THURSDAY, NOVEMBER 21, 1907.

MODERN SCIENCE AND AMERICAN TECHNOLOGY.

The Chemistry of Commerce. A Simple Interpretation of some New Chemistry in its Relation to Modern Industry. By Robert Kennedy Duncan. Pp. x+263. (London and New York: Harper and Brothers, 1907.)

THE author of the book with this alliterative and not very apt title is a teacher of chemical technology in a university of one of the western States of North America. He appears to have spent a year's leave in Europe in making himself more or less familiar with certain manufacturing processes depending upon more or less recondite facts of modern chemistry, and he is constrained to publish what he has learnt in the hope of convincing the American manufacturer, in particular, that modern science is "absolutely applicable" to the economy and progress of his operations. He was the more encouraged to put forth the present attempt for the reason that, as he tells us, a former venture of his received "words of appreciation" from mining engineers in South Africa and school teachers in China, as well as from captains of the navy and captains of industry. From which we may infer that the professor of industrial chemistry at the University of Kansas, of whose literary productions we confess we were hitherto in complete ignorance, is in reality one of the most widely-read authors of his time.

The dozen chapters of which the book is made up are so many detached fragments, and from the fact that they have been copyrighted at different times during the last three years, they would seem to be reprints of magazine or newspaper articles. Their literary style is indeed characteristic of much of Transatlantic journalism. When the author seeks to be convincing he is merely turgid and inflated, and what he strives to gain by emphasis he loses in the effect which might have been secured by sober, accurate, and impartial statement. Perhaps, however, Mr. Duncan is the best judge of the appetite of the class for whom he caters. His own particular world of educated laymen intellectually eager to know of the advance of knowledge, who, we are parenthetically informed, "are not fools," may like to have what he calls their "pabulum" served up to them hot and strong, and with plenty of condiments. But in his attempts to whet that appetite the author at times comes perilously near to the "sensational misinformation" of which we gather "the other fellow" has been occasionally guilty. Whilst regretfully admitting that in his book "there does not inhere the romantic interest attached to radio-activity and the nature of the chemist's atom," he yet claims for it "the glorious interest that attaches to the doing of real things."

These extracts from the author's "foreword" are characteristic of the rest of the work. He has a passion for strong words, and his vocabulary is simply amazing. But unfortunately the words occasionally prove too strong for him; they get beyond his control—carry him off his feet, as it were—and rush him into a labyrinth of phrases where he gets effectually lost.

But to a reader who is not over-fastidious as regards literary style, or whose sensitiveness has been dulled by daily perusal of the journalism of Kansas, there is much in this book to interest and amuse. To begin with, the reader will not be bored by too much theory. Theory, we perceive, is not the author's strong point, and he has little sympathy with it. To him "the doing of real things is the preferred work of the world." He never forgets that he is a professor of technology. Speculations on the why and wherefore are, of course, not wanted in the eager, pushful, strenuous life of young America—at least not in Kansas; and as for the question "Why is gold?" it is, we are told, as insoluble as the question "Why is a hen?"

"No man of science can justifiably make of himself an anchorite." Shades of Cavendish and Cayley! Our author remembers a brilliant young researcher who "told him that he had developed a wholly new chapter in mathematics. 'And the best of it is,' he said with a glow of enthusiasm, 'that it can be of no earthly use, either practical or theoretical!' Had that man passed observingly through the vicious purlieus of the Bowery or through the vast sordid stretches of East London, surely it would have struck home to him that his work was not only not right, that it was a crime."

Oh! Mathematics, Mathematics! What crimes are committed in thy name! Perhaps it is an acute consciousness of this that leads the man of Trinity or the "gentle Johnian" to prefer King's Cross as a mode of entry to London rather than gaze upon the vast sordid stretches through which Liverpool Street is reached, and which a too selfish devotion to "pure" mathematics leaves neglected and unrelieved.

The American manufacturer, we gather, is not over-sensitive. If he were, he would surely wince under what the author calls the "stings and arrows" which are hurled against him in this book. The general character of much of American technology, we are told, is summed up in the phrase, "Save at the spigot and waste at the bung." What pulls the manufacturers through, however, is "expert office management," "efficiency of exclusive control obtained through business intrigue," "huge and lying advertisements," combined with "gross adulteration of manufactured products." This is a fair sample of the author's "pretty way" of expressing himself, but as he is a professor of technology in America he ought to know what he is talking about when he deals with American technology, and we must suppose, therefore, that his strictures are merited. Certainly the evidence he affords of "the utter stupidity and ignorance displayed by glass-makers" (in America) in the chemistry of their manufacture is only less marvellous than the ingenuity they display in the complicated and efficient mechanisms—for the most part of American origin

and device—which are to be found in their glass factories. But perhaps, after all, this is only the author's method of adorning his tale and of pointing his moral—to enable him, in fact, to bring out in high relief, and by forcible contrast with this story of confusion and waste, how the science of glass-making is studied and practised at Jena.

"The romantic deportment of the nitrogen atom"—due to a certain "temperamental nervousness" "which sends it flying on the slightest pretext from one atomic community to another," is, he confesses, fascinatingly interesting, and this interest prompts him to follow the vagaries of this "labile element"—this "versatile restless nitrogen"—until it is caught and transformed into what he calls "Kaltstickstoff," whence it passes into carrots and potatoes. The story, as a story, loses nothing in the telling as told by Mr. Duncan, but the serious student who eagerly desires "to know the significant results of modern knowledge" will be saddened, but not made wiser, by the total lack of accurate statement of ascertained facts in connection with "the problem of the fixation of nitrogen and what man may do when he must," which constitutes the subject-matter of chapter iii.

America has recently grappled with the subject of industrial alcohol, and Mr. Duncan deals with the new departure in characteristic fashion. As regards the alcohols in general, "the one bearing the peculiarly graceful name of *Ethyl* is the flower of the sisterhood and the subject of chapter vii." In beginning to enumerate its properties, "it is embarrassingly plain" that its properties "are not in one bundle"; "it is the most perplexing substance with which man has ever had to deal"—"a perfect femininity of varying and conflicting properties" functioning "ubiquitously and contrariously in the affairs of man." But chequered and dubious as is the reputation of "the flower of the sisterhood"—"the theme of poets, and contrariwise, the rage of publicists," this "angel-demon" is sweetness and purity when compared with "the wine of wood"—methyl alcohol—of which it appears some ten million gallons "have, yearly, been floating about America in various use."

"A not inconsiderable quantity of it is absorbed by the low negro populations of the country, who drink it under the appellation 'white horse' or 'old mule,' or by a pleasing mode of rhetorical transition, and in order, perhaps, to distinguish it from 'Ethyl,' as 'Maude.' Much of it again has appeared in 'witch hazel,' 'bay rum,' 'eau de Cologne,' 'Florida water,' essences, 'Jamaica ginger,' 'extract of lemon,' 'liniments,' patent medicine nostrums, and red ink. Poor and decadent people drink these things, and barring individual idiosyncrasies, whether it be a man in Indian Territory who drinks red ink, or a man in North Dakota who drinks 'Jamaica ginger,' there is apparently a fairly uniform result. Out of ten men who drink four ounces each of pure methyl alcohol in any form whatever, four will probably die, two of them becoming blind before death; the remaining six may recover, but of these two will probably be permanently blind. Even the absorption of its vapour through the lungs, or of the liquid through the skin, may produce permanent blindness. The 'hearings' before the Committee on Ways and Means afford ample confirmation of this in the procession that filed before it of blind wrecks that had once been hat stiffeners, varnishers or shellackers, men who did not drink methyl alcohol, but who merely handled it as a solvent. The harm wrought by the substance has been greatly accentuated in the last few years by its manufacture and sale in a purified form, the so-called 'deodorized' methyl alcohol, whose smell gives no warning of its deadly nature."

Let the sporadic drinkers of methylated spirit in this country now take warning from this fearful recital of the risks they run. Perhaps, too, the users of industrial alcohol among us may congratulate themselves that the revenue authorities now require only half the former quantity of this pernicious substance to be used in "methylation." And perhaps, too, they may see some justification, in the interests of the community, for the maintenance of the present high duty on "potable" methyl alcohol. It was, of course, the relatively low price of this alcohol in America—70 cents as against 2 dollars and 8 cents for the taxed ethyl alcohol, that led to such a widespread substitution of the wood alcohol for the alcohol of fermentation.

What with the "whisky trust" "nobbling" the "wood naphtha trust," and the druggists forcing up the retail price of industrial alcohol to ninety cents a gallon—"a disgrace," says the author, "to commercial decency"—America is only at the beginning of her troubles in this matter, and there are already signs that the present regulations will have to be considerably modified if her manufacturers are to reap the full benefits of untaxed spirits.

The other chapters of the book deal with the industrial applications of catalysis; the use of the rare earths in illumination; the electric furnace, the manufacture of synthetic perfumes and of medicines; opsonins and inoculation, and the applications of cellulose. The last chapter gives an account of a scheme of industrial fellowships to be held in connection with a university which, like that of Kansas, enjoys the advantage of a department of applied chemistry, and the author illustrates its working by its application to the discovery of improvements in the chemistry of laundering, with the object of discovering "how the swift and progressive disintegration of the shirt" in the laundry may be arrested. Considering that the people of America pay a laundry bill of nearly twenty-five million dollars a week, Mr. Duncan thinks that a yearly subsidy of five hundred dollars, payable monthly to the holder of the fellowship for two years, in return for a comprehensive monograph on the chemistry of laundering, is the merest trifle in view of its bearing on the problem of the welfare of shirts. "What more can be desired by a young man at the threshold of his activity, even if it means that he must leave the 'nook merely monastic' of a professor in embryo for a life of industrial alarums and strenuous war?"

But this is only one of the many "exasperating, vitally important" problems which await solution at the hands of him who will combine the practical knowledge of the workshop with the special knowledge that awaits him in the class-rooms at Lawrence, Kansas, U.S.A.

THE PHILOSOPHY OF A BIOLOGIST.

Éléments de Philosophie biologique. By Félix le Dantec. Pp. iii+297. (Paris: F. Alcan, 1907.)

PROGRESS in knowledge takes place by the discovery of facts, and by drawing inferences from the facts discovered. It is commonly supposed that the facts existed before we discovered them; and this hypothesis stands the test of practical utility. But it is not supposed, except by the most careless thinkers, that the inferences which we draw from the facts—our laws and principles—are anything more than conceptual summaries of the facts and sequences of facts within our ken. (We use the word fact, not because in current usage it means that about which there can be no doubt, but because it includes a wider range of phenomena than the word "thing." The fact that 25 per cent. of the peas, produced by breeding from hybrids resulting from the union of a yellow and a green pea, are green can hardly be described as a "thing.") Our inferences may be right or they may be wrong, but they did not exist before we made them. Whether we can draw any sharp distinction between fact and inference; or, to put it in terms of space, whether we can draw a line of demarcation and say where fact ends and where inference begins, is a question which concerns the modern biologist perhaps more vitally than any other; yet it is one which very few have definitely formulated, much less attempted to answer. The cause of the almost universal failure to provide a satisfactory answer is a habit of the mind, encouraged by text-books of logic, which drives it to classify things, often dichotomously, into two mutually exclusive categories. Music affords an example. Some folk hold that the music of certain authors is good, whilst that of others is bad. Others, however, say that taste is a purely relative matter, and that no one has a right to say that the music of a given author is good, or bad, as the case may be.

The real truth is that whilst at one pole there are classes of music which are unquestionably good, that at the other there are types which are equally unquestionably bad; between the two there is a series of intermediate kinds about which it is debatable whether they are good or bad.

It is the same with fact and inference. At one pole there are undoubtedly things which can be classed as facts; at the other, things which cannot be claimed to be more than inference. But between the two there is a whole range of things which some regard as facts, whilst others regard them not only as inferences, but as unwarrantable ones. Biologists are far too much occupied with discovering facts and with drawing inferences to stop to consider the relation between these two processes. It is therefore with particular pleasure that we note the appearance of Prof. le Dantec's book, "Éléments de Philosophie biologique," at the present moment.

The book is divided into two main divisions, of which the first embraces the methods and the second the facts—an arrangement which, at first sight, appears natural, but which, on closer inspection, in our opinion loses this feature. It seems, at first glance, natural that we should first describe the method of quarrying slate, and then dilate on the properties of the material brought to the surface by the machinery we have described. But in our opinion a truer picture of nature is conveyed by displaying the profusion and chaos of her phenomena first, and then tentatively enunciating the general conclusions we have ventured to draw from them afterwards. When we look closer at that part of Prof. le Dantec's book which deals with method, the temporary illusion of naturalness of arrangement completely vanishes; for an array of possibly true but extremely abstruse generalisations meets our eyes. The first chapter deals with the conceptions of "unity" and "diversity," which are surely not part of the equipment by means of which facts are brought to light, but some of the fruits which their discovery has borne.

But we do not wish to convey the impression that in our opinion the book is not a valuable one. It contains some much needed caution on the dangers of an unconscious anthropomorphism in the interpretation of nature, and on the dangers of, what is merely a result of that fallacy, a too premature attempt to analyse phenomena. But perhaps what makes the book more valuable than anything else is Prof. le Dantec's familiarity with the facts with which the science of pathology deals, a range of phenomena which more directly concerns, but is perhaps less heeded by, the student of evolution than any other.

THE HAMBURG EXPEDITION TO SOUTH-WESTERN AUSTRALIA.

Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise, 1905. Edited by Prof. W. Michaelsen and Dr. R. Hartmeyer. Vol. i., part i. Reisebericht by Prof. W. Michaelsen and Dr. R. Hartmeyer. Pp. viii+116; illustrated. (Jena: Gustav Fischer, 1907.) Price 4 marks.

THE zoological collections of the German South Polar Expedition to South Georgia in 1882–83 are preserved in the Natural History Museum at Hamburg, the staff of which therefrom acquired a special interest in the subantarctic fauna. On the renewal of Antarctic research, the Hamburg zoologists decided they could contribute most usefully to that work by continuing the investigation of the adjacent regions. The marine subantarctic fauna is most accessible on the western coasts of the three great southern continents, where its range is extended northward by cold ocean currents. The Hamburg Museum accordingly arranged zoological expeditions to each of these three areas. The first went to South America, and worked in the Straits of Magellan and along the western coasts of Chilian Patagonia; its collections have been described in a series of monographs issued from 1896 to 1907. The second expedition was led by Dr. Schultze to the coasts of south-western Africa, and the series was completed by the visit of Prof. Michaelsen and Dr. Hartmeyer to Westralia from June to October, 1905. They there made marine collections

in Shark's Bay, Champion Bay, Geographe Bay, and King George's Sound; they collected on land, especially around Perth, Geraldton, and Albany, and travelled inland as far eastward as Kalgoorlie. They describe the south-western part of Australia as zoologically "a forgotten corner," for as Westralia is younger and larger and has a smaller population than the Eastern States, it has not been able to organise such extensive studies of its fauna and flora.

The authors regard their expedition as very successful, and their scientific results are to be issued in a series of volumes, of which the part now published is only the general introduction. It describes the authors' journey, and gives a list, with a map of their collecting stations. It consists of two reports, one by Prof. Michaelsen, describing his general observations on the geography of Westralia, including its scenery, physiography, flora and fauna, and the aborigines. Dr. Hartmeyer contributes an account of the sheep-farming, the mining industry at Kalgoorlie, and of the dredging expeditions. Both essays give a pleasant account of the country in spite of sufferings from the ubiquitous Worcester sauce. They gratefully acknowledge the ready help of the officials and people. They remark the "extravagant" width of the Kalgoorlie streets, and the difficulties of railway administration on lines where, as Prof. Michaelsen expresses it, there is no fear of collisions. Their Shark's Bay boatman seems to be a typical Australian; "he speaks not much, but he understands his business, and what he does he does with hand and foot." The report contains interesting comparisons with other faunas. Thus Prof. Michaelsen, who had previously studied the zoology of Lake Baikal, contrasts the fauna of that very ancient, perhaps pre-Devonian, deep lake, with the life of the recent, shallow pools of Western Australia.

The most generally interesting zoological result given is probably Prof. Michaelsen's conclusion as to the relations of eastern and western Australia as indicated by the earthworms (pp. 49–50). He holds that since the appearance of the ancient genus *Plutellus*, south-western Australia has been united by land only to the eastern States. There are no affinities to other lands, which are not also common to eastern Australia. Comparatively few foreign earthworms entered eastern Australia, and they arrived at different dates, and crossed subsequently into south-western Australia. There they developed into distinct though closely allied species, probably at a time when the land extended farther south-westward in separate peninsulas or had been temporarily divided into islands, which gave the worms on them complete though temporary isolation.

As the authors' journey was naturally confined to the best known areas in Westralia, there was not much opportunity for obtaining new geographical information, and the value of the work of the expedition will depend on the technical and biological memoirs which are to follow. This preliminary account gives evidence of such thorough and careful work, that important results may be expected from the work of two such skilled zoological experts. J. W. G.

OUR BOOK SHELF.

Experimental and Theoretical Applications of Thermodynamics to Chemistry. By Dr. Walther Nernst. Pp. x+123. (London: A. Constable and Co., Ltd., 1907.) Price 5*s.* net.

Technische Anwendungen der physikalischen Chemie. By Dr. Kurt Arndt. Pp. vii+304. (Berlin: Mayer and Müller, 1907.) Price 7 marks.

THE first of the above volumes contains a series of ten lectures delivered by Prof. Nernst at the Yale University in 1906 under the Silliman Foundation. After two introductory chapters, a *résumé* is given of the experimental investigations which have been carried out by the author and his students on chemical equilibria at high temperatures. In a theoretical discussion of the results, the author develops the view that relationships exist between chemical energy and heat other than those expressed by the first and second laws of thermodynamics. From a consideration of the conditions under which the principle of Berthelot comes nearest to expressing the true relation between heat and chemical energy, the conclusion is drawn that the total and free energies are not only exactly equal at absolute zero, but that their values coincide completely in the vicinity of this temperature. In the last three chapters the practical application of the integrated equation of the reaction isochore is illustrated by calculation of the equilibrium in various dissociating systems at high temperatures, such as water vapour, nitric oxide, hydrogen chloride, carbon dioxide, and metal ammonia compounds.

