it is continued, still further light and interest will be thrown on the records of past ages.

W. D. HALLIBURTON.

[1] "Chemische und biologische Untersuchungen von ägyptischen Mumien-material, nebst Betrachtungen über das Einbalsamierungsverfahren der alter Ägypter." (Published in Max Verworn's *Zeitsch. f. allg. Physiol.*, vol. vii., pp. 369-392, 1907.)

[2] "Chitin in the Carapace of the *Pterygotus osiliensis* from the Silurian Rocks of Oesel" (Proc. Roy. Soc., vol. lxxvi., B, pp. 398-400, 1905).

DR. H. C. SORBY, F.R.S.

ON March 9, Dr. Henry Clifton Sorby, F.R.S., died, aged eighty-two, at his residence in Sheffield. The news of his death, although not unexpected, was received in the city of steel with profound regret, and those who had had the privilege of knowing Dr. Sorby felt that science had lost one of her greatest sons and that Sheffield must now look back upon "another yesterday." It is a little difficult for many of the inhabitants of "steelopolis" to realise that never again can they see the familiar figure hurrying along with bowed head, or the grave face, with, in its eyes, that far-off look which sees things beyond the ken of most men.

It is more than a little sad for those who could venture to intercept him with a "Good morning, Doctor," to know that never more can they receive his semi-startled, ultra-courteous recognition and hearty handshake, or again hear the cheery, almost laughing "*Good* morning. How are you?"

Combined with a complete absence of self-consciousness, two great personal characteristics of Dr. Sorby (which much handicapped him from the worldly point of view of non-scientific honours) were modesty and an immovable love of truth. The characteristic last named somewhat dimmed the brilliancy and lucidity of his papers, since in an enunciation he could never bring himself to omit any possible or even improbable qualification concerning the accuracy of the particular theory he happened to be formulating from his observed facts.

As a speaker Dr. Sorby could not claim to be an orator, but he had, nevertheless, a peculiar style all his own, by means of which he fully conveyed his meaning to his sympathetic audiences. Dr. Sorby belonged to a past generation of men of science the like of whom the world will do well to breed again. He loved science for her own sake, but so far from holding the view that science applied was science degraded, his almost child-like pleasure on hearing that some of his discoveries had been of practical use in the great workaday world was good to see. Dr. Sorby was not a family man, and though in easy circumstances he laboriously devoted his life to scientific research. The fact that those services to science were never adequately rewarded remains a permanent disgrace to the powers that be.

Turning from personal matters to the works of this great man of science, the writer is confronted by the fact that he must attempt the impossible task of compressing into a few hundred words an account of the labours of a versatile genius spread over a period of nearly sixty years, and embodied in about 240 papers, a number which, taking into consideration the length of Sorby's scientific life, corresponds to an average of four papers *per annum*.

His first research on sulphur and phosphorus in agricultural crops was published in 1847; his last paper on geology was written a few months before his death.

In 1849 Sorby founded the science of petrography, preparing in that year the first rock section ever examined by transmitted light. His alleged "wild ideas" as to the capabilities of this method were laughed at by the authorities of the period. Indeed, for a young man, not long past his teens, to attempt to upset the generally accepted dictum of de Saussure that mountains could not be examined by microscopes was regarded as bordering on presumption. In the early 'fifties, Sorby was much engaged on the subjects of the crystalline tetramorphism of carbon and the vexed question of slaty cleavage. In connection with the latter, in spite of rebukes, he persisted in his work, and in 1857 the young man of science buried both the electric and the 45° theories, by proving that slaty cleavage was due to the fact that lateral pressure on argillaceous rocks compressed them in one direction, elongated them in another, thus setting the small particles with their longest dimensions parallel, and so developing the characteristic structure in a plane perpendicular to the pressure.

In 1856 Sorby enunciated his now generally accepted theory that the Cleveland ironstone hills had been originally calcium carbonate, which had been gradually replaced by carbonate of iron derived from associated strata.

In the organic world Sorby did much work on colouring matters, and in this connection, for practical value, his microspectroscopic examinations of blood perhaps stand first. In 1865 he described his "new form of spectrum microscope" and the results registered thereby before the British Association. Proceeding upon information published by Hoppe, and two years later (1864) in greater detail by Prof. Stokes, Sorby exhaustively examined the microspectroscopic properties of red and brown cruorine and hæmatin, and from these figured no less than seven characteristic absorption spectra, showing incidentally that well-marked bands could be obtained from a minute blood-stain when only one-thousandth part of a grain of colouring matter was present. The importance of such marvellously delicate analysis was at once obvious to medical men and public analysts liable to be called upon to give evidence in criminal cases.

Sorby, the "Father of Petrography," was also destined to become the Father of Metallography.[1] His pioneer discoveries in petrography led him to the sagacious conception that steel itself might be a crystallised igneous rock; and in February, 1864, he placed in the hands of metallurgists for all time a new and most valuable method of scientific investigation.

On that date he read before the Sheffield Literary and Philosophical Society a paper "On a New Method of Illustrating the Structure of Various Kinds of Blister Steel by Nature Printing." In this paper he revealed the cellular structure of hard blister steel. He then attempted to produce artificial meteorites, but his efforts were not attended with success, because, as is known now, his experimental conditions were unsuitable, and it was not until 1904 that an "artificial meteorite" was described in NATURE on November 10, p. 32.

Sorby (as evidenced by the numerous carefully dated and initialled iron and steel sections now in the writer's possession [2]) worked on iron and steel metallography during the years 1863, 1864 and 1865, and, taking into consideration the meagre chemical data then extant, his final theory as to the nature of steel seems almost of the order of inspiration. He described crystals of nearly pure iron as consisting probably of interfering cubes and octahedra, and after a lapse of nearly forty-three years the accuracy of his conclusions (with only sectional planes to guide him) remains unshaken. In his "pearly constituent" (now called pearlite) he discovered a mineral the importance of which to mankind is still in this, the steel age, imperfectly realised. His "intensely hard constituent" is the cementite of the modern metallographer. The pearly constituent Sorby described thus:—"The optical characters of this substance led me to conclude that it had a very fine laminar structure before I was able to prove it by the use of high powers. It seems difficult, if not impossible, to explain its structure by supposing that it is an accidental mixture, whereas the facts are easily explained, if we suppose that it exists as a *compound*[1] at a high temperature, and breaks up into a *mixture* on further cooling, as more fully described in my paper on the use of high powers. For this reason it will be convenient to retain the name *pearly constituent* with the understanding that, *as seen when cold*, it is a mixture."

Persistent attempts to disprove the accuracy of Sorby's views of the nature of pearlite have, up to the present, consistently failed. Sorby's efforts to analyse pearlite quantitatively by micrographic means were, from the very nature of the problem, unsuccessful. He provisionally suggested that the hard plates constituted about 33 per cent. of the mass. Subsequent researches have shown that analyses on planes of section are misleading. The quantitative determination of the percentage and composition of these plates in pearlite occupied (in the metallurgical laboratories which were founded at Sheffield, largely owing to the energy and interest of Dr. Sorby) a period of three years, 1891–4, and was only accomplished by a triple attack conducted (*a*) by the microscope; (*b*) by quasi-quantitative pyrometric measurements of the heat of transformation of pearlite; and (*c*) by differential chemical analysis of the carbides as distinguished from carbon. The result obtained and now generally accepted indicated that in pure pearlite the percentage of hard plates always approximates 13.

It would occupy an inordinate amount of space even to summarise the results of Sorby's work conducted on his yacht *Glimpse* in connection with marine zoology. Dr. Sorby was a member of the Established Church, and made considerable researches in ecclesiastical architecture.

In concluding, it may be remarked that the final answer to the more or less good-natured derision with which his first rock section was regarded in 1849 was given, not by Dr. Sorby himself, but fifty-seven years afterwards by a cloud of witnesses at the centenary meeting of the Geological Society in February, 1906. Then many of the most distinguished foreign and British petrographers sent to the invalid man of science the following special message, expressing their "profound conviction of the important service rendered to the branch of geological science which they cultivate by the pioneer labours of Dr. Henry Clifton Sorby. They deplore the circumstances which prevent him from joining them on this interesting occasion, but beg to be allowed to assure him of their great admiration of his life's work, of their filial regard and deep affection."

Of Dr. Sorby it cannot be said that a prophet has no honour in his own country. Amongst the

[1] The attempt made by an American writer to transfer this title to a Russian metallurgist is best answered by silence.

[2] Some years ago the writer was exhibiting Sorby's pioneer sections of iron and steel at the Royal Institution, and was asked by an interested spectator, "How much each are you asking for them?"

[1] This is now known as hardenite (writer's note).

most treasured possessions of the University of Sheffield will always remain the marble bust of Sorby at the entrance to the Firth Hall, and his portrait, which hangs in the council room. So—his "task accomplished and the long day done."

"Beyond the loom of the last lone star, through open darkness hurled
Further than rebel comet dared or hiving star-swarm swirled
Sits he with those that praise our God for that they served His world."

J. O. A.

NOTES.

WE regret to learn at the moment of going to press of the death of Sir John Eliot, K.C.I.E., F.R.S., who until recently was the distinguished head of the Indian Meteorological Service.

AT the anniversary meeting of the Royal Irish Academy on Monday, March 16, the following were elected as honorary members of the academy in the section of science:—Sir Archibald Geikie, K.C.B., F.R.S.; Prof. J. C. Kapteyn, Groningen; Prof. A. A. Michelson, Chicago; Prof. J. D. van der Waals, Amsterdam; and Dr. A. R. Wallace, F.R.S.

IT is understood that provision will be made by the Canadian Government in the estimates for the coming financial year for a grant of 25,000 dollars (5000*l*.) by the Dominion Parliament towards the expenses of the British Association's visit to Winnipeg next year. The city of Winnipeg itself proposes to make a grant of 5000 dollars (1000*l*.). The week of the meeting will probably be from August 25 to September 1, 1909.

A MEMORIAL to the late Sir Leopold McClintock is to be placed in Westminster Abbey, with the consent of the Dean and Chapter. The memorial will consist of an alabaster slab, underneath the monument to Sir John Franklin, whose fate was definitely ascertained by Sir Leopold during his celebrated expedition on board the *Fox*. The inscription will be as follows:—"Here also is commemorated Admiral Sir Leopold McClintock, 1819–1907. Discoverer of the Fate of Franklin in 1859." The expense of the memorial has been undertaken by the Royal Society, the Royal Geographical Society, and Trinity House.

THE Canadian Mining Institute is arranging, in connection with its summer meeting, a general excursion to the mineral districts of Nova Scotia, Quebec, Ontario, and British Columbia, starting towards the end of August next. Members of the Institution of Mining and Metallurgy have been invited to take part in the general excursion (or any part of it) on the same specially favourable conditions as will be accorded to its own members. The Dominion Government, and the various provincial governments concerned, will cooperate in making the excursion a success, and the occasion will afford an excellent opportunity for engineers to inspect the important mineral areas of the Dominion.

THE second International Conference on Sleeping Sickness, to the proceedings of which attention was directed in our issue of last week, has terminated without being able to agree on the draft convention before it. Reuter's Agency states that the French and Italian plenipotentiaries declared themselves unable to accept a proposal, made at the last conference in June and then unanimously recommended, for the establishment of a central bureau in London. It was proposed that the work connected with sleeping sickness should be taken over by a hygiene bureau to be established in Paris, but this proposal the German plenipotentiaries declined to accept, and they strongly supported the British plan for the establishment of a bureau in London. The president (Lord Strathcona), the vice-presidents, and council of the Royal Institute of Public Health gave a dinner on March 11 at the Hôtel Métropole "to meet the delegates of the International Sleeping Sickness Conference." Lord Strathcona presided, and in proposing the health of the delegates to the international conference hoped that the result of that and successive conferences will be, if not to eliminate, at all events to mitigate the great scourge of sleeping sickness. Dr. Koch, in reply, said it is but the duty of medical men to investigate diseases. Especially is this the case with countries which, on account of their colonies, are particularly interested in certain dangerous diseases. Dr. Cureau expressed the thanks of the French delegates. The Marquis de Villalobar, Prof. S. Liquido, Colonel Lantonnois, Dr. Kopke, and Sir Walter Foster also replied.

THE Bakerian lecture of the Royal Society will be delivered on Thursday next, March 26, by Prof. C. H. Lees, F.R.S., upon the subject of the thermal conductivities of solids.

