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THE PEOPLING OF AUSTRALIA.

Eaglehawk and Crow: a Study of the Australian Aborigines, including an Inquiry into their Origin and a Survey of Australian Languages. By John Mathew, M.A., B.D. Pp. xvi + 288. Five Plates and a Linguistic Map. (London: David Nutt. Melbourne: Melville, Mullen and Slade, 1899.)

A GREAT deal has been written, and has yet to be written, about the origin of the Australian natives. Considering the immense area that they occupy, there is a considerable amount of uniformity both from a physical and a cultural point of view; but it is now recognised that this apparent uniformity does not necessarily imply purity of origin; indeed, a dual or multiple element in the population may be said to be generally accepted.

The latest investigator of this problem is the Rev. John Mathew, who in his "Eaglehawk and Crow" has boldly restated his previous solution that Australia was first occupied by a branch of the Papuan family; these first-comers occupied all the continent, and having spread across to the southern shores, they crossed what is now Bass Strait, and their migration terminated in Tasmania. Then followed a hostile Dravidian invasion. Mr. Mathew thinks that this ingredient of the population first touched on the north-east coast of Queensland, not in one boat-load, but in an unintermittent stream for many years, probably being forced southwards by the attacks of a more powerful race. Finally, a Malay invasion came later, and in a desultory way by detachments at irregular intervals.

The term Papuan is employed by Mr. Mathew as the equivalent of Melanesian, and is meant to include the Tasmanian Aborigines; hence the Tasmanian Papuans are invariably referred to in this volume as the substratum for the present Australian race; that in them there may be a strain of Negrito blood is not questioned, on the contrary, he inclines to that opinion. Dravidian is not to be understood as indicating the direct descent of Australians from Dravidians, but rather that one strong strain of the Australian people is of common origin with the Dravidians of India and their congeners. Malay refers generally to the people of that race to the north of Australia without distinguishing nationality. It is evident that Mr. Mathew uses these three race terms in a very broad sense, and his view on the two first migrations do not materially differ from those of Flower, Howitt and other students. There is reason to believe, with De Quatrefages and Hamy, Garson and Ling Roth, that the Tasmanians are closely allied to the Negritos, and it may be granted that this stock was formerly widely spread in Australia. Keane in his recent work, "Man: Past and Present," places the Australians, with the Tasmanians, as one of his three divisions of the "Oceanic Negroes," the "Negritoes" and "Papuasians" (Papuans and Melanesians) being the other two. He regards the Australians as a highly specialised type of a single ethnical division.

The Melanesian stock is itself either complex, as several anthropologists hold, or very variable, as Dr. A. B. Meyer advocates. So far as British New Guinea is concerned, there appears, speaking in general terms, to be a western group, traces of which also occur in the south-east, of a dark-skinned, frizzly-haired, usually dolichocephalic people, whose language, as Mr. S. H. Ray has pointed out, has a grammatical construction somewhat analogous to that of the Australian languages. To the south-east is a lighter-coloured people, more or less brachycephalic, and with typically frizzly, but also with curly and wavy hair, whose language is essentially similar to that of the Melanesian Archipelago, and allied to Polynesian; indeed, Dr. Codrington regards the latter language as degraded from the former. The ethnology of British New Guinea is more complex than this brief statement implies; but these two main elements in the population must not be overlooked. Unfortunately, Mr. Mathew states that his term "Papuan is applied, not in its narrowest application (dark New Guinean), but as the equivalent of Melanesian" (p. 5), which, as we have just seen, he leaves quite vague. Later on he tries to show that the Victorian speech has more "Papuan" (or Tasmanian) elements than the languages further north, and hence is by inference more Melanesian than other Australian languages. The radical difference between Melanesian and Australian grammar is not thought to be worthy of even an attempted explanation. The languages of the "dark New Guineans" (Kiwai, Bugilai, &c.), which are expressly excluded from Mr. Mathew's "Papuans," have some analogies in grammatical structure with those of Australia.

Mr. Mathew says a good deal about the colour of the skin and character of the hair of the Australians, and points out that numerous observers have recorded considerable differences in these two features. Unfortunately, these statements are general, and we have no direct comparison with recognised standards, and all the observers were by no means equally competent. We must assume that marked variations in colour do occur, and that the hair may be variedly curly, but without corroborative specimens we can scarcely admit that the hair is sometimes straight or woolly. The evidence collected by Mr. Mathew indicates that on the south-eastern and western coasts the hair is more curly than towards the interior. He speaks of "a decided Papuan fringe . . . with a departure from it landwards and in the north."

We must now consider the Dravidian element in Australia. The argument in favour of this view was first stated by Huxley, and it has been generally adopted (Huxley, it must be remembered, considered that the Australians belonged entirely to that ethnic group). The Sarasins in their elaborate monograph on the ethnology of Ceylon admit that the Australians belong to a "Primitive Dravidian" stem. Mr. Mathew makes the following remarks with regard to this migration:

"Coming as a later offshoot from the first home of humanity, this invading band was of higher intelligence and better equipped for conflict than the indigenes of Australia. Physically, they were more lithe and wiry, and of taller stature. They were lighter in colour, though a dark race; less hirsute; and the hair of their head was perfectly straight" (p. 6).

Several of these statements are open to question. Some of the "Dravidian" peoples are amongst the hairiest of mankind, and perhaps none have perfectly straight hair. Although the present writer agrees with the hypothesis that the Australians arose in part from the same stock as the pre-Dravidians—that is, the indigenous population of Southern India—there are numerous difficulties which have not yet been thoroughly faced. Most writers assume that they arrived by sea, but there is no evidence that the pre-Dravidians were ever seamen; their descendants are not so to-day either in India or Australia. If they came by land, as Howitt suggests, it is strange that no trace of their migration has been noted in the East Indian Archipelago, and there are many other points that require explanation. There is also some ambiguity in the use of the term "Dravidian," as, from the researches of Thurston, it would appear that there is a dark, broad-nose, curly-haired primitive race in Southern India which may for the present be termed the pre-Dravidian race. The typical Dravidians (Telugus, Kanarese, &c.) are regarded by some as a later immigrant people. In his "Man: Past and Present," Keane states that "all attempts to affiliate this group [the Australian languages] to the Dravidian of Southern India, or to any other, have signally failed."

The Malay invasion is supposed to have taken place "also from the north, first with some degree of continuity and then intermittently" (p. 61). "In the extreme north-west, where Malay words might be most naturally expected, very few are distinguishable. . . . It is rather in unexpected places that Malay words turn up" (p. 57). ". . . A track across the centre of Australia from the Gulf of Carpentaria southward is marked by a few Malay words . . . another region where unquestionable Malay lingual traces exist is a tract on the east coast of Queensland, from about 17° to 21° S. lat., and inland to a distance of some two hundred miles" (p. 59). "There is proof positive that the best cave paintings have been executed by people of Malay blood from the island of Sumatra, a strong presumption also that the rite of circumcision was derived from the same people and place, and I am disposed to think that the Australian message-stick is a childish imitation of Malay writing upon bamboo and rattan as practised in Sumatra" (p. 60).

As the author lays great stress on the linguistic side of his investigations, the present writer consulted his friend Mr. L. H. Ray on this very matter in order to obtain the opinion of an expert. Mr. Ray informs me that 'the author's elaborate comparisons of Australian words with Malay and New Hebridean are absurd and misleading, and show that, in spite of his disclaimer on p. 44, Mr. Mathew belongs to that school of Australian pseudo-philologists who believe that a likeness of words in sound and meaning is a proof of common origin. In Chapter iv. we are asked to believe that Malay immigrants, presumably from various parts of the Archipelago, entered Australia from the north, and wandering about the interior scattered "astonishing relics" of the speech (of one of their sections) all over the island continent. They left the words for "father" and "where" in New South Wales and East Queensland, and "hand" in the extreme east. The word for "head" (not the Malay, but Indian) was left on the Hunter River, the terms for "elder brother," "little," and "louse" were scattered from the Gulf of Carpentaria, southward through Central Australia. "Father," "moon," and "rain" were stranded on the east coast of Queensland; there are other "remarkable analogies" which Mr. Mathew uses to support his theories. Philologists will scarcely be inclined to admit the "especially valuable analysis" which derives the Australian word "wenyo" or "wendyo" ('where') from a New Hebridean interrogative "wa" or "we," and the verb "to" ('to stand') (p. 157). Although Mr. Mathew has evidently taken great pains to make his book of real service to students, individual words in the languages quoted are not always accurately given or properly understood by the author, although he uses them as pegs upon which to hang a theory. For example, he regards the "bapa" type of terms for "father" as a mark of Malay descent, and the "mama" type as evidence of Papuan influence. Yet connectives of "mama" are more common in the Malay region than "bapa," and words like "bapa" are found in all kinds of unconnected languages, *e.g.* Dravidian and Tibeto-Burman in Asia, Bantu in South Africa, and in North America. Other examples are seen in the comparison of numerals (pp. 165, 169), where the New Guinea words are explainable compounds. "Ori Kaiza" (p. 67) is mongrel, "ori" ('bird') is Toaripi, Papuan Gulf, and "kaiza" ('big thing') is Saibai, West Torres Straits. Mr. Mathew might have made a stronger case if he had drawn his examples, not from the colloquial Malay of commerce, but from that common root-stock of the languages of the Indian Archipelago, which is undoubtedly akin to that of the Melanesian tongues. It would have been of great advantage to students if uniformity in spelling had been attempted in the numerous languages quoted.'

Mr. Mathew dwells at some length on some remarkable rock paintings discovered in North-West Australia by Grey and by Bradshaw. One of Grey's figures he identifies with Siva of Hindu mythology, the other he identifies as Daibaitch, a deity of the Battas of Sumatra. This identification is based on some marks on the figure which Mr. Mathew compares with specimens of Sumatran writing in Van der Tuuk's "Les Manuscripts Lampongs." Of course this interpretation assumes that Grey copied the painting with perfect accuracy, and that it was in perfect preservation. These two figures copied by Grey certainly have a non-Australian appearance. Bradshaw's figures are more complicated. The author considers

"it is obvious that there has been an attempt to present pictorial fragments of Hindu mythology in the confused form which has been developed by naturalisation in Sumatra."

These rock paintings are certainly very puzzling, and deserve renewed investigation on the spot. Mr. Mathew's interpretation of them strikes the present writer as somewhat far-fetched.