Whether the reader is interested in the fundamental theoretical speculations or the practical application of the derived formulæ, Prof. Nernst's series of lectures cannot be too warmly recommended.

In his "Technische Anwendungen" Dr. Arndt presents an account of certain chapters of physical chemistry and of recent investigations which have an important bearing upon technical processes. The volume does not make any pretence to be a complete treatise on the subject, but carefully chosen examples of the application of physico-chemical principles to industrial processes are discussed in considerable detail. In the first three chapters the formation of nitric oxide from air, the equilibrium in the manufacture of generator and water gas, the manufacture of sulphuric acid by the contact process, the formation of ammonia and of ozone are dealt with, the remaining ten chapters being devoted to a less detailed consideration of catalysts, changes of state, solutions, alloys, dissociation pressures, and the measurement of high temperatures.

The book is distinctly worthy of attention, has many good features, and contains a lot of useful references, although the author—if one may judge from the very small number of references to English chemical literature—does not appear to be very familiar with work carried out in this country. This is an unfortunate circumstance, and detracts not a little from the value of the book. H. M. D.

Die Ausgleichungsrechnung nach der Methode der kleinsten Quadrate. By F. R. Helmert. Second edition. Pp. xviii+578. (Leipzig and Berlin: B. G. Teubner, 1907.) Price 16 marks.

THE principal changes in this new edition consist in the more detailed discussion of errors of observation, instrumental corrections, interpolation problems, and the reduction of triangulations. The last chapter deals with the choice of favourable conditions in various surveying problems. In its present form the work appears to be admirably suited for those who have to make practical use of the theory of errors, especially

surveyors and astronomers. The examples are mostly taken from actual observations, and the necessary calculations are given in considerable detail. In the earlier chapters a knowledge of determinants is not assumed, and the explanations given ought to make the method intelligible to readers of quite moderate mathematical ability. For the more difficult and controversial points of the theory, reference is made to the treatise of Czuber; at the same time, a very good example of the unavoidably empirical nature of the whole subject is given by working out the same elementary problem according to each of three different laws of error. Now that the measurements of physics and chemistry are approaching, not to say surpassing, in exactness those of astronomy and geodesy, a practical work of this kind is likely to assist a larger and larger body of experimenters.

Die Purpurbakterien. Eine mikrobiologische Studie. By Prof. Hans Molisch. Pp. 92. (Jena: Gustav Fischer, 1907.) Price 5 marks.

THIS memoir deals with an interesting group of chromogenic microorganisms, viz. those producing brilliant pigments ranging in tint from pink, through rose and deep red to reddish-purple. They are probably more nearly allied to the coloured algæ (Phycochromaceæ) than to the bacteria proper, and one of the earliest descriptions of a member of the group was given by Sir Ray Lankester in 1873 under the title of a "peach-coloured bacterium." The author first discusses the occurrence in nature of these organisms. Sometimes they are met with in great abundance on the sea-coast, in river estuaries, and in hot and sulphur springs. Directions are given for obtaining growths in various organic mixtures, for the preparation of suitable culture media, and for obtaining pure cultures in the latter. The biological and physiological properties are next considered; while light has an inhibitory, or a germicidal, action on most bacteria, the "purple" bacteria develop best in its presence. They are sensitive to all light rays, but in particular to the ultra-violet ones; they do not, however, evolve oxygen in the presence of light, and their need for oxygen varies much, some species being almost anaërobic.

The colouring matter produced by the "purple" bacteria is a mixture of two pigments—a green, "bacteriochlorin," and a red, "bacteriopurpurin." The chemical and other properties of these are described fully.

As regards classification, the organisms are grouped in a special order, the Rhodobacteria. This is divided into two families, distinguished by the presence or absence of sulphur granules, and several new species isolated by the author are described. Altogether the book forms a very useful summary of our knowledge of an interesting and peculiar group of microorganisms. R. T. HEWLETT.

The Case of Existence. By Norman Alliston. Pp. xiii+262. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1907.) Price 5*s.* net.

"OF the enigmas of life," says Mr. Alliston in his introduction, "all speak; but nobody acts as if there were an enigma." It is his object to remove this inconsistency by exposing the confusions of thought of those who "want life speculatively to be a mystery." The book has three parts. The first contains a good account of the nature of Explanation and some not ineffective criticisms of Knowledge, Nature, &c., mingled, it must be admitted, with much rather ill-informed dogmatism. The second, in the course of a review of man's "obstinate questionings" about existence, develops the author's peculiar egoistic optimism. The third, in which he draws his ethical corollaries, unfortunately contains some chapters which many readers will find offensive both in matter and in tone. The book contains little to engage the attention of the practised student of philosophy, but, being written with obvious conviction and enthusiasm, may here and there attract a useful recruit to the study of first principles. At a later stage the student may not unprofitably return to these pages to detect and analyse the crudities and ambiguities which abound under a surface of apparent lucidity.

Science German Course. By C. W. P. Moffatt. Pp. xii+228. (London: W. B. Clive.) Price 3*s.* 6*d.*

THE portion of this book devoted to grammatical construction and word formation occupies about eighty pages, and is followed by extracts for translation from the German. These selections deal with various scientific subjects, and can be commenced after the student has made himself familiar with the first few pages of the grammar that precedes them. Short vocabularies are given of technical terms in mathematics, physics, chemistry, geology, botany, and zoology. The book thus provides a convenient means of obtaining sufficient acquaintance with the German language to read simple scientific descriptions in it with intelligence.

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 Wehnelt Kathode in a High Vacuum.

THAT a good vacuum can be made into a good conductor by the use of an incandescent kathode is known since the discovery of the Edison effect, and has been investigated with great thoroughness by O. W. Richardson (Trans. Roy. Soc., 1903, 201 A, 497). Wehnelt has shown (*Ann. d. Physik*, 1904, iv., 14, 425) that if the incandescent kathode is coated with one of the alkaline earths, surprising results can be obtained. From a platinum foil kathode at 1300° C. to 1400° C. coated with lime, two to three amperes per sq. cm. of surface can be passed through a good vacuum, the kathode fall being practically negligible, and the total voltage across the vacuum tube being below 30 volts. This result is so very remarkable that I have repeated it in the following way to test whether, as is commonly supposed, the phenomenon is really independent of the perfection of the vacuum.

In a tube provided with a Wehnelt kathode of about a sq. cm. area was mounted an anode of the metal calcium. I have recently shown (Proc. Roy. Soc., 1907, 78 A, 429) that calcium at its volatilising temperature (700° C. to 800° C.) absorbs practically instantaneously and very perfectly all known gases and vapours except the chemically inert gases of the argon family, and have described a form of vacuum furnace suitable for this operation. The tube was prepared in the usual way by preliminary exhaustion and washing out with oxygen to remove argon, and then subjected to the action of calcium heated in a furnace attached to the apparatus. When a good vacuum had been obtained, current from the 250-volt supply was passed through the tube between the heated Wehnelt kathode and the calcium anode in order to heat the latter.

The gases evolved from the anode and tube under this treatment were absorbed by the calcium in the furnace. The current was regulated by a resistance to about 1·2 amperes, and was interrupted at intervals to give the evolved gases time to flow out of the apparatus. When the gases had been for the most part removed the current was passed continuously, heating the calcium anode up to its volatilising point. Quite suddenly and completely the current through the tube stopped, and at the same moment a copious mirror of calcium was volatilised from the anode. In a little while a very feeble glow started and passed

intermittently from time to time, but it was not enough to move the ammeter needle, and was most likely due to a further slow evolution of gas from the still heated surfaces. A current could be passed by a coil from the hot kathode to a third electrode as anode without causing any appreciable resumption of the flow in the 250-volt circuit.

More gas was then generated within the apparatus by heating the third electrode with the coil discharge, and the current in the main circuit resumed its original intensity, again heating up the calcium anode. The original phenomenon was repeated, a sudden cessation of current taking place when the calcium volatilised. Just before stopping, the glow of the tube changed to that characteristic of argon, so probably a trace of air had not been removed. The whole phenomenon could be repeated by admitting oxygen to the apparatus and proceeding as before.

This experiment shows that in a sufficiently high vacuum the Wehnelt electrode ceases to be effective. In the experiments so far recorded the saturation current has increased with the improvement of the vacuum, and the phenomenon has been supposed to be in the first place independent of the residual trace of gas present. Wehnelt (*loc. cit.*, p. 445) remarks:—"Für Drucke unter 0·1 mm. ist die für eine bestimmte Temperatur ausgesandte Zahl von negativen Ionen unabhängig vom Druck," and (p. 456) "die Grenzstromstärken um so höher sein . . . je tiefer die Druck ist." In his description of his modification of the Braun tube (*Phys. Zeit.*, 1905, vi., 732) he says the vacuum in the tube must be as perfect as possible.

Richardson, whose mathematical theory of the general phenomenon has received quantitative experimental confirmation, and has been accepted by Wehnelt in the case of his electrode, regarded the action as purely electronic. Commenting on the magnitude of the current and the smallness of the residual gas—in one experiment 2 amperes per sq. cm. at a measured pressure of 0·0016 mm. from a carbon lamp-filament—he says (*loc. cit.*, p. 546):—"This (the current) is twenty-five times the maximum value obtained by supposing each molecule to produce one ion; so that it is highly improbable that any considerable part of the conductivity investigated is due to ions produced in this way. . . . Both these points of view lead to the conclusion that the corpuscles are not produced by a dynamical action between the molecules of the surrounding gas and the surface of the metal. In fact, all the experimental results seem to point to the view that the corpuscles are produced from the metal by a process similar to evaporation."

These isolated quotations, of course, may not fairly express the opinions of the authors about what is a very complex phenomenon; but the general impression their results has conveyed, I think, has been that the large currents dealt with were wholly conveyed by the expelled electrons, and therefore should pass through any vacuum, however perfect. I do not think the electronic emission can account for more than a negligible fraction of the total current, which is carried almost wholly by the residual gas.

The results here given bear out the general view I have from time to time advocated since my experience with the use of calcium, that degrees of vacuum are in practice apt to be overrated, and really high degrees of vacuum are not so readily obtained as is commonly supposed.

FREDERICK SODDY.

Physical Chemistry Laboratory, The University, Glasgow.

The Interpretation of Mendelian Phenomena.

I AM strongly inclined to agree with Dr. Archdall Reid that Mendelian investigations throw no light on many of the most important problems of biology, such as the causes of variation, the evolution of adaptations, and many others. On the other hand, it is difficult to understand what Dr. Archdall Reid means by the statement that Mendelism is the investigation of sex. In one of his letters he describes Mendelian phenomena as "abnormalities of sexual reproduction which occur under conditions of artificial selection." If this means peculiarities of heredity in sexual reproduction observed in cultivated varieties, it may be allowed to pass; but in an appendix to the second edition of his "Principles of Heredity," Dr. Reid states that the inheritance of Mendelian characters is probably sexual. He proceeds as follows:—"Nature has evolved alternative inheritance to create and perpetuate sexual differentiation, but, just as blending of sexual characters sometimes occurs, so on the other hand the inheritance of non-sexual characters is sometimes alternative. As we have seen, whenever the latter happens, the non-sexual differences are, like the sexual differences, usually considerable. Nature makes the mistake, so to speak, of treating them as sexual. Of course, however, the alternative inheritance of large non-sexual differences is not certain, not so 'clean' as that of sexual differences, the alternative inheritance of which has been established by a long course of selection."

According to this, the alternative inheritance of non-sexual characters is of the same nature as sexual dimorphism. It seems to me that Dr. Reid has not sufficiently studied the inheritance of secondary sexual characters. It is admitted by almost all evolutionists from Darwin himself downwards that selection cannot have been the cause of the alternative inheritance of sexual differences. The female in selecting a particular male cannot prevent the transmission of his peculiarities to her daughters. The male characters must be limited to the male sex from their first origin as variations, because otherwise the selection of the individual male would merely ensure their transmission to both sexes.

The essential peculiarity of secondary sexual characters is their physiological connection with the primary, *i.e.* with the male or female gonads. It is not merely a question of alternative inheritance; both male and female characters are inherited by each individual, but normally only one set is developed. When, however, the male gonads are removed, the male characters are usually not normally developed, but suppressed. In Mendelian cases the development of alternative characters is usually entirely independent, both in theory and fact, of the sex or condition of the gonads.

The contrast of male and female corresponds to alternative dominance in a heterozygote; male characters are dominant in male, female in female, but either can and does transmit both. In Mendelian cases alternative inheritance is segregative; a recessive transmits only recessive characters, a pure dominant only the dominant. In other passages which I could quote Dr. Reid has shown that he has failed to appreciate this fundamental distinction between dominance and segregation, between the heterozygote and the homozygote, between the first generation of a Mendelian cross and the second.

Excepting parthenogenesis, the heredity of all characters is sexual in that it is connected with fertilisation, but I do not see that Mendelian characters are sexual in any other sense. The theory that the inheritance of sexual characters is Mendelian is one which has a definite meaning and can be investigated. Dr. Archdall Reid's statement that Mendelian inheritance is sexual is in one sense a truism, in another seems to me to have no real meaning at all, for to say that nature has evolved alternative inheritance to perpetuate sexual differentiation explains nothing.

J. T. CUNNINGHAM.

Highgate, November 3.

I AM very willing, and, like most people with theories, I believe I am able to maintain the correctness of the views to which Mr. Cunningham refers; but to discuss my speculations now would be to confuse the issue. I may say, however, that the appendix to the second edition of my work, from which Mr. Cunningham quotes, is a mere sketch hastily thrown together to meet the objections of critics who had advised the lay and scientific public that a book, which I fondly hoped contained a little that was new, and which certainly contained more than a little of which Mendelians seem profoundly unaware, was antiquated and worthless, not because there were no new facts or inferences in it, nor because its facts and inferences were invalid, but simply and solely because I had not adopted "the new method" nor accepted the

"new views," nor limited myself to matters which came within the range of the "new science." The criterion of merit struck me as highly remarkable and certainly very new, and indicative of a degree of toleration which, if not altogether new, is at least unusual amongst men of science. The passage quoted by Mr. Cunningham demonstrates that I expressed myself very badly. Soon, however, I shall have an opportunity of trying to do better, and I suggest that until then Mr. Cunningham shall suspend judgment.

In previous communications to NATURE I have admitted that Mendelism may conceivably shed a light on the function of sex, but I challenged its exponents to mention a single other problem on which it has the remotest bearing. No one has as yet mentioned another problem, and Mr. Cunningham denies, apparently, that it has a bearing on that of sex. Must we assume, then, that it sheds no light on anything at all?

IF, instead of dwelling on the dangers incurred by those who venture to differ from Darwin, Mr. Lock (November 14) demonstrated my errors, he would be more convincing; and, since he is probably the only human being who doubts the blending of the black and white races in Mulattoes and their descendants, it would be well if he, rather than I, undertook the collection of pedigrees. He would feel himself on the track of a great discovery which would enlighten even Mulattoes, whereas I should feel I was wasting time. I do not know what I can gain from the renewed study which he is good enough to suggest. I am well aware of the three principal Mendelian doctrines—segregation of units, independent inheritance of characters, Mendel's law is the greatest of biological discoveries—and the more I see and read the more thoroughly I am convinced that they are all demonstrably erroneous, and that nothing but the restricted area covered by Mendelian studies has prevented a recognition of that fact by Mendelians themselves.

According to selectionists blending is the function, or at least the effect of conjugation. According to Mendelians, not blending, but segregation, occurs. Taken by itself, this doctrine assigns no function to conjugation; it merely controverts the theory of blending. Taken in conjunction with the Mendelian hypothesis of the independent inheritance of characters, it assigns to conjugation the function of effecting an exchange of units between the paternal and maternal sets of allelomorphs. That much the Mendelian doctrines imply—that much and no more. Clearly, then, Mendelism is concerned solely with the function of sex. At any rate, I can conceive of nothing else, and, judging from their spoken and written communications, Mendelians have been so rapt in contemplation of the grandeur of the discovery that they have given no further thought to the matter.

"But everybody said," quoth he,
"That 'twas a famous victory."

Mr. Lock declares that, since conjugation is nearly universal, all, or nearly all, the questions of heredity are problems of the function of sex. He might as reasonably argue that, since assimilation and death are universal, all problems of heredity are problems of assimilation and death. The looseness of thought which pervades Mendelism is well illustrated by his remarks on parthenogenesis and bud-variation. Mendelian segregation implies the separation of allelomorphs which, through the union of two gametes, have previously met in a zygote. There can be no meeting, and therefore no separation when reproduction is parthenogenetic. Mr. Lock, in fact, enunciates the surprising doctrine that all variation is Mendelian segregation. I hope he will forgive the bluntness of the expression, but he trifles with established terms.

Southsea, November 17. G. ARCHDALL REID.

The Winding of Rivers in Plains.

SIR OLIVER LODGE'S letter in NATURE of November 7 is itself an illustration of his comment on the way in which misunderstanding of cause may lead to misrepresentation of fact. The statements quoted by him are, as is often the case in text-books, inaccurate in so far as they are incomplete, but, nevertheless, in closer accordance with the facts of nature, viewed from the geological point of view, than he supposes.