WE have received a copy of the introductory number of *Neue Weltanschauung*, a scientific journal to be published at Stuttgart in monthly parts at fourpence each. It appears that a Neue Weltanschauung Society has been established at Stuttgart which is to issue, not only the monthly journal bearing the same name, but likewise another publication at irregular intervals. We shall be better able to judge of the merits of the former when we receive one of the regular numbers.

IN the March issue of *British Birds* Mr. N. F. Ticehurst records a number of bird-bones obtained by excavating an ancient mound known as the Broch of Ayre, near the Bay of Ayr, in Orkney. The most interesting of these is an imperfect leg-bone of the great auk, a species hitherto unknown from the Orkney mainland. It would, however, remarks the author, be rash to take the evidence of such a specimen as proof that the bird was once an inhabitant of the mainland.

NO. 1579 of the Proceedings of the U.S. National Museum contains an interesting account of the mode of collecting the sap of the Mexican agave and manufacturing therefrom the national beverage known as *pulque*. When the agave is in the proper condition some of the leaves are stripped away so as to expose the central core of unfurled leaves; a year later the core is cut out bodily, and a hollow made in the base to serve as a reservoir for the limpid sap, which soon flows from the wound, and is stated to have a taste very like cocoanut-milk. The sap, or *aquamiel*, is drawn off by means of a siphon, and transported in skins to undergo fermentation, and thus be converted into pulque.

WE have been favoured with a reprint of a note published in the *American Naturalist* for December last, in which Mr. F. T. Lewis disputes the commonly accepted view that the mimicry among South American butterflies is connected with birds. The original mimicry theory, it is explained, has been so extended as to embrace and account for not only resemblances between an edible and an inedible form, but also between two inedible species. The author now raises the question whether the re-

semblances have anything to do with edibility, or the reverse, and quotes Werner and Weismann to the effect that they have not. One of the arguments used is that, as a general rule, birds do not molest butterflies to any great extent. The real explanation of the resemblances in question will, in the author's opinion, be supplied by a chemical theory of animal coloration.

THE third part of the Bergen's Museum *Aarbog* for 1907 contains a long article by Mr. C. F. Kolderup on Scandinavian glaciation. At the period of greatest extension, it appears that the whole country was covered with an ice-sheet moving in a westerly direction altogether independent of local contours. When, however, the ice began to diminish, the direction of movement gradually became more and more dependent upon that of the valleys, until finally the ice-sheet became resolved into a number of large isolated glaciers filling the latter. Some geologists admit only one great Ice age, and deny the intercalation of a warm period between two such maxima, during which the snow well-nigh disappeared from the Scandinavian highlands. The evidence of the moraines and their embedded shells is, however, in the author's opinion, amply sufficient to justify belief in such an intercalation. Indeed, the occurrence of several oscillations of level, with concomitant climatic changes, appears to be demonstrated.

THE Cotteswold Naturalists' Field Club has recently issued in part i. of its sixteenth volume a paper by Dr. C. G. Cullis and Mr. L. Richardson on the Old Red Sandstone conglomerate of the Forest of Dean, in which gold has undoubtedly been detected. A comparison with the "banket" beds of the Rand is made, favourable to the Forest of Dean so far as convenience in working goes; but the authors do not commit themselves as to the average gold-contents of the British deposit. The same part contains several papers on local geology, and a finely illustrated account of species of the terebratuloid genus Cincta, by Mr. S. S. Buckman. *Terebratula numismalis* here finds itself split up into a number of species of Quenstedt's genus Cincta, which has priority over several other names.

THE fourth part of vol. xx. of the Proceedings of the Geologists' Association (January, 1908, price 3*s*.) consists of a complete memoir by Dr. A. W. Rowe on the zones of the White Chalk of the Isle of Wight, with an index that includes all places and fossil species mentioned in this and in the four memoirs that have preceded it. Mr. C. D. Sherborn, who has often collaborated in this great zonal work, supplies coloured maps on a large scale, and the photographic illustrations are of extraordinary delicacy and beauty. Dr. Rowe's twelve years' labour is here brought worthily to a conclusion, and the necessity of accurate zonal collection, if one would study any sequence of fossil forms, is again set clearly before the reader. The true course of invertebrate evolution can, after all, be traced only by the painstaking methods of field observation inaugurated by William Smith at the close of the eighteenth century.

IN the *Bolletino* of the Italian Seismological Society Prof. Mario Baratta gives a detailed account of the methods of construction adopted in re-building the Calabrian villages destroyed in the earthquake of September 8, 1905. Frame buildings in wood, filled in with masonry or concrete, were largely adopted, and armoured concrete for the more important buildings. The report would have been of greater interest had it contained an account of the behaviour of these erections in the earthquake of October 23, 1907, which was said, in the daily newspapers, to have destroyed some of the newly built villages.

WE have received an advance copy of a paper by Dr. E. Oddone, to be published in the *Bolletino della Società Sismologica Italiana*, in which he makes the suggestion, already put forward by Prof. Milne in the last report of the British Association committee on seismological investigations, regarding the possibility of a causal connection between the two earthquakes on August 16, 1906, which occurred within about thirty-two minutes of each other, one in the northern Pacific, the other in Chile. This interval being approximately that which the wave motion of the second phase might be expected to take in travelling from the origin of the one earthquake to that of the other, it is suggested that the arrival of these waves was the determining cause of the time of occurrence of the Valparaiso earthquake. An objection to the acceptance of this suggestion is the uncertainty as to whether the second-phase waves are not extinguished before reaching a distance of 120° from the origin, that is to say, somewhat less than the distance separating the origins of the two earthquakes in question.

THE Queensland Geological Survey has issued a Bulletin (No. 216), by Mr. B. Dunstan, on the Great Fitzroy copper and gold mine, Mount Chalmers, Rockhampton district. The ore deposits, which have been known since 1860, occur in quartzite, which appears to be the result of the alteration of limestone. It is estimated that there is about 145,000 tons of ore still available, containing 4½ per cent. of copper, 3½ dwt. of gold per ton, and 1 ounce of silver per ton.

THE weathering of coal forms the subject of an investigation by Prof. S. W. Parr and Mr. N. D. Hamilton (University of Illinois, Bulletin No. 17). They find that an exudation of combustible gases from coal occurs from the time of breaking out of the sample from the seam, and that an absorption of oxygen accompanies the exudation. The process of deterioration is probably due to oxidation of hydrogen or of hydrocarbons. It may also be due to a simple loss of combustible gases and their replacement by oxygen. The extent of the deterioration varies with different coals, but the deterioration is probably most active during the first two or three weeks from the taking of the sample.

AN interesting monograph on the rural highways of Wisconsin, by Mr. W. O. Hotchkiss, has been issued (Bulletin No. 18) by the Wisconsin Geological and Natural History Survey. It covers 136 pages, and is illustrated by sixteen plates. The improvement of the rural highways of the State is a matter to which much attention has been devoted, and the author supplies useful information regarding methods of road construction. He gives a summary of the general principles of making roads, and discusses the conditions obtaining in the State of Wisconsin. In conclusion, he adds a digest of the laws of those States where legislation in the matter of roads has received most careful attention.

IN comparison with the thorough treatment of bridge trusses by eminent writers, very little attention has been devoted to roof trusses, and consequently the exhaustive study described by Dr. N. Clifford Ricker in the University of Illinois Bulletin, No. 16, forms a valuable addition to technical literature. The investigation had for its original object the determination of a formula for the weight of roof trusses more accurate than those in existence. Other

interesting results were incidentally obtained, and the Bulletin gives in detail the results obtained in reference to the formulæ for normal wind pressure, the system of calculation and design, the form of stress sheet, the formula for weight of truss, the comparative weights of trusses of various materials, the economical distance between trusses, length of panels and number of purlins per panel, the effect of raising the lower chord at the centre of span (from which no advantage results), and the most economical ratio of rise to span of roof trusses.

WE have received parts i. and ii. of the meteorological report of the Survey Department of Egypt for the year 1905. Part i. contains very complete hourly readings and means for each month at Helwan Observatory. Attention is directed to the well-marked daily and annual variations of wind direction and to its prevalence to the east of north, whereas in the Delta it is usually west of north. Part ii. deals with climatological stations, rainfall, and river-gauge observations in Egypt and the Sudan. The annual rainfall was in excess in the Delta and in the Sudan, but deficient in the Cairo district and over middle Egypt. The Nile flood did not reach its mean level at any time during the year.

A DISCUSSION by Prof. J. Schneider of the moon's influence on the wind components at Hamburg is published in vol. xxx. (1907) of *Aus dem Archiv der deutschen Seewarte*. As the work was undertaken principally with the view of ascertaining whether any daily or half-daily influence was exhibited, only the observations for the six winter months, 1887–1896, were used, so that the influence of the sun might be eliminated as much as possible. Among the various results, we note that from the records of the best anemometers the moon's influence is shown to be practically imperceptible in the daily range; the results for anomalistic months show that both components (W.-E. and S.-N.) apparently increase with the approach of the moon to the earth, and decrease as it recedes. The values are tabulated in various ways; for details we must refer to the paper in question.

IN the Bulletin of the Manila Weather Bureau for March, 1907, Father Algué gives an account of a typhoon of extraordinary intensity which visited the Caroline Islands in that month. The storm apparently formed to the south of Ponape (Eastern Carolines) between March 24 and 26, and moved in a W.N.W. direction to Wlea (Western Carolines), where it arrived on the morning of March 29; by the afternoon of March 30 it reached Mackenzie Island (lat. 10° N., long. 140° E.), when it began to re-curve to the N. and E., passing to the N. of the Ladrones Islands (lat. 20° N., long. 145° E.) on the evening of April 3. In the Wlea group the destruction was almost complete; immense waves carried away houses and everything in their path, and some 200 persons perished on two of the islands. At 7h. 30m. a.m. on March 29 the barometer there read 28·58 inches, and fell rapidly to 27·24 inches at 10h. a.m.; at 4h. p.m. it had risen to 29·10 inches. The wind blew with typhoon force from N.N.E. and N.E. from 3h. a.m. to 10h. a.m., and then shifted to S.E. and S.W., and was still blowing a hurricane from S.S.E. at 8h. p.m. The influence of the storm was not felt in the Philippines, but owing to the vigilance of Father Lopinot, observer at Yap (Western Carolines), who took hourly observations during its passage in that locality, the Manila Observatory was enabled to give timely warning of danger in the Pacific to China and Japan when the cyclone centre was some 1100 miles distant.

FROM Messrs. C. F. Casella and Co., of 11, Rochester Row, Victoria Street, S.W., we have received a set of the "Stonyhurst Sun Discs" which they have recently issued. These discs have been made at the suggestion, and with the assistance, of Father Cortie, and are similar to those used at Stonyhurst College Observatory for a number of years for the determination of the heliographic positions of sun-spots and faculæ. Each set includes eight discs, and on each of these is a true orthographic projection of the parallels of latitude and longitude corresponding to the value of the declination of the sun's centre, from 0° to ±7°, for each period of the year. The discs are 6 inches in diameter, and are nicely printed on cardboard, for use with a projected image of the sun, or on transparent glazed linen for use with a drawing of the solar disc. Each set is enclosed in a strong cloth wallet, and may be obtained from the above firm at the price of 10*s*. 6*d*. per set.

THE January number of the *Astrophysical Journal* contains a very suggestive article, by Mr. E. Goldstein, of Berlin, on the two-fold line spectra of chemical elements. Mr. Goldstein has found, during a long series of experiments, in which he produced his spectra by employing heavier condenser discharges than have hitherto been employed, that he could replace the well-known spectra of the alkali metals rubidium, cæsium, and potassium by an entirely new line spectrum. Previous workers have found some of the new lines appearing with the arc spectra, but have not succeeded in eliminating the latter; in Mr. Goldstein's spectra, however, the new sets of lines appeared alone. As the lines of the ordinary arc spectra fit themselves into series, whilst the new lines fit into no series, it appears that powerful discharges extinguish all the series lines and replace them by non-series lines in the case of the three metals named. In the case of sodium, Mr. Goldstein has not yet succeeded in eliminating the series lines, only in weakening them, whilst in the case of lithium the effect is still less marked. As the density of the discharge necessary to affect the transformation from the series to the non-series, or "fundamental spectra" ("Grundspectra"), lines appears to increase as the atomic weights decrease, it may be that increased experimental facilities will bring sodium and lithium into line with the other three alkalies. Amongst a number of other important suggestions, reference is made to the possibility of the ordinary, or "series," line spectra being emitted by regular groupings of particles which, when subjected to a heavy condenser discharge such as was employed in the present experiments, are broken up, leaving single particles which emit the single uncorrelated lines of the "fundamental spectra."