It is to be regretted that Mr. Mathew does not distinguish between the Malays and the taller, light-coloured Indonesian or non-Malayan inhabitants of the Eastern Archipelago. Keane in his "Ethnology" says:

"Dr. Hamy points out that the Battas and other pre-Malay peoples of Malaysia so closely resemble the

Eastern Polynesians that the two groups should be regarded as two branches of an original non-Malay [Indonesian] stock" (p. 326).

According to Mr. Mathew's theory, Indonesian and Malay elements are implicated in his third invasion of Australia.

Mr. Mathew devotes several chapters to a concise account of the handicrafts, institutions, social customs, sorcery and religion of the Australian natives, and one may gain from the book a very good idea of the Australians as a whole; this account is not a mere compilation from published sources, as Mr. Mathew has had practical experience with "black fellows," and numerous original and hitherto unpublished observations are scattered throughout the book. The careful grammatical study and vocabularies of Australian languages, which occupy nearly half the book, will be of great assistance to students of linguistics—the Kabi grammar is an original contribution. The appropriate title of the book is derived from the widely-spread names of the two main clan divisions of the Australians; the author asks (p. 19):—"Is there any better explanation of the facts possible than that the eaglehawk and the crow represent two distinct races of men which once contested for the possession of Australia, the taller, more powerful and more fierce 'eaglehawk' race ["Dravidian"] overcoming and in places exterminating the weaker, more scantily-equipped sable 'crows'?"

The present writer has endeavoured to give a fair summary of the views held by Mr. Mathew, but it appears to him that the author has not fully appreciated the complexity of the problem which he has set himself to solve. It is also evident that Mr. Mathew has not had access to a number of works that bear upon his subject; some excuse in this respect must, however, be granted to students who reside in the Colonies. The author must be credited with a broad grasp of Australian ethnography, and even if his theories do not receive the support of other students, he will have the satisfaction of knowing that he has done some good service, since generalisation is the salt of science. ALFRED C. HADDON.

CYPRIAN ARCHÆOLOGY.

A Catalogue of the Cyprus Museum, with a Chronicle of Excavations undertaken since the British Occupation, and Introductory Notes on Cypriote Archæology. By John L. Myres, M.A., and Max Ohnefalsch-Richter, Ph.D. Pp. xii + 224. With eight plates. 8vo. (Oxford: at the Clarendon Press, 1899.)

THIS work aspires to be at once a scientific catalogue of, and a handy guide to, the contents of the Cyprus Museum. For the latter purpose it is provided with a flexible cloth binding, for the former it is written in a logical and "scientific" manner, although, by the way, prehistoric archæology is not a science, and never will be one: it is simply a body of disconnected observations, from which one or two more or less probable conclusions can be drawn. The authors deal with an enormous mass of material, and the necessity of compressing this into a portable form has made their book resemble more a collection of transcribed shorthand notes than anything else. These notes, which are only rendered intelligible by reference to headings which themselves have sometimes to be elucidated by further headings, will no doubt be of use to the student of Cyprian archæology, but will hardly be understanded of the casual student tourist who essays to visit the Museum with this book in his hand. What, for instance, will he make of the following (p. 169): "6061–6063. Legs and feet. 6061. Colossal. 6062–6069. Sandalled. 6067. Corkscrew curls and diadem with quatrefoils in relief. 6068–6069. Faces." He will not at once realise the fact that for the necessary elucidation of these mysterious fragments he must refer back a page or so to the headings: "XI. TAMASSOS," "B. Statues of deity or votary in native style; colossal, life-size, or smaller: all male," "*a. Terra-cotta; moulded; hollow,*" and that similar researches will have to be made whenever he wishes to obtain an intelligible description and explanation of any object which he may be looking at. Only persons with some knowledge of archæology will be able to find their way about this catalogue, and they will often have to complain of the marvellous epigrammatic manner in which many of the objects are described. No. 5569 is described as follows (p. 156): "H. o. 10.' That is all. Nor does the heading "Miscellaneous" lighten our darkness very much. We eventually discover that Nos. 5501–5569 are terra-cottas from Kition, but what kind of miscellaneous terra-cotta No. 5569 is we have not found out yet. And surely such a description as "SILVER VESSELS, &c. 4871–4873. Spoons. Cf. *Bibl. Nat.* 1635–7." (p. 139), is insufficient. Other similar instances might be quoted, but at the same time Mr. Myres' descriptions are often full and careful enough; *e.g.* Nos. 5017, 5048, 5571, or the group 5801–5826.

No doubt the form of the book is extremely logical, but this very characteristic, pushed to its extreme as it is here, makes it quite useless to the casual tourist, unless he has a very considerable knowledge, not only of Greek archæology generally, but also of the current theories on the subject. The two aims of this catalogue are, in fact, mutually exclusive.

Treating the book entirely from the point of view of the archæologist, we still find something to criticise as well as to praise. The commencement of the introduction (up to the middle of p. 16) is clear and good: nothing is more probable in early Greek archæology than the general position of the præ-Mycenæan and Mycenæan cultures with relation to the general development of European civilisation; they were the local phases of the general European culture of the Ages of Copper and Bronze. But later on the introduction becomes somewhat wild and therewith also somewhat too dogmatic in tone; all its statements as to the predominant influence of *Cyprian* culture, as distinct from that of the "præ-Mycenæan" lands generally, on that of early Europe, or the derivation of the pottery-types of the Mondsee-area from that of Cyprus and of the Central European knowledge of copper from the same island are stated with very little intimation of the fact that they are one and all purely hypothetical, and are founded on a series of arguments from analogy which are often of doubtful validity. In fact, the whole gospel of the "Typology" of pots and pans, which is nowadays so fashionable, and is relied

upon to explain the whole course of the development of early civilisation, probably rests on no firmer bases than do the similar gospels which profess to elucidate man's early history by means of a comparison of his languages or the varying shapes of his skull.

The statements in the latter part of Mr. Myres' introduction are, then, purely hypothetical. Many are probable enough, but they are not proven historical facts. Take, for instance, his reference to the date of the Mycenæan (he prefers the hideous and hybrid form *Mykenaean*) period of Greek culture. Now it seems very probable that the art of the Mycenæan period, marking the culminating point of the Bronze Age culture of Greece, came to an end in Greece proper in consequence of the overthrow of the Achaian hegemony by the Dorians, who very possibly introduced the use of iron and the rude "Geometrical" style of art into Greece about 1000–800 B.C. But this is only a theory. And neither this theory nor the fact that Mycenæan pottery has been found in the remains of King Khuenaten's city at Tell el-Amarna in Egypt (date about 1430 B.C.) justify Mr. Myres in saying (p. 20) that "the Mykenæan Age is placed between 1700 and 900 B.C. by the find-groups in Egypt, Rhodes and Mykenæ," although it is quite true that "this date agrees with the best Greek tradition." All we can say is that the Mycenæan Age *apparently* goes back to at least 1430 B.C., and probably earlier. That it ended in Greece proper about 800 (not 900) B.C. seems very probable, but that it continued in the always backward and conservative island of Cyprus till the beginning of the seventh century at latest seems to be shown by the new discoveries at Kurion and Enkomi, where, in conjunction with Mycenæan remains of a debased type, Babylonian cylinders of the eighth century have been found. Mr. Myres falls foul of this hypothesis (p. 20), as was to have been expected.

In some respects the catalogue is not quite up-to-date. It is a year or two since Prof. Petrie's theory of a "New Race" of "Libyans" was given up, and the true position of the "New Race" remains as those of the prehistoric Egyptians was pointed out by M. de Morgan. Yet in a book published in 1899 we read (p. 16) of

"the Libyan race, discovered in 1895 by Prof. Flinders Petrie in the settlements and tombs at Ballas and Nagáda . . . this civilisation, which fills the gap between the sixth and the eleventh dynasty . . .," &c.

The gap between these dynasties covers the period 3500–3000 B.C.: the remains from Ballas and Nagáda are those of the late Neolithic or "Æneolithic" periods in Egypt, and most certainly date long before 4500 B.C. It is a pity that Mr. Myres did not even at the eleventh hour insert a paragraph in his list of corrigenda noting this fact.

Prof. Petrie connected this "Libyan" culture with the early civilisation of Palestine, which he ascribed to the Amorites, of whom we know nothing more than their name. So Mr. Myres talks of a "Libyo-Amorite culture" (p. 17). Prof. Petrie also closely connected the præ-Mycenæan stage of southern European civilisation with the "Libyo-Amorite culture." But this connection Mr. Myres hesitates to accept, although he admits resemblances of pottery-technique, &c., between the two.

An acceptance of this theory means now an acceptance of the idea that the præ-Mycenæan stage of Greek culture goes back to at least 5000 years B.C., and that it was at that time closely connected with the primitive civilisation of Egypt. It is difficult to imagine how this connection can be maintained to have ever existed. The famous copper sword which was found in the prehistoric tomb 836 at Nagáda is of late præ-Mycenæan type ("quasi-Mykenæan," *teste* Mr. Myres, who also claims it as especially Cyprian in style), and so probably dates *after* 2000 B.C., while the things with which it was found belonged to the half-savage ancestors of the Egyptians of the first dynasty. This is an example of the uncertainties of the archæological method generally. The sword proves no connection. We are by no means inclined to grant the contention that the præ-Mycenæan culture may go back to an indefinite period B.C., and that such swords may have been in use as well 5000 as 2000 B.C. And the other evidence does not allow us to date even the earliest remains of the præ-Mycenæan age, the lowest towns of Hissarlik and Athens, a day earlier than 2500 B.C., so that the prehistoric Egyptian and prehistoric Greek cultures cannot be regarded as contemporaneous. Both were primitive, half-savage; hence the analogies between their artistic methods. To argue a contemporary connection from such analogies is impossible.