We are not dependent on the calculations of mathematicians for our knowledge of the behaviour of rivers; at one time I had a goodly collection of notes of observations made and published by others, but having unfortunately lost this, I shall write only of what I have seen myself, having had many opportunities of observing the behaviour of rivers which are subject to large variations of flow. In the dry season, when the water is low and the stream flows quietly in a channel of more than sufficient size to carry the discharge, I have noticed that the current is often perceptibly more rapid over the shallow water on the inner side of the bend than in the deep channel on the outer. The line of maximum velocity of flow would, consequently, lie nearer the inner than the outer side of the bend, and be less sinuous than the general course of the river, in accordance with the investigation quoted by Sir Oliver Lodge; but at these times the geological activity of the stream is so small as to be almost negligible. When, on the other hand, the same stream is in flood, and a day's work is more than that of a decade or a century of the placid flow, another state of things prevails; then the current sweeps rapidly round the outer side of the curve, and on the inner side is comparatively slack water. The line of maximum velocity must, therefore, become more sinuous than the river itself, and not only is this result to be reached by deduction, but in some cases it has been visibly perceptible. Further, the undertow on the outer edge of the curve has not been visibly distinguishable in any case that I have seen; if existing, its effect must have been insignificant in comparison with that of the horizontal movement of the stream, and often it certainly does not exist. At times, and in certain circumstances, sand and even pebbles may be thrown up to the surface of the water near the outer bank of the stream, and where the waters have overflowed the banks pebbles may be found lying on the dry ground after the flood has passed away; these facts show that there must, in some cases at least, be an upward, not a downward, current along the bed on the outer side of the bend of a stream.

Do not let me be misunderstood. So far as Sir Oliver Lodge is pleading for accuracy in text-books we are all with him, but when he states, as a positive fact, that the line of maximum velocity of current in a river is less sinuous than the river itself, and that the current along the outer bank of a curve is more rapid than along the inner, then I must join issue with him and maintain that these statements are only sometimes true. This is no question of the accuracy of Prof. James Thomson's calculations, but they evidently cover only that part of the problem which is least important from a geological point of view.

R. D. OLDHAM.

"Magic Mirror" Effects.

I HAD occasion recently to coat with collodion a silver surface mirror on patent plate 2 millimetres thick. During the operation the mirror was held with one of the rubber pneumatic holders frequently used by photographers when coating or varnishing plates. As the film of collodion set, a series of interference colours disposed in concentric circles appeared immediately over the region of the suction disc of the holder. I could scarcely bring myself to encourage the idea which at once occurred to me, viz. that the slight suction of the pneumatic holder was actually deforming so thick a plate of glass and producing an appreciable concavity in its vicinity.

But this seems really to have been the case. For when the beam of light from a lantern (placed with its back to the screen) was reflected back on to the screen by the mirror held with the pneumatic holder, there appeared in the rectangular patch of light determined by the size and shape of the mirror a much brighter internal circular patch which changed its position conformably with any alteration of the position of the pneumatic holder.

I have never seen any reference made to deformations produced in this way; yet such deformations might be found to have a practical significance in critical coating operations where absolute uniformity in the thickness of the coating is desired.

DOUGLAS CARNEGIE.

NOTES ON ANCIENT BRITISH MONUMENTS.

I.

SINCE the publication of my book "Stonehenge" some months ago I have received so much valuable information, so many suggestions and promises of work, that I feel it will be convenient if I refer to some of the points which have been thus raised. They refer to many sides of the inquiry, and indicate how very many questions susceptible of local study are raised by the idea of the possible astronomical use of the monuments.

It is only right, however, that I should state *in limine* that the reviews of the book have been almost entirely condemnatory. I am consoled, however, by the fact that there is evidence that the volume had not been read, and that the reviewers have taken so little trouble to inform themselves that they confound the changes brought about in the places of stars by the precession of the equinoxes with those produced in the case of the sun in consequence of the gradual lessening of the obliquity of the ecliptic.

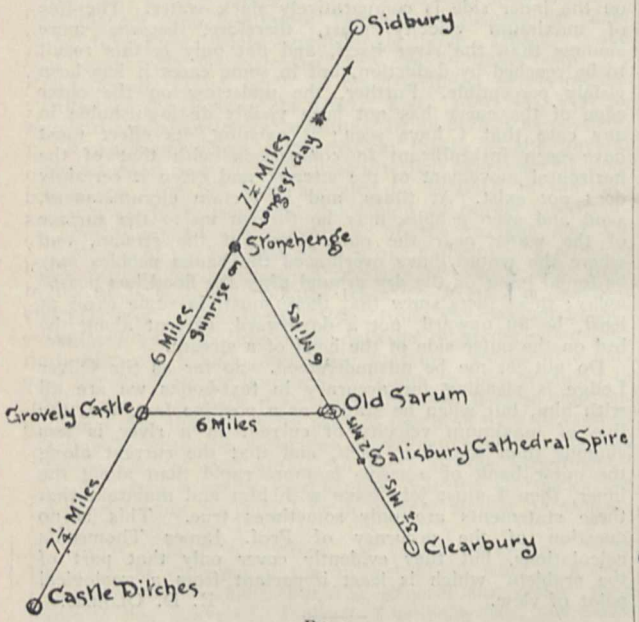


FIG. 1.

Ignoring all the new observations the statement of which was the object of the book, they condemn what they are pleased to call my *theory*, as if a theory were anything but an attempt—even if only a feeble one—to group facts together so that they may be properly understood, and rigid tests applied to it by further work. It is a supreme satisfaction to me to know that further work is going on. Societies for the "Astronomical Study of Ancient Monuments" have been started in Cornwall and Wales, and local inquiries of great value are being made. I am glad to say that these efforts are being sympathetically aided by the existing archæological societies, which, I think, have much to gain by the constant companionship of the spade and theodolite. I also have spent some holiday time in Cornwall, Wales, and Aberdeenshire, adding a special study of cromlechs to the inquiry. What I have previously written concerning the May-year is greatly strengthened by the fact that most of the cromlechs I have examined were constructed so that the sunrise in May or November could be watched from the priests' quarters inside the cromlech through the narrow opening necessary for their protection. I shall give the details of these observations later.

The Inter-relation of Monuments.

In my "Notes on Stonehenge" (NATURE, vol. lxxi., p. 391) I referred to some remarkable relations between Stonehenge and the surrounding localities which had been communicated to me by Colonel Johnston, the late director-general of the Ordnance Survey. These are rendered manifest by the accompanying diagrams which I reproduce.

Fig. 1 shows that Stonehenge is (1) on the same straight line which contains Sidbury, Grovely Castle and Castle Ditches; (2) at the apex of an equilateral triangle of *exactly six miles in the side*; (3) that Salisbury, *i.e. Solis*bury Cathedral, from its name an old solar temple, was on the same straight line which contained Stonehenge and Old Sarum.

Fig. 2 shows that the oldest cross-roads on Salisbury Plain exactly occupy the centre of the triangle referred to.

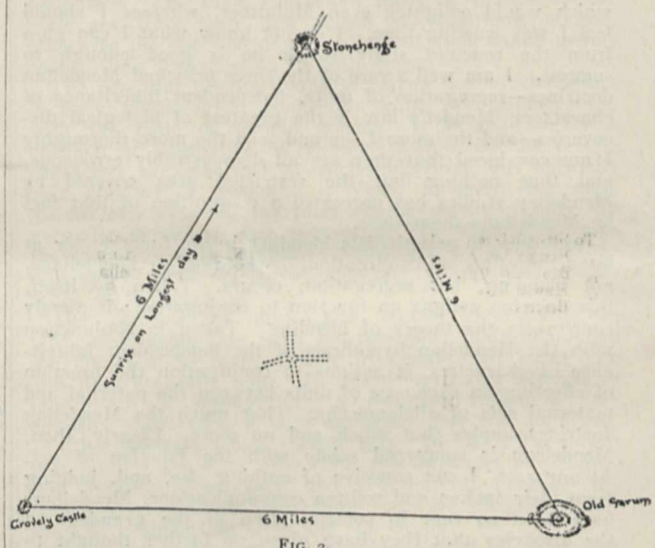


FIG. 2.

Such relations as the above, but on a smaller scale, are often to be noticed, in some cases between monuments, in others between monuments and decided natural features on the sky line as seen from them.

I give some examples from Cornwall.

At Trevethy is one of the most famous cromlechs in that county, and it has not been *restored*, so that we need not hesitate to measure it to try to determine its meaning. Close by, at St. Cleer, is a renowned holy well, and a little further away King Doniert's stone.

The accompanying photographic reduction of the Ordnance map shows the strict relation of these monuments. The entrance of the cromlech is directed towards the November sunrise, az. S. 63° E.; looking in the opposite direction it commands the May sunset. I shall refer to this later. As seen from the holy well the cromlech marks the azimuth of the May sunrise. The monolith, King Doniert's stone, is true west from the cromlech, and so marks the equinoctial sunsets.

In the Bodmin district are two famous circles, the Stripple stones and Trippet stones, some half-mile apart.

The following table shows the relation of the latter to the former, and also to the surrounding hill-tops, as I believe was first noticed by Mr. A. L. Lewis.

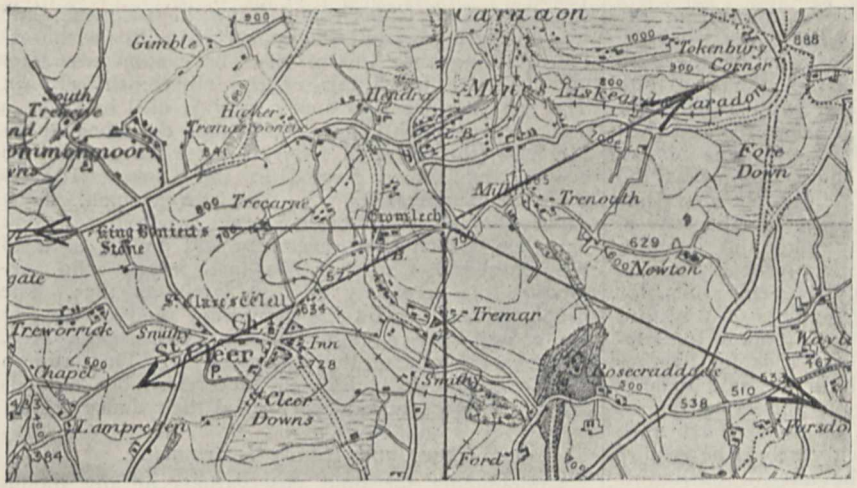


FIG. 3.—The inter-relation of the monuments near Liskeard.

We indeed learn why the circle was erected on the precise spot it occupies.

Trippet Stones, Blisland, lat. 50° 33′ N.

	Az.	Hill	Dec.	Star	Date
To Stripple Stones.	N. 81° 30′ E.	2°	N. 6° 42′	Pleiades	1720 B.C.
,, Rough Tor ...	N. 15° E.	1½°	N. 39° 1′	Arcturus	1700 B.C.
,, Brown Willy ...	N. 31° E.	1½°	N. 34° 5′	Capella	1420 B.C.
,, Hawks Tor ...	N. 63° E.	2½°	N. 18° 34′	May Sun	May 14.
,, Barrow	S. 63° E.	1½° assumed	S. 19° 31′	Nov. Sun	Nov. 21.

My wife and I visited the Trippet stones in April, 1907, in the company of Mr. Horton Bolitho and Mr. Collings. A hail-storm made observations difficult, and this may explain the departure of the May and November days from the normal. The coincidence of the dates of the possible observations of Arcturus and Capella suggests that we have then the true date of the erecting of the circle, Brown Willy being subsequently used with Capella when the old alignment of Arcturus on Rough Tor became useless in consequence of the precessional movement.

I shall have more to say on the inter-relation of monuments and double and multiple circles on a future occasion.

Ancient Connection between Stonehenge and Grovely.

Figs. 1 and 2 suffice to show the old association between Stonehenge and Grovely. Canon Wordsworth, in a paper on "Grovely Customs," communicated to the annual meeting of the Wiltshire Archæological Society held in July, 1906, at Wilton, has brought together some additional particulars touching this association.

Some of the new information refers to the gathering of wood in the valleys near Stonehenge; this, I think, may be accepted as strengthening the evidence that the plain at Stonehenge was not wooded, contrary to the opinions of many that the monument was built in a sacred grove of oaks. My argument against this view was that if the monuments had any astronomical use at Stonehenge, Dartmoor, or elsewhere, they would not have been erected among trees, which would have spoiled the observations which were always made on the horizon.

Next, in support of my view that Stonehenge was initially a May-year temple, the celebrations referred to by Canon Wordsworth occur in May. He recalled an extract from a paper written by Mr. J. N. Powell, on "South Wilts in Romano-British Times," in which the writer approached the subject from the point of view of the folklorist and student of primitive religion. Mr. Powell said:—"At Wishford an oak bush is cut annually, formerly at Whitsuntide, but since the Restoration on May 29, and hauled down into the village. It is then decked with ribbons and hung from the church tower, and the day is kept as a revel." Canon Wordsworth said that, if he rightly understood his drift, he supposed that that symbol of the villagers' right to gather wood, and in olden times also to pasture cattle in Grovely Forest, was associated with, or found its expression in, a ceremony of prehistoric cult or nature-worship. He then read a number of extracts from documents lent by the Rector of Wishford, the Rev. F. W. Macdonald, amongst which were the following:—"The aforesaid lords, freeholders and tenants of Barford St. Martin, have had, or should time out of mind have, yearly brought unto them against every Whit Sunday by the Ranger or his assigns, one fat Buck, the one half to

FIG. 4.—The Trevethy Cromlech.

Wishford and the other to Barford, to make merry withal amongst the neighbours. And the Ranger is to have from each of the Manors of Wishford and Barford one white loaf and one gallon of beer and a pair of gloves, or twelve pence in money for the whole, and if the Ranger do not bring nor send the fat Buck then the inhabitants of any of the said Manors or any of them, after that day may go into the said forest and kill and bring away a Buck for each of the said parishes at their pleasure, and then the Ranger is not to have anything." "The custom is and ever time out of mind hath been, that the lords and freeholders of Wishford Magna, and Barford St. Martin, and their tenants, by themselves, their servants and assigns, may take and fetch in the woods of Grovely, speeke rods (probably spicks or spars for use in thatching) and breeding rods, for their houses standing in the said manors of Wishford and Barford, and also fould shoars (stakes for supporting hurdles) and wreethrs (long rods for turning into hurdles) to be employed within the said manors at all times without controulment, and every one of the said lords and tenants that do use to fetch such ought to give the Ranger one hen yearly if he require and send for the same." "The ancient custom is that at all Courts holden for Grovely the Jury and Homage for the said forest hath ever been made, and in Right ought still to be made, of the freeholders, tenants, or inhabitants of Wishford Magna, or Barford St. Martin aforesaid and of none other."

Among the entries in the Rector's book is the following:—"Whereas the lord of the manor and parishioners of the parish of Wishford aforesaid did time immemorial use and enjoy laudable custom yearly in the month of May to cut down and carry away boughs of trees growing in the Chase of Grovely in the said county of Wilts (being part of the estate of the Earls of Pembroke) therewith to adorne the said Church of Wishford, and whereas the right honourable Philip, late Earl of Pembroke (probably seventh Earl, 1647–83), finding that the said usage and entry on the said Chase in the said month of May was a prejudice to his deer in that Chase, it being about fawning time, Did come to an agreement with the said Richard Howe, lord of the said manor of Wishford, and the parishioners of the said parish, and did grant to the said parishioners an annual rent charge in fee simple of six pounds a year issuing out of a meadow called Burdenball Meadow in the parish of Wilton in the said county of Wilts. And whereas the said rent of six pounds has been much in arrear and the right honourable Thomas, now Earl of Pembroke (Thomas Herbert, 8th Earl of Pembroke 1683–1733, Lord High Admiral 1702–1708, Lieut. of Ireland 1707), hath agreed with the said lord of the said manor and parishioners to give them the sum of 260*l.* of lawful money of Great Britain, in case they would release their right of the said rent of six pounds of the arrears."

Here we see how dates are changed, and we get a new reason for the abolition of an ancient custom. But this is not all. There is a suggestion of the old stone worship at Salisbury, the spire of which, as we have seen, is exactly in the line Stonehenge-Old Sarum prolonged.

"The lords, freeholders, tenants and inhabitants of the Manor of Great Wishford, or so many of them as would, in ancient time have used to go in a dance to the Cathedral Church of our Blessed Lady in the city of New Sarum on Whit-Tuesday in the said County of Wilts and there made their Claim to their custom in the forest of Grovely in these words, 'Grovely! Grovely!! and All Grovely!!!'" With reference to the last extract, Canon Wordsworth remarked that the dance to the Mother Church of Salisbury might have been connected with the procession to pay chimney-money, "smoke-farthings," or Pentecostal oblations. But after the Restoration of Church and King in 1660 the date was changed to May 29 in connection with the annual thanksgiving then instituted. The custom was kept up until the beginning of the nineteenth century. The last survivor who took part in it died in 1891, in her eighty-eighth year, and she described it to Mr. Hill (the rector in 1885) as a regular revel, with booths and shows erected in the Close. It was therefore suppressed, but still two women, as a deputation from the bough-bearers, went in with oak branches, which they reverently laid on the altar of the Cathedral Church. The last person who performed this ceremony died so lately as 1853. The people taking part in the procession used to dress in white, and they assembled first at Townsend's Tree, at the south end of the village street. They still in 1885 carried oak boughs in procession, but only as far as the Rectory, and performed their dance there.

Cheap and Handy Instruments.

Undoubtedly for final observations at any monument a theodolite must be employed, using the sun or Polaris in order to avoid all magnetic difficulties, and reversing the telescope to secure the correct altitude of the horizon.

But for rapid surveys there are many handy forms of instrument by means of which preliminary information can be gathered, both with regard to azimuth and, what is equally important, the angular height of the horizon. In a reconnaissance lately among the Aberdeen circles I employed a clino-compass of Barker's pattern; this weighs only a few ounces and is carried in a sling over the shoulders; even a tripod can be dispensed with, though it is much better to have one; the lightest form is that used by the Kodak Company for their cameras. In the clino-compass, as the name implies, both azimuths and altitudes are measured by the same instrument, the level being replaced by a pendulum; in this form, especially in the case of the altitudes, the mean of several observations should be taken. In my opinion, a desideratum for such work is a simple small instrument with level and reversible telescope for small altitudes only—a miniature dumpy level, fitting on to the same tripod which carries the azimuth compass.