THE firm of Gustav Fischer (Jena) has published an address on the modern analysis of psychical phenomena delivered by Prof. A. Hoche at the congress of German Naturalists and Physicians held at Dresden last September. Dr. Hoche, who spoke from a point of view that would exclude all quasi-metaphysical discussion from psychology, characterised the present phase of the science as one of "spade-work" carried out by many hands over a wide area, such as commonly recurs after a period of rapid deepening and widening of our conceptions. Progress has presented itself in the form of new demands upon psychology, followed by the appearance of new methods of investigation and the conception of new aims for its efforts. Under the first of these headings fall the applications of psychology to the scientific study of

history and religion, as well as to matters of legal and medical interest. Among the new modes of investigation are the comparative methods, which have to a great extent taken the place of the older introspection; the experimental method, which commands most attention in the present day; and the pathological method, which, taking advantage of nature's own experiments, has thrown much light on the real character of the contents of some parts of our normal experience. Finally, the newer aims of psychology include the attempts to classify actual personalities with reference to standard equilibrated types, and to find a field for practical applications in pedagogy and in the treatment of criminals.

AT the suggestion of Prof. A. A. Michelson, Mr. L. E. Gurney, of the University of Chicago, has investigated the viscosity of water at very low rates of shear in order to determine whether any change in its value occurs when the motion of the liquid is slight. The water was enclosed between concentric cylinders, the outer one of which was rotated at a measured rate about its axis, while the inner one was prevented from rotating by means of a couple of measured moment. For rates of shear varying from 5 radians down to 0·66 radian per second the author finds no evidence of an increase of viscosity as large as 1 per cent. (*Physical Review*, January).

IN the *Physikalische Zeitschrift* for March 1 Dr. W. Lohmann describes his measurements of the Zeeman effect for the principal lines of helium. The helium tubes were placed in cylindrical holes bored through the pole pieces of the electromagnet in such a way that the electric current through them flowed parallel to the magnetic field. The separation of the outer from the middle lines of the triplets produced was observed by means of an echelon spectroscope. Dr. Lohmann finds that the separation measured on the scale of reciprocal wave-lengths, *i.e.* the quantity $d\lambda/\lambda^2$, where $d\lambda$ is the observed change of the wave-length λ, is the same for the whole of the nine lines of helium observed, and is proportional to the strength of the magnetic field used. He considers this result points to an extremely simple form of helium atom.

PROF. AUGUSTO RIGHI announces the discovery of a new type of rays in the *Rendiconti dei Lincei* for February 2. It was Plücker who first observed that kathode rays, immersed in a strong magnetic field, trace out the magnetic lines of force. This is now held to mean that the projected electrons really describe high-pitched spirals about the lines of force, which nearly coincide with those lines when the field is very strong. Now Prof. Righi has found that these rays do not, as a rule, convey an electric charge. They are therefore not simple kathode rays. They are more probably sets of molecular magnets, constituted by electrons revolving about positive atoms in the planetary fashion. Such systems would possess considerable stability in a magnetic field of the same sign. They would not, of course, carry an electric charge, being themselves neutral combinations, but less close than ordinary chemical combinations. As the field gets weaker, the orbits would open out, and the system would be retarded, and might even return to the kathode. Prof. Righi has found evidences of such return. He proposes the term "magnetic rays" for the new radiation.

A WORK on "Stone: Quarrying and Preparation for the Market," by Mr. A. Greenwell and Mr. J. V. Elsden, will shortly be published by the Chichester Press, Furnival Street, London, E.C.

THE thirty-eighth annual report of the Wellington College Natural Science Society has been received. It deals with the society's work during 1907, and serves to show that the activity of the members is well maintained. A complete meteorological report for the year is included in addition to the proceedings of the society.

THE Royal Swedish Academy of Sciences is publishing a new edition of Swedenborg's scientific works in Swedish and the original Latin. The first volume has appeared, and two others are in the press. These three volumes include Swedenborg's contributions to geology, chemistry, physics, mechanics, and cosmology. Introductions are provided to the various volumes, that to the first by Prof. Alfred G. Nathorst, and those to the second and third by Prof. Svante Arrhenius, while those for forthcoming volumes on anatomy and physiology will be by Profs. Gustaf Retzius and S. E. Henschen respectively. The volumes are being edited by Mr. A. H. Stroh, of Philadelphia, and the price of each volume is 8*s.*, payable in advance.

THE general report on the operations of the Survey of India administered under the Government of India during 1905–6 is now available. It has been prepared under the direction of Colonel F. B. Longe, R.E., Surveyor-General of India, and deals with the operations of the department for the survey year ending September 30, 1906. It appears that the total out-turn of detail topographical and forest surveys on all scales was 23,312 square miles, against 26,340 square miles of similar surveys during the previous year, and that no surveys on a smaller scale than 1 inch equal to the mile were carried out during the year. The total area triangulated or traversed for topographical or forest surveys was 27,134, against 19,265 square miles for the previous year. The total area of cadastral and special surveys was 2982 square miles, and the area traversed was 6464 square miles, as compared with 7305 square miles of survey and 6398 square miles of traversing in 1904–5. Among special observations during the year may be mentioned systematic vertical observations of the Himalayan peaks of Kedarnath, Srikanta, Jaunli, Bander Punch, and Nanda Devi from stations near Dehra Dun; if this series of observations can be continued over five or six years the varying effects of refraction and snow-fall will be deducible. Pendulum observations were carried across the plains of the Punjab from Simla to Quetta, and the results have proved that a zone of excessive density crosses the Punjab plains from north to south, underlying Montgomery, Ferozepore, and Mian Mir. The field work of the magnetic survey over different portions of the country has been continued and extended.

OUR ASTRONOMICAL COLUMN.

A POSSIBLY NEW SATELLITE TO JUPITER.—A note in No. 4237 of the *Astronomische Nachrichten* (p. 207, March 6) announces the discovery of a new minor planet, or, possibly, a satellite, near Jupiter. The object was discovered by Mr. P. Melotte on a plate taken by him with the 30-inch equatorial reflector on January 27, and is of the sixteenth magnitude; it has been observed at Greenwich on seven nights since that date, and Prof. Wolf photographed it at Heidelberg on March 3. Should this faint object prove to be a minor planet, its temporary designation will be 1908 CJ, and it will probably prove to be a unique object, as regards its orbit, of its class. But it seems likely—so far as can be judged from the few observations yet made—that it is, really, an eighth member of Jupiter's satellite system, and if this is so it is probably the faintest and most distant yet discovered.

OBSERVATIONS OF JUPITER DURING THE PRESENT OPPOSITION.—M. P. Vincart, of Antwerp, to whom we referred in our issue of January 16 (No. 1994, p. 259) as having made his own reflector, describes his more recent observations of Jupiter in No. 3 of the *Gazette Astronomique* (p. 27). On February 5 the shadow of the fourth satellite, projected on to the bay of the Red Spot, appeared elongated, and was encircled by a brilliant halo where it came in contact with the Red Spot. On February 13, despite prolonged attention, M. Vincart was unable to find the least trace of the regular markings recently described by Mr. Bolton.

M. Vincart states that with his instrument he is able to separate, clearly, the components of γ^2 Andromedæ, whilst with the naked eye he is able to count thirteen stars in the Pleiades and to see Jupiter's third satellite when at its elongations.

RECENT OBSERVATIONS OF VENUS.—The third number of the *Gazette Astronomique* (February 29, p. 21) contains an interesting description, by Mr. J. M. Harg, of Lisburn, Ireland, of his recent observations of Venus, made with refractors of 104 mm. and 123 mm. aperture, and using a magnifying power of 200. Four sets of markings were recognised from time to time during the period December 29 to January 20, and are illustrated by the drawings accompanying the note. The first, in longitude 180°, is a long oblique shadow; the second is in longitude 270°, and is an irregularly shaped marking showing numerous details in its outline; the third is a doubtfully permanent, double marking in longitude 0°; and the fourth is of a curiously bent form in longitude 90°. Mr. Harg's observations indicate that the rotation period does not exceed 23h. 28m.

THE SYSTEM OF ζ URSÆ MAJORIS (MIZAR).—Prof. Frost, in a brief note communicated to No. 4235 of the *Astronomische Nachrichten* (p. 171, February 29), confirms Dr. Ludendorff's observation of the variable radial velocity of the fainter component of ζ Ursæ Majoris, but states that the Yerkes spectrograms show a greater range of velocity, varying from −17 km. to +10 km. per second; the period of the variation cannot yet be stated.

The plates of Alcor, the naked-eye companion to Mizar, show that the radial velocity of this star also is variable, the changes in the spectrum being so rapid that it has been found necessary to take spectrograms in continuous succession for several hours; it seems probable that the period will be found to be exceedingly short. A qualitative examination of the spectra obtained shows that the 4481 Mg line and the hydrogen lines are sometimes double, sometimes single. The displacement of the 4481 line with respect to the Ti line of nearly the same wave-length also varies considerably.

MARS AS THE ABODE OF LIFE.—The title of Prof. Lowell's article in the March number of the *Century Magazine* is "The Sun Dominant," and in it the author discusses the analogies between areographical and terrestrial conditions. The evolution of the conditions of habitability on the earth is described, and it is shown that the same kind of evolution is probably taking place on Mars. From the fact that the same species of animals, often the same individuals, are able to sustain life under the vastly different conditions of temperature and atmospheric pressure exhibited at various altitudes in the Andes and similar mountain ranges, it is argued that the variations of temperature and the constant lowness of the pressure on Mars should prove no bar to the possibility of living creatures existing there. The presence of water—demonstrated, since the article was written, by Mr. Slipher's spectrograms—and of vegetation are also discussed, and the article concludes with a discussion of the mode in which the presence of organic life is manifested.

THE VARIABLE STAR 31, 1907, AURIGÆ.—A telegram from Prof. Hartwig, published in No. 4238 of the *Astronomische Nachrichten* (p. 223, March 9), states that the variable star 31, 1907, Aurigæ, which he has found to be of the U-Geminorum type, was of the ninth magnitude on March 6, having increased four magnitudes in one day, whilst within eight days it was less than the fourteenth magnitude.

THE CARNEGIE INSTITUTION.

THE "Year-book" for 1907 of the Carnegie Institution of Washington is now available. It contains the minutes of the last meeting of the board of trustees, the reports of the president, Prof. R. S. Woodward, and the executive committee of the institution, and the reports on investigations and projects. The volume, of 230 pages, serves excellently to indicate the admirable work in science which is being done by means of the grants made by the institution. The subjoined summary of the reports shows the position of the institution and some of the directions in which progress was made during the past year.

At the meeting of the board of trustees in December last a letter from Mr. Andrew Carnegie was read announcing his intention to add 400,000*l.* to the endowment of the institution. The financial statement for the year ending October 31, 1907, shows that the assets of the institution, including real estate and equipments, amounted to nearly two and a quarter millions sterling, the endowment being 2,000,000*l.* At this meeting of trustees the following general appropriations were made for the present year:—publication fund, 10,000*l.*; administration, 10,000*l.*; grants for departments and large projects, 75,988*l.*; and for previously implied grants, new minor grants, and research assistants, 10,000*l.*

The report of the president for the financial year 1906–7 shows that the amounts available during that year were:—for large grants, 109,538*l.*; for minor grants, 15,226*l.*; for research assistants, 5080*l.*; and for publication, 16,400*l.* The aggregate receipts from interest on endowment, interest on deposits in banks, sales of publications, and miscellaneous items, amounted to 578,274*l.*

From the income of the institution during the last six years there has been spent, for large projects, 240,462*l.*; for minor and special projects, 138,530*l.*; and for publication, 28,117*l.* The gross sums allotted to large projects since the organisation of the institution amounted to 271,237*l.*, and for minor projects and research assistants to 156,936*l.*

The report of the president also summarises the work of the various departments of the institution. The department of botanical research is engaged on a series of problems the elucidation of which cannot fail to be of the greatest interest and value, whether applied to the restricted field of botany or to the broader domain of biology. By means of observation, experiment, and measurement it is proposed to determine, as nearly as may be, the conditions of development, growth, distribution, migration, and variation of desert plants. Thus, in addition to systematic studies of the forms and distribution of these plants, there must be carried on studies of the factors of temperature, rainfall, evaporation, soil moisture, and anatomical and physiological adaptability. The location of the desert laboratory in a country affording a wide range of plant-forms, as well as a wide range of conditions in altitude, temperature, soil-moisture and soil-composition, presents unequalled opportunities for such studies. Along with these lines of work, the anatomical, physical, and physiological researches of the department staff have already resulted in noteworthy contributions to biological science.