And no such connection can be shown to have existed by way of Libya: we cannot say that there is anything particularly Libyan about the prehistoric Egyptian pottery, &c., because we have not the slightest idea of what early Libyan pottery was like. In fact, the "New Race" objects were dubbed "Libyan" on account of their curiously isolated and strange appearance when placed chronologically between two well-defined periods of the regular Egyptian civilisation: it was foreign and barbarous, why not Libyan? (In much the same way every inexplicable object found in Egypt used to be called "Ethiopian," the remains of Mycenæan culture were dubbed Phœnician or Karian, and those of the Assyrizing civilisation of Asia Minor received the now somewhat discredited appellation "Hittite." It is quite true that unless some theory is made to account for inexplicable phenomena, little progress is possible. But such theories ought never to be, as they so often are, regarded as dogmas to be persistently maintained in spite of controverting evidence.) These inexplicable objects being then "Libyan," people began to think about Lake Tritônis and its legends, about the alliance of the Greek "Akaiuasha" (who may quite possibly have been Achaians) with the Libyans (*n.b.* as late as 1250 B.C.), and so the "præ-Mycenæan" culture of the north-eastern coasts of the Mediterranean was connected with the "New Race" culture through the medium of Libya. Even now that we know that the "New Race" culture is at least two thousand years older than Prof. Petrie's first dating, this Libyan-Greek connection seems to be maintained, although there is no need to suppose that the remains from Ballas and Nagáda are Libyan, or anything else than primitive Egyptian. Even those yellow-haired Kabyles from Ballas and Nagáda have been shown by the unenthusiastic Virchow to owe their Indo-Germanic locks to the action of the salt in the soil!

In a list of Egyptian (Naukratite) porcelain charms and ornaments on p. 137, Mr. Myres mentions "4726–4732. Hawk-headed deity with disc on head. . . . 4736–4737. Hippopotamus-headed deity. . . . 4746. Ram-headed deity." We are not informed whether 4746 is Amen or Khnemu, and the names of 4726–4732 (apparently Rā) and 4736–4737 (Taurt) might well have been given. And what is the inscription on the Babylonian cylinder, No. 4501, which, by the way, is not necessarily of early date, about? The "hieroglyphic inscriptions" on the scarabs (Nos. 4541, 4547–4549; p. 135) are ignored.

Turning to a comparatively unimportant detail, we note a frequent occurrence of the hideous Germanism, "snow-man technique." Cannot some better term than this be devised for the style of what are merely rude hand-made figures?

The labour of correcting misprints in such a work must have been colossal; but the result is extremely good. We only notice Ra-men-kepher for Ra-men-kheper on p. 135. To Mr. H. B. Walters, who read the proofs through, much praise is due. He is also responsible for the annexed reports on excavations at Kurion, Salamis and Maroni, from which a good idea of the marvellous mixture which the average Cyprian tomb contains may be obtained. We are still far from being able to dogmatise with regard to Cyprian archæology!

The indices also deserve praise, but the mistaken aim of making the book serve as a traveller's guide has, by restricting its size, sadly curtailed the number and size of the plates.

Generally speaking, the book will be to the "wayfaring man" (p. viii.) of little use, but to the archæologist it will no doubt prove valuable. Although, we expect, that if he already knows the collection, he will often find it difficult to recognise the objects from Mr. Myres' and "O-R"'s somewhat meagre descriptions of them, yet the care with which the known *provenance* of all objects is noted, and vague statements on the subject are sifted and verified by the authors, will be of great assistance to him. He will know how far Mr. Myres' archæological theories will be of service to him. If archæology is to be constructive, if it seeks to explain its discoveries, it must formulate hypotheses. These hypotheses are often suggestive, often really explain things in a manner which, as far as we can know, is perfectly satisfactory; but as often they are mere *ballons d'essai*, improbable and unsatisfactory. Hypotheses of both kinds occur in the introduction to the *Cyprus Museum Catalogue:* the archæologist will be able to distinguish between them, but the "wayfaring man" has no means of separating the wheat from the chaff. On him, therefore, it cannot be too strongly impressed that the whole story of the development of human civilisation in Cyprus and the Ægean basin before the 8th century B.C. is still merely a collection of hypotheses, sometimes agreeing, more often disagreeing, with one another, and therefore that any description of "Early Man" in Greece or in Cyprus is not a statement of historical facts, but a simple expression of the individual opinion of its author on the subject.

TEXT-BOOK ON THE STRENGTH OF MATERIALS.

The Strength of Materials. By Prof. J. A. Ewing, F.R.S. Pp. xii + 246. (Cambridge University Press, 1899.)

ALL teachers and students of applied mechanics will heartily welcome this book. It is based on the author's article, "Strength of Materials," which appears in the ninth edition of the *Encyclopædia Britannica.* As in his book on the "Steam Engine," the present book is characterised by Prof. Ewing's excellent style and clearness of exposition. The subject matter includes those portions of the subject which are usually taught at the higher colleges.

The author wastes no time in plunging into his subject. The first two chapters are devoted to a general analysis between stress and strain, and the relation between the three elastic coefficients in an isotropic body. Probably many teachers would prefer to postpone the consideration of part of these two chapters—particularly the contents of the second—to a later stage of the book, and this can readily be done without interfering with the usefulness of the book as a text-book. Chapter iii. deals with non-elastic strain, a part of the subject on which Prof. Ewing is particularly qualified to speak. A concise account is given of some of the recent experiments of Mr. Muir on the effect of heating in facilitating recovery of elasticity after overstraining, and it is to be hoped that in any future editions the author will give a full account of the very recent experiments by Mr. Rosanhain and himself on the crystalline structure of metals—a subject which, in the present edition, is merely referred to. The fourth chapter will be found exceedingly valuable to the teacher, dealing, as it does, with the testing of materials, and containing photographs of several pieces of self-contained apparatus designed (by the author) to determine the various elastic constants, and which have been proved to be serviceable in the author's laboratory at Cambridge. Chapters v. and vi. deal with uniformly-varying distributions of stress, and the bending and shearing stresses induced in beams. On page 98 will be found some interesting remarks on the variation of stress over different sections of a tie-rod. In dealing with this subject it is interesting to notice that in a uniformly strained piece of any shape whatever having parallel sides, the distribution of stress over any section might be graphically determined by Prof. Hele-Shaw's method of the flow of a viscous fluid between two parallel plates placed very near together, the boundaries having the same shape as the piece considered. The stress at any point will then be inversely as the distance between adjacent stream-lines, the stream-lines being supposed spaced at equal distances apart at a section where the stress is uniformly distributed. The deflection of beams and the question of continuous girders are discussed in Chapter vii., whilst in Chapter ix. will be found a luminous treatment of struts and columns. Chapter x. is devoted to a consideration of the torsion of shafts and of springs, whilst in Chapter xi. the stresses induced in thin and thick cylinders due to internal or external pressure, and in a thin rotating disc are treated in an exceedingly lucid manner. A valuable addition to the contents of these chapters would be an

analysis of the stresses induced in the different parts of high speed connecting rods and crank shafts. Finally, Chapters viii. and xii. are devoted to a very concise discussion of frames, hanging chains and arched ribs.

In the preface, the author states that the book is only intended to be a lecture-room treatment of the subject, which to be effective must be supplemented by laboratory and drawing office work. We venture to think that the work usually done in the drawing office is, in many cases, of such a special and routine character that it only serves to illustrate a very few branches of the subject. It is, of course, true that a properly equipped laboratory, such as the one at Cambridge, enables the student to provide himself with examples which illustrate a very considerable portion of the subject, but some teachers of applied mechanics—fortunately few in number—do not possess a laboratory, and even many of those who do find it desirable to still further supplement the work done in it by means of tutorial classes. The complete absence of any numerical examples will be consequently much felt, and the author would considerably increase the value of his books as *class-room* text-books if he would add, at the end of them, a set of judiciously selected numerical examples which would forcibly illustrate the different points raised in the text.

A word of praise should be given to the Cambridge University Press for the excellent manner in which the book is printed and arranged. It is to be hoped that the present book, together with the same author's "Steam Engine," are intended to form the nucleus of a library of text-books dealing with engineering subjects.

S. D.

A NEW WORK ON LEAD.

Metallurgy of Lead and Silver. Part I. By Henry F. Collins. Pp. xvi + 368. (London : C. Griffin and Co., Ltd., 1899.)

THIS work is one of a series of metallurgical treatises edited by Sir W. C. Roberts-Austen, F.R.S., and written by one of his former pupils, who, besides having gone through a course of training at the Royal College of Science with distinguished success, has had a large amount of practical experience in mines and metallurgical works, which renders him well qualified to successfully undertake the compilation of a work on lead smelting. In these days of great metallurgical enterprises it is of the utmost importance that we should be kept acquainted with the up-to-date methods of our competitors all over the world ; and although there are several good books in existence dealing with the metallurgy of lead, the present one is a welcome addition.

The author starts with methods of assaying lead and silver ores, which is a necessary part of the process, and gives valuable information on the method of correct sampling ; he also points out those methods of assaying which yield the best results by the wet and dry ways. A very admirable feature of the book is the abundant reference to authority, in which he follows the notable example of his distinguished editor. With the object of economising space, as well as facilitating reference and comparison, details of the practice in particular localities have been thrown into the form of tabular statements, and these should prove useful for reference.

It is much to be regretted that so many errors have been allowed to remain in the text and referred to in the table of errata, when by a little more care they might have been avoided. The section on alloys of lead is very meagre, and chiefly compiled from the writings of other metallurgists. Such loose statements as "No definite alloys of lead and antimony are known" (p. 24) are entirely misleading, as several varieties of lead-antimony alloys are used for type metal. The properties of lead as used in trade with the various defects experienced in practical work, such as plumbing, would have formed a valuable adjunct, as many persons are interested in lead-working who care little about the smelting of ores.

The chapter on lead ores, although somewhat condensed, contains the chief information required for practical purposes. The greater part of the book is devoted to lead smelting. It is treated in a sufficiently full manner, the information is reliable, and the language explicit. We are sorry to learn that the various forms of mechanical roasters are not more generally applicable, and that the hand-rabbled reverberatories, with the enormous cost of manual labour, are still in extensive use on account of the scarcity of skilled labour in many localities, mechanical furnaces only being adopted in the larger works where the required skill is available. Various kinds of roasting furnaces are carefully described and their merits discussed. The chemical side of the question is admirably dealt with, and greatly adds to the value of the book for scientific readers.

The principles of blast furnace practice here given forms the most prominent and important part of the work, and should be extremely useful to those engaged in the lead-smelting industry. A correct knowledge of the scientific basis of the processes has not been attained in the past by those responsible for *some* of our works, and possibly this method of treatment may enable some of our closed mines to be reopened and profitably worked. At any rate, we commend the suggestion to those concerned. The author has brought a wide range of knowledge to bear on the subject, and gives useful data for correct blast furnace practice. The nature of fluxes and composition of slags, with their proper chemical formulæ, are here given in considerable detail, and indicate a complete grasp of the subject.