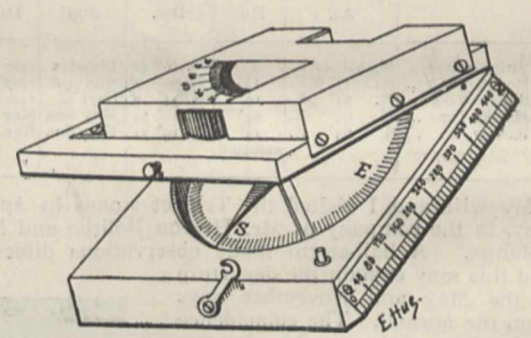


FIG. 5.—M. Hue's combined compass and clinometer.

We learn from the "Manual of Prehistoric Researches" published by the Société préhistorique de France that the French archæologists are much more thorough and philosophical in their inquiries than their British brethren. It is not a question of the spade *versus* the theodolite, but of the spade *and* the

theodolite, and as full instructions are given about one as about the other.

It is quite refreshing to read the chapter "Indications pour faire un levé de Terrain à la Boussole," and then the instructions given relating to subsequent work with the large-scale maps published by the French Government.

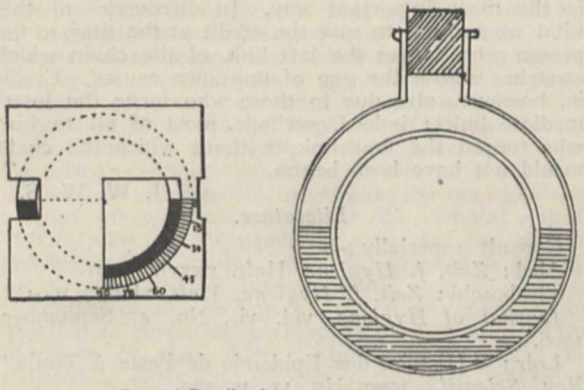


FIG. 6.—Details of the water-level clinometer.

For the angular measurement of elevation, including, therefore, the angular height of the horizon as seen from any monument, the archæologist is recommended to use a very simple and convenient addition to the compass devised by M. Hue. The method employed can be readily gathered from the accompanying woodcuts, obligingly sent to me by the publishers of the "Manual."

It would be a good thing if some one of our many archæological societies would prepare an edition of this excellent French manual for the use of British workers. NORMAN LOCKYER.

PLAGUE AND FLEAS.

IT is a matter of dispute as to where in ancient literature the first definite mention of rats and plague is to be found, and where such mention does occur it is again uncertain what the author intended to convey. It can hardly be doubted, however, that Avicenna, who flourished about the year 1000, clearly refers to this relationship when he says, "Et de eis quae significant illud (the approach of plague) est ut videas mures et animalia quae habitant sub terra fugere ad superficiem terrae et 'pate sedar" id est commoveri hinc inde sicut ebria."

It is noteworthy, however, that Avicenna does not state that the rats died. Passing over many other records of more or less definiteness we come to the important statement of the Byzantine historian Nicephorus Gregoras, who wrote of the plague in Constantinople in 1347, "Nec vero homines solos morbus ille usque flagellabat; sed et si quae alia animalia cum hominibus plerumque degerent et habitarent; canes inquam et equos et cujusque modi avium genera; ipsos etiam mures, si qui forte in domorum parietibus latitabant." Orraeus also, in the plague of Moscow in 1771, mentions rats, but no special stress is laid on the fact, and other animals, as by many other authors, are included. He says, "De avibus a plurimis narrabatur quod minores cantatrices caveis detentae in domibus infectis emorerentur, immo quod mures et glires quantumvis antea copiosi disparuerint; sed de his fides apud relatores esto."

In modern times the death of rats during or before epidemics of human plague was first noticed in India, viz. in Kumaon, 1833–35, by Gowan, in the Pali plague; 1836–8, by Forbes White; and in Kumaon, 1853, by Francis and Planck. Renny states that during the epidemic of 1851 in Kumaon, in two huts occupied by sixteen men (twelve of whom died of plague) a large number of dead rats was found, but that the cattle, thirty in number, escaped. Rocher, in 1878, in Gun-nam, Baker and Lovry in China, state that the rats were first attacked. Yersin, studying the great epidemic of 1894 in China, states that the rats found dead contained the plague bacillus in abundance, and many of them presented true buboes. Many other observations of a similar kind might be quoted. Not always, however, is the relationship manifest, for Hankin states that despite the most careful inquiries no evidence could be obtained of the existence of an outbreak among rats during or after the outbreak among human beings in Hurdwar. Nor, again, in the epidemic of Glasgow could the relationship be established, though it was proved in the outbreak in 1901–2. Further research will show whether these exceptions are real, or due to insufficient observation.

Not only rats, but other animals have in recent years been found to suffer from plague. Thus there exists in Mongolia a peculiar form of plague known as tarbagan plague. The tarbagan is a marmot-like rodent (*Artomys bobac*).

Almost every year an epidemic disease breaks out among these marmots, and a marmot that is affected always dies. The natives of the Baikal districts avoid handling any animal that has axillary and inguinal buboes, though dogs and wolves are said to eat them with impunity. In the skinning and handling of these marmots the peasants contract the disease, and epidemics of this origin are reported throughout the whole of the east Asiatic plateau of Siberia and Mongolia to Tibet. The disease is almost undoubtedly plague, though bacteriological proof is not yet forthcoming.

It has been noted, further, that palm squirrels (*Sciurus palmarum*) die of plague in great numbers in certain parts of India. Further, among the Carnivora, dogs and cats may develop plague. In certain parts of India cats have been found in abundance with suppurating buboes in the neck, the position of the bubo, it is interesting to note, suggesting its origin in ingested food (rats). Finally, monkeys have died of plague in several places in India.

Rats and Fleas.—Ogata, in 1897, succeeded in giving a mouse plague by means of bacilli got from fleas taken from rats dead of plague. Simond, in 1898, attributed the infection of man to the fleas which had left the bodies of rats dead from plague.

"It is usually in the morning that the carcass of a rat which has died in the night is fatal to him who touches it. We were unable to discover a single case of a rat whose death had occurred twenty-four hours previously having communicated the plague. Simond also made the following experiment. He placed twenty fleas (obtained from a cat) in a bell jar, with a rat dying of plague. He then placed a healthy rat in a cage into the bell jar, but also allowed the cadaver of the first rat to remain thirty-six hours in the vessel. The second rat died on the fifth day of plague. The experiment was repeated, but not always with success" (Quoted from Nuttall, "Insects, Arachnids, and Myriapods as Carriers of Bacterial and Parasitic Diseases," pp. 9–20).

Simond believed that infection from man to man takes places, but in an insignificant number of cases as compared to those where fleas carry the infection from rat to man. He regards rats as the main cause in the spread of plague among human subjects.

Loir affirmed that the fleas of rats are the main

agents through which the disease is transmitted to man. Kolle and Nuttall, however, obtained negative results in this direction. The Indian Plague Commission (1899) came to the conclusion that Simond's proposition that suctorial insects play an important part in the transmission of plague from sick to healthy animals is so weak as to be hardly deserving of consideration.

In 1902 Gauthier and Raybaud, at Marseilles, carried out further experiments, and got positive results. "Recueillant en bloc un certain nombre de puces sur des rats capturés sains, nous avons parasité artificiellement à leur asile des animaux de laboratoire préalablement inoculés de cultures pures. Nous avons cherché ensuite à produire infestation parasitaire et l'infection consécutive d'animaux neufs. Les résultats absolument concordants de cette série d'expériences (five experiments) nous permettent de conclure que les puces des rats sont capables d'une façon constante de transmettre la peste d'animal à animal rat ou souris."

Further, they showed that rat fleas could bite man.

Ashburton Thompson, studying the plague epidemics in Sydney from the epidemiological standpoint, came to the conclusion that Simond's hypothesis of the flea best explains the phenomena of the epidemic plague as seen at Sydney. He further states that the laboratory proof has been given by Raybaud and Gauthier, and by Dr. J. S. C. Elkington at Bombay, "whose observations are affirmatory of Simond's original experiments made in India."

Elkington [1] describes his own results in the following words:—"The technical difficulties were considerable . . . and a great deal of experiment was required before a satisfactory means was obtained of insuring the captivity of such a small and active insect whilst feeding. This was finally effected by confining them in a test tube of which the mouth was covered with very fine gauze through which the insect could thrust its proboscis when the gauze was applied to the skin of the feeder-animal. Fleas were then fed on experimentally infected rats. . . . The fleas were then kept in a dark drawer still in the feeding tube for varying periods, after which they were again fed on healthy young rats selected for their vigour and health. The results were most successful, and I have records of four instances in which I was able to carry out this method of infection. Captain Liston also was successful in several cases. Attempts were then made to convey the disease from human beings to rats. Two instances were successful, the period from the first feeding being eight hours. . . . Both rats died of plague, one on the fourth, the other on the sixth day."

Much attention was now given to the question as to what species of fleas those found on rats belong.

Tidswell, in 1903, working at Sydney, found that 81 per cent. of the fleas on rats were *P. pallidus* (*i.e. P. cheopis*). Tiraboschi found that 40 per cent. of fleas on ship rats belonged to the same species. Liston, 1005, found that while other species were found on European rats in India, 99 per cent. of the fleas were *P. cheopis*. Though unable himself to get positive results in the transmission, yet he says, "To sum up, then, rat fleas (*P. cheopis*) can always be found in (plague) infected houses; these fleas will take to an animal which is not their normal host." Finally we have the experiments of the Plague Commission of 1905 working in Bombay. These elaborate and very carefully conducted experiments have conclusively established the fact of the conveyance of plague from the infected to the healthy rat by means of the plague flea. We still require light on the exact method by which the bacilli are conveyed; why so many other investigators have failed in similar experiments, and whether rats transmit the disease in any other way, and, indeed, whether this is the most important way. In discoveries of this kind we are apt to give the credit at the time to the person who forges the last link of the chain which stretches across the gap of unknown causes. Credit is, however, also due to those who forge the intermediate links; indeed, perhaps most of all to him who forged the first link, without which the chain would not have been begun.

J. W. W. S.

[1] Board of Public Health. Address on Fleas and Plague Convection by Dr. J. S. C. Elkington, delivered before the Victorian Branch of the British Medical Association, July 22, 1903.

Literature.

Consult especially:—

Abel: *Zeit. f. Hygiene*, Heft. xxxvi., 1901.

Tiraboschi: *Zeit. f. Hygiene*, Heft. xlviii., 1904.

Journal of Hygiene, vol. vi., No. 4, September, 1906.

Loir: "Histoire des Epidemie de Peste à Tunis." *Rev. Scientif.*, 1900, No. 13, p. 395.

Allbutt and Rolleston: "System of Medicine," vol. ii., part ii., p. 375, Art. "Plague."

Gauthier et Raybaud: *Revue d'Hygiène*, 1903.

Ashburton Thompson: Report on the Outbreak of Plague at Sydney, dated July, 1903.

J. S. C. Elkington: *Australasian Medical Gazette*, xxii., p. 348.

THE INTERNATIONAL ASSOCIATION OF SEISMOLOGY.

THE first general meeting of the International Association of Seismology was held at The Hague on September 24 and 25, and was preceded on September 21 and 23 by a meeting of the permanent committee, which is the body charged with carrying out the decisions of the general assembly.

The following countries (in alphabetical order according to their French names) now form part of the association:—Germany, Austria, Belgium, Bulgaria, Canada, Chili, Congo, Spain, United States, Great Britain, Greece, Hungary, Japan, Italy, Mexico, Norway, the Colonies of the Netherlands, Portugal, Roumania, Russia, Servia, and Switzerland. It was understood that the French Government was prepared to join, but as the necessary money grant had not been submitted to the Chamber of Deputies, the adhesion has not yet been formally made. Nevertheless, the French delegates were requested to take part in the proceedings on the same footing as those of the other countries.

The budget for the forthcoming year was submitted to the permanent committee, and was carefully discussed. The income of the association is now about 1900*l.* The secretary, Prof. Kövesligethy, of Budapest, on whom a great part of the labour of the association falls, receives 200*l.*; 460*l.* is spent in other salaries, including those of a type-writer, mechanic, and in connection with the Central Bureau at Strassburg; office expenses amount to about 150*l.*

In addition to the above salaries, two scientific assistants, Mr. Rosenthal, of Pulkowa, and Mr. Oddone, of Rome, were during last year paid out of the funds of the association, and were engaged in preparing separate catalogues of microseismic and macroseismic disturbances. The question how far scientific assistants of this kind should during the next two years be maintained by the association was left to the decision of the executive committee, which

consists of the president, vice-president, and secretary. There is no question, however, that the formation of the catalogues will always form one of the great objects of the association, and its publication will absorb a material fraction of its funds.

One of the subjects discussed at the meetings was the study and origin of small periodic disturbances, some of which have short periods of 6 to 11 seconds, or the somewhat longer period of 30 seconds. The latter seem to occur when strong winds sweep over a country, but no connection of the former with meteorological occurrences has been proved, and the only suggestion of a rational explanation is that due to Prof. Wiechert, who believes them to be due to the impact of ocean waves on the shores. A small committee was appointed to investigate the question, and a sum of 50*l.* was placed at its disposal. Prof. Omori, who had independently expressed the wish to investigate this matter, was also granted a sum of 50*l.* to carry out his investigations.

Another committee was appointed to report on the question of preparing a complete annual index of the literature of the subject. The committee was instructed to enter into communication with the International Catalogue and the "Office international de Bibliographie," in order to ascertain whether one of the existing organisations may be utilised for the purpose.

According to a resolution arrived at in Rome in October, 1906, the president of the association vacates his office on April 1 following the general meetings, which, as a rule, take place every four years. The permanent committee had therefore to elect a new president; Prof. Palazzo, who has held the office during the last year, not being re-eligible, a ballot was taken, and Prof. Arthur Schuster received the majority of votes. In thanking the meeting for the honour bestowed upon him, and accepting the office, Prof. Schuster said that he was not an expert on seismological questions, but considered it to be his duty to accept the position, as he considered that it was intended as a recognition of the services rendered by Great Britain, and notably by Prof. Milne, not only in originating the scientific study of earthquakes, but also in first organising combined observations on an international basis. Prof. Forel, of Lausanne, who is well known through his work on seiches, was elected vice-president.

The general meeting was opened on the morning of September 24 by a speech of the Minister of the Colonies, and the two succeeding days were taken up in great part by addresses on various subjects connected with seismology. Of special interest were the account given by Prince Galitzin of his seismometric studies, and a paper by Prof. Wiechert on the utilisation of seismic records towards the investigation of the physical properties of the earth.

It was the duty of the general meeting to fix the locality of the central bureau, and it was resolved to retain Strassburg for the next period of four years.

The delegates were most hospitably entertained; an evening entertainment, as well as a dinner, was given by the Minister of the Colonies on behalf of the Government of Her Majesty the Queen, and the meeting concluded with an excursion by boat through some of the characteristic canals and inland lakes of the country. Prof. van der Stok, the vice-president, and his able assistants, Dr. Hartmann, Dr. Romeijn, Mr. Levoir, and Baron van Voorst tot Voorst, must be congratulated on the perfection of the organisation, which more than anything else allowed the meeting to do its work smoothly and effectively. The permanent committee will come together in 1909 at some place in Switzerland not yet determined, and the place for the next general meeting in 1911 will then have to be fixed. It was too soon to come to any definite decision, but an informal expression that the meeting might appropriately take place in England seemed to meet with a very general approval.

SIR F. L. McCLINTOCK, K.C.B., F.R.S.

ADMIRAL SIR FRANCIS LEOPOLD McCLINTOCK, whose death on Sunday last, at eighty-eight years of age, we regret to announce, will be remembered so long as the story of polar exploration has any interest for the human race. Fifty years have passed since the *Fox*, with Sir Leopold (then Captain) McClintock in command, sailed in search of the Franklin expedition, and the fiftieth anniversary of this memorable event was appropriately marked on June 30 last by a letter of congratulation sent to him from the Royal Geographical Society.

Sir Leopold McClintock's Arctic service began in 1848, when he accompanied Sir James Clark Ross as second lieutenant on board H.M.S. *Enterprise*, in the expedition sent out by the Admiralty. Returning unsuccessful in November, 1849, McClintock joined a second expedition sent out early in 1850 as senior lieutenant of H.M.S. *Assistance*, with Sir Erasmus Ommanney. It was his fortune in August, 1850, to see, at Cape Riley, the first traces of the missing Franklin expedition. In the following spring, whilst frozen up at Griffith Island, he signalised himself by a remarkable sledge journey of 80 days and 760 geographical miles, reaching the most westerly point which had been attained from the east in the Arctic regions. Upon the return of this expedition to England in October, 1851, he was promoted to the rank of commander; and in the following spring he proceeded to the Arctic regions in command of H.M.S. *Intrepid*, one of five vessels composing the third searching expedition, under Sir Edward Belcher's command. In accordance with instructions from the Admiralty, the *Intrepid*, in company with the *Resolute*, Captain Kellett, wintered at Melville Island, in order to search for Captain McClure and his companions; and, fortunately, they were discovered and rescued, after their three years' imprisonment in the ice. McClintock again distinguished himself by his sledge journey of 105 days and 1210 geographical miles into the hitherto unexplored region northward of Melville Island. The advances which Arctic sledge-travelling has made are almost entirely due to the improvements effected by him. Abandoning four out of the five ships imbedded in the ice, and also McClure's ship, the *Investigator*, the *personnel* of this expedition, with McClure and his companions, returned to England in October, 1854, in the depôt ship *North Star*, and two relief ships, freshly arrived out, under Captain Inglefield.

In 1857 McClintock accepted the command of the search expedition fitted out mostly at Lady Franklin's expense. He selected and equipped the steam-yacht *Fox*, of 177 tons, and with twenty-four companions sailed on July 1, 1857. He returned on September 20, 1859, having discovered, upon the north-west shore of King William's Island, a record announcing the death of Sir John Franklin and the abandonment of the *Erebus* and *Terror*. He brought home intelligence of their discoveries and the fate of their crews, and many relics of the expedition. The story of this voyage was fully related by McClintock himself in "The Voyage of the *Fox* in the Arctic Seas: a Narrative of the Discovery of the Fate of Sir John Franklin and his Companions," a work which ran through

many editions, and is a classic story of geographical achievement. In recognition of his services McClintock was knighted, and in 1865 was elected a Fellow of the Royal Society. He was appointed a K.C.B. in 1891.