The work of the department of experimental evolution is progressing favourably along lines explained in preceding reports, the principal problems under investigation being those of heredity in plants and animals.

The completion and occupancy of the geophysical laboratory mark a noteworthy advance in the progress of the novel and difficult experimental work carried on in this department of research.

The experiments and investigations of Mr. Luther Burbank in horticulture, and the work of preparing a scientific account of his methods and achievements, are progressing as favourably as the available division of time and labour will permit.

During the season under review, as hitherto, the department of marine biology has extended its laboratory and collecting facilities to specialists in zoological research, eleven such guests having availed themselves of the opportunities afforded at Dry Tortugas and in the adjacent

regions accessible by means of the vessels of the department.

The work of the department of meridian astrometry during the year was mainly devoted to preparations for its larger enterprise of a comprehensive catalogue giving accurate positions of all stars from the brightest to the seventh magnitude, inclusive. Amongst these preparations

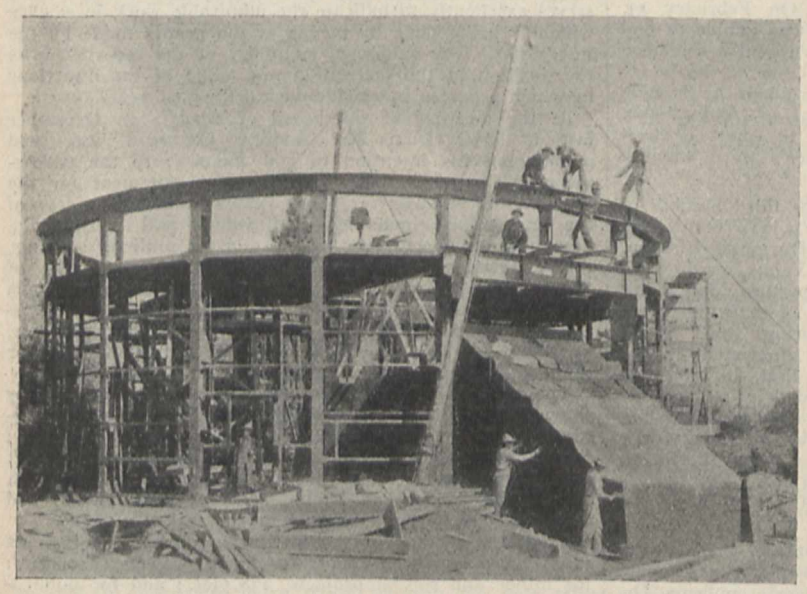

FIG. 1.—Steel Building for 60-inch Reflector, Mount Wilson Solar Observatory.

is a preliminary catalogue, embracing the precise positions for upwards of 6000 stars, which has been brought to substantial completion during the year. This will not only be of great service to the department, but it will be of signal aid also to astronomical science in general. Preparations for the establishment of a temporary observatory in the southern hemisphere are likewise approaching completion. An exhaustive study of the meridian instrument to be used at this observatory has been made, so that its constants and peculiarities may be well known before observations with it are begun.

In conformity with the provision made by the board of trustees at its last meeting for the establishment of a laboratory to be devoted especially to an extension of the physical and chemical investigations in nutrition carried on hitherto under the direction of Profs. Atwater and Benedict, steps were taken early in the year to select a suitable site and to prepare tentative plans for the building. Since experiments on men in an abnormal as well as in a normal condition of nutriment are contemplated, one of the first requirements of a site was proximity to hospitals, whence pathological cases may be furnished. It was decided to establish the proposed laboratory in the city of Boston, near the power-house of the Harvard Medical School.

The work of the solar observatory is still largely in the preparatory stage, and is thus as much a work of engineering as of astronomy. The novelties of construction, equipment, and programme of research for the observatory, along with the initial difficulties presented by a mountain site, conspire to make the undertaking a formidable one.

The optical parts of the 60-inch reflecting telescope have been made ready for mounting, but owing to the labour strikes at San Francisco the completion of the dome for the telescope may delay its erection until the spring of 1908. The novel tower telescopic apparatus, part of which is above and part below the ground-level, has been substantially completed. This consists essentially of a vertical telescope with a 12-inch objective and 60 feet focal length in combination with a Littrow grating spectrograph of 30 feet focal length, thus furnishing a powerful component in the battery of instruments for direct observations of the sun.

Preparations for grinding, figuring, and testing the 100-inch reflector, the construction of which was rendered possible by the gift of Mr. J. D. Hooker, have likewise gone forward. A fire-proof building for this work has been constructed, and the necessary grinding machine is nearing completion. In the meantime it is expected that the Plate Glass Company of St. Gobain, France, will soon have the large disc for this reflector ready for shipment, since it was successfully cast on August 28 last. In the rough, this disc will weigh about 4·5 tons.

Simultaneously with these varied works of construction, daily photo-heliographic and spectroheliographic observations have been made by aid of the Snow telescope. Daily studies of the sun and sun-spot spectra have supplemented these observations, and to them have been added pyrheliometric and solar magnetic measurements, along with numerous laboratory investigations bearing directly on the physical properties of the sun.

The year for the department of terrestrial magnetism has been one of varied activities, and one specially fruitful in the quantity and quality of the results attained. The operations have embraced magnetic surveys of the North Pacific Ocean; surveys on land in Alaska, Bermuda Islands, Canada, Central America, China, Mexico, and South Pacific Islands.

The list of publications issued during the year shows

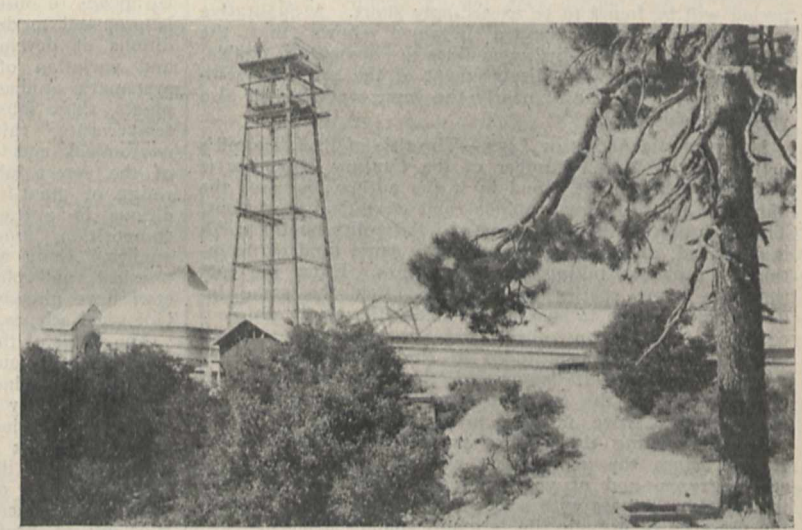

FIG. 2.—Vertical Cœlostat or Tower Telescope, Mount Wilson Solar Observatory.

that thirty-eight volumes were published, with an aggregate of 3428 quarto pages and 6284 octavo pages respectively. Moreover, there are now in the press twenty-three volumes. The total cost of completed publications issued during the five years ending with that under review reaches 33,897*l*. As regards the general aspects of this subject, there are indications of over-production in the line-

of scientific publications. The world appears to be accumulating knowledge faster than it can be assimilated. Even by aid of the comprehensive bibliographies now issued, it is difficult, if not impossible, for the specialist to become conversant with the current literature of his own field. On the other hand, the standard of excellence in publications is undoubtedly higher now than at any previous epoch, although it may not have kept pace adequately with the increasing productivity of our times.

SOME LONDON PROBLEMS.

London's Traffic.

THE deputation a short time ago from Browning Hall to the London County Council, and the numerous references which have been made in Parliament and elsewhere to the question, make it appear likely that before very long steps will be taken by the Government to establish a Traffic Board for London. In fact, the President of the Board of Trade has given us to understand that his department is in favour of it, and that he will endeavour to get the matter settled without delay; for the new Traffic Department of the Board of Trade cannot be anything but a temporary step.

Among the mass of valuable information collected by the last Royal Commission not the least interesting was that dealing with the history of this problem, for the London traffic problem is almost as old as the city itself. From the earliest days London has suffered from the congestion of its narrow streets, arising from the accumulation of traffic and the encroachments of buildings, and just as at the present day so in previous centuries every attempt made to widen individual streets or to provide increased facilities led to such an increase of traffic in that particular avenue as to render the final state of congestion worse than before. Nothing is more characteristic of the traffic problem than this phenomenon, that every increase of facilities produces an increase of traffic, and so on.

Spasmodic attempts had been made by the corporation of London and other bodies to widen streets here and there, and during the earlier part of the seventeenth century several proposals were brought forward, but were shelved owing to the state of politics at the time.

After the Restoration, however, and just before the Great Fire, an Act was passed for repairing and enlarging the streets with the express object of improving traffic, stating that many streets were too narrow for vehicles. It is interesting to note, however, that increased traffic was anticipated, and the Act also provided for the regulation and licensing of hackney carriages; but immediately after came the plague and the fire, after which a new Act was passed. This was London's great opportunity, and both Sir Christopher Wren and John Evelyn brought forward comprehensive schemes for rebuilding. Had either of these been followed, untold millions would have been subsequently saved to London. It would to-day have been one of the most orderly and carefully laid out cities, with great avenues radiating from the centre. Had this taken place the subsequent growth of the suburbs would have naturally followed on the same plan, and the present heterogeneous arrangements of suburban streets would have never grown up.

In the eighteenth century the conditions were very analogous to those of the nineteenth. If we suppose mail coaches for railways, riding horses for bicycles, hackney carriages for cabs and motors, we see that London was even then provided with a considerable variety of means of transport.

The first Parliamentary Committee upon metropolitan traffic met in 1830, the matter being brought into prominence by the imminence of railways being built in the London district. Other committees succeeded, and in 1842 a Royal Commission was appointed under the Earl of Lincoln, the Commissioner of Woods and Forests, as chairman; various improvements were therein suggested, but it was not until 1853 that Parliament gave a definite start to the modern idea of London local government.

In 1845 the need of improved means of locomotion were realised, and no fewer than nineteen Bills were promoted in that year dealing with railways in the metropolitan district, at least one of them containing the suggestions for a metropolitan central station.

Not until 1854, however, did the first underground line from Paddington to Farringdon Street receive Parliamentary sanction. It was opened in 1863, and was followed by the construction of a similar line from Victoria to Kensington in 1868, but the inner circle was not completed until 1884.

London's Port.

The chief difficulty under which London suffers in connection with its port, as in connection with so many other matters, arises from its age. It is so much older than its rival ports that steps which are taken by them so as to keep them up to date are rendered far more difficult in the case of London. Nothing is easier than to point to Rotterdam or Liverpool as examples of what might be done, but those who do so too often forget the fact that the Port of London has a history of 500 years, compared with less than a century of serious trading in those other ports. The Port of London question is a good, nay, one of the best, examples of the truth that "circumstances alter cases."

The result is that there are an inordinate number of authorities concerned in dealing with the question, and an inordinate number of vested interests to be considered. Moreover, the conditions of transport have changed very materially. In the Middle Ages London was the *entrepôt* for the whole of western Europe. The East Indiamen unloaded there, and their cargoes were distributed by smaller vessels over the whole of western Europe. At the beginning of the nineteenth century, however, trade began to go to other ports. The rise of Liverpool, Glasgow, Hamburg, Antwerp, &c., means that the population surrounding those ports are now no longer supplied from London. Nevertheless, the great increase of population in London itself and all England as a whole, maintains the actual amount of traffic coming into London at its former figure, and London acts as a distributing centre for 10,000,000 to 12,000,000 persons.

The control of the Thames is in the hands of the Thames Conservancy, the dock companies, the Trinity House, the Corporation of the City of London, and the County Council, while the wharfingers and lightermen also have most important interests.