Chapter ix. commences with some recognised methods of analysing ores and slags, so as to enable the operator to properly apportion the constituents of the charge. This is followed by instructions as to the method of calculating the charge, which is somewhat complicated in large works, dealing with a variety of complex ores. Chapter x. deals with blast furnace products, and as these may consist of lead speiss, regulus, slag and secondary products, which have to be separately dealt with, it will be seen how important their consideration to the lead smelter must be. It also contains a considerable number of analyses of mattes, speisses and slags very valuable for purposes of reference.

The subject of flue-dust, its composition, collection and treatment, is discussed in a clear and instructive manner. The difficulties met with in smelting mixed ores of lead and zinc, and the various processes, dry and

wet, proposed from time to time by different authorities, are here discussed, and indicate how much more scientific most metallurgical processes are becoming.

The last part of the book deals with the highly important subject of desilverisation, and is written in no way inferior to the preceding pages. Altogether the author has succeeded in producing a trustworthy and fairly comprehensive treatise on the metallurgy of lead, and we trust his enterprise may be rewarded by a deservedly large sale.

OUR BOOK SHELF.

Zur Stereochemie des fünfwertigen Stickstoffes mit besonderer Berücksichtigung des asymmetrichen Stickstoffes in der aromatischen Reihe. By Edgar Wedekind. Pp. 126. (Leipzig: Veit, 1899.)

ALTHOUGH nearly fifty years have passed since Hofmann succeeded in preparing methylethylamylphenylammonium chloride—a compound in which the nitrogen atom is directly united with five different groups or atoms—very little progress has been made with the study of the stereochemistry of pentavalent nitrogen. It is true, no doubt, that the first and the most important step in advance was made nearly nine years ago by Le Bel, who succeeded in preparing an optically active liquid from a solution of methylethylpropylisobutylammonium chloride, but until quite recently, when Pope accomplished the resolution into its optically active isomerides of Wedekind's benzylphenylallylmethylammonium iodide, Le Bel's work afforded the only evidence which we had of optical activity due to pentavalent nitrogen. The number of known compounds which contain such an asymmetric nitrogen atom, and which might possibly be resolved into optically active components, was also comparatively limited.

In these circumstances it might seem a little premature to write a book on the stereochemistry of pentavalent nitrogen, since the facts to be dealt with are few in number, and the theories which have been advanced to explain them—although nearly as numerous as the facts themselves—still require a groundwork of experimental confirmation.

This difficulty of the lack of material no doubt forced itself upon the author, whose book is not merely an historical review of our present knowledge of the stereochemistry of pentavalent nitrogen; this portion of his subject is, in fact, disposed of within the limits of the first seventeen pages, and by far the largest part (ninety-five pages) of the book consists of an account of the work which the author himself has published during the current year in the *Berichte;* the remaining thirteen pages are devoted to a discussion of the theoretical conclusions to be drawn from the results of his experiments.

As the discussion or criticism of the author's investigations—interesting and important though they are—is a task which does not lie within the scope of this review, little remains to be said except that the whole book is written in much the same way as if it were a paper intended for publication in Liebig's *Annalen;* consequently it contains a great many experimental details, including even the results of many analyses, and this rather detracts from its value as a literary effort. Those, however, who take a particular interest in the stereochemistry of pentavalent nitrogen will certainly welcome the book, and principally on account of its historical survey and theoretical conclusions, for here they will find the scattered literature of the subject conveniently collected and discussed in the light of the author's own important observations. F. S. K.

Handbook of Metallurgy. By Dr. Carl Schnabel. Translated by Henry Louis. Two vols. Vol. i. Pp. xvi+871; Vol. ii. Pp. xiv+732; 927 Figures in the text. (London: Macmillan and Co., Ltd. 1898.)

BERGRATH DR. CARL SCHNABEL is professor of metallurgy and chemical technology at the Royal Academy of Mines at Clausthal, and his work has long enjoyed a well-deserved reputation. Prof. Henry Louis, who translates it, points out that it is a curious fact that there does not exist in the English language a single complete treatise on metallurgy. Dr. Percy's treatises remain only splendid fragments. Dr. C. Schnabel's object has been to give a complete account of the metallurgical treatment of all the metals ordinarily employed, together with all the recent improvements in the art. The two volumes before us are, however, incomplete, as neither they nor the original work deal with the vast section of metallurgy which includes iron and steel.

Prof. Louis modestly says that his chief object has been to present a faithful interpretation of the original. In this he has admirably succeeded. With the full consent of Dr. Schnabel, the translator has introduced brief rules of any new processes, or improvements on old ones, that have been brought out since the German original was produced. It is a pity, therefore, that the additions made by Prof. Louis are not distinguishable from the rest of the text. In a compressed work of this kind space is, of course, valuable; but it appears to have been in more than one case unequally allotted. The Augustin process, for instance, is now but little used, and is, in fact, nearly obsolete, but it has ten pages devoted to it, while the cyanide process for the extraction of gold from "tailings," which is now the most important wet process in the whole range of metallurgy, has only thirteen pages. The wet process for extracting copper, which does admit of brief statement, has no less than forty-nine pages. Many of the illustrations, from their freshness and originality, will be a great boon to students. In a second edition it would be well to devote more care to the illustrations; at present, though they give a good general idea of the processes or machines they illustrate, they are seldom drawn to scale. The writer of this notice has found general diagrammatic schemes of processes to be of great value to students, and some might well have been introduced into the present work. The sections devoted to the metallurgy of zinc and of aluminium may be mentioned as, considering the size of the volume, being singularly complete and conscientious. Viewed as a whole, the book is very accurate and trustworthy, and in welcoming this addition to metallurgical literature Prof. Louis is to be congratulated on the translation.

W. C. ROBERTS-AUSTEN.

La Philosophie Naturelle. By Dr. W. Nicati. Pp. xi+308. (Paris: Giard and Brière, 1900.)

DR. NICATI has, it seems, published books on medicine, on physiology proper, and on psychology. A sense of incompleteness has led him at last to make a raid upon philosophy.

An uncompromisingly positive mind, which does its own thinking *en amateur*, is rarely uninteresting. And Dr. Nicati has ideas upon Rabelais and Zola, upon art and politics in general, on immortality and evolution, on the ultimate formulæ for matter and life. His art-criticisms and his political discourses with a socialist leaning are often readable and sometimes suggestive. A reduction of the idea of responsibility to causation does not lack ingenuity. Unfortunately, any further worth in the book it is impossible to discover, save as it reveals the writer's very abnormal psychosis. "Architectonic" faculty united with incoherence, naivety mostly

seen in etymologies, but also in bizarre analogies as of existence to a tricycle, are salient faults of the book. But Dr. Nicati's obsession by what may be called the fallacy of the graphic formula is its dominant characteristic. In the logical calculus "it is atrociously done," has its adverb expressed by the radical sign; the anti-Dreyfusard admits fluxional considerations. In *l'energétique*, life is formulated by Cae decorated with arrows, because it arises in the decomposition of matter which has cohesion and other qualities. Pictures on p. 250 are quite exciting.

This sort of inanity throughout makes the writer's charge upon Kant, that he lacks logic in speaking of "empty space," and his attack upon evolution, with a view to substitute "a theory simply evolutionarist," quite devoid of weight. The index is quite excellent.

H. W. B.

Kleiner Leitfaden der Practischen Physik. Dr. F. Kohlrausch. Pp. xix + 260. (Leipzig: Teubner, 1900.)

EVERY physicist is familiar with Dr. Kohlrausch's "Text-book of Physical Measurements," either in the original or in its English translation. It is not too much to say that it was the foundation of the numerous text-books of practical physics which have since appeared. Owing to the successive additions that have been made, Dr. Kohlrausch feels that it has lost its original character, and now fails to be suitable, as formerly, to the needs of a beginner. This feeling has induced him to prepare the present "Kleiner Leitfaden" by selecting from and otherwise modifying the larger volume.

In what sense can this new volume be regarded as a book for beginners? One of the most difficult questions for a teacher to solve is: How far ought a student be left to work out his own salvation? No answer can be given which would be applicable to all students. A youth of keen intelligence only requires outline directions: the details he learns best by finding them out for himself. But such men are exceptions in any laboratory. The more ordinary student will miss a point unless it is explicitly brought before his notice. We think it is to the former class that this book will be most useful. Dr. Kohlrausch has certainly not erred on the side of superabundance of instruction. We think, for example, that it might be found better fitted as a general laboratory manual if a larger number of fully worked out numerical examples were supplied. But as for ourselves, we have only admiration for the dignified restraint which is everywhere displayed. This is no cram-book intended to meet the temporary requirements of an examining board; but it is what the author has aimed to make it—an aid to general culture.

Further, the volume is well and accurately printed. We have read it through, and only detect one small error. The G Fraunhofer line is, in the diagram on p. 133, apparently identified with the third line in the hydrogen spectrum; the difference between them would only be about a millimetre in the diagram; but it is a difference which ought to be exaggerated rather than diminished, in order to prevent a student running away with a wrong idea.

A. W. P.

Elementary Algebra. By C. H. French and G. Osborn. Pp. vii + 349. (London: J. and A. Churchill, 1899.)

THIS book has been purposely written to help elementary students who have to do much of their study privately, and with this aim in view the authors have avoided as far as possible all technical terms in the explanation of the various theorems. It is possible that there may be a tendency to leave too little for the student to think out for himself by this procedure, but that is matter for individual opinion. Apart from this, the treatise is excellent in its numerous selections of examples and for the clear arrangement of the various sections.

Magnetism and Electricity for Beginners. By H. E. Hadley. Pp. viii + 327. (London: Macmillan and Co., Ltd., 1899.)

THIS little manual is written specially to meet the requirements of students preparing for the annual examination of the Science and Art Department, and consequently it follows to a considerable extent the lines of the syllabus provided. In many details, however, it very ably satisfies the desirability of providing fuller treatment, while a conspicuous and commendable feature is the insertion of many original diagrams and photographs of actual experimental apparatus.

The general arrangement is to give certain facts or definitions, followed by one or more experiments to be performed for their complete verification, so that in this respect the book may serve very well as an introduction to the electrical side of practical physics.

The apparatus described is almost entirely simple enough for the average reader to make readily, and the very generous number of illustrations (197) will be very helpful to the clear understanding of the statements made.

Part i., on magnetism, occupies 103 pages, and all the chief phenomena are illustrated by facsimile reproductions of the fields of force as shown by iron filings or small magnetometers. The explanation of electrical screening is very simply and clearly stated; in fact, the text is brought up to date as far as is possible in an elementary manual.