NOTES.

IN consequence of numerous reports as to the occurrence of a very serious disease among bees in the Isle of Wight, known locally as "paralysis," the Board of Agriculture and Fisheries instructed Mr. A. D. Imms to undertake an inquiry into the nature and cause of the disease; his report on the result of his investigations has now been issued by the Board in pamphlet form. Fortunately, the geographical distribution of the disease is confined apparently to the Isle of Wight, so that with due precaution there should be little or no fear of its spreading to the mainland apiaries. "The disease is eminently one of the digestive system, and might be described as being a condition of enlargement of the hind intestine." Smears made from the contents of the colon showed large numbers of bacteria, and it is possible that there may be some connection between this disease and the well-known form of "dysentery" in bees. The symptoms are complete loss of flight, crawling aimlessly over the ground or up grass stems and the supports of the hive.

THE cablegrams from America in Monday's papers announced the tragic death of Prof. L. M. Underwood, of Columbia University, New York. His mind had been unhinged by the recent financial crisis, and he committed suicide after killing his wife and attempting to kill his daughter. He was born in New York State in 1853, and became professor of botany in Columbia University in 1896. His published works included "Descriptive Catalogue of North American Hepaticæ," "Moulds, Mildews and Mushrooms," "Our Native Ferns and their Allies," and "Our Native Ferns and How to Study Them."

AT the unanimous invitation of the executive committee of the Yorkshire Naturalists' Union, Dr. Wheelton Hind has accepted the presidency of the union for the forthcoming year. Dr. Hind is well known throughout the country for his successful work amongst Carboniferous rocks, and in Yorkshire he has been unusually successful in identifying and tracing various zones in the Carboniferous limestone. His work in Yorkshire makes the selection of him as president of the county society very appropriate, and will doubtless result in increased attention being paid to the geological problems of the Carboniferous period by the members of the union.

THE gold medal of the Institution of Mining and Metallurgy has been awarded to Sir Archibald Geikie, K.C.B., F.R.S., in recognition of his services to geological science. The Consolidated Gold Fields of South Africa gold medal and premium has been awarded to Dr. T. K. Rose for his researches on the metallurgy of gold.

THE programme of the arrangements for the new session of the Society of Arts which has just been issued includes a series of six lectures on industrial hygiene by different experts, who will deal with such subjects as dust in factories and in mines, lead and mercury poisoning in pottery and match-making, work in compressed air, and child labour. A course of lectures on the "Navigation of the Air" is to be given under the Shaw trust by Dr. Hele Shaw, F.R.S. Four courses of Cantor lectures are announced, the first on the microscope, by Mr. Conrad Beck. There is a very full list of papers for the ordinary and sectional meetings, and at Christmas Mr. Martin Duncan will lecture to a juvenile audience on the kinematograph.

DR. KOCH, who returned to Berlin early this month after an absence of eighteen months in German East Africa, has been promoted to the rank of Wirklicher Geheimer Rath, with the title of Excellency, in recognition of his researches into the causes of the sleeping sickness.

AT the meeting of the London Mathematical Society on November 14, the council and officers for the ensuing session were elected as follows:—*President*, Prof. W. Burnside; *vice-presidents*, Prof. A. R. Forsyth and Prof. H. M. Macdonald; *treasurer*, Prof. J. Larmor; *secretaries*, Prof. A. E. H. Love and Mr. J. H. Grace; *other members of the council*, Dr. H. F. Baker, Mr. A. Berry, Mr. T. J. I'A. Bromwich, Mr. A. L. Dixon, Prof. E. B. Elliott, Mr. G. H. Hardy, Dr. E. W. Hobson, Sir W. D. Niven, Mr. H. W. Richmond, and Mr. A. E. Western.

THE *Times* correspondent at Paris gives in the issue of November 14 particulars of an improvement of wireless telegraphy apparatus on board French warships which has enabled communication to be made with facility at a distance of 750 kilometres (466 miles), while the previous *maximum* distance was 300 kilometres (186 miles). According to a telegram from Algiers, the cruiser *République*, on leaving Toulon, proceeded to Ajaccio, a port chosen in order to increase the difficulties of transmission to the *Jules Ferry*, anchored at Toulon, Ajaccio being situated in a hollow of the mountains. Communication was maintained without interruption between the two ships while the *République* was *en route*. It is also stated that the *République* has been able to communicate with the Eiffel Tower in Paris from the Golfe de Jouan, in the Alpes Maritimes Department, a distance of 800 kilometres (500 miles), the ship not merely receiving messages from the tower, but communicating with it in reply.

A PROMISING career has been cut short by the death, on November 12, of Dr. A. M. Pirrie, at the early age of twenty-eight. Dr. Pirrie went to the Sudan in 1906 as anthropologist to the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. Under the direction of Dr. Balfour, the director of the laboratories, he made his first expedition up the Nile to the southern limits of the Sudan, and penetrated to remote parts of the Bahr-el-Ghazal. A second expedition took him to the borders of Abyssinia. On both occasions he was engaged on anthropological and physiological researches into tropical diseases; but unfortunately he contracted fever, and was compelled to return to England. Dr. Pirrie brought back a valuable collection of objects of anthropological and other scientific interest, and at intervals during his illness he was engaged on his report to the Carnegie Institution and the Wellcome Research Laboratories, Khartoum, for which institutions he acted jointly in the work he carried out in the Sudan.

THE sixth annual meeting of the South African Association for the Advancement of Science will be held at Grahamstown during the week ending July 11, 1908, under the presidency of the Hon. Sir Walter Hely-Hutchinson, G.C.M.G. The presidents of the sections are as follows:—Section A, mathematics, physics, astronomy, meteorology, geodesy, and geography, Prof. Alexander Ogg, of Rhodes University College, Grahamstown; Sections B and C, chemistry, metallurgy, mineralogy and geology, engineer-

ing, mining and architecture, Prof. E. H. L. Schwarz, of Rhodes University College, Grahamstown; Section D, botany, zoology, agriculture and forestry, bacteriology, physiology, hygiene, Dr. S. Schönland; Section E, education, philology, psychology, history and archæology, Mr. W. G. Bennie; Section F, economics and statistics, sociology, anthropology and ethnology, Mr. W. Hammond Tooke. The local honorary secretary at Grahamstown is Prof. J. E. Duerden, of the Rhodes University College.

THE Paris correspondent of the *Times* states that, according to a telegram from Montpellier, a mass of earth, having a volume of about 400,000 cubic metres, and forming one whole slope, as it were, of Mont Bringuez, near Lodève, in the Department of the Hérault, has become detached and has moved over a distance of about 1200 feet, carrying with it the tilled soil, fields, woods, and meadows, and obliterating all the ordinary landmarks, bridges, roads, &c., on its passage. A large chestnut grove has thus been moved about 500 feet without, apparently, suffering any damage, but numerous lakes have been formed in the vicinity, and the spectacle is said to resemble that of a region devastated by an earthquake.

AN appeal to the charitable public on behalf of the underfed children attending elementary schools has reached us from the London County Council. For many years past various associations have rendered valuable assistance in collecting and distributing funds. With these associations the Council is in close connection, and every effort is being made to bring the Council, the associations, and the schools into such relationship as will result in a highly efficient organisation for relieving distress. In order to meet the needs of the coming winter, the Council is anxious that at least 15,000*l.* should be raised. If, however, the response is not adequate this winter, there will probably be no alternative in the winter of 1908–9 but to resort to the rates. The Council has voted a sum for equipment and appliances, and will place every convenience at the disposal of the associations. Contributions may be sent to any of the other associations cooperating with the Council, or to Mr. H. Percy Harris, chairman of the London County Council, 98 Gloucester Terrace, Hyde Park, W.; Mr. John T. Taylor, chairman of the Education Committee, 19 Woodchurch Road, Hampstead, N.W.; or Mr. E. A. H. Joy, chairman of the Subcommittee on Underfed Children, Tower House, Woolwich.

A MEETING of representatives of sanitary committees of county and borough councils and port sanitary authorities of England and Wales was held at Caxton Hall, Westminster, on November 15. The object in view was to consider the establishment of a permanent union of such authorities to secure uniformity of action in the administration of matters relating to public health. Mr. H. W. Newton, chairman of the sanitary committee of the Newcastle Corporation, who presided, moved the following resolution, which, after considerable discussion, was adopted by a large majority. The resolution approved of the establishment of a union of the sanitary authorities of England and Wales for the purpose of promoting the public-health interests of the nation. The union is to have for its immediate objects:—(1) to secure, so far as may be practicable, harmony of interest and uniformity of action among sanitary authorities in general on matters relating to the public health; (2) to stimulate and concentrate effort for the purpose of effecting necessary sanitary reforms, whether for the public weal or the benefit of individual sanitary districts; (3) to encourage and promote the study of practical hygiene, and to educate opinion with respect to the national as well as the local importance of public-health work in general; (4) to consider the different conditions and circumstances, general or local, whereby disease is liable to be caused to man, and, so far as may be, to obtain their removal. Other resolutions were also adopted empowering the chairman and Dr. H. E. Armstrong, of Newcastle, as a provisional committee, to draw up a constitution to be discussed afterwards, and to communicate with sanitary authorities asking their adhesion to the union under the name of "National Union of Public Health Authorities."

THE October issue of the *Museums Journal* is illustrated with a portrait of the late Mr. John Maclauchlan, president of the Museums Association, 1906–7. Mr. Maclauchlan presided at the July meeting of the association in Dundee, when he appeared to be in excellent health, but in September he was prostrated by the acute development of a mortal disease with which he had been afflicted for some time, and on October 1 the attack had a fatal termination.

IN the August number of the *Philippine Journal of Science* (ii., No. 4), Lieut. Clarence Cole records the frequent occurrence of the parasitic worm *Necator americanus* in natives of the Philippine Islands; Mr. Harry Marshall gives a good summary of the trend of recent research in immunity; and Dr. Musgrave and Mr. Richmond discuss the relation of infant feeding and infant mortality in the Philippines.

WE have received No. 8 of vol. i. of the Bulletin of the Committee for the Study of Special Diseases, Cambridge. It contains an inquiry into the value of the opsonic index by Messrs. FitzGerald, Whiteman, and Strangeways. As the result of an enormous amount of work, the conclusion is arrived at that, unless at least 1000 cells are counted, the percentage error may be so great as to render the method worthless. In view of the concordant experience of a number of different observers on the value of the method, this conclusion cannot be accepted as final, though it is difficult to detect any fallacy in the experimental details.

TO the sixth number of *British Birds* Mr. H. S. Gladstone communicates some interesting particulars with regard to the Irish nesting-colony of red-necked phalaropes, the one place in the United Kingdom where the species is known to breed. Although not reported until 1903, it appears that a few pairs of the birds had established themselves three years previously. In 1902 seventeen birds, mostly females, were seen; two years later Mr. Gladstone estimated the number at thirty pairs, while in 1905, when the nesting-area had become considerably enlarged, he considered there were nearly fifty couples. Unfortunately, the original tenant, who did all he could to protect the birds, has left the farm, and there are ugly reports of a big egging-raid having taken place during the past season.

A REMARKABLE new dipterid larva, *Acanthomera tetratruncum*, from Paraguay, is described by Mr. Karl Fiebrig in the *Zeitschrift für wissenschaftliche Insectenbiologie*, ser. 2, vol. ii., pp. 316–323 and 344–347. The larva, it appears, is a wood-borer, and has the mouth-parts modified into a powerful boring organ. The terminal segment of the body forms an extremely hard, chitinous shield, beneath which is a "mouth-like" chamber for the reception of the posterior stigmata, these being thereby completely protected from contact with foreign bodies. There is, moreover, a finger-shaped tracheal organ in this region which may act as a kind of "gill-stigma." The adapta-

tion of the larva to its peculiar mode of existence is thus very marked. The larval stage seems to be unusually prolonged, an apparently almost full-grown larva observed at the end of July not having developed into the imago until the following January. As it was observed to be still active a short time before the final transformation the pupa-stage is inferred to be brief. An enlarged figure of the adult fly is given in the second part of the paper.

Two papers in the October number of the *Journal of Anatomy and Physiology* relating to Australian natives are of more than ordinary interest. In the first, Dr. W. L. H. Duckworth describes several brains, pointing out that these afford evidence of the low grade of the aborigines. They frequently show, for example, features very rarely met with in the white races, which are, however, normal in apes. Such simian features are, nevertheless, by no means restricted to Australians, whose brains are in other respects essentially human. In the second paper Dr. Ramsay Smith, after describing the results of an investigation into the mode of development of the teeth of Australians, discusses the bearing of this on tooth-development generally. He finds that simple cuspidate teeth, like canines and incisors, are developed from a single tube of dentine, tipped or capped with enamel, and also that this development takes place by constriction. This being so, he urges that in the case of complex teeth, such as molars, in place of any fusion or absorption of cusps, development has taken place by plication or constriction of an original primitive, single, simple tube, according to the method revealed by his observations. Hence the theory of the origin of "heterodont" teeth from fused primitive cones, as well as the theory of the aggregation of cusps, so far at least as it involves the origin of roots, must be re-considered.

On the subject of school gardens, attention is directed in the editorial of *Irish Gardening* to the absence of these in Ireland, although it is an essentially agricultural country, while in most European countries they have been extensively provided. Mr. W. Johnston contributes a practical article on raspberry cultivation, and Mr. P. Brock writes on the propagation of chrysanthemums; special articles are also concerned with the development and classes of carnations, and the culture of Cape heaths.

Miss A. G. Stokey has contributed to the July number of the *Botanical Gazette* a description of the roots of *Lycopodium pithyoides*, a subtropical plant in which every stem is a potential sporophyll. The stem is characterised by the large number of roots that run through the cortex, amounting to more than fifty in one instance. The roots arise within a few millimetres of the apex of apparently mature stems. The vascular strand in the root shows in transverse section a crescent-shaped mass of xylem, with phlœm lying between the horns of the crescent. At the apex of the root four distinct initial regions can be distinguished.

With the object of disseminating the information locally and for others interested, Dr. W. L. Bray has prepared an account, published as Bulletin No. 82 of the University of Texas, of the distribution and adaptation of the vegetation in that State. The factors that control the various plant zones are discussed upon the principles laid down in Schimper's "Pflanzen-Geographie." In connection with water supply, the author distinguishes primarily a moisture-demanding vegetation in east Texas and a dry-climate vegetation in west Texas. Mesophytic types of woodland, notably long- and short-leaf pine and mixed forests, are characteristic of the east, whereas in the west, xerophytic formations abound, such as the "chapparal" scrub, grassy plains, and the "sotol" country inhabited by succulents and dwarf shrubs. There is also a wide range of temperature, from the semi-tropical region where the culture of tropical plants is only prevented by occasional forests, to a cold zone where the Douglas spruce is dominant. Between these lie the "cotton-belt" and the "corn-belt."

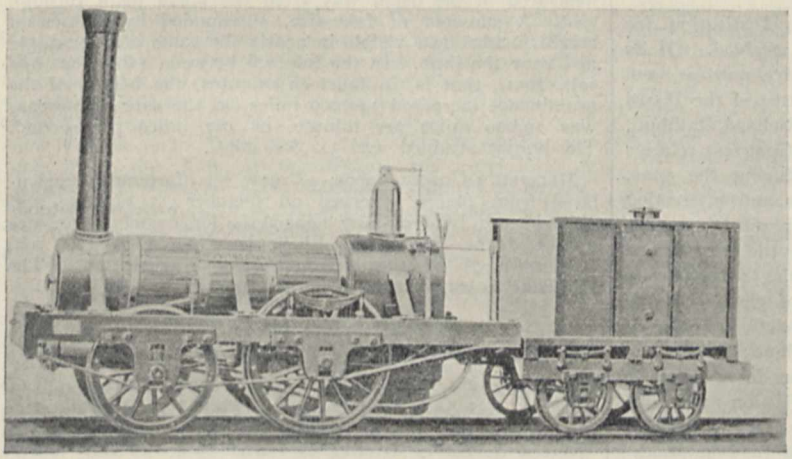
In the September number of the Cape of Good Hope *Agricultural Journal*, Mr. Robertson describes his investigations on a local cattle disease he considers to be identical with Nocard and Leclinche's "pasteurellose." He isolated from the affected tissues a bacillus which produces all the symptoms of the disease when inoculated into healthy sheep or cattle. Dr. Nobbs also gives an account of the work proposed to be done at the experiment stations at Knysna, on the wet "sour veld," and at Robertson, in the semi-arid "Karroo" district. These two widely different types of country are fairly common in Cape Colony. "Sour veld" is known by its vegetation; much of it is, or was, forest, but a good deal is covered with scrubby bushes 2 feet to 10 feet high, and reeds, sedges, bracken, and the sugar-bush family (Proteaceæ) are numerous. There is abundant rainfall. The land is being brought into cultivation, but is found to be very sterile in spite of being virgin soil of excellent mechanical condition. Cropping, manuring, and tillage experiments are in progress. On the fertile "Karroo" land the conditions are altogether different; the rainfall is only 10 inches or 12 inches, and as this comes chiefly in winter, recourse must be had to irrigation and special cultivation methods during summer. The experiments at Robertson are in these directions.

The Bulletin of the American Geographical Society, Nos. 7, 8, contains a paper by Miss E. C. Semple on geographical boundaries. After dwelling on the indefinite character of most natural boundaries, Miss Semple gives an account of the conditions generally existing in the border zone between two races or states, illustrations being afforded by the early history of the United States and the wide frontier between Russia and the East. The system of maintaining a waste boundary strip for protective purposes has been superseded in modern States by a fixed political boundary, which, however, does not prevent the existence of a frontier district, the inhabitants of which are generally a mixed race of the two contiguous elements. By means of a map showing the races of Central Europe, the migrations of Slav and Teuton over the political boundary are strikingly illustrated. Attention is also directed to the tendency of border zones to become inhabited by undesirable refugees from both sides.