In Liverpool, on the other hand, or in Glasgow, the Harbour Trust has practically a monopoly of authority, and this enables a policy to be adopted which is far less trammelled by outside interference.

Certain of the docks in London are so old that it is impossible to think of modernising them in any way, but the India Docks could undoubtedly be very much improved, while the Tilbury Docks are said to be capable of docking nearly any ship at present afloat. The problem of docking, however, is one that has to be constantly altering on account of the growth of steamships. Hence docks, if they be large enough to-day, would, in a few years' time, be too small, and any docks which are now constructed, in order to have something in hand, need to be of the order of 1000 feet in length. It is not, however, in length that the docks are so much lacking in London, but in the depth of the sills, which render it impossible for vessels of more than 30 feet to enter, for the Royal Albert Dock can take ships up to 536 feet long.

New York and Boston are arranging for 40-feet channels into their ports and steamers are to-day leaving Baltimore loaded down to 32 feet, whereas, at the present time, a ship drawing only 28 feet may be delayed for five hours in the Thames on any day.

What is really wanted is a channel at least 30 feet deep at low tide and 1000 feet wide, as far as the Albert Dock gates, and 1000 feet is not at all too wide to allow a 750-feet vessel to be turned.

Numbers of schemes are constantly being brought out dealing with the port, such as the Thames Barrage Scheme of last year, in which the whole river was to be docked

from Gravesend upward, providing for deep-water quays. Less ambitious proposals are the docking of the River Lea and the provision of jetties at Canvey Island, and minor alterations of the docks. All these are, however, matters which should be dealt with by the Trust if one be appointed.

LONDON'S ATMOSPHERE.

Several causes have recently combined to direct attention to the question of London's atmosphere. The memorandum issued last year by the First Commissioner of Works relating to the damage done to vegetation in the parks, the recent report by the L.C.C. upon the regulation of the smoke nuisance, and the invention of several smokeless fuels, have alike brought home to the public the fact that we have as yet only touched the outskirts of the problem of smoke nuisance. Useful as the various palliatives suggested may prove, consideration of them must always ultimately lead to the fundamental question, Why should any fuel be burned in London at all?

From its position in the Thames Valley, London will probably always be subject to white fogs, and the presence of six million human beings and numerous animals must always be the cause of great pollution of the atmosphere. There is all the more reason, therefore, for seeking some way of reducing or removing the present consumption, within the metropolitan area, of nearly fifteen million tons of fuel annually. Regulations and the use of smokeless fuels would undoubtedly be a move in the right direction, and might to some extent reduce the amount of the visible products of combustion. They would, however, hardly affect that equally important side of the problem, the production of carbonic and sulphurous acids. To do this to any considerable extent means the ultimate abolition of the consumption of fuel in the metropolitan area. Utopian as such a step may appear at the present time, the evidence tendered before Parliament during the past few years in connection with the proposed supply of electric power shows that the establishment of a large central system would have undoubtedly tended in this direction.

This result involves two steps:—

First, the reduction, by the adoption of improved methods, of the total quantity of coal burned to produce the power required in the metropolitan area; and, secondly, the removal of the place of combustion to the metropolitan limits.[1]

These two results can only be secured by the general substitution of electric power for other forms.

Let us now consider to what extent it is to-day practicable for electricity to replace the direct combustion of coal in various industries.

Owing to the high price of electricity, the use of gas for street lighting is in many cases still quite as cheap as the electric light, while there are still many parts of London where power derived from gas engines is even cheaper than the supply of electric power at present available; but the abolition of gas for lighting the streets and for driving gas engines will certainly follow its abandonment for lighting purposes in good private houses, if only the price of electricity be reduced sufficiently low. The flame arc lamp, containing as it does the necessary rays for piercing a fog, removes the objections which apply both to ordinary arc lamps and to incandescent mantles, and is the most suitable system of lighting for important streets which one could have. If electricity were available in London at a maximum price of $\frac{3}{4}d.$ a unit for street lighting, there would be a great saving effected over every other system of lighting now in use. At the present time, however, interior electric lighting is chiefly used in the West End and in large shops and offices where the price is a secondary consideration, while public lighting is only done widely where the municipality itself provides the current. It cannot be said to have penetrated the poorer quarters in the way that gas has done by means of penny-in-the-slot meters, which it was recently stated bring in to the Gas Light and Coke Company 1,000,000*l.* per annum; but at $1\frac{1}{2}d.$ to $2d.$ per unit, electric light would certainly be cheaper than any gas which is being sold in the metropolitan area to-day.

The adoption of electricity for suburban traffic is long past the experimental stage, and provided power can be obtained sufficiently cheaply, there is nothing to prevent all the railways in London being driven electrically. The experience already obtained on the North-Eastern Railway, where the heavy suburban traffic is handled electrically, or at Liverpool or on the Underground Railway, has shown this. That the haulage of main-line trains by electricity in suburban areas is also feasible is proved by the fact that the two most important railway companies in New York—the Pennsylvania and the New York Central Companies—have arranged to haul the whole of their main-line trains by electric locomotives while in the suburban districts.

Nearly half the cost of operating suburban services by electricity is due to the cost of the power, while in many cases the capital outlay on the generating station forms half the total cost of the electrification. Thus the price of electricity and the difference in capital outlay between the erection of independent stations or its avoidance may make all the difference between it being commercially feasible to electrify or not; but at the present time there is no means by which the railway companies of London can get a suitable supply except by putting up stations for themselves. The supplies which are at present in existence are on too small a scale, and were primarily intended for lighting purposes. Moreover, as the law stands, the majority of the electric lighting authorities can only supply for use in their own areas, so that the railway companies would be obliged to purchase their supplies piecemeal along their routes. As there are twenty-one different systems in London, the impracticability of this, for this reason alone, is obvious. The cost of electrification under these conditions would, of course, be out of the question. In order to be really satisfactory the price of power should be of the order of $\frac{1}{4}d.$ per unit. On the Tyne, the North-Eastern Railway Company pays rather more than this, but in London the higher cost of coal would be far more counterbalanced by the enormous output. The average consumption of locomotives at the present time is 4 lb. to 5 lb. per horse-power, as against 2 lb. per horse-power in a central generating station. It has been estimated that the total horse-power required for operating the *present suburban line traffic* in the London district would be 120,000, while the suburban traffic on main lines would take another 30,000, and that an annual production in all of some 600,000,000 Board of Trade units would be needed. As a matter of fact, a larger output would probably be required, because one of the chief objects of electrification is to enable a more frequent service to be run; but as the total output of the London electric lighting stations last year was of the order of 150,000,000 units, it is obvious that one cannot look to them for a supply for this purpose even if they were all united into one station and supplying on one system, instead of supplying from more than fifty stations with more than twenty systems. It is a question of price, and the price is one the existing systems cannot supply at.

Coming now to the factories, it will be noted that these account for nearly one-half of the coal consumption of London, and probably for three-quarters of the smoke and deleterious fumes; yet these offer the best field for electric power of any, for the possibility of driving factories electrically has been conclusively demonstrated on the Tyne, where, practically speaking, every factory and shipyard on the north bank of the river obtains its supply from the power company which is there in operation. Power is applied to all kinds of purposes. The three-phase electric motors, which contain no exposed electrical parts, work without trouble in the most exposed conditions.

Cranes, both stationary and travelling, are more conveniently operated by electric motors than by the old vertical boilers and engines. In fact, there are practically

[1] So far as gas consumption goes this question of removal has partly taken place already. In place of the seventeen or eighteen gas companies with works scattered throughout London which are shown on the old Ordnance maps, there are now practically three authorities, and by far the larger part of the coal consumption to make gas for London is used on the Greenwich Marsh or at Beckton.

no uses to which the electric motor does not lend itself in factories.

The objection which is often raised, however, to the replacing of steam-driven machinery by electricity, especially in chemical works, breweries, soap works, &c., is that the steam is required for heating and boiling; but here, again, it is a question of price only; the chief chemist of one of the most important soap makers in the east of London recently stated that it was purely a question of price for him to use electricity for boiling purposes instead of steam, and he estimated that it would pay him to do this if he could obtain it at not more than ½*d.* per unit.

Now a certain number of London factories are already supplied from the existing lighting stations. So great are the benefits of electricity that it has paid people to adopt it even although electric energy is so expensive, for so long as electricity is provided from electric lighting stations as an adjunct, so long must it necessarily be expensive; but the wholesale adoption of electricity in factories on the scale that it has taken place on Tyneside can only take place when electricity is produced on an enormous scale, and is used for all purposes in the district. Hitherto, power has been supplied as a bye-product of electric lighting, and this accounts for the fact that out of 555,000 horse-power required to drive the factories in the industrial districts of London, only some 26,000 or 27,000 horse-power of electric power is obtained from the present stations.

This great field that remains can only be tapped by putting down a system for the express purpose of supplying the power needs of East London; while such a scheme must, in order to produce cheaply, have as great a variety of consumers as possible, it cannot hope to be completely successful if it is made an adjunct of electric lighting or electric traction. Power supply must be the first aim of the undertaking, even although in the process of getting a power supply an even greater load may be obtained from the supply to railways.

The consumption of coal in domestic fires accounts for 4,570,000 tons a year, or 25 per cent. of the total consumption. Electric heating has hitherto been very little used, and even in America is confined to the heating of tramcars and workshops in places where it is only a question of the cost of electric energy is undoubted, and that electricity forms a most convenient agent in heating and cooking, and can replace all other forms, is now generally admitted. The reason is this, that whereas the ordinary gas fire only, as a rule, gives out from one-half to one-third of its heat usefully, while the best stove probably does not give out more than about 75 per cent. of its heat, the efficiency of the electric radiator is practically 100 per cent. It can be shown that if the cost of electricity be 1*s.* 3*d.*, it is as cheap for cooking as gas at 3*s.* per 1000 feet; but to compete with coal at 25*s.* a ton for heating, electricity must be supplied about ¼*d.* per unit. In a number of houses already electric radiators are being adopted on account of their convenience, even though they cost somewhat more than gas fires; with cheap electricity they would be adopted universally.

Thus, although electricity for heating and cooking has been looked upon as a purely Utopian proposal, as a matter of fact the time is not far distant when it will be found quite as cheap as any other form of heating. It is true that an electric radiator in its present form, although efficient in itself, converts but a very small portion of the energy of the *coal* into heat; but this is, of course, due to the inefficiency of the present methods of producing electricity, and there can be little doubt that we shall before very long witness a very considerable improvement in this respect. Whereas the best modern turbines and boilers convert only 15 per cent. of the energy of the coal into electricity, the internal combustion engine converts 35 per cent.; but even at the present time such are the advantages of electricity for heating and cooking, such is its applicability, such is the cost of re-decorating and cleansing in London, that at prices considerably higher than those above stated electricity would be as cheap to adopt as coal or gas. The question again resolves itself into one of price.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Goldsmiths' Company has resolved to make a grant of 10,000*l.* for the purpose of founding and endowing a readership in metallurgy, such readership to be associated with the name of the company. It is hoped that research and other work in the precious metals, and the theory and practice of assaying, will be kept somewhat prominently in view in connection with the proposed readership.

Mr. R. H. Biffen has been elected to the recently established chair of agricultural botany. Mr. Biffen is the author of numerous papers, the earlier of which dealt with the preparation of india-rubber and the coagulation of latex, and he has devoted a great deal of attention to fungi. His researches on the hybridisation of wheat and barley have attracted the attention of civilised Governments throughout the world, and attempts have been made to induce him to leave England and place his services at the disposal of at least one foreign Government. It is satisfactory that largely owing to the generosity of the Drapers' Company Mr. Biffen will be able to continue to carry on his researches in Cambridge.

Mr. C. L. Boulenger has been appointed assistant to the superintendent of the museum of zoology from March 25 to September 30, 1908.

ON Friday evening, March 13, Lord Alverstone distributed the certificates and prizes at the South-Western Polytechnic Institute, Chelsea. The report of the principal to the governing body showed that the session 1906–7 had been a very successful one, the highest honour obtained being the D.Sc. degree of Mr. Crocker, who had done all the necessary chemical research in the institute. In the course of a short address, Lord Alverstone laid great stress on the necessity for concentration in study. The development of any one subject is so great at the present time that the utmost concentration of thought is required to advance knowledge. He took as illustration the discoveries of Lord Kelvin in regard to the mariner's compass.