Part ii., statical electricity (106 pages), is specially noticeable for the way in which the usual difficulty of dealing with potential is met by geometrical interpretations; potential-diagrams being given for fields of force, electroscopes, condensers, electrical machines and contact electricity.

Part iii., voltaic electricity (93 pages), is somewhat terse in style, probably necessarily owing to the number of matters in this part of the subject which need description, but the fundamental points in all the sections are well brought forward. The book is certainly an excellent one for elementary students, and is also likely to form a sound basis on which a teacher may frame his course of lessons.

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.*]

Racial Aspect of Voluntary Enlistment.

THERE is one aspect of our voluntary enlistment system which has never been touched upon so far as I know. It is that by our method the most brave and warlike men of each generation are exposed to far more than the ordinary risks of life, and generally at an age when they have left no descendants. A process of selection has, therefore, been going on in the nation for centuries by which, in the long run, the non-fighters, such as commercial classes, luxurious people, and any cowards, have more descendants proportionally than the brave and warlike. So that the average opinion is growing more and more unwarlike, less brave, and more inclined for peace at any price. The above selection is brought home to us if we consider that of those soldiers killed during the last few weeks how few have left two descendants. I foresee two remedies for this state of things, but will not ask for any more of your valuable space.

R. C. T. EVANS.

9 Heathcote Street, Gray's Inn Road, W.C.

The Wind during Eclipses of the Sun.

I WOULD like to draw attention to the importance of observations of the wind in and near the path of a total eclipse of the sun.

At the Indian eclipse of 1898 I employed at Sahdol, in

Central India, a simple arrangement for observing the strength and direction of the wind. On the morning of the eclipse, as on previous days, the wind was blowing strongly from the north-north-east with frequent gusts of greater force. As totality approached it diminished in strength and became a steady draught of air almost imperceptible to the senses. At the same time it shifted a little to the east. Before the moon had quite left the sun's disk it was again blowing in the same manner as at the beginning of the eclipse. Subsequently, as the sun approached the horizon, the wind diminished and blew with exactly the same force, direction, and uniform character as during totality.

Apparently the normal wind in the daytime at Sahdol contained two elements, one due to the distribution of pressure over Central and Southern Asia and the Indian Ocean, the other the result of comparatively local causes. The latter was suppressed by the eclipse, and the former was represented by the steady movement of the air that remained.

The total eclipse of 1900 does not present such simple conditions, but I believe that much might be learnt from similar observations.

JOHN W. EVANS.

Royal College of Science for Ireland, Dublin,
December 16.

THE APPROACHING TOTAL ECLIPSE OF THE SUN.

THE astronomers of both Europe and America are now busy in making arrangements to observe the total eclipse of the sun which will occur on the 28th of next May. As usual, our American cousins are better off than we are, for they can observe the eclipse without going out of their own country. British astronomers will have to travel to Spain or Portugal. The eclipse path stretches from the west of New Orleans to Algiers and N. Africa on the east. The local times and conditions at certain points along this path are thus given in the "Local Particulars" published by the *Nautical Almanac* Office :—

Position W. of New Orleans.
Long. 90° 6′ W., Lat. 30° 4′ N.

	Local Mean Times. d. h. m. s.	Central Standard Mean Times d. h. m. s.	Sun's Altitude.
Eclipse begins	May 27 18 26 13	May 27 18 26 37	18°
Totality begins	,, 27 19 29 42	,, 27 19 30 6	30
Totality ends	,, 27 19 31 0	,, 27 19 31 24	
Eclipse ends	,, 27 20 43 10	,, 27 20 43 34	46

Duration of Totality, 1m. 17·8s.

Angle, from N. point, of: first contact, 104° towards the W.; last contact, 76° towards the E. — for *direct* image.
Angle, from Vertex, of: first contact, 40° towards the W.; last contact, 145° towards the E. — for *direct* image.

Position near Union Point, Georgia.
Long. 83° 5′ W., Lat. 33° 29′ N.

	Local Mean Times. d. h. m. s.	Central Standard Mean Times. d. h. m. s.	Sun's Altitude.
Eclipse begins	May 27 19 0 25	May 27 18 32 45	25°
Totality begins	,, 27 20 7 52	,, 27 19 40 12	39°
Totality ends	,, 27 20 9 24	,, 27 19 41 44	
Eclipse ends	,, 27 21 26 16	,, 27 20 58 36	55

Duration of Totality, 1m. 32·0s.

Angle, from N. point, of: first contact, 104° towards the W.; last contact, 76° towards the E. — for *direct* image.
Angle, from Vertex, of: first contact, 41° towards the W.; last contact, 139° towards the E. — for *direct* image.

Map of the Eclipse track across Spain and Portugal, 28 May, 1900.

Position South of Cape Henry, Virginia.
Long. 76° 5′ W., Lat. 36° 42′ N.

	Local Mean Times. d. h. m. s.	Eastern Standard Mean Times. d. h. m. s.	Sun's Altitude.
Eclipse begins	May 27 19 36 35	May 27 19 40 55	33°
Totality begins	,, 27 20 48 7	,, 27 20 52 27	47°
Totality ends	,, 27 20 49 53	,, 27 20 54 13	
Eclipse ends	,, 27 22 11 2	,, 27 22 15 22	62°

Duration of Totality, 1m. 45·6s.

Angle, from N. point, of { first contact, 103° towards the W. / last contact, 78° towards the E. } for *direct* image.
Angle, from Vertex, of { first contact, 44° towards the W. / last contact, 130° towards the E. }

Position near Ovar (Portugal)—Long. 8° 38′ W., Lat. 40° 50′ N.

	Local Mean Times.				Greenwich Mean Times.				Sun's Altitude.
	d.	h.	m.	s.	d.	h.	m.	s.	
Eclipse begins	May 28	2	8	35	May 28	2	43	7	56°
Totality begins	,, 28	3	27	10	,, 28	4	1	42	42°
Totality ends	,, 28	3	28	43	,, 28	4	3	15	
Eclipse ends	,, 28	4	38	42	,, 28	5	13	14	30°

Duration of Totality, 1m. 33·6s.

Angle, from N. point, of { first contact, 89° towards the W. / last contact, 93° towards the E. } for *direct* image.
Angle, from Vertex, of { first contact, 137° towards the W. / last contact, 38° towards the E. }

Position S.W. of Talavera de la Reina (Spain)—Long. 5° 10′ W., Lat. 39° 47′ N.

	Local Mean Times.				Greenwich Mean Times.				Sun's Altitude.
	d.	h.	m.	s.	d.	h.	m.	s.	
Eclipse begins	May 28	2	29	18	May 28	2	49	58	53°
Totality begins	,, 28	3	46	2	,, 28	4	6	42	39°
Totality ends	,, 28	3	47	29	,, 28	4	8	9	
Eclipse ends	,, 28	4	55	38	,, 28	5	16	18	26°

Duration of Totality, 1m. 27·4s.

Angle, from N. point, of { first contact, 88° towards the W. / last contact, 94° towards the E. } for *direct* image.
Angle, from Vertex, of { first contact, 140° towards the W. / last contact, 38° towards the E. }

Position West of Puerto del Infierno (Spain)—Long. 1° 43′ W., Lat. 38° 38′ N.

	Local Mean Times.				Greenwich Mean Times.				Sun's Altitude.
	d.	h.	m.	s.	d.	h.	m.	s.	
Eclipse begins	May 28	2	49	40	May 28	2	56	32	49°
Totality begins	,, 28	4	4	28	,, 28	4	11	20	35°
Totality ends	,, 28	4	5	49	,, 28	4	12	41	
Eclipse ends	,, 28	5	12	9	,, 28	5	19	1	23°

Duration of Totality, 1m. 21·5s.

Angle, from N. point, of { first contact, 87° towards the W. / last contact, 94° towards the E. } for *direct* image.
Angle, from Vertex, of { first contact, 143° towards the W. / last contact, 38° towards the E. }

Cape De Sta. Pola (Alicante), Spain—Long. 0° 30′ W., Lat. 38° 13′ N.

	Local Mean Times.				Greenwich Mean Times.				Sun's Altitude.
	d.	h.	m.	s.	d.	h.	m.	s.	
Eclipse begins	May 28	2	56	47	May 28	2	58	47	48°
Totality begins	,, 28	4	10	52	,, 28	4	12	52	34°
Totality ends	,, 28	4	12	11	,, 28	4	14	11	
Eclipse ends	,, 28	5	17	55	,, 28	5	19	55	21°

Duration of Totality, 1m. 19·4s.

Angle, from N. point, of { first contact, 87° towards the W. / last contact, 94° towards the E. } for *direct* image.
Angle, from Vertex, of { first contact, 144° towards the W. / last contact, 38° towards the E. }

The accompanying map of the line of totality will show the parts of Spain and Portugal from which this eclipse can be observed. It will be seen that the track, after leaving Spain near Alicante, crosses the Mediterranean and enters Africa close to Algiers.

We may be perfectly certain that the astronomers of the United States and France will man the beginning and the end of the line quite efficiently. It is clear, therefore, that the attention of British astronomers with serious work to do will be directed to the observing stations in Spain and Portugal.

The weather chances were stated by Prof. Arcimis in a former number of NATURE,[1] and may be considered excellent.

There are many branches of work, such as securing photographs of the corona, in which amateurs may do good service. For them the well-found steamers leaving Marseilles may make the coast near Algiers more convenient.

[1] Vol. lix. p. 439.

HERO OF ALEXANDRIA.[1]

THE reputation of Hero of Alexandria has always been somewhat doubtful, and some difficulty has been felt in apportioning to him his proper place among the scientific worthies of the past. Mr. Schmidt, however, in the communication mentioned below, has attempted to do justice to his reputation, and to resuscitate the memory of him whom most of us remember only through the well-known experiment of Hero's fountain. In another place Mr. Schmidt has endeavoured to fix the approximate date of his career, and by his intimate acquaintance with the various MSS. and authorities, to do something to clear away the doubts that linger around a Hero the younger and some other anonymous writers. Mr. Schmidt may be said to have taken Hero under his particular care, and though, of course, it is unfortunate that many of the original writings are not extant, and that others have not been printed yet, Mr. Schmidt, by a careful study of the remnants, has probably placed himself in a better position to reconstruct the history of this ancient philosopher than any other commentator.