In compliance with a request made by the Solar Commission of the Meteorological Congress at Innsbruck in 1905, the Weather Bureau of the Philippines has published a useful statement of the rainfall of that archipelago, in the preparation of which all the available data at the disposal of the Manila Observatory have been revised by the Rev. M. S. Masó, S.J., under the direction of the Rev. Father Algué. The rainfall differs considerably, owing to the extension of the archipelago in the N.–S. direction; the annual average amount is about 87 inches, the extreme values being 35·5 inches and about 157 inches. Three different climates are distinguished; the first and worst has two well-defined seasons, wet and dry, in which more than 80 per cent. of the annual fall

occurs during the summer months. The second climate consists of eight or nine rainy months, the percentage being high in both summer and winter. The third and best climate has a fairly even distribution of rainfall over the whole year. Reference should be made to the paper in question for particulars as to the location of these districts; tables are given showing the monthly and annual rainfall at all stations.

THE Journal of the Franklin Institute (vol. clxiv., No. 4) contains an interesting report on the development of the American locomotive as exemplified in the Baldwin Locomotive Works of Philadelphia. Founded in 1831, the works in 1832 completed one locomotive and employed thirty men. In 1906 they built 2652 locomotives and employed 17,432 men. Illustrations are given of seventeen locomotives of different types made by the company, the most interesting being the famous "Old Ironsides," completed and tried on November 23, 1832. In these early days mechanics were few, and suitable tools could hardly be obtained. Cylinders had to be bored with a chisel fastened in a block of wood, whilst blacksmiths who could weld bars of iron exceeding 1¼-inch square were not to be had. Mathias Baldwin, therefore, had to do most of the work himself in order to educate the men who assisted him to fashion the necessary tools for the various processes.



"Old Ironsides" Locomotive.

IN view of the large number of ancient coins and medals that have been preserved, it is surprising that so little is known regarding the dies used. Some important contributions to the knowledge of the subject are made by Prof. C. Zenghelis in the *Chemiker Zeitung* of November 9. In 1904 a die used for coinage was found by a native at Tel El Athrib, Egypt, and was subsequently presented to the museum at Athens. It dates from 430 B.C. to 322 B.C., and is probably the only genuine antique die preserved. It consists of bronze, and is 6 cm. high and weighs 164·12 grams. On the base is engraved the owl exhibited by the Athenian tetradrachma pieces. The surface was covered partly with a patina of copper carbonate and partly with red cuprous oxide. On analysis it was found that the die consisted of a bronze with 22·51 per cent. of tin and 69·85 per cent. of copper. The remaining 7·64 per cent. undoubtedly consisted of oxygen, as careful tests failed to show the presence of other elements. Some cuprous oxide was mixed with the material for analysis, and as in such alloys the tin oxidises more rapidly than the copper, it may safely be assumed that the mean composition of the alloy was 75 per cent. of copper and 25 per cent. of tin. The strikingly large proportion of tin in the alloy is quite unusual for bronzes of that period, which usually contain 90 per cent. of copper and 10 per cent. of tin, and the oldest bronzes of all are still poorer in tin. The die affords remarkable evidence of the metallurgical skill of the ancients. The extreme hardness required for a die was secured by increasing the proportion of tin, whilst the requisite malleability was secured by carefully using in the preparation of the alloy the purest copper and tin, absolutely free from lead or zinc, which would have made it softer, and from antimony and arsenic, which would have made it brittle.

MADAME CURIE announces in the October number of *Le Radium* the result of her re-determination of the atomic weight of radium under conditions much more favourable to accuracy than those which existed in 1902, when she had only 9 centigrams of chloride of radium on which to work. The present determination has been made with 4 decigrams by the method used in the former case, and gives as the result 226·2, if the atomic weight of silver be taken as 107·8. Madame Curie estimates the possible error of the determination as less than half a unit.

THE Munich *Medizinische Wochenschrift* for October 15 contains a description of an induction coil for Röntgen-ray work, constructed by Dr. J. Rosenthal, which is capable of producing a photograph of a man's thorax in two seconds with the tube 50 centimetres away. This certainly brings us nearer to the much desired Röntgen-ray kinematograph of the action of important organs like the heart, and it is to be hoped that Dr. Rosenthal will succeed in still further reducing the time of exposure. One feature of his coil is the division of both primary and secondary into two or more parts, which can be placed in series or in parallel with each other without stopping the coil.

THE August Bulletin of the Bureau of Standards of Washington contains an article on the melting points of the elements of the iron group by Mr. G. H. Burgess. The determinations were made by placing minute quantities (0·001 milligram) of the elements on a platinum strip heated by the passage of an electric current through it. The temperature of the strip was measured by an optical pyrometer standardised by reference to the melting points of zinc, 419° C.; antimony, 630°·5 C.; copper, 1084° C.; and platinum, 1753° C. The results are as follows:—iron, 1505° C.; chromium, 1489° C.; cobalt, 1464° C.; nickel, 1435° C.; manganese, 1207° C.

THE report of the director and librarian to the Warrington Museum Committee for the year ending June 30 provides evidence that good work in the direction of encouraging scientific observation is being done at Warrington with the aid of the museum and its staff. Among other arrangements made at the museum to interest students and young pupils in natural history may be mentioned the wild-flower table, which appears to be visited regularly by students and by teachers preparing

object-lessons. With the assistance of voluntary helpers, the staff provided for the table during the year more than 2500 specimens of freshly gathered wild-flowers, the greatest number on a single day being 168, on July 23.

THE Proceedings of the council of the Institute of Chemistry from July to October of the present year show that the council has directed the attention of the Local Government Board to the desirability of making the condition of appointment of public analysts attractive to candidates with the highest qualifications, and has also urged that the tenure of offices held by men of such ability and experience should be made more secure. Approval is expressed of the action of the County Council of East Suffolk, which has lately set an example by empowering the county coroner to order an analysis by a properly qualified analyst in any case of suspected poison, not being one of alleged foul play. The council has deemed it desirable to advise fellows or associates of the institute who may be seeking appointments in India to make sure they are gazetted as officers, and recognised as such in the regulations of the department under which they are seeking appointment, so that they may not find themselves in a position inferior to that to which they have a right, both officially and socially.

THE annual report of the Smithsonian Institution for the year ending June 30, 1906, has been received. Of its 546 pages, ninety-one refer to administrative matters, and include the reports of the executive committee of the Board of Regents and the acting secretary, Mr. Richard Rathbun, together with the Acts and Resolutions of Congress relative to the Smithsonian Institution adopted during the year. The appendix is again the most extensive and interesting part of the publication. Among other important contributions to this part of the volume we notice the translations of Madame Curie's opening lecture at the Sorbonne on November 5, 1906, on modern theories of electricity and matter; Prof. Himstedt's essay on radio-activity; M. H. Radau's account of astronomy on Mont Blanc; an abstract of M. A. Lacroix's description of Vesuvius in eruption in April, 1906; M. E. Bugnion's contribution to polyembryony and the determination of sex; Herr E. Pfizenmayer's contribution to the morphology of the mammoth; M. L. Cuénot's lecture on heredity; M. A. Yermoloff's description of the bisons of the Caucasus; Dr. Jakob Huber's account of the founding of colonies by Atta Sexdens; M. Hugues Obermaier's description of Quaternary human remains in central Europe; Prof. R. Blanchard's lecture on zoology and medicine; and M. Eugène Lemaire's account of the *rôle* of chemistry in paintings. Among original contributions to the appendix are those of Mr. C. G. Abbot on recent progress in astronomical research, and Mr. C. J. Blanchard on the national reclamation of arid lands. Royal Institution discourses reprinted include those of Mr. Marconi on recent advances in wireless telegraphy, and Prof. Schuster on international science. As usual, the appendix contains a profusion of beautiful illustrations.

A THIRD impression of Dr. David Nabarro's "Laws of Health" has been published by Mr. Edward Arnold. The book provides a simply worded description of the organs of the human body, and much sensible advice as to how to ensure their health and general well-being. The author has acquainted himself with the needs of schools, and his book should be of service to teachers in the preparation of lessons on elementary hygiene.

THE third volume of the "Index of Economic Material in Documents of the States of the United States" has been received. The index is being prepared for the department of economics and sociology of the Carnegie Institution of Washington, and is being published by the institution. The present instalment is by Adelaide R. Hasse, and is concerned wholly with the documents of Vermont, and deals with the years 1789–1904. The index is confined to printed reports of administrative officers, legislative committees, and special commissions of the States, and to governors' messages. It does not refer particularly to constitutions, laws and legislative proceedings, or to court decisions.

OUR ASTRONOMICAL COLUMN.

A LARGE SOLAR PROMINENCE.—Dr. A. A. Rambaut, F.R.S., sends us particulars of a large solar prominence observed by him on Friday last, November 15, at the Radcliffe Observatory, Oxford. Using a slit tangential to the sun's limb, a prominence having the form of two smooth rounded hills was observed at 11h. 45m., and it quickly increased in height until it filled the slit. A few minutes later the whole aperture in the brass plate to which the jaws of the slit were attached on the collimator was not large enough to contain the whole of the outburst. The prominence was in position-angle 273° on the sun's disc measured in the usual way from the north point through east. A sun-spot of fair size, surrounded by masses of bright faculæ, was visible in nearly the same position-angle and near the limb. In the interval between 11h. 56m. and 12h. 10m., that is, in fourteen minutes, the height of the prominence increased 140,000 miles, so the rate of increase was 10,000 miles per minute, or 167 miles per second. The height attained was 324,600 miles.

MELLISH'S COMET, 1907*e*.—A new set of elements, calculated from places observed on October 15 and 19 and November 2, and a daily ephemeris for comet 1907*e*, are published by Herr M. Ebell in No. 4212 (p. 195, November 7) of the *Astronomische Nachrichten*. The following is an abstract from the ephemeris:—

Ephemeris 12h. (M.T. Berlin).

1907	α (app.) h. m.	δ (app.) ° ′	log *r*	log Δ	Brightness
Nov. 20	2 14·3	+28 8·4	0·1720	9·7179	1·66
,, 24	1 32·0	+28 33·1	0·1855	9·7865	1·14
,, 28	1 1·9	+28 19·9	0·1987	9·8541	0·78
Dec. 2	0 40·5	+27 55·1	0·2116	9·9172	0·55
,, 6	0 25·3	+27 29·7	0·2243	9·9748	0·40

At the time of unit brightness (October 15) the comet's magnitude was about 9·5.

On November 23 the comet will pass about 40′ S. of α Trianguli, and on November 28 it will be 6¾° S. of β Andromedæ, crossing the meridian at about 8.30 p.m.

MARS AS THE ABODE OF LIFE.—The *Century Magazine* for November (No. 1, vol. lxxv., p. 113) contains the first of a series of articles on the possibility of Mars being inhabitable, in which Prof. Lowell discusses, as an introduction, the possible origin and evolution of planets. He commences with a description of meteorites, and traces out the various steps of the meteoritic hypothesis, and then defines six stages through which the cooling celestial mass passes in its progress from a self-luminous sun to a cold dead body. Discussing the present aspects of the planets, he shows that these are in accord with the stages defined, and points out that the crumpling which produces landscape variations is essentially an effect of cooling. The relative roughness of the surfaces of the earth, of Mars, and of the moon is then discussed, and the comparatively abnormal mountainous character of the last-named explained by its initial temperature being the temperature of the combined earth and moon masses, and therefore sufficient to produce, in the cooling of so small a mass, the huge lunar mountains with which we are familiar; the non-mountainous character of the Martian landscape is also explained. This first paper concludes with a discussion of the formation and distribution of continental and oceanic areas.

SATURN'S RINGS.—Several recent observations of Saturn's rings are reported in No. 4213 (p. 219, November 10) of the *Astronomische Nachrichten*. Dr. Ristenpart reports that on November 5 he was able to see the ring distinctly, as a ghost-like fine line, with the 12-inch equatorial of the Urania Observatory at Berlin.

Prof. Hartwig, observing at Bamberg on November 7, was surprised to find that the ring on both sides appeared of a reddish-brown colour. The shadow of the rings on the surface of the planet was very distinct, and broader than it was four weeks previously. A telegram from Cambridge (Mass.) reports that Prof. Lowell confirms the observation of the symmetrical knots in Saturn's rings made by Prof. Campbell.

In the same journal Herr Paul Guthnick places on record the results of observations of Saturn's rings and satellites made at the Royal Observatory, Berlin, during part of the week referred to by Prof. Campbell.

ELEMENTS AND EPHEMERIS FOR THE MINOR PLANET PATROCLUS.—A set of elements and an ephemeris, covering the period October 31 to November 16, for Patroclus (1906 VY), one of the three Jovian asteroids, are given in No. 4212 (p. 193, November 7) of the *Astronomische Nachrichten* by Herr V. Heinrich. The opposition will take place on November 30, the magnitude of the minor planet being 14·5.

COMPARISONS OF THE PLACES OF MARS FOR THE OPPOSITIONS OF 1907 AND 1909.—In a paper communicated to the Royal Astronomical Society (Monthly Notices, vol. lxvii., No. 9, p. 575) Dr. Downing compares the places of Mars calculated from Newcomb's tables with the places calculated from Le Verrier's tables near the times of opposition in 1907 and 1909. The results are tabulated for every eight days from May 26 to August 14, 1907, and from August 14 to November 2, 1909. On September 23, 1909 (near the time of opposition), the correction to Le Verrier's place is $-10\cdot5$ seconds of arc in R.A. and $-5''\cdot5$ in declination, to his heliocentric longitude of Mars $-4''\cdot1$, and to the longitude of the sun $-0''\cdot9$; the distance of Mars from the earth will be 0·39.

SCIENCE AT THE FRANCO-BRITISH EXHIBITION OF 1908.

IT has been announced in various newspapers that there will be a Franco-British Exhibition next year. Those who have passed near Uxbridge Road will have also noticed that a large area of ground is being covered rapidly with exhibition buildings.

According to its prospectus, it is to be an exhibition of science, arts, and industries, and it is a matter of concern to all English men of science to see that in such an exhibition science is given its proper place.

Up to the present time no accounts of any attempt to represent science at this exhibition have been made public; we give, therefore, a short sketch of the efforts which are being made to have a pure science section as a part of the exhibition. Such a section is a novelty in exhibitions, and that there will be a science section is due to the action of the British Science Guild. That body approached the executive committee of the exhibition, suggesting that a section should be set apart for pure science, dealing mainly with original research as carried on both in the laboratory and in factories.

The executive committee accepted the suggestion, and a committee was formed which has been at work since June last.

It is hoped that the French side of the exhibition will deal with French science in a similar way.

The committee is constituted as follows:—Sir Norman Lockyer, K.C.B., F.R.S., chairman; Prof. John Perry, F.R.S., vice-chairman; Sir Alexander Pedler, C.I.E., F.R.S., hon. secretary. Members: Captain Sir Wm. de W. Abney, K.C.B., F.R.S., Prof. J. O. Arnold, Major B. F. S. Baden-Powell, Dr. F. A. Bather, Prof. C. V. Boys, F.R.S., Prof. Callendar, F.R.S., Major Close, R.E., Captain Ettrick W. Creak, R.N., C.B., F.R.S., Mr. Horace Darwin, F.R.S., Prof. J. A. Ewing, F.R.S., Prof. Farmer, F.R.S., Rear-Admiral Field, F.R.S., Mr. L. Fletcher, F.R.S., Mr. G. H. Fowler, Sir Archibald Geikie, K.C.B., F.R.S., Sir David Gill, K.C.B., F.R.S., Dr. R. T. Glazebrook, F.R.S., Prof. Gotch, F.R.S., Mr. Walter Rosenhain, Colonel Hellard, R.E.; Colonel Sir Thomas Holdich, K.C.M.G., K.C.I.E., C.B., Sir E. Ray Lankester, F.R.S., Dr. W. J. Lockyer, Prof. R. Meldola, F.R.S., Prof. H. A. Miers, F.R.S., Dr. H. R. Mill, Prof. Milne, F.R.S., Prof. Poulton, F.R.S., Lieut.-Colonel D. Prain, C.I.E., F.R.S., Sir William H. Preece, K.C.B., F.R.S., Sir William Ramsay, K.C.B., F.R.S., Dr. Ridewood, Mr. Frederick Rudler, I.S.O., Prof. Rutherford, F.R.S., Dr. W. N. Shaw, F.R.S., Mr. A. E. Shipley, F.R.S., Mr. L. J. Spencer, Dr. J. J. H. Teall, F.R.S., Prof. Silvanus Thompson, F.R.S., Prof. T. E. Thorpe, C.B., F.R.S., Prof. Trouton, F.R.S., Colonel Sir Charles M. Watson, R.E., K.C.M.G., C.B., Sir H. Trueman Wood.

The exhibits are for convenience subdivided into three sections:—

(*a*) Historical apparatus which has been used by eminent scientific discoverers, or has been the means of elucidating important truths.

(*b*) Instruments and methods used in experiments and observations, including those used in laboratory and works research.

(*c*) Instruments and methods used in and results obtained from the exploration of (1) the land; (2) the sea; (3) the air; (4) the heavens.

The various subjects are dealt with as follows:—

Division 1: arithmetic and mathematical science, geometry, measurement, molecular physics, and sound. Subcommittee, Prof. Perry, Prof. C. V. Boys, and Mr. Horace Darwin; convener, Prof. Perry.

Division 2: light and photography. Subcommittee, Captain Sir Wm. de W. Abney and Sir H. T. Wood; convener, Sir H. T. Wood.

Division 3: invisible radiations. Subcommittee, Prof. S. P. Thompson, Prof. Rutherford, and Hon. R. J. Strutt; convener, Prof. Rutherford.

Division 4: heat. Subcommittee, Prof. Callendar and Mr. Horace Darwin; convener, Prof. Callendar.