THE reports for the year ending June 30, 1907, of the librarian of the U.S. Congress and of the superintendent of the library building and grounds have been received from Washington. As indicative of the generous scale on which this great American library is subsidised, it may be stated that the appropriations made for the present year reach 123,000*l.*, and that the salaries to be paid during the year for the various officers reach 69,570*l.* In 1907 the number of books in the library reached 1,433,848, representing a gain of 54,604 over the previous year. In addition there were nearly 100,000 maps and charts and a quarter of a million prints. The most important accessions to the library were the Yudin library, consisting of 80,000 works relating to Siberia and Russia, and a notable collection of the literature of Japan, consisting of some 9000 works.

A BILL to promote agricultural education and nature-study in public elementary schools, introduced in the House of Commons by Mr. Jesse Collings, was read a second time on March 11. The object of the Bill is to provide for the teaching in all public elementary schools of agricultural and horticultural subjects; to give facilities for nature-study, and generally by means of object-lessons to cultivate habits of observation and inquiry on the part of the pupils. To this end the Bill provides for school gardens and such collection of objects as may be necessary for the practical illustration of the instruction given. The education specified in the Bill, while optional in urban schools, is to be compulsory in all schools situate in rural and semi-rural districts. A special grant, not exceeding 75 per cent. of the cost, is provided for in the Bill towards the expenses of local education authorities in carrying out the provisions of the Bill.

IN his capacity of Chancellor of the Bombay University, Sir George Clarke presided at the recent annual Convocation of the University and delivered an address. From a report of his speech in the *Pioneer Mail* we learn that

the Chancellor directed attention to the fact that at present there is in the University no provision for post-graduate training, which, in Japan, can be carried on for five years. The University at present receives immature students, and has been unable to utilise the best of its teaching powers and to train up to the high standard now required to produce leaders of original research and professors in the great departments of knowledge. The institute which the munificence of the late Mr. Tata is providing will afford facilities for post-graduate courses in science, and Sir George Clarke expressed the hope that the University will be able to move in this direction in the future. India, he continued, is crying aloud for science, but in the last years only twenty-five degrees of Bachelor of Science were conferred as compared with 1321 Bachelorships of Arts. The Bombay system is defective in regard to scientific training. The inculcation of scientific ideas does not begin early enough, and cannot be carried far enough, for want of adequately equipped laboratories. In Japan science is taught in the upper primary courses, but does not appear until a much later stage in Bombay, and may almost be said to be confined to the colleges, which cannot all be equipped with the expensive appliances necessary for the training they ought to be able to impart. The attempt to make each college into a complete teaching university must, the Chancellor said, necessarily fail, and concentration, in the case of science training especially, appears to be essential. A beneficent patron of learning could render no better aid to the advancement of science than by providing the University with first-class physical and chemical laboratories. Principal Sharp has pointed out that expenditure on education in India would have to be increased from about four millions sterling to twenty-seven millions to provide an amount per head equal to that available in Japan.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 20.—"Notes on the Application of Low Temperatures to some Chemical Problems: (1) Use of Charcoal in Vapour Density Determinations; (2) Rotatory Power of Organic Substances." By Sir James **Dewar** and Dr. H. O. **Jones.**

(1) In a recent paper (*Phil. Mag.*, 1907, vi., 14, 408) Barkla and Sadler describe the investigation of the penetrating power of secondary Röntgen radiations emitted by different elements, which they find to be dependent on the atomic weight of the elements. The behaviour of nickel could only be reconciled with that of other elements by assigning to it an atomic weight of 61·4, a value considerably higher than the accepted value, 58·7.

Determinations of the vapour density of nickel carbonyl made by the authors (Proc. Roy. Soc., 1903, lxxi., 427) had given no indication that the accepted value for the atomic weight of nickel was too low, but it was considered of interest to make further determinations at low pressures, when the vapour would approximately obey the gas laws.

A new method of manipulation was devised for this purpose depending on the use of charcoal at low temperatures for absorbing gases.

A large flask, the volume of which with the connecting tubes was 2163·2 c.c., was connected to a mercury manometer and exhausted by means of a Fleuss pump followed by charcoal in liquid air. The flask was surrounded by melting ice, and the vapour admitted to any desired pressure. The mass of gas was finally collected in a weighed charcoal reservoir by immersing this in liquid air. Thus the weight of vapour filling the flask at 0° C. under a known pressure was easily determined. The accuracy of the method is dependent on the determination of pressure, since the errors in the other operations are comparatively negligible.

In order to test the method the vapour densities of carbon dioxide, sulphur dioxide, and ether were determined, and the following results (referred to 1 c.c. of hydrogen as 0·00009 gram) show that the method readily gives results sufficiently accurate for the purpose in hand:—

CO_2		SO_2		Ether	
Press mm.	V.D.	Press mm.	V.D.	Press mm.	V.D.
115·4	21·91	76·1	31·81	31·4	36·90
206·5	21·98	198·5	31·94	63·9	36·91

The theoretical values of these vapour densities are 21·83, 31·79, and 36·76 respectively.

Determinations of the vapour density of nickel carbonyl were then made, with the following results:—

Press mm.	V.D.	Press mm.	V.D.	Press mm.	V.D.
16·6	84·67	41·7	84·69	46·8	84·79

Taking the atomic weight of nickel as 58·3 (H=1), the theoretical density is 84·73, whereas on the assumption of the atomic weight suggested by Barkla and Sadler, 60·95 (H=1), the vapour density would be 86·05. These experiments therefore show that it is impossible that the atomic weight of nickel should be as high as 60·95.

The accuracy of the method used could be greatly improved by the use of a larger vessel and more delicate manometric measurement, and if the charcoal condenser was made of metal instead of glass the method might be applied to the more volatile gases.

(2) A preliminary account is given of the results obtained in determining the rotatory power of optically active carbon compounds at low temperatures. Two substances, *l*-nicotine and "bitter orange oil," were selected as suitable for examination, because their solutions in ethyl alcohol could be solidified without losing their transparency, and on account of their high rotatory powers. Up to the present it has only been found possible to make observations down to about −100° C., since below this double refraction interferes with the reading of the polarimeter.

A solution of nicotine (21·2 grams in 100 c.c.) which gave a rotation of −30° at +20° C. gave a rotation of −22° at −120° C.

The relation between temperature and rotatory power is approximately linear, and shows that nicotine behaves below 0° C. just as it does above that temperature. The specific rotatory power at −115° C. is calculated to be −99°, and, assuming the linear relation to hold, would be about −54° at −273° C.

The rotatory power of bitter orange oil increases with diminishing temperature below 0° C. as it does above that temperature.

A 20 per cent. solution in alcohol, which gave a rotation of +18°·5 at +8° C., gave a rotation of +25°·5 at −95° C. The relation between temperature and rotatory power is linear, and the calculated specific rotatory power at −273° C. would be about +156°.

Similar results have been obtained with other substances, and these show that the molecules of optically active carbon compounds would exhibit in all probability considerable rotatory power at the lowest temperatures we can command.

Linnean Society, February 20.—Lieut.-Col. Prain, F.R.S., vice-president, in the chair.—Wild types and species of the tuber-bearing Solanums: A. W. **Sutton.** Many hundreds of attempts were made to fertilise *Solanum Maglia* with the cultivated potato, but only one hybrid seedling resulted, from a cross made in July, 1887, and though cultivated for twenty years it has shown no superiority to ordinary potatoes. The so-called "*Solanum Commersonii*, Violet," was stated to be a mutation obtained through bud variation from the wild *Solanum Commersonii*, Dunal. In opposition to this claim, many growers assert that it is identical with a German potato, the "Blue Giant," raised by Herr Paulsen. Many wild types of tuber-bearing Solanums have been experimented with during the last few years. All these wild types flower freely, but in every case where a wild type produces fruit it has, with the exception of *Solanum etuberosum*, reproduced itself absolutely pure from seed, whereas all varieties of the cultivated potato which produce seed give rise to the greatest possible variation in the seedlings, none corresponding exactly to the parent. There is also a striking difference in the form of the pollen-grains of the wild types of tuber-bearing Solanums com-

pared with pollen-grains of cultivated potatoes, the former being elliptical and the latter very irregular in form. *Solanum etuberosum* is the only wild type of which the seedlings have not reproduced the typical form, but have, on the other hand, given precisely the same variation in habit of foliage, form, size, and colour of tuber, &c., as is found in the seedlings from the cultivated potato. During the twenty years of cultivation, no plant of *Solanum etuberosum* has ever been noticed as affected by the fungus *Phytophthora infestans*, although during the whole period it has been grown in close association with potatoes which have suffered more or less from it year after year. It is a fact that the potatoes originally introduced into England or into Europe were certainly introduced as cultivated potatoes, and not as wild types, and also that it is at least doubtful whether in Chili, Peru, or elsewhere, any specific type of tuber-bearing Solanum (apart from *Solanum etuberosum*) can be found which will, under cultivation, give plants at all like the potato of commerce.—Life-histories and larval habits of the tiger-beetles (Cicindelidæ): Dr. V. E. **Shelford.** The paper is intended to be followed by a series in which the distribution, variation, effects of environment, and evolution of colour will be considered. Eleven races were studied, and the results detailed from three or four thousand individuals which had been reared to maturity; the detailed account of *Cicindela purpurea* is followed by a comparison of the other races, and the paper concludes with a bibliography.

March 5.—Lieut.-Col. Prain, F.R.S., vice-president, in the chair.—A possible case of mimicry in the common sole: Dr. A. T. **Masterman.** There are two species of weever-fish, *Trachinus draco* and *T. vipera*, both venomous, with the poison concentrated at the spines of the first dorsal fin and the opercular spine. These fishes bury themselves in the sand until only the top of its head, with eyes, mouth, and dorsal fins are above the sand. The dorsal fin is of intense black, and conspicuous amongst the sand when protruded; it has been suggested that this may be regarded as a warning signal to the enemies of these fishes. The right or upper pectoral fin of the common sole (*Solea vulgaris*) is well developed, and the upper half of that fin has a large, deep, black patch. It also has the habit of concealing itself under the sand, and the distribution of the weever-fishes and the common sole is almost the same. In the other species of sole the pectoral fin is smaller, or almost wholly wanting. The suggestion is that the common sole has adopted the habit and coloration of the weever-fishes as a protective measure. —The morphology of Stigmaria and of its appendages in comparison with recent Lycopodiales: Prof. F. E. **Weiss.** The discovery by Binney of an organic connection between Stigmaria and the base of Sigillaria did not settle definitely the morphological value of the stigmarian axis. It might still be regarded either as a large bifurcating root bearing lateral roots or as an underground stem (rhizome), in which case its appendages might be adventitious roots (Scott) or leaves modified to serve absorptive purposes (Solms-Laubach), or possibly both kinds of lateral organs might be present (Renault). Some recent observations have tended to re-open the discussion of the morphology of the appendages, particularly the recognition of peripheral "transfusion" tracheids in the stigmarian appendages and the presence of a parichnos-strand in these organs. But though both have their counterpart in the leaves of the Lepidodendraceæ, the author only sees analogy and not homology in these structures, and believes their presence is due to the physiological requirements of the organs in question. On the whole, it seems likely that these problematical organs are lateral extensions of the protocorm of a primitive member of the Lycopodiales.