But though Mr. Schmidt attempts to place the object of his study in the most favourable light, to make us see in him one as influential as Euclid, we cannot say that

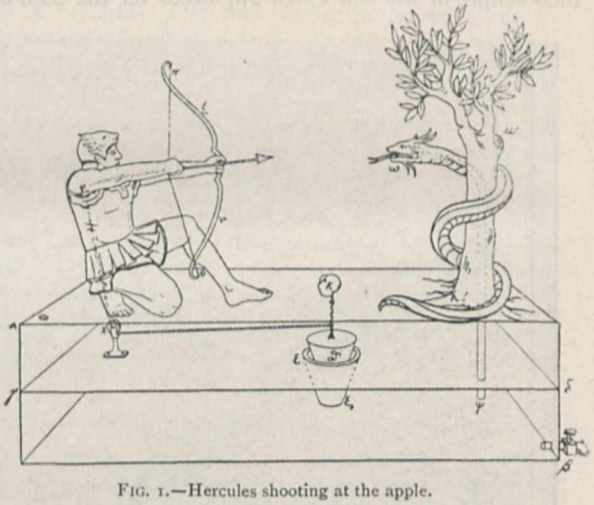


FIG. 1.—Hercules shooting at the apple.

we think the steps he has taken are the most judicious or the most successful. Instead of a philosopher we perceive rather an able artificer and an expert mechanician. The points selected for elaborate illustration are not those which exhibit Hero in the most capable light. There can be no doubt but that Hero successfully solved the problem of determining the area of a triangle from the three sides, and it would have been very interesting to see the method he employed set out in detail, but the author passes over this feat with a bare mention, although the treatment of such a problem appeals more potently to modern students, and bespeaks a higher position in the intellectual scale, than the skilful manipulation of automatic figures over the details of which Mr. Schmidt lovingly lingers. Again, we have indistinct ideas of his experiments on the elasticity of air and steam, and we should like to know whether he made any approach to a knowledge of Boyle's law, and in any way anticipated its enunciation by that philosopher. Of course it may be urged that these are among the best-known results of Hero's life and writings, and that as such they do not need the aid of a commentator, but

[1] "Heron von Alexandria." By W. Schmidt. Sonder abdruck aus den neuen Jahrbüchern für das Klassische Altertum Geschichte und Deutsche Litteratur. (Leipzig: B. G. Teubner, 1899.)

that on the other hand his numerous mechanical devices need to be insisted upon in order to obtain an adequate idea of his varied capacity. But the result is, nevertheless, to present Hero simply as the maker of philosophic toys.

Mr. Schmidt sketches for us, but without sufficient explanation, the devices by which fountains were made to flow, and doors to open by unseen mechanical agency, but one's enthusiasm is scarcely roused though Hercules may shoot at an apple and a serpent be made to hiss his discontent with the arrangement (Fig. 1). But the author does ample justice to the description of the automatic marionettes, whose behaviour and contortions afforded

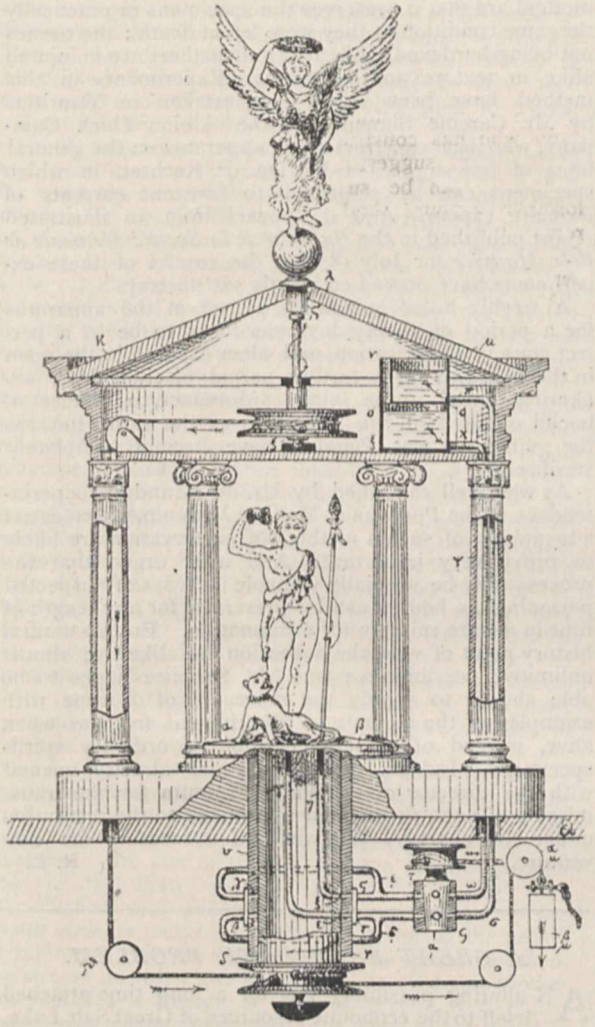


FIG. 2.—Showing the machinery for moving the Bacchante, &c.

sincere delight to the spectator. Two of these automatic theatres, in which some attempt at dramatic action was made, are described in detail, and we learn how the fire was suddenly kindled on the altar of Dionysius, while from the Thyrsus cup spouted respectively milk and wine, the Bacchantes urging their wild career at the same time (Fig. 2). The legend, too, of Nauplius seems to have been illustrated with great care and nicety in a succession of scenes, in which were represented the departure of the Greek ships, the rising of a storm, and the luring of the ill-fated Greeks by lighted torches to the dangerous promontory of Caphareus where they suffered shipwreck. All this tale is told, with the proper accompaniment of lightning and thunder, by means of moving and hidden machinery. Even Ajax is made to swim towards the land, and subsequently to perish in one of various ways according to the fancy of the stage manager. That Hero should devote himself to the construction of the necessary tricks, required to reproduce these scenes, when he seemed clearly capable of higher intellectual flight, does not increase our respect for his memory; but Mr. Schmidt, whose philological tastes seem to be in advance of his scientific, seems to think it would be worth while to reconstruct the machinery, and play the little drama over again to a select audience. He admits the difficulties, both in following the original MSS. and in filling up some necessary lacunæ, but considers the labour would be well spent, since it would illustrate in a most realistic manner the amusements of the ancient inhabitants of Alexandria.

THE SITUATION OF OPHIR.

A REUTER'S correspondent has had an interview with Dr. Carl Peters on the subject of the re-discovery and identification of the ancient gold-bearing site now so well known by the name of Ophir. According to the eminent German traveller, this much discussed locality is situated on or near the Zambesi river, and he is confident that the theories which would place Ophir either in India or in Arabia are both wrong. Dr. Peters is not the first who has convinced himself that Ophir lay somewhere on the east coast of Africa, for the late Mr. Bent and other recent writers believed that they had identified the famous emporium whence Solomon, the king of Israel, obtained gold for the temple at Jerusalem. It must, of course, be admitted that remains of extensive gold workings undoubtedly exist in the locality, and that these possess considerable antiquity cannot be denied. It is, however, open to discussion whether the ruins and workings are "of undoubtedly Semitic type," and also whether the emblems which Dr. Peters identifies as phallic are really connected with "the ancient Semitic sun worship." Until Dr. Peters distinctly states his case in print, and gives his reasons for the faith which is in him, we can do little more than point out that up to the present the theory which would place Ophir, or Aphar, or Sôphir (1 Kings ix. 28; x. 11; 2 Chron. viii. 18; ix. 10) the great metropolis of the Sabeans, which is described in the "Periplus" attributed to Arrian, on the Gulf of Akabah, has not been disproved. The theory which would place Ophir in India, on the banks of the Indus, has much in its favour, and when it is remembered that the precious stones and *almug* trees, which are mentioned with the gold of Ophir, are the peculiar products of India, it is a little difficult not to accept it without more ado. On the other hand, the apes and peacocks (or parrots as some would translate the word *tukkiyyîm*), which were brought to Solomon from the neighbourhood of Ophir, indicate that its site was nearer Palestine than India; for it is well known that peacocks would not survive a long voyage which must have lasted several months, and must also have been made in an open boat. The fact is that many places can produce, and must always have produced, gold in great abundance, and we are driven irresistibly to the conclusion that more than one place bore the name of Ophir.

It is not necessary for the Ophir, whence Solomon obtained gold, to have been situated as near as the northern end of the Red Sea, for it is most likely that the seamen, who traded through Hiram, with him obtained the goods which they had to sell from the larger boats which sailed through Bâb el-Mandeb either to India, or to ports on the north-east and east coasts of Africa. Meanwhile Dr. Peter's claim to the discovery of the Ophir mentioned in the Bible will evoke consider-

able interest, and we must hope that he will lose no time in bringing before the world the important facts which he must have collected, and the evidence which would connect the phallic rites and worship of the Northern Semites (which have been so carefully described by old John Selden in his "De Diis Syris") with the nature worshippers on the east coast of Africa.

FORMALIN AS A PRESERVATIVE.

ALTHOUGH as a preservative medium for perishable zoological specimens, formalin has scarcely realised all the expectations entertained on its introduction, yet there can be little doubt that it has a great future before it, and that for certain purposes it is likely to prove invaluable. It has, however, many undoubted disadvantages; and in the minds of some museum officials these disadvantages appear to outweigh its manifest valuable properties, so that an unfavourable opinion is entertained of it in general. On the other hand, those who weigh more carefully the *pros* and *cons*, realise that, under proper conditions and restrictions, its value is really very great.

As regards its disadvantages, it must be admitted that it is unsuitable for the permanent preservation of specimens that are likely to be manipulated, as not only are its effects on the hands of the worker most unpleasant, but in many cases it renders the tissues of the specimens themselves so hard that they are practically unworkable. Then, again, it is quite unsuited for all specimens containing calcareous matter, such as molluscs, echinoderms, and crustaceans; while unsatisfactory results appear to have been obtained in the case of certain insects and myriapods. Moreover, it does not seem to be well suited for the preservation of reptiles; and it is said to deteriorate the colours of bird-skins.

Turning to its advantages as a permanent preserving fluid, it is acknowledged to be unrivalled for specimens of watery and "flabby" animals, such as jelly-fish, rendering them more coherent and less likely to disintegrate than any other known medium. Apart from this group, it does not, however, appear to be at present used to any great extent in the exhibition series in the British Museum; although we have reason to believe that its possibilities are occupying the serious attention of the officials. In the series of worms, all the more valuable specimens that were received in formalin have been transferred to spirit, and only the commoner forms left in the original medium. Of the six specimens of eggs, embryos, and larvæ of *Lepidosiren paradoxa* recently added to the exhibition series from Mr. Graham Kerr's Paraguay collection, three are in alcohol and three in formalin; the latter having been sent home in that fluid, and it being thought not advisable that the medium should be changed. If these six specimens are carefully watched, they will afford a test-case of the comparative value of the media. At present, we believe, none of the exhibits in the "Index Museum" are in formalin.