Division 5: magnetism and electricity. Subcommittee, Prof. S. P. Thompson, Prof. Trouton, and Sir Wm. H. Preece; convener, Prof. Trouton.

Division 6: chemistry. Subcommittee, Prof. Thorpe, Prof. Meldola, Sir Wm. Ramsay, and Sir Alex. Pedler; convener, ——.

Division 7: mineralogy and crystallography. Subcommittee, Prof. Miers, Dr. Fletcher, and Mr. L. J. Spencer; convener, Prof. Miers.

Division 8: animal biology. Subcommittee, Sir E. Ray Lankester, Prof. Gotch, Mr. A. E. Shipley, Prof. Poulton, and Dr. Ridewood; convener, Prof. Gotch.

Division 9: vegetable biology. Subcommittee, Lieut.-Colonel D. Prain and Prof. Farmer; convener, Prof. Farmer.

(1) *Exploration of the Land.*

Division 10: geography. Subcommittee, Sir D. Gill, General Sir T. Holdich, Prof. J. Milne, Colonel Sir Charles M. Watson, Colonel Hellard, and Major Close; convener, Colonel Sir C. M. Watson.

Division 11: geology. Subcommittee, Sir Archibald Geikie, Dr. J. J. H. Teall, Mr. F. Rudler, and Dr. F. A. Bather; convener, Mr. F. Rudler.

(2) *Exploration of the Sea.*

Division 12: oceanography and hydrography. Subcommittee, Rear-Admiral Field, Captain Creak, Mr. G. H. Fowler, and Mr. D. J. Matthew; convener, Captain Creak.

(3) *Exploration of the Air.*

Division 13: meteorology. Subcommittee, Dr. Shaw, Dr. Mill, and Major Baden-Powell; convener, Dr. Shaw.

(4) *Exploration of the Heavens.*

Division 14: astronomy. Subcommittee, Sir D. Gill, Sir Norman Lockyer, and Dr. Lockyer; convener, Dr. Lockyer.

Division 15: geodesy. Subcommittee, Committees 10 and 14 sitting together; convener, Major Close.

Division 16: metallography. This additional subsection

has only lately been formed, and should have been included between subsections 6 and 7 (chemistry and mineralogy and crystallography). Subcommittee, Prof. Arnold, Prof. J. A. Ewing, Mr. Walter Rosenhain, and Mr. J. E. Stead; convener, Mr. Walter Rosenhain.

It is hoped that everyone interested in the welfare of science will materially assist the committee, the work of which is a labour of love. Such help, in the form of the loan of objects, photographs, &c., of scientific interest which they may possess, will add greatly to the value of the sections. The conveners of each section will gladly communicate with such intending exhibitors if applications be made to them through the main office (56 Victoria Street, S.W.).

THE EXTINCT VERTEBRATE FAUNA OF PATAGONIA.[1]

IF eccentric originality stand for genius, and refusal to follow the beaten track, even when compass-bearings indicate that it is the right one, be deemed merit, then, unquestionably, the author of the work before us is entitled to stand in the first rank of scientific men. If, on the other hand—but perhaps it will be better to leave our readers to complete this sentence as their own judgment dictates after the perusal of the following remarks and criticisms.

Dr. Ameghino was, it seems, engaged on a monograph on Patagonian fossil fishes, when the appearance of an article by Mr. O. Wilckens on the Cretaceous and Tertiary strata of Patagonia led him to direct his attention to the task of confuting the (to him) heterodox views therein expressed. The result is the present bulky volume, which comprises within its purview a survey of the whole of the vertebrate-bearing strata of Patagonia, together with a summary of the author's views with regard to their geological ages and the relationships and phylogenies of their faunas.

So far as vertebrate palæontology is concerned, Dr. Ameghino has long been imbued with the idea that the Argentine Republic (like Boston in another sense) is the "hub of the universe." In previous works he has demonstrated to his own satisfaction that South America was the birth-place of every mammalian group save that typified by man. He now goes one better, and claims that even *Homo sapiens* himself traces his ancestry to the great South American birthplace and nursery of creation, where he was represented by "*Homo pampeanus*" in the reputed Lower Pliocene strata of Mar del Plata.

There was, however, we are told, a yet earlier forerunner of the human race in Patagonia, to wit, the still apparently unknown Homosimius of the Lower Miocene or Oligocene, and it was this hypothetical creature which passed from South America by a land-bridge across the Atlantic, in company with Cercopithecidæ, to colonise the Old World, where the more bestial man-like apes made their appearance at a later date as a lateral offshoot from the human stock. Finally, to go still further back, the whole order of the Primates (not to mention other mammalian groups) traces its descent to the Argentine Microbiotherium, which the prosaic palæontologists of other countries persist in regarding as neither more nor less than an aberrant type of opossum. We have thus the direct descent of man from marsupials, in defiance of the accepted view that marsupials and placentals are not in the same line.

The above is merely one example from among many elaborate mammalian phylogenies to be met with in this volume; all, if we may say so, evolved from the author's fertile imagination rather than based on any tangible foundation of fact—or, at least, upon any that is apparent to ourselves.

To put the matter briefly, it may be said that whereas most palæontologists of repute who have practical acquaintance with the country or its fossils, or with both together, see in the Patagonian sequence a series of Cretaceous strata with dinosaurian remains followed, after an interval, by others containing one or two mammalian faunas of apparently Miocene age, Dr. Ameghino recognises in the lower beds a mingled mammalian and dinosaurian Cretaceous fauna, succeeded by several distinct mammalian faunas extending from the Eocene upwards. Nor is this all, for while those who do not accept his views consider that the exclusively Patagonian extinct mammalian fauna (and more especially the Ungulate) is *sui generis* and strictly local, the author is of opinion that the various faunas recognised by himself present numerous ramifying affinities with practically all the other Tertiary faunas of the globe, of which, indeed, he regards the former as the *fons et origo*.

It is, however, only fair to add that at the commencement of the volume Dr. Ameghino puts these two irreconcilable views candidly before his readers, and if he elects, in opposition to, practically, the united opinion of the rest of the palæontological world, to adhere to the second alternative, he has, of course, a perfect right to do so. To attempt to refute his views by summarising and criticising the evidence would manifestly be impossible within the limits of a single short article, and it must accordingly suffice to reiterate emphatically that they are not endorsed by even a respectable minority of expert opinion elsewhere.

It may, however, be well to refer to a couple of instances (in addition to those already cited) of what we venture to call Dr. Ameghino's idiosyncrasies in the matter of classification and phylogeny. European palæontologists, after very careful study, have arrived at the conclusion that the remarkable Eocene Egyptian ungulate Arsinöitherium either represents a special group of the order by itself or that it is an aberrant hyrax. Our author scouts both these opinions, and without any apparent reason refers the genus to the Ancylopoda, as typified by the European Chalicotherium (Macrotherium). Again, if there is one apparently well-established fact in palæontology it is that the Egyptian Mœritherium is on the direct ancestral line of the modern Proboscidea. In this, according to our author, palæontologists are, however, altogether wrong, and instead of Africa having been the birthplace of the elephants, we are to look for this in South America, whence, by some unexplained magic, various (shall we say imaginary?) genera with almost unpronounceable names blossomed on the one hand into Palæomastodon and the elephants, and on the other into the forlorn and childless Mœritherium.

To enter into further details would be mere waste of space, and it must suffice to add, in conclusion, that, while fully appreciating the great industry Dr. Ameghino has displayed in collecting and describing the palæontological marvels of Patagonia, we sincerely regret our inability to accord him that encomium on the results of his labours which it would have been a real pleasure to bestow.

R. L.

[1] "Les Formations sédimentaires du Crétacé Supérieur et du Tertiaire de Patagonie, avec un parallèle entre leurs Faunes mammalogiques et celles de l'Ancien Continent." By Florentino Ameghino. Pp. 568+plates. Buenos Aires An. Museo Nacional, vol. xv. (1906.)

HYDROLOGY IN THE UNITED STATES.

WE have been favoured by the Department of the United States Geological Survey with seven[1] more papers on the geology and water resources of various States. Most of these, although containing valuable information on such subjects as underground water supplies, rainfall and stream flow, pollution and its relation to typhoid fever, weir experiments as to the measurement of running water, are principally of local interest.

Paper No. 194, on the pollution of the Illinois and Mississippi Rivers by Chicago sewage, by Marshall O.

[1] "The Geology and Water Resources of the Western Portion of the Panhandle of Texas." By C. Gould. Water Supply and Irrigation Paper, No. 191.

"The Water Supply of Nome Region, Seward Peninsula." By J. C. Holt and F. Henshaw. Paper No. 196.

"Underground Waters of the Costal Plain of Texas." By T. U. Taylor. Paper No. 190.

"Potomac River Basin." By Parker, Willis, Bolster and Marsh. Paper No. 192.

"The Quality of Surface Waters in Minnesota." By Wesbraat. Paper No. 193.

"Weir Experiments, Coefficients and Formulas." By R. E. Horton. Paper No. 200. (Washington: Government Printing Office, 1907.)

Leighton, is of much wider interest, containing the particulars of a most searching investigation as to what distance it is possible for the typhoid bacillus to travel in a running stream, and so convey disease from one place to another.

It is well known that the city of Chicago, in order to preserve the purity of the water in Lake Michigan, from which it derives its water supply, diverted the sewage from the lake into a canal thirty miles long for conveying it into the Desplaines river, which connects with the Illinois River, and so with the Mississippi, on which is situated the town of St. Louis. The law authorising the construction of the canal required that the sewage was to be diluted with 20,000 cubic feet of water from the lake per minute for each 1000 inhabitants of the sanitary district.

An epidemic of typhoid fever having broken out in St. Louis, the sanitary authorities were advised that this could be traced to germs transported from Chicago, where a large number of typhoid-fever cases had prevailed. The State of Missouri, in which St. Louis is situated, therefore commenced proceedings in the Law Courts against the State of Illinois and the sanitary district of Chicago for an injunction to prevent further pollution of the Mississippi water. The evidence taken "comprises the best symposium on river pollution, its biological and chemical aspects, and general and special sanitary significance that has ever been assembled." The contentions of both parties were supported by all the most qualified chemists, biologists, and sanitary experts in the United States, no less than forty-one expert witnesses having been called. The record of the evidence occupies 8000 printed pages. The paper now under notice contains a digest of this evidence and the finding of the court.

The distance between the two cities is 322 miles, and there are on the main stream and its tributaries between these two points a population of 1½ million inhabitants. The quantity of sewage discharged from Chicago at the time of the trial was given as 1500 tons daily, and the volume of fresh water sent down with this 300,000 cubic feet a minute. By means of float experiments, most carefully carried out, it was shown that it took nearly eleven days for the water to travel from Chicago to St. Louis.

It was also shown that typhoid fever had prevailed more or less every year for the previous ten years in the towns on the banks of the Mississippi and its tributaries, the number of cases in 1902 amounting to more than 1200, of which 800 occurred in the Chicago district.

One of the most interesting of the experiments made to determine how long a typhoid bacillus would live in a running stream was the discharge into the Mississippi River, just below the junction with the Illinois, of several millions of *Bacillus prodigiosus*, an organism of the same type as the typhoid bacillus, but which had never been found in the Mississippi water. This bacterium was subsequently found in samples collected at different places between the Illinois outfall and the intake of the St. Louis water supply. It was shown that this particular bacillus could live in running water for periods extending from thirty to fifty days, and was still alive when the experiments ceased. Dr. Ravold, who conducted these experiments, testified that it was highly probable that a typhoid bacillus can be carried in a virulent condition a distance equal to that between Chicago and St. Louis. It was admitted that sunlight was detrimental to the life of "bacteria," but the effect depends on the turbidity of the running water and the depth to which it will admit the sun's rays. In the Illinois River the effect of the sun was dissipated in a depth of less than a foot. The factors which cause the disappearance of bacteria are aëration, dilution, sunlight, sedimentation, and absence of food supply.

Cases were brought forward in which it was shown that typhoid fever germs had travelled along a river upwards of fifty-seven miles, and caused infection in water supplies; in another outbreak of typhoid which had been investigated, the distance over which the typhoid germ had been traced as having travelled was 175 miles, and in another 113 miles. It was shown that although the dilution of the Chicago sewage by the clean water from the lake would render it less injurious, yet this would not destroy the typhoid bacillus or hinder it from travelling down the river.

On the other side it was contended that it had never yet been satisfactorily proved how long the typhoid bacillus will live in the sewage-contaminated water of a stream, but, according to laboratory experiments, the time might be stated as varying between weeks and months. It was held by some experts that typhoid bacilli disappeared when water bacteria became active. As an illustration of this was quoted the fact that the water of the river Spree, which passed through Berlin and received the city sewage, after the course of a few miles widens out into a quiescent body of water. The sewage water entering the lake became so purified that when leaving it was practically as pure as it was above Berlin before it became polluted. The same result happened to the river Limmat, which flows into Lake Zurich.

It was stated also that the river Seine, after receiving the sewage of Paris, purified itself within a distance of forty-three miles.

An elaborate series of experiments was made to determine the longevity of the typhoid bacillus under natural conditions in the water of the drainage canal and other places. The bacilli were placed in parchment sacks suspended in the water by floats, through which substances in solution could pass, but which did not permit the bacilli to pass out. These sacks were suspended in a light cage, and into them was introduced a quantity of sewage, together with a strong culture of typhoid bacilli. The results of these experiments, closely simulating those in nature, indicated that the typhoid bacillus does not survive for a period longer than four days in water similar to that discharged from Chicago.

Experiments made by the witnesses for Chicago as to the survival of the *B. prodigiosus* failed to confirm those of the complainants, and their evidence was to the effect that it was improbable that the organisms reported to have been found at the intake of the St. Louis water were the same as those placed in the drainage canal. It was also stated that, although the typhoid bacillus may remain alive in the human body for many months, and in wet soil some weeks and possibly months, yet in water it dies out quickly, the length of time depending on the character of the water, being longer in pure water than in that which is polluted, where it has to fight for its existence with other bacteria.

The judgment of the Supreme Court of the United States was given in February, 1906, to the following effect:—that the case as presented to the court fell so far below the allegations that it was not brought within the principles heretofore established, and the Bill was therefore dismissed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The thanks of the University are to be given to the Rev. Dr. Bonney, who has presented to the Sedgwick Museum the whole of his collection of rock slices, consisting of two thousand seven hundred specimens, of which the British examples number about thirteen hundred. The latter represent especially the rocks of Cornwall, Charnwood, the Wrekin, the Bunter pebbles, north Wales, Scotland, and the Channel Islands. The European collection contains some four hundred and fifty specimens collected from different parts of the Alps, Brittany, and the Ardennes. There is also a large collection of specimens from the Himalayas, Novaia Zemlya, Ararat, Canada (Eozoon, &c.), Rocky Mountains, Andes, Ecuador, Bolivia, Aconcagua district, Socotra, and the diamantiferous district of South Africa.

Dr. Myers has been appointed university lecturer in experimental psychology until Michaelmas, 1912, and Dr. W. H. R. Rivers university lecturer in the physiology of the senses until the same date.

Mr. A. Hutchinson has been appointed chairman of the examiners for the natural sciences tripos.

The Walsingham medal for 1907 has been awarded to E. Mellanby, formerly research student at Emmanuel College, for his essay on the metabolism of creatinin and

creatin. The Walsingham medal for 1908 will be awarded for a monograph or essay giving evidence of original research on any botanical, geological, or zoological subject, zoology being understood to include animal morphology and physiology.

GLASGOW.—Dr. Charles E. Fawsitt has been appointed to the newly instituted Graham Young lectureship in metallurgical chemistry, and Dr. T. S. Patterson to the Waltonian lectureship in organic chemistry. The endowments for the new lectureships have been provided in part by Mr. Graham Young's trustees, in part by the Carnegie trust, and in part by the old Waltonian foundation.

Mr. F. H. Downie and Mr. F. R. Stewart have been appointed demonstrators in engineering, and Dr. G. H. Clark Muirhead demonstrator in physiology.

The University Court has instituted a new lectureship in psychology, general and experimental. The lecturer will be charged with the equipment and conduct of the laboratory of experimental psychology, for which provision is made in the new buildings of the physiology department, and will also give instruction in educational psychology to teachers in training. The first appointment will be made on December 12. Applicants are referred to the secretary of the University Court for further information.

The following regulations for the final examination for the degree of B.Sc. (pure science), proposed by the faculty of science, were adopted by the Senate on November 7:—(*a*) one of the subjects taken by each candidate shall be chosen by him to be the principal subject in his examination, and the remaining two or more shall be considered to be subsidiary subjects; (*b*) the subsidiary subjects must be, in part at least, cognate to the principal subject, and the examination in them shall also be upon an honours standard, but shall have special regard to those parts of the subjects which are cognate to the principal subject; (*c*) candidates shall be required to state at the time they enter for the final examination in each subject whether they desire it to be regarded as their principal subject or as a subsidiary subject, and in the event of the latter being the case they shall be required to state which subject they propose to take as their principal subject; (*d*) in estimating the attainments of the various candidates in any subject, the examiners may take into account the duly attested records of their practical work.

LONDON.—The question of the establishment at South Kensington of an institute for preliminary and intermediate medical studies is being vigorously discussed. For the vacancy on the Senate caused by the resignation of Dr. Lauriston Shaw, three candidates have been nominated, the constituency being the faculty of medicine, composed of teachers of medical subjects who are recognised by the University, to the number of nearly 400. Those candidates are Prof. Starling, of University College; Dr. Norman Moore, of St. Bartholomew's; and Mr. F. C. Wallis, of Charing Cross. The concentration of the teaching of preliminary medical subjects is the principal question now before the electors. It will be remembered that Dr. J. K. Fowler and Prof. Rose Bradford, who formerly represented the faculty of medicine on the Senate, lost their seats on the Senate in a recent election owing to their advocacy of concentration, their places being taken by Dr. Caley and Mr. Leonard Hill.