Physical Society, February 28.—Dr. C. Chree, F.R.S., president, in the chair.—The contact potential differences determined by means of null solutions: S. W. J. **Smith** and H. **Moss.** When a mercury jet breaks in the surface of an electrolyte there is an E.M.F. between the jet and a still immersed mercury electrode. If the contact p.d. between the still mercury and the solution is π_s, that between the jet and the solution being π_d, the observed E.M.F. is $E_p=\pi_s-\pi_d$. This E.M.F. is found to be equal to the polarising E.M.F., E_m, required to produce the maximum surface-tension between mercury and the electrolyte. Since $E_m=\pi_s-\pi_m$, where π_m is the p.d. between the Hg and the electrolyte when the surface-tension is a maximum, it follows that $\pi_m=\pi_d$. A solution for which $E_p=0$ is called by Palmaer a "null solution." He found by trial two solutions for which $E_p=0$. Although he concluded that $\pi_s=\pi_d=0$, without special assumptions, the only necessary conclusion is $\pi_s=\pi_d=\pi_m$. The object of this paper is to show that Palmaer's deduction is wrong. If an experimental method can be found of obtaining from any electrolyte MX a solution for which $E_m=0$, then an indefinite number of null solutions can be obtained. Such a method consists in the addition to the electrolyte of a small quantity of M_2S. A number of null solutions were found, including one which gave results identical with those obtained by Palmaer.—An experimental examination of Gibbs's theory of surface concentration regarded as the basis of adsorption, and its application to the theory of dyeing: W. C. M. **Lewis.** An experimental investigation of Gibbs's theory of surface concentration. A particular form of the more general equation is

$$\Gamma=\frac{-c}{RT}\frac{d\sigma}{dc},$$

where Γ = the excess mass of solute per sq. cm. surface, c = the bulk concentration of the solution, T = the absolute temperature, R = the gas constant, and σ = the surface-tension. Assuming surface-tension effects to be the basis of adsorption, measurements were made of the quantities above. The material at the surface of which adsorption took place consisted of a pure hydrocarbon oil. The material adsorbed was bile-salt in aqueous solution. The interfacial tension σ was measured by the drop-pipette method. Γ was measured in two ways:—(1) at the surface of oil-drops of radius about 1 mm., and (2) at the surface of drops of radius about 10^{-4} mm., *i.e.* emulsion particles. The general result was that the actual values found for Γ exceeded the calculated by about fifty times the latter, the conclusion being that there is a discrepancy of considerable magnitude.

Zoological Society, March 3.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—A young female Kordofan giraffe: P. C. **Mitchell.** The author compared the coloration of this specimen, born at the gardens, with that of its parents and with that of a young female giraffe from Nigeria, now living in the society's collection, and stated that the evidence to be derived from the study of this specimen strengthened the case for the distinctness of the giraffes from Kordofan and Nigeria.—A comparison of the neotropical species of Corallus, *C. cookii* with *C. madagascariensis*, and on some points in the anatomy of *Corallus caninus*: F. E. **Beddard.**—A new species of monkey of the genus Cercopithecus: R. I. **Pocock.** The species differs from *C. neglectus* principally in the absence of the black band across the head, in the reddish tinge of the hairs beneath the callosities, and in the similarity in colouring between the tail and the body. It is proposed to name this new monkey *Cercopithecus ezrae*.

Entomological Society, March 4.—Mr. C. O. Waterhouse, president, in the chair.—*Exhibits.*—F. B. **Jennings**: (*a*) A specimen of the weevil *Phyllobius maculicornis*, Germ., retaining both the "false" mandibles, and another in which one of them is intact, both from Enfield, also a single example of *P. urticae*, De G., from Cheshunt, retaining one of these mandibles, the particular point of interest in connection with the false mandibles in these species being that they are toothed in the centre; (*b*) a remarkable specimen of the common Chrysomelid beetle, *Sermyla halensis*, L., from Deal, showing unusual coloration of the elytra, which are blue and coppery-red instead of bright green; and (*c*), on behalf of Mr. C. J. Pool, a specimen of *Otiorrhynchus tenebricosus*, Herbst, from Newport, I.W., and of *Barynotus obscurus*, F., from Galway, Ireland, in the first of which both the pupal mandibles were toothed, and in the second not.—H. St. J. **Donisthorpe**: *Otiorrhynchus sulcatus*, *Polydrusus sericeus*, and *Osmius bohemanni* with pupal mandibles. The Otiorrhynchus was dug up in its pupal cell at Oakham in 1895.—The Rev. G. **Wheeler**: A case containing specimens of Melitæid butterflies taken by him at Reazzino in Tessin, near Bellinzona, which he had identified with

Assmann's *Melitaea aurelia*, var. *britomartis*, they being absolutely identical with the specimens so labelled in the Swiss national collections at Berne. The close affinity on the underside with *M. dictynna* made separation superficially very difficult, and until all forms were reared from the ovum it would be impossible to determine whether *britomartis* constituted a separate species or not.—*Papers.*—Descriptions of new species of Lepidoptera-Heterocera from the south-east of Brazil: H. D. **Jones.**—*Erebia lefebvrei* and *Lycaena pyrenaica*: Dr. T. A. **Chapman.**—A contribution to the classification of the coleopterous family Dynastidæ: G. J. **Arrow.**—Hymenoptera-Aculeata collected in Algeria by the Rev. A. E. Eaton and the Rev. F. D. Morice, part iii., Anthophila: E. **Saunders.**

Royal Meteorological Society, March 11.—Dr. H. R. Mill, president, in the chair.—The dawn of meteorology: Dr. G. **Hellmann.** Some of the modern weather proverbs can be traced back to Indo-Germanic and Babylonian sources. Some of the tablets excavated from old Babylon contain references to the weather. Speaking of the names of the winds and their combinations, Dr. Hellmann said that the cardinal points, north, east, south, west, were found in old Babylonian times. The Greeks were the first to make meteorological observations, and had parapegmata or weather almanacks fixed on public columns. The measurement of rain was first recorded in Palestine. After referring to the first idea of the thermoscope, the lecturer alluded to the meteorology of Aristotle, and said that it had very little influence on English meteorologists. It was the fathers of the Church who kept meteorology alive, for in their works on the Creation they devoted much attention to the atmosphere. The writings of the Venerable Bede were also referred to. The resuscitation of experimental science in the thirteenth century led to the development of regular meteorological observations in the fourteenth century. The earliest known record in this country was kept by the Rev. William Merle at Oxford from January, 1337, to January, 1344, the manuscript of which is still in the Bodleian library.

Mathematical Society, March 12.—Prof. W. Burnside, president, in the chair.—The projective geometry of some covariants of a binary quintic: Prof. E. B. **Elliott.** The roots of the quintic being represented by points on a conic, ruler constructions, depending only on symmetric functions of the roots, and not on the roots individually, are given for those linear covariants which are of degrees 5 and 7 in the coefficients, and for the quadratic covariant which is of degree 2 in the coefficients. Constructions are also obtained for the linear covariants of degrees 11 and 13 in cases where the roots of the quintic are known individually. It appears that sets of four linear covariants and three quadratic covariants can be arranged as a quadrangle on a conic and the pairs of points in which the conic is met by the sides of the harmonic triangle of the quadrangle, but that two members of such sets of seven covariants are reducible to simpler members of a complete system.—The inequalities connecting the double and repeated upper and lower integrals of a function of two variables: Dr. W. H. **Young.** Difficulties arise in the theory of integration of a function which may become infinite, especially as to the possibility of replacing a double integral of such a function by a repeated integral. The paper contains a systematic investigation of such cases, and conditions are obtained which are sufficient to secure that the double integral can be evaluated as a repeated integral.—The operational expression of Taylor's theorem: Dr. W. F. **Sheppard.** Cases arise in which it is desired to express $f(x+y)$ in a form depending on $f(x)$, some differential coefficients of $f(x)$, and some differential coefficients of $f(x+y)$. Operational formulæ are obtained for such cases, and the remainders discussed.—Note on a soluble dynamical problem: Prof. L. J. **Rogers.** The problem is of a general type which includes Jacobi's problem of the attraction of a body to two fixed centres and various problems appropriately expressed in terms of elliptic coordinates.—A formula for the sum of a finite number of terms of the hypergeometric series when the fourth element is unity (second paper): Prof. M. J. M. **Hill.** The formula previously obtained by the author was proved to hold for the sum of s terms of the series $F(\alpha, \beta, \gamma, 1)$, provided $\gamma-\alpha-\beta$ is not zero or a negative integer. It is now proved to hold in the case of the negative integer, and the appropriate modification is obtained in the case of the zero value.

Royal Astronomical Society, March 13.—Mr. H. F. Newall, F.R.S., president, in the chair.—A suggested explanation of the ancient Jewish calendar dates in the Aramaic papyri, translated by Prof. A. H. Sayce and Mr. A. E. Cowley: E. B. **Knobel.** The papyri are business documents relating to a Hebrew colony in Syene, and date from B.C. 471 to 410; they have duplicate dates, according to the Egyptian and Jewish reckoning, and are thus of unique importance for the elucidation of the ancient Jewish calendar, about which very little has hitherto been known. The Egyptian year and chronology are perfectly well understood. The period of the documents is extended by a Babylonian record of the eclipse of B.C. 523, translated by Father Strassmaier, in which the Jewish date is also given, and from these data a calendar has been constructed.—Double-star observations, 1902–7: W. H. **Maw.** The author described his method of measuring the position angle of a bright star and faint companion. The wire was set near the bright star, at right angles to the line joining the two stars; it was then found easy to estimate a perpendicular to the wire.—Investigations on the distribution and motions of stars: F. W. **Dyson.** The conclusions of Prof. Kapteyn and Mr. Eddington as to two drifts of stars were confirmed, and the same result found from stars in the southern hemisphere.—The variability of the nucleus of the planetary nebula N.G.C. 7662: E. E. **Barnard.** A drawing made with the Yerkes telescope showed the nebula as a broad ring with a dark space in the centre, in which was a star-like nucleus. From Prof. Barnard's observations of the variability of this nucleus Prof. Turner deduced a period of 27½ days.—Note on the discovery of a moving faint object near Jupiter: **Royal Observatory, Greenwich.** The object had been detected by Mr. Melotte on several plates taken for Jupiter's sixth and seventh satellites. It was not yet certain whether it is a new satellite or a minor planet moving very near Jupiter, but in either case it appeared of much interest.—The relative number of star images photographed in different parts of the plates for the Oxford portion of the Astrographic Catalogue: H. H. **Turner.**—The perturbations of Halley's comet, 1759–1900: P. H. **Cowell** and A. C. D. **Crommelin.** Further investigations indicated that Pontécoulant's date for the perihelion passage in 1910 was somewhat too late; the most probable date is April 8.—The perturbations of Halley's comet in the past. Third paper, the period 1066–1301: P. H. **Cowell** and A. C. D. **Crommelin.** Four returns of the comet from 1066–1301 now appeared to be well identified from Chinese and European observations. It had been found that a satisfactory identification of the return of 1222 was obtained by accepting the Chinese observations as they stood, and making a change in the interpretation of the Western records.

CAMBRIDGE.

Philosophical Society, February 24.—Mr. D. Sharp, vice-president, in the chair.—Relation between the geographical distribution and the classification of the Onychophora: Prof. **Sedgwick.** The Onychophora comprise the single genus Peripatus, which was discovered in St. Vincent in the Antilles in 1826. Later, specimens of it were obtained from South Africa and Australasia, and its arthropodan nature was established by Moseley in 1874. In 1888 it was shown by the author of the present communication that the species of it fell into discontinuous groups, all capable of precise definition. At present seven such groups are known, each occurring in a definite geographical area. The geographical groups, together with the names which have been applied to them by the author, are as follows:—(1) Neo-Peripatus from the neotropical region as far south as Rio de Janeiro; (2) Congo-Peripatus from the Congo district in Africa; (3) Eo-Peripatus from Malaya (Malacca and Sumatra); (4) Capo-Peripatus from South Africa (Natal to Cape Town); (5) Melano-Peripatus from New Britain; (6) Austro-Peripatus from Australia, Tasmania,

and New Zealand; (7) Chilio-Peripatus from Chili. The author showed (1) that these geographical groups of species are natural zoological groups, the members of which are more closely allied to each other than to those of the other groups; (2) that the distinguishing specific characters are distributed in an entirely haphazard manner among the different specific groups, so that it is quite impossible to show their phylogenetic affinities by any tree-like arrangement.—The method of impregnation in Peripatus: Prof. **Sedgwick.**—Exhibition and description of Welwitschia collected by Prof. Pearson: Prof. **Seward.**—Note on a method of demonstrating the syncytial appendages of the placental villi: Dr. **Duckworth.** The placenta provides material for a ready and quick method of demonstrating the appearance of multicellular or syncytial masses of protoplasm. Small portions of the placenta are stained in bulk, and the syncytial appendages can be easily shown by teazing out the villous processes from whence they spring.—Six new species of the Ixodoidea: W. F. **Cooper** and L. E. **Robinson.**—Note on the protozoan intestinal parasites of frogs and toads: C. C. **Dobell.**

EDINBURGH.