For sterilising freshly killed specimens of mammals and birds, as well as eggs, that have to be sent some distance to a museum in the flesh, there can be no doubt that formalin is invaluable. And it is no less valuable to the field-collector of mammals, not only on account of the small bulk a sufficiency of the fluid occupies, but also from the marvellous preservative power of the fluid itself. According to Mr. O. Thomas (who reports very favourably of it for this purpose), commercial formalin, which is itself 40 per cent. under proof, must be diluted with no less than twenty-five times its own bulk of water before use. Moreover, whereas when mammals are preserved in spirit it is necessary to allow a very large amount of fluid to each specimen, when formalin is employed the vessel may be crammed as full as possible with specimens, which are preserved without exhibiting the slightest traces of putrefaction. When received at the British Museum all such specimens are, however, immediately transferred to alcohol, on account of their unsuitability for handling when in the original medium.

The foregoing instances suffice to show that for certain specific purposes formalin has advantages as a preservative medium not shared by alcohol. But, as many of our readers are aware, another application of formalin has been recently proposed by Dr. G. de Rechter, of the Brussels University, who, in the twelfth volume of the *Annales de l'Institut Pasteur* (1898), has advocated the use of currents of formalin vapour for the preservation of animal specimens. The advantages claimed for this method are that it preserves the specimens in practically the same condition as they were left at death; the tissues not being hardened, while hair and feathers are uninjured alike in texture and in colour. Experiments in this method have been recently undertaken in Mauritius by Mr. Camille Sumeire, of the Albion Dock Company, who has constructed an apparatus on the general lines of one suggested by Dr. de Rechter, in which specimens can be subjected to constant currents of formalin vapour. And it appears from an illustrated report published in the *Bulletin de la Société Médicale de l'Ile Maurice* for July 18, that the results of these experiments have proved eminently satisfactory.

A freshly killed guinea-pig placed in the apparatus for a period of twenty days was found to be in a perfect state of preservation, and when exposed in the open in the museum for a further period of eight days, was likewise found to be intact. Moreover, a culture of bacilli exposed in the apparatus at the same time as the guinea-pig was found to have become completely sterilised.

As was well remarked by Dr. de Grandprè, superintendent of the Port Louis Medical Museum, the potential advantages of such a method of preservation are likely to prove very important. And it is urged that the process may be specially valuable in cases of suspected poisoning, as bodies can be preserved for any length of time in a state suitable for examination. From a natural history point of view the invention has likewise almost unlimited possibilities; and Mr. Sumeire hopes to be able shortly to supply the museums of Europe with examples of the animals of Mauritius as fresh as when alive, instead of in the condition of ordinary spirit-specimens. Indeed, negotiations are already opened with the director of the Paris Museum for the transmission of such formalined specimens to the institution under his charge. We wish all success to the new venture.

R. L.

A GREAT SALT LAKE PROBLEM.

AN alluring possibility has for a long time attached itself to the economic resources of Great Salt Lake, in the Western United States, in the way of establishing in its waters, as permanent residents, forms of marine life of commercial importance. The United States Fish Commission recently made an examination of the lake with a view to determining the feasibility of such a plan. The work was undertaken by Mr. H. F. Moore, of the Commission, who finds in the peculiarly interesting conditions which prevail in this unique body of water a decisive answer.

Crustacea, insect larvæ, and the lower plant-life abound in its fresher parts, but for the ordinary inhabitants of the sea the salinity is much too great in the main body of the lake. Great Salt Lake is a remnant of the prehistoric Lake Bonneville, which was fresh, or nearly so, until its drainage basin became isolated by climatic and

other changes, its salinity then increasing by evaporation. Brackish springs are common in the vicinity, and these, with the salts of the feeding streams, still contribute to the accumulation of saline matter. On the authority of the United States Geological Survey, the present rate of accumulation will charge the lake with common salt within a period of 25,000 years. The present density is about 1·168, while that of the ocean is but 1·025. It appears that it is not the nature of the saline materials, but their excessive quantity alone, that makes the water unfit for ocean life; for the relative proportions of the solids in solution do not differ materially in the lake-water and sea-water. Three-fourths of these solids are common salt in both cases. The lake, while strongly salt, is not alkaline, and would presumably support the higher organisms of the ocean if properly diluted. Diatoms have been grown experimentally in the diluted Salt Lake water, and, indeed, have been found native in the lake, together with other low plant and animal life, in its brackish parts.

On account of the removal for commercial purposes of large quantities of salt, many have looked forward to a day when the consequent freshening process shall have reduced the density of the water sufficiently to make it an inhabitable medium. About 42,000 tons of common salt are removed annually, while 16,000 tons, according to the calculation of the 25,000 year period required to saturate the lake, enter it each year. From the present density, 1·168, the lake must now hold about 400,000,000 tons of salt, and with these figures as a basis, it appears that in 14,000 years—the processes continuing at the present rate—the lake-water will reach the density of sea-water. As this is a far cry into the future, some would believe that the solution of the problem was to be found in acclimatisation of marine forms to the present briny waters. There is no evidence that this is feasible or remotely possible; the oyster has the best possible opportunity to adapt itself to salt or fresh water, but clings to an intermediate brackish zone of a density between 1·010 and 1·020. The plan which seemed to offer the only possibility of success concerned the oyster, and the location, near the mouths of the fresh streams that feed the lake, of water-zones of a degree of brackishness favourable to oyster growth. The conditions which were found to exist were such as to show conclusively that there is no hope for the utilisation of the lake in this way. The favourable zones, which are narrow at best—in no case over three hundred yards—are subject to great fluctuations in position due to the wind and to seasonal changes. The variation in the volume of water carried by the inflowing streams is remarkable. In one of them the ratio of the greatest flow to the least was as 28 to 1. When they are flushed with the melting of snow in spring the oyster zone is carried lakeward, and during the period of minimum flow in autumn it travels up the mouth of the stream in which it is located. The wind alone sometimes makes a change of level of several feet, and a consequent change of density from 1·009 to 1·014 within five minutes has been observed. Moreover, the deltas of the streams, which must of necessity be the location of the oyster beds, are subject to deposits of silt in amounts fatal to oysters. All these conditions in conjunction make the difficulties of successful oyster culture insuperable.

The brackish springs characteristic of the Bonneville bed have a low density, none exceeding 1·005, and suggest a plan by which they might be utilised. By making them the sources of artificial ponds the evaporation, which is greater than the rainfall, would raise the density to the desired point at which it could be maintained by a proper regulation of the brackish inflow and outflow. On a commercial scale, however, the experiment would be expensive, and might or might not justify itself.

PAUL KNUTH.

BORN on November 20, 1854, Paul Erich Otto Wilhelm Knuth, Professor at the Oberrealschule of Kiel, was only in his forty-sixth year at his death on October 30. After graduating at Griefswald in 1876, he was engaged in teaching at Iserlohn in Westphalia, and from 1881 at Kiel. His first scientific investigations were in the realm of organic chemistry, his chief works a Handbook of Flower-Biology, a Flora of Schleswig-Holstein, and a series of short papers upon the botany of the islands off the German coast—Rügen, Heligoland, Sylt, &c.

The "Handbuch der Blütenbiologie" is based on the English edition of Hermann Müller's "Befruchtung der Blumen," and is destined to replace it. Increasing knowledge has swelled the literature-list from 825 entries to 2871, and Knuth's plan allowed for three volumes in the place of the single one issued in English in 1883; of these the last, designed to contain all we know of the fertilisation of flowers in lands outside Europe, remains unpublished. There is hope that the work may yet be completed. Knuth's own observations in Java, Japan, and California, made in 1898 and 1899, were made to add to the rather meagre knowledge available for this unpublished volume.

His observations on the flora of the North Friesian Islands, of Heligoland and of Rügen, demonstrate how the winds that blow over sea-girt islets, inimical to insect life, impose a limit to the distribution of plants whose highly specialised flowers need insect aid for their fecundation. The lesser the island the greater the influence. Rügen is large, and it is not evident; the Halligen are small, and it is very apparent. These Halligen are "low-lying, marshy islets, hardly rising more than a metre above high tide, wind-swept, where one wanders hour after hour without taking a single anthophilous insect, save on the rare hot and windless days which coax a few to fly from flower to flower." On them the high-types of floral development are rare.

His Flora of Schleswig-Holstein, named above, was largely a compilation, intended to supply a real need, and was followed by a History of Botany in the double province. These, however, as the first steps towards his botanical work, have their own interest. I. H. B.

NOTES.

SOME particulars concerning the vessel which is being built at the Howaldt Shipbuilding Yard at Kiel, for the German Antarctic expedition, are given by the Berlin correspondent of the *Times*. The ship will be built of wood, the only material strong and elastic enough to resist the pressure of the ice. In form she will be somewhat rounder than the *Fram*, and will not fall away towards the keel in the same manner. The length of the ship will be about 46 metres, the breadth between 10 and 11 metres, and the draught about 5 metres. She will be constructed to carry coal and other stores sufficient for three years, and will contain accommodation for five scientific observers, five officers, and a crew of about twenty men. Each of the observers, and each of the officers, will have his own cabin. The centre of the ship will be occupied by the rooms for scientific work, and the forecastle will contain space for fifty Arctic dogs. The ship will be rigged as a three masted schooner. Two steam winches will serve the anchor and will also be used for scientific purposes. The ship will be illuminated throughout with electric light. The Howaldt Shipbuilding Yard, which is under a contract to have the ship built by May 1, 1901, and fitted out not later than the end of August, 1901, has already begun the construction. A model of the vessel will be shown at the Paris Exhibition.

THE *British Medical Journal* states that the Italian Parliament has voted a sum of 1,300,000 lire for the erection of new buildings in the University of Bologna. The work will be begun next spring.

WE learn from the *Times* that M. Raphael Bischoffsheim has presented to the Paris University his observatory at Nice worth 2,700,000f., and 2,500,000f. the interest of which is to cover its expenses.

M. T. Ribot, professor of psychology at the College de France, has been elected a member of the Paris Academy of Moral Sciences in succession to the late M. Nourrisson.