MANCHESTER.—During the last two years the University has collaborated in the work of the International Committee for the investigation of the meteorological conditions of the upper atmosphere. A kite station has been erected on the Derbyshire moors near Glossop, and the results, which have been supplemented by records obtained with free balloons, have proved most encouraging. Prof. Schuster has now intimated his intention of presenting 500*l*. to the University in order to make it possible to pursue this work actively. An observer will be permanently stationed on the moor, and, commencing on January 1, 1908, it is intended to send up meteorological instruments daily by means of kites and balloons. The work is to be continued, in the first instance, during one year.

DR. R. T. GLAZEBROOK, F.R.S., will distribute the prizes and certificates and deliver an address at the Sir John Cass Technical Institute on Tuesday, December 3. The chair will be taken by Sir Owen Roberts, chairman of the governing body. There will be an exhibition of students' work and apparatus in the laboratories, workshops, and other rooms of the institute.

THE aggregate number of students at German technical colleges amounted last winter term to 12,000, of whom 2700 were foreigners—that is, about 22 per cent. At the colleges at Dresden, Darmstadt, and Karlsruhe more than one-third of the students were foreigners, and of these 80 per cent. were Russians.

WE have received from Prof. V. Karapetoff, of Cornell University, a copy of an interesting paper read by him before the American Institute of Electrical Engineers on the concentric method of teaching electrical engineering. The method he advocates is based on the principle of passing from practice to theory instead of from theory to practice, as is now usual. The study of engineering should, he considers, begin in the freshman year, and be carried throughout four years. Engineering education should be taken up first with a bird's-eye view of actual practice, and not with theory. Auxiliary sciences (mathematics, mechanics, physics, and chemistry) should not be required further than is necessary for the understanding of engineering, and should be given later in the course. Each year of study should be, so far as possible, self-contained, the mental horizon of the student being gradually and concentrically widened. The same author also delivered an address before the New York Electrical Society on the human side of the engineering profession. He argues that the true purpose and value of engineering activity lie in providing better and easier ways for satisfying ordinary human needs. This provides more leisure and opens new possibilities for a higher intellectual development of humanity. The engineer's personal satisfaction consists in knowing this high purpose of his vocation, and in giving his service at maximum efficiency. The other compensation is a result, and not the purpose.

THE final report of the National Association for the Promotion of Technical and Secondary Education has now been published. In accordance with a resolution of its executive committee, adopted at a meeting on March 20 last, the association was wound up on June 30 of this year. The final report takes the form of a brief historical review of the work of the association, and incidentally serves to show the substantial progress which has been made in our national education during the last twenty years. The inaugural meeting was held on July 1, 1887, when the president, the Duke of Devonshire, who served in that capacity throughout the society's existence, took the chair. The association certainly had an excellent record of service. Largely as the results of its activities were passed the Technical Instruction Act and the Welsh Intermediate Education Act in 1889, the Local Taxation (Custom and Excise) Act in 1890, the Technical Instruction (Amendment) Act in 1891, and the Schools for Science and Art Act in 1891, and many administrative improvements were also secured. Several of the association's publications, too, did much to educate public opinion, and among these may be mentioned "Studies in Secondary Education," "A Manual to the Intermediate Education (Wales) Act, 1889, and the Technical Instruction Act, 1889," and the quarterly issues of the *Record of Technical and Secondary Education*. As was only natural, many prominent men of science were from its inauguration closely identified with the association. It will suffice to refer, among many others, to the late Prof. Huxley, to Lord Avebury, Sir William Abney, Sir William Mather, and Sir Henry Roscoe. It is greatly to be hoped that the work so successfully accomplished by the association will be carried on by existing societies of a kindred nature, for, as the Duke of Devonshire remarked at the last annual meeting, a great deal more still remains to be done. The library of the association has been purchased by Sir William Mather, and presented to the Manchester Free Library, and the balance of its funds, amounting to nearly 250*l*., has been voted to the late secretary, Mr. Frederick Oldman, as an acknowledgment of his services.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 7.—"Observations on the Life-history of Leucocytes. Part II. On the Origin of the Granules." By C. E. **Walker**. Communicated by Prof. C. S. Sherrington, F.R.S.

The granules that are so frequently found in leucocytes generally seem to lie scattered quite irregularly in the cytoplasm of the cells in which they occur. In the bone marrow, however, where the leucocytes containing granules are often extremely numerous, a section of properly preserved material will show that the granules are arranged in a more or less definite manner. The granules in these are, as a rule, oval in shape, and seem to lie in sequence close to each other, so that a line drawn through their long axes would appear as a thread or wire coiled up irregularly in the cytoplasm of the cell. There are many gradations in the regularity of this arrangement of the granules. It varies from a mere suggestion of some of them having been strung together, to a very definite order, and the joining of several end to end. There are again other cells in which a large number of granules join together, forming in places a thick, deeply staining thread, the axis of which is continuous with the axis of the strings of separate granules. From these it is possible to pass by almost insensible gradations to cells where there are no granules, but only a thick thread coiled round the nucleus. From this stage it is again possible to pass to cells where the coiled-up thread occupies a space slightly larger than, or equal to the nucleus, until we arrive at some where it seems to be about the same size in proportion to the nucleus as is the archoplasm in the case of the spermatid. Though it has not been possible as yet to trace the origin of this thread farther, it is strongly suggested that it arises in the archoplasm, which is often seen to be connected with it. During the whole of its existence the thread stains very deeply, and always with the basic in preference to the acid stain. When it has entirely broken up, the granules formed from it still stain in the same manner, but as they begin to lose their regular arrangement so they begin to lose their affinity for the basic stain. These phenomena have only been met with among the cells of the bone marrow. It has been seen that the staining reaction in some at any rate of the granular cells changes from basic to acid; the presence, therefore, of cells containing acidophile and basiphile granules in various proportions is just what one would expect, and is no argument against a common origin of both from the thread here described as occurring in the cells of the bone marrow. The opportunity is taken of pointing out the relationship between the structures which arise from the true archoplasm. Among such structures are the archoplasmic vesicles found in the cells of the testis, which develop into the cephalic cap of the spermatozoon, the similar structures (Plimmer's bodies) which appear in some of the cells in malignant growths, and the granules in leucocytes.

June 27.—"Observations on the Life-history of Leucocytes. Part III." By C. E. **Walker**. Communicated by Prof. J. B. Farmer, F.R.S.

The author in a previous communication described the occurrence of the meiotic phase and of a number of post-meiotic generations among the leucocytes in vertebrate animals. The number of chromosomes in such cells must, if this occurs, be reduced to one-half of that found in the somatic cells. Such leucocytes will, in fact, have passed through that change which appears to be a necessary prelude to conjugation throughout the animal and vegetable kingdoms. The present paper describes certain phenomena as occurring in leucocytes, and claims that these are most probably to be interpreted as a process of conjugation between individual leucocytes that have passed through the meiotic phase. This conjugation is said to be accomplished in a somewhat complicated manner. The nucleus of one leucocyte sends out a process which penetrates the cytoplasm belonging to itself and to that of the partner in conjugation. This process is in the form of a tube, and through it the linin and chromatin of the one nucleus are drawn into that of the other. The absorption of one cell by another is a well-known phenomenon, but is a comparatively simple affair. The absorbed cell is taken into the cytoplasm of the absorbing cell, and is there digested. No nuclear change takes place, and the absorption is apparently carried out in the cytoplasm without the nucleus being directly involved.

It is claimed that the appearance of a special and complex apparatus with no apparent result but the transference of the contents of one nucleus to the other without exposing the contents so transferred to the action of the cytoplasm, shows that some process other than mere absorption of one cell by another is taking place, and that fertilisation is the probable explanation. It is also suggested that this may be a form of fertilisation not hitherto observed in unicellular forms, and that its occurrence among leucocytes is a case of phylogenetic reversion.

Physical Society, October 25.—Prof. J. Perry, F.R.S., president, in the chair.—Magnetic oscillators as radiators in wireless telegraphy: Dr. J. A. **Fleming**. The paper describes experiments made with flat square coils of various sizes used as magnetic oscillators in the quadrangle of University College, London. In one circuit undamped oscillations were set up by means of a Poulsen arc, and the induced oscillations created in the other circuit at a distance were detected and measured by means of the author's oscillation valve or glow-lamp detector. The distance separating the two circuits was varied from about 50 feet to 250 feet. Curves were obtained showing how the secondary current varied with the distance of the circuits apart and with their relative position. It was shown that the inductive effect was greatest when the flat coils were in a horizontal position and at a certain distance above the earth. The law of variation with distance proved to be something between the inverse cube and the inverse square of the distance. It was then shown that increase in size of the coils had a very marked action in increasing the inductive effect, and also that for equal power the use of the spark method, creating intermittent oscillations in the primary, gave better effects than the use of the arc or undamped oscillations. It was also shown that for the coils used the true radiation of energy was very small, and therefore that the distance effects obtained were almost entirely due to magnetic or Faradaic induction. Suggestions were then made for increasing the efficacy of the ordinary inductive type of wireless telegraphy by the use of high-frequency oscillations in the primary circuit, and a suitable detector such as the author's oscillation valve combined with a telephone as a receiver in the secondary circuit. Such a method would have a far greater reach than the ordinary low-frequency alternating current inductive telegraphy, and not be open to the objection of disturbing commercial telephonic circuits.—The use of variable mutual inductances: A. **Campbell**. In connection with wireless telegraphy, the measurement of small inductances and capacities is of importance; one of the methods described has special reference to small self-inductances. Mutual inductances can be more easily dealt with than self-inductances, for the former can be (1) more accurately calculated from dimensions; (2) are less affected by change of frequency; and (3) when variable can be made to pass through zero value. A convenient form of variable mutual inductance consists of a continuously variable part and a series of steps. The first consists of two equal parallel coils with a third coil moving parallel to their planes round an axis eccentric to the fixed coils. The scale thus obtained is very open near zero (which is an advantage), and the graduation is done by experiment, a theoretical discussion being given in an appendix. The steps are obtained by means of another fixed coil of stranded wire, each strand giving an equal subdivision. The model shown had two ranges, from 0·01 up to 200 and 2000 microhenries.

Entomological Society, November 6.—Mr. E. Saunders, F.R.S., vice-president, in the chair.—*Exhibits*.—A. H. **Jones**: A specimen of the longicorn beetle *Acanthocinus aedilis*, L., a Rannoch species, found in Gray's Inn Road.—Dr. F. A. **Dixey**: ♂ and ♀ specimens of a new Pinacopteryx, discovered by Mr. S. A. Neave in northern Rhodesia. The ♀ resembled that of *P. rubrobasalis*, but the ♂ was quite distinct. Both sexes of *P. rubrobasalis* and the female sex of Mr. Neave's species were mimics

of *Mylothris agathina*.—W. G. **Sheldon**: A series of *Limenitis populi* and ab. *tremulae* with intermediate forms taken this year near Laon, and a series of *Chrysophanus hippothoë* from the same region, the females displaying a wide range of variation for so restricted a locality as that in which they were captured.—G. C. **Champion**: A fully developed example of *Mesovelia furcata*, M. and R., from Slapton, south Devon, and *Thamnotrizon cinereus* from Lynmouth, north Devon.—A. **Harrison** and Hugh **Main**: A case of *Aplecta nebulosa*, arranged to show the great range of variation of this species in Delamere Forest, with series from Epping Forest, north Cornwall, and the New Forest for comparison.—R. S. **Mitford**: (1) Two ♂ specimens of *Cryptocephalus bipunctatus*, taken by him at Niton, in the Isle of Wight, in July, these being two forms of varieties well known on the Continent, but hitherto found in Britain; (2) *Paracymus aeneus*, captured on the north Essex coast in June, 1898, thus establishing the claim of *P. aeneus* to be regarded as a British beetle; (3) an example of the very rare *Lathrobium rufipenne*, taken at Niton, Isle of Wight, in July, 1906, a specimen of the rare *Ceuthorrhynchus viduatus*, taken by him at Brading, Isle of Wight, in July, 1907, and a specimen of *Cis dentatus*, taken at Sandown, Isle of Wight, in July, 1906; this species, although well known on the Continent, had never before been recorded in Britain.—*Papers*.—A large series of Nycteribiidæ (parasitic Diptera) from Ceylon: J. E. **Collin**.—(1) Some butterflies taken in Jamaica; (2) some butterflies of Tobago: Dr. G. B. **Longstaff**.

GÖTTINGEN.

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

March 9.—The uniformisation of real algebraic curves: P. **Koebe**.

May 11.—The uniformisation of given analytic curves: P. **Koebe**.—The radio-activity of the air over the open sea: C. **Runge**.—Researches from the Göttingen University chemical laboratory, xvii.:—(1) on oxygenated derivatives of sylvestrene; (2) on nopinone; (3) on the synthesis of higher homologues of terpin and of higher homologous terpenes: O. **Wallach**.—Contribution to the theory of undamped electric oscillations in gas discharges: E. **Riecke**.—Numerical survey of the near and remote earthquakes registered at the Samoa Observatory during 1906: F. **Linke**.

July 6.—The effect of light upon the formation of sulphuric acid: A. **Coehn**.—The class enumeration of the *Körper* of complex multiplication: R. **Fueter**.

July 7.—The boundary values in the case of the differential equation $\Delta\Delta U = 0$: A. **Haar**.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—Results of the Interaction of Mercury with Alloys of Other Metals: Dr. J. W. Mallet, F.R.S.—Note on the Sensibility of the Ear to the Direction of Explosive Sounds: A. Mallock, F.R.S.—On the Silver Voltameter: Part i., A Comparison of Various Forms of Silver Voltameters: F. E. Smith; and a Determination of the Electrochemical Equivalent of Silver: F. E. Smith and T. Mather, F.R.S.; Part ii., The Chemistry of the Silver Voltameter: F. E. Smith and Dr. T. M. Lowry.—On the Normal Weston Cadmium Cell: F. E. Smith.—On a Method of Depositing Copper upon Glass from Aqueous Solutions in a Thin Brilliantly Reflecting Film, and thus Producing a Copper Mirror: Dr. F. D. Chattaway, F.R.S.—On Luminous Efficiency and the Mechanical Equivalent of Light: Dr. C. V. Drysdale.—The Dispersion of Double Refraction in Relation to Crystal Structure: Dr. T. H. Havelock.

CHEMICAL SOCIETY, at 8.30.—The Interaction of Metallic Sulphates and Caustic Alkalies: S. P. U. Pickering.—The Chemistry of Bordeaux Mixture: S. P. U. Pickering.—Aromatic Azoimides, Part iii., The Naphthylazoimides and their Nitro-derivatives: M. O. Forster and H. E. Fierz.—Studies of Dynamic Isomerism. Note on the Action of Carbonyl Chloride as an Agent for Arresting Isomeric Change: T. M. Lowry and E. H. Magson.—Emulsions: S. P. U. Pickering.—The Electrometric Measurement of the Hydrolysis of the Salts of Anilinium, Ammonium, Aluminium, Chromium, Thallium, Zinc, Magnesium, Cerium, Thorium, Nickel and Cobalt: H. G. Denham.

INSTITUTION OF MINING AND METALLURGY, at 8.

LINNEAN SOCIETY, at 8.—Abnormal Structures in Leaves, and their Value for Morphology: W. C. Worsdell.—Specimen-preservation in Australian Museums: J. G. Otto Tepper.—Revision of the Genus Illigera, Blume: S. T. Dunn.—*Exhibits*:—Luminous Larva from British Guiana: C. W. Anderson.—Living Specimens of Peripatus, from South Africa: Prof. A. Dendy.—*Linaria arenaria*, and other British Plants: G. C. Druce.

FRIDAY, NOVEMBER 22.

PHYSICAL SOCIETY, at 5.—On Singing Sand from New England: S. Skinner.—Exhibition of a Micromanometer: L. Bairstow.—A Diabolo Experiment: Vernon Boys.—Exhibition of a Gyroscope illustrating Brennan's Monorailway: Prof. H. A. Wilson.

MONDAY, NOVEMBER 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Exploration of the Nun-Kun Mountain Group and its Glaciers: Dr. W. Hunter Workman.

SOCIOLOGICAL SOCIETY, at 8.—The Psychological Origin of Religion: Prof. J. H. Leuba.

SOCIETY OF ARTS, at 8.—The Theory of the Microscope: Conrad Beck.

INSTITUTE OF ACTUARIES, at 5.—On the Valuation of Staff Pension Funds, Part ii., Widows' and Children's Pensions (continued): H. W. Manly, with Tables by W. A. Workman.—A Pension Fund Problem; with some Remarks on the Deduction of Salary-scales: J. Bacon.

TUESDAY, NOVEMBER 26.

ZOOLOGICAL SOCIETY, at 8.30.—On some New and Little-known Araneidea: Rev. O. Pickard-Cambridge, F.R.S.—Descriptions of New Species of South-American Cryptocephalini; M. Jacoby.—A Monograph of the Chiropteran Genera Uroderma, Enchisthenes, and Artibeus: Dr. K. Andersen.—Environmental Studies on the Limpet: E. S. Russell.—Contributions to the Knowledge of the Anatomy of the Batrachian Family Pelobatidæ: F. E. Beddard, F.R.S.—On the Microlepidoptera of Tenerife: Lord Walsingham, F.R.S.—Dates of Publication of the Separate Parts of Gmelin's Edition (thirteenth) of the "Systema Naturæ" of Linnæus: J. Hopkinson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Tranmere Bay Development Works: S. H. Ellis.

WEDNESDAY, NOVEMBER 27.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Address by Sir David Gill, K.C.B., F.R.S.

SOCIETY OF ARTS, at 8.—The Franco-British Exhibition, 1908: Sir John A. Cockburn, K.C.M.G.

THURSDAY, NOVEMBER 28.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Development of Turbo-Generators: Dr. Robert Pohl.

FRIDAY, NOVEMBER 29.

SOCIETY OF ARTS, at 8.—The Hygiene of Work in Compressed Air (Diving, Caisson Work, Sub-aqueous Tunnelling, &c.): Dr. J. S. Haldane, F.R.S.

CONTENTS.