Royal Society, March 2.—Dr. John Horne, F.R.S., vice-president, in the chair.—A preliminary notice of new iron-bacteria: Dr. D. **Ellis.** Five new forms were described, four being new species and one—*Notofolium ferrugineum*—a new genus. They had all been discovered in the iron waters of Scotland. The methods of reproduction were the same in all, namely, a process of conidia formation, and also by transverse splitting of individuals.—The effect of load and vibrations upon magnetism in nickel; supplementary communication: James **Russell.** In determining the effect of off-and-on load the two important factors were the position on the loop and the intensity of the vibrations. In particular, the conditions under which the Villari reversal shows in nickel were studied and described.—A simplified calendar: Alex. **Philip.** The aim of the author was to establish a perpetual calendar by arranging so that any particular day of the month would be the same day of the week. This was accomplished by making New Year's Day a day apart, not to be reckoned in the months or weeks. January would begin on what is now the second. There would be exactly fifty-two weeks of seven days, and by a slight re-arrangement four quarters of three months of ninety-one days in all. The proposed system did not interfere in any way with astronomical principles, the odd day in Leap Year to be treated like New Year's Day, as a midsummer holiday between June and July. So far as the author knew, it violated no scientific principle.

PARIS.

Academy of Sciences. March 9.—M. H. Becquerel in the chair.—The neutral alkaline and alkaline earth carbonates: M. **de Forcrand.** A re-calculation, with some new experimental data, of the whole of the thermochemical data relating to the carbonates of sodium, potassium, rubidium, cæsium, lithium, calcium, strontium, and barium. The bearing of these results upon the temperatures of dissociation of these carbonates is also discussed.—The Ordovician iron minerals of Lower Normandy and Maine: M. **Œhlert.**—New researches on variable stars: Charles **Nordmann.** The amplitude and form of the luminous variation of the two variable stars studied differ markedly according to the part of the visible spectrum compared.—A hyperelliptic surface of the fourth degree upon which are traced thirty right lines: E. **Traynard.**—Problems of elasticity in two dimensions: G. **Kolossoff.**—A case of reduction of the differential equations of the trajectory of an electrified corpuscle in a magnetic field: Carl **Störmer.**—The increase in the sensitiveness of electrolytic detectors under various influences: Édouard **Branly.** The effects produced by a rise of temperature, mechanical agitation, and gaseous disengagement in the electrolyte are separately discussed.—The theory of Brownian motion: P. **Langevin.** A simplified proof of Einstein's formula is given, and this is shown to be identical with the formula of Smoluchowski.—Singing flames reinforcing several notes: G. **Athanasiadis.**—A spectrophotometric arrangement: J. **Thovert.**—The action of alkaline salts with fixed base on the combustion of gases and fixed combustibles: M. **Dautriche.** The effect produced on the heat evolved by several nitro explosives by the addition of alkaline salts was studied, with especial reference to the safe use of these explosives in fiery mines. The salts of the alkaline earths, according to these experiments, appear to prevent the combustion of the carbon monoxide formed by the detonation, and thus add to the safety of the explosive.—Combustion without flame and the inflammation of gases at the extremity of a metallic tube: Jean **Meunier.**—The composition of the starch grain: Mme. Z. **Gatin-Gruzewska.** A method is given for separating the amylopectin and amylose by means of dilute alkali and subsequent neutralisation with acetic acid.—Observations on the preceding note: L. **Maquenne.**—The duration of the peroxydiastases in seeds: MM. **Brocq-Rousseu** and Edmond **Gain.** Seeds varying in age from two to upwards of 2000 years were examined for the presence of peroxydiastases. These ferments may disappear in seeds only twenty years old; two exceptional cases were found in which seeds more than 200 years old still gave the reaction for peroxydiastase.—The metamorphism and tectonic of the Palæozoic strata of Morvan and the Loire: Albert **Michel-Lévy.**—The eruptions of the Limagne. Seven periods of volcanic activity from the Lower Miocene to the Pleistocene: Ph. **Glangeaud.**—Observation of a case of ball lightning: Isidore **Bay.** This was observed on May 26, 1907, at Saint Georges-de-Reneins. An incandescent ball was seen, lasting five minutes. On its disappearance the disruptive effects of ordinary lightning were observed.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (mathematico-physical section), part v. for 1907, contains the following memoirs contributed to the society:—

July 20.—Difference-formulæ for the calculation of optical systems: K. **Schwarzschild.**

October 26.—Contributions to the theory of atmospheric electricity: E. **Riecke.**

November 23.—The potential gradient in the positive glow, from observations by H. Schwienhorst: E. **Riecke.**—Comparison of the magnitudes of horizontal magnetic intensity at Potsdam and Cheltenham in the year 1904: F. **Linke.**—A calculation of the wave-length of the Röntgen rays from Planck's "energy-element": W. **Wien.**—Langbeinite ($K_2SO_4.2MgSO_4$) and vanthoffite

$$(3Na_2SO_4.MgSO_4):$$

R. **Nacken.**—The uniformisation of given analytical curves (ii.): P. **Koebe.**

December 7.—The nature and age of the geological displacements in the neighbourhood of the Sackberg and in the valley of the Leine at Alfeld and Elze: A. **von Koenen.**—The proper motions of the fixed stars: K. **Schwarzschild.**

December 21.—An application of the theory of invariants to the development in series of integrals, particularly rational, elliptic, and hyperelliptic: W. F. **Meyer.**

The business communications (part ii., 1907) of the same society include a report by K. **Schwarzschild** on Lambert's letters on cosmology.

NEW SOUTH WALES.

Royal Society, December 4, 1907.—Mr. H. Deane, president, in the chair.—The effect of Polar ice on the weather: E. **Du Faur.** The author urged the necessity for frequent accurate observations on the varying position of Antarctic ice, at points within easy access of Hobart, on account of its influence upon southern climate. Provision should be made for frequent, even annual, observations to be taken for the future in the Victoria quadrant.—A comparison of the rainfall of Sydney and Melbourne, 1876 to 1905: A. **Duckworth.** The average rainfall of Sydney is given as 47·36 inches, and that of Melbourne as 24·92 inches. In Sydney, the year 1888 was the driest and 1890 the wettest, whilst in Melbourne 1898 was the driest and 1887 the wettest. If we were to judge solely from the *amount* of the annual rainfall of Sydney, without regard

to its periodical distribution and the intensity of its precipitation, it might be said there was no actual period of serious drought, the rainfall of Sydney being below the average of Melbourne only in the exceptional year 1888. The divergencies in the rainfall of these two great cities were so striking as to tend to make one careful in formulating any conclusions based on the rainfall experience of either city taken alone.—The Australian Melaleucas and their essential oils, part ii.: R. T. **Baker** and H. G. **Smith.** This section (part ii.) of the subject covers an investigation of the two species, *Melaleuca uncinata*, R. Br., and *Melaleuca nodosa*, Sm. The former is restricted more particularly to the interior of the continent, not having been recorded east of the dividing range. It does, however, occur on Kangaroo Island. It is mostly a slender shrub having acicular leaves terminating with slender hooks. *M. nodosa* is a coastal plant, and is a more compact shrub.—Aboriginal navigation and other notes: R. H. **Mathews.**—A short volumetric method for the estimation of sulphuric acid: Dr. T. **Cooksey.** The method depends upon the volumetric estimation of the excess of barium salt left in solution after the precipitation of the sulphuric acid as sulphate of baryta. The barium is estimated by standard carbonate of soda—phenolphthalein being used as indicator. Spirit of wine is added to promote the rapid precipitation of the barium carbonate.

DIARY OF SOCIETIES.

THURSDAY, MARCH 19.

ROYAL SOCIETY, at 4.30.—On Vapour-pressure and Osmotic Pressure of Strong Solutions: Prof. H. L. Callendar, F.R.S.—On Secondary β-Rays: Prof. J. A. McClelland.—On the Measurement of the Atmospheric Electric Potential Gradient and the Earth-air Current: C. T. R. Wilson, F.R.S.—Note on the Trajectories of Rifled Projectiles with Various Shapes of Head: A. Mallock, F.R.S.

ROYAL INSTITUTION, at 3.—Standardisation in Various Aspects: (1) Mechanical Engineering: Dr. R. T. Glazebrook, F.R.S.

ROYAL SOCIETY OF ARTS, at 8.—The Navigation of the Air: Dr. H. S. Hele-Shaw, F.R.S.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Electronegative "Thiocyanates": A. E. Dixon and J. Taylor.—An Improved Form of Pyknometer: W. R. Bousfield.—The Quantitative Conversion of Aromatic Hydrazines into Diazonium Salts: F. D. Chattaway.—The Action of Heat on α-Hydroxycarboxylic Acids, Part iv., Racemic αα-Dihydroxyadipic Acid and Meso αα-Dihydroxyadipic Acid: H. R. Le Sueur.—The Spontaneous Crystallisation of Sodium Sulphate Solutions: H. Hartley, B. M. Jones, and G. A. Hutchinson.—Quantitative Relations of Salts of Thallium and its Separation from Silver: J. F. Spencer and Miss M. Le Pla.—Constitution of Hydroxyazo Compounds, Action of Diazomethane and of Mercuric Acetate: C. Smith and A. D. Mitchell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—New Alternate Current Instruments: Dr. W. E. Sumpner and J. W. Record.

LINNEAN SOCIETY, at 8.—The Podosomata of the Atlantic and the Arctic Oceans: Rev. Canon Norman, F.R.S.—A Revision of the Genus Codonopsis: T. F. Chipp.—On the Holothurians from the Red Sea: E. Hindle.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting.

FRIDAY, MARCH 20.

ROYAL INSTITUTION, at 9.—Recent Earthquakes: Prof. J. Milne, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Stresses in Brick Arches: J. D. W. Ball.

SATURDAY, MARCH 21.

ROYAL INSTITUTION, at 3.—Electric Discharges through Gases: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 23.

ROYAL SOCIETY OF ARTS, at 8.—Fuel and its Future: Prof. V. B. Lewes.

SOCIOLOGICAL SOCIETY, at 8.—The Definition of Magic: Principal Jevons.

TUESDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—The Egyptian Sudan: its History, Monuments, and Peoples, Past and Present: Dr. E. A. Wallis Budge.

ROYAL SOCIETY OF ARTS, at 4.30.—The Mineral Resources of Western Australia: Hon. C. H. Rason.

FARADAY SOCIETY, at 8.—Presidential Address: Some Aspects of the Work of Lord Kelvin: Sir Oliver Lodge, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—(1) Sinhalese Magic, with Especial Reference to Charming Ceremonies and Amulets; (2) Exhibition of Amulets, Objects employed by Devil Dancers and Buddhist Votive Offerings: Dr. W. L. Hildburgh.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Curzon Bridge, at Allahabad: R. R. Gales.—The Netravati Bridge, at Mangalore: A. S. Napier.

WEDNESDAY, MARCH 25.

ROYAL SOCIETY OF ARTS, at 8.—Recent Improvements in Decorators' Materials: A. S. Jennings.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MARCH 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—Bakerian Lecture: The Thermal Conductivities of Solids: Prof. C. H. Lees, F.R.S.—Comparison of the Board of Trade Ampere-Standard Balance and the British Association (Ayrton-Jones) Current Weigher: T. Mather, F.R.S., and F. E. Smith.—Note on the Rise of Meteorological Balloons and the Temperature of the Upper Air: A. Mallock, F.R.S.

ROYAL SOCIETY OF ARTS, at 8.—The Navigation of the Air: Dr. H. S. Hele-Shaw, F.R.S.

ROYAL INSTITUTION, at 3.—Standardisation in Various Aspects: (2) Electrical Engineering: Dr. R. T. Glazebrook, F.R.S.

CHEMICAL SOCIETY, at 5.—Annual General Meeting.—Presidential Address: The Electron as an Element: Sir William Ramsay, K.C.B., F.R.S.

FRIDAY, MARCH 27.

ROYAL INSTITUTION, at 9.—Radio-active Change in the Earth: the Hon. R. J. Strutt, F.R.S.

PHYSICAL SOCIETY, at 5.—(1) Notes on the Plug Permeameter; (2) On the Use of Shunts and Transformers with Alternate Current Measuring Instruments; (3) On Wattmeters; Dr. C. V. Drysdale.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Combustion Processes in English Locomotive Fire-Boxes: Dr. F. J. Brislee.—Combustion Processes in American Locomotive Fire-Boxes: L. H. Fry.

SATURDAY, MARCH 28.

ROYAL INSTITUTION, at 3.—Electric Discharges through Gases: Prof. J. J. Thomson, F.R.S.

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