GENERAL GALLIENI, Governor of Madagascar, has been elected a correspondant of the Paris Academy of Sciences. The Academy has also elected M. Méray as correspondant of the section of geometry, and M. Rosenbusch as a member of the section of mineralogy.

A SPECIAL correspondent of the *Times* reports: "six Marconi wireless telegraphy instruments intended for the Boers have been captured at Cape Town. The experiments at Orange River have been highly successful. The communication with De Aar, seventy miles distant, is perfect."

MR. C. VERNON BOYS, F.R.S., will deliver the first of a course of six Christmas lectures specially adapted for young people, at the Royal Institution this afternoon. The subject will be "Fluids in Motion and at Rest" (experimentally illustrated). The remaining lectures will be on December 30 and January 2, 4, 6, 9, 1900.

THE two astronomers whose names have been submitted to the French Minister of Public Instruction, who will select one to fill the vacancy in the Bureau des Longitudes caused by the death of M. Tisserand, are M. Radau and M. Bigourdan.

AN exhibition of food, clothing, medicines, and other articles suitable for travellers in uncivilised and unhealthy regions of the globe, will be held at St. Martin's Town Hall, Charing Cross, on January 1–5, under the title of the "Livingstone Exhibition." A loan collection of Livingstone relics and of objects of interest connected with the work of other travellers will be on view.

AN interesting account of experiments on the growth and regeneration of the tails of tadpoles, conducted by means of Born's method of grafting, is given by Mr. R. G. Harrison in the October number of the *Bulletin* of the Johns Hopkins Hospital. In the neighbourhood of Baltimore there occur two species of frogs whose embryos differ so markedly in colouration from one another, that in any case where parts derived from each are united by grafting into a single organism it is easy to follow in the living specimen, as development proceeds, the change in position of any group of cells in respect to the original line of section. During the development of the tail after grafting it was noticed that a remarkable shifting of the epidermis over the underlying organs took place; so that after a time the epidermis properly belonging to the tail was restricted to the terminal third of that appendage. Now it is well known that the cutaneous nerves of the trunk and tail of the full-grown larvæ and frogs, in passing from the vertebral column to their termination in the skin, pursue an oblique course; and this is obviously due to the above-mentioned backward shifting of the epidermis. Certain other interesting features were also brought to light in the course of the experiments.

WITH the view to ascertain what displacement, vertically or horizontally, took place in the Khási and Gáro Hills during the Indian earthquake of June 1897, a revision of the principal triangulations in the district was made by officers of the Survey of India Department during 1898, and the results are referred to in the report just issued. Horizontal and vertical observations were taken at thirteen stations, fixing the positions of twenty-two and the heights of twenty-five old stations, embracing an area of 1020 square miles. The results show that the whole of this area lay within the region affected by the earthquake, so it is impossible to state how much any one station has been displaced in comparison with the unaffected area outside, but apparently all have suffered more or less. The average horizontal displacement appears to be about 7 feet, whilst the changes in height vary from a subsidence of 4·3 feet to an upheaval of 24 feet; these, however, for the reasons already mentioned, cannot be considered as absolute, but only relative changes. The general apparent effect is that the area has been both widened and raised. If possible, the revision work should be continued and extended, with instruments of equal calibre to those employed in the original triangulation; for accurate measurements of the movement of the earth's crust due to a large earthquake are of deep scientific interest.

THE Antiquity of Man in America is an important problem, and it is well that Mr. W. H. Holmes should revise, as he has done in the *American Anthropologist* (N.S., I., 1899, p. 614), the evidence relating to Auriferous Gravel Man in California. He discusses this special aspect of the question in a full, lucid and judicial spirit. His conclusion is that the testimony furnished is greatly weakened by the facts (1) that the finds on which it was based were made almost wholly by inexpert observers, and (2) that all were recorded at second hand. Affidavits cannot redeem it. Nothing short of expert testimony, amply verified and vigorously stated, will convince the critical mind that a Tertiary race of men, using symmetrically-shaped and beautiful implements, wearing necklaces of wampum and polished beads of marble or travertine bored accurately with revolving drills, fishing with nets weighted with neatly-grooved stone sinkers, and having a religious system so highly developed that at least two forms of ceremonial stones had been specialised, occupied the American continent long enough to develop this marked degree of culture without leaving numerous and distinctive traces of its existence. All these objects resemble modern implements in every essential respect. They are such as may have fallen in the mines from Indian camp sites or been carried in by the Indians themselves.

AN article upon electrolytic processes in industrial operations, contributed to the *Engineering Magazine* by Dr. W. Borchers, shows some of the remarkable developments of electro-technology during late years. Descriptions are given of the various processes by which industrial products are obtained electrolytically. The Castner process for manufacturing sodium is well known, and several similar devices have recently been introduced. Magnesium is obtained from melted magnesium salts by a process founded upon Bunsen's investigations. For the production of aluminium, the Pittsburg Reduction Company use a mixture of chlorides and fluorides of the metals of the alkalis and alkaline earths as electrolytes and solvent for the aluminum oxide. Copper, nickel, silver, and gold, in so far as electrolysis may be said to be applicable to them, are chiefly obtained in pure form by electrical means from the crude metal produced by the smelter. Gold is also electrolytically deposited from weak solutions obtained by chemical lixiviation processes. Caustic soda, caustic potash, chlorate of potash, and chlorine are obtained by electrolysis from aqueous alkali-chloride solutions. By suitable appliances and working conditions, the chlorine and caustic alkali solution may be carried off separately to produce chloride of lime and solid caustic soda, or they may be made to form a solution of chlorate of potash in the place of caustic potash and chlorine. The methods by which these and

other electrolytic products are obtained are briefly described by Dr. Borchers in his interesting paper.

WE have received from Dr. L. Carnera, Voluntary Assistant at the Royal Observatory of Turin, a discussion of the amount of bright sunshine recorded at that Observatory, showing *inter alia* the mean duration of sunshine during the different hours and months of the years 1896–8, together with a comparison with the means obtained in a discussion by Dr. Rizzo of the values of the previous six years. While the variations between the two series show that the period is much too short for the deduction of trustworthy means, the results are valuable owing to the comparative rarity of this important climatic factor; for although observations of barometric pressure, temperature, &c., have been made at that institution for more than a century, a sunshine recorder has only been in use there for the last ten years. In fact, the instrument has only come into general use during the last twenty years, principally owing to improvements made by Sir G. G. Stokes in a recorder devised some years previously by the late Mr. J. F. Campbell.

THE Government Astronomer of Western Australia has sent us a copy of the meteorological observations made at the Perth Observatory and other places in that colony during the year 1898. This is the second of a series of annual publications issued by the Perth Observatory; annual meteorological reports have been published since 1876, but the new series shows a marked improvement. In past years the observers were dependent solely upon written instructions without inspection, and had to find out how to do their duties as best they could. In addition to the usual observations, a set of four Platinum Resistance thermometers have been sunk to various depths at Perth, and daily weather forecasts are now issued, which, on the whole, have been remarkably successful. In the year 1898 there were 31 stations provided with barometers and other instruments, and 213 rain-gauge stations, but the monthly charts show that large tracts are still unrepresented.

THE U.S. Government is pushing on its researches of the economical resources of Porto Rico. *Bulletin* No. 25 of the U.S. Department of Agriculture (Division of Forestry) consists of a report by Mr. Robert F. Hill, of the U.S. Geological Survey, on the forest conditions of the island. He states that the climate and soil are well adapted to the growth of a large number of trees and shrubs of great economical value, and he advocates a reversal of the deforesting policy pursued by the Spaniards. Besides those valuable for timber and constructing purposes, he names, as specially adapted to the climatal conditions, the tamarind, the papaw, the castor-oil plant or "palma Christi," the all-spice, the lime, a large number of edible fruits, as the orange, citron, lemon, guava, anona, mango, banana, and many others whose names are less known in this country. The coffee cultivated is of a superior quality. There are comparatively few harmful animals or poisonous plants.

PROF. W. B. SCOTT (*Trans.* Wagner Free Inst. of Science Philadelphia, vol. vi.) describes and figures a series of Ungulate Mammals from the Uinta and White River formations (Oligocene) of Utah and Colorado in North America. The mammals belong to the sub-order of "Selenodont Artiodactyls," and they include two groups; the first comprises forms generically identical with, or clearly related to, Old World anthracotheres and true ruminants, which reached the American continent by migration; the second group includes forms indigenous to America, the successive stages of whose descent may be traced through several of the Tertiary formations.

THE ninth volume of the Iowa Geological Survey (1899) contains the Annual Report for 1898, with accompanying papers. Statistics of mineral productions, including coal, clay, stone, lead and zinc, are contributed by Mr. S. W. Beyer. There are also reports on the Counties of Caroll, Humbolt, Story, Muscatine, and Scott, accompanied by colour-printed maps, and followed by an account of the Artesian Wells of the Belle Plaine Area. The county reports contain concise accounts of the various formations including Silurian, Devonian, Carboniferous, Cretaceous, Pliocene, Glacial and more recent deposits, together with notes on their economic products. In Muscatine county the Devonian rocks afford many points of special interest, and they have yielded a number of fossils.

THE *Mittheilungen* of the Vienna Geographical Society contains an excellent abstract of a paper by Dr. Eduard Richter, published by the Swiss Geological Society at the end of last year, on the advance and retreat of the glaciers in the Alps during the Ice Age. Dr. Richter arrives at the important result that the variation of climate was probably much smaller than has been supposed, because the resistance to the outflow of the ice increases with its quantity in a rapid ratio, and the level of the snowfields would therefore rise quickly to levels where the temperature was lower. The variations of level due to this cause would themselves give rise to sudden and irregular changes in the glaciers according as the ice-surface rose above, or fell below, the snow-line. They also account for the enormous amount of moraine detritus carried by these glaciers; each was made up of a large number of small ice-streams, and the debris was not carried as a ground moraine, but in the body of the ice.

THE *Biologisches Centralbatt* for November 1 contains an article by Dr. L. Kathariner on the influence of light on the colours of the pupæ of butterflies, in which many interesting points are recorded.

THE following lectures will be delivered at the Royal Victoria Hall, Waterloo Road, S.E., on Tuesday evenings during January:—January 2: "Chronicles of a Clay Cliff," by W. H. Shrubsole; January 9: "A Peep Behind the Scenes," by Metcalfe Wood; January 16: "Birds at Home and Abroad," by Mrs. Lemon; January 23: "Plants of Long Ago," by A. C. Seward, Esq., F.R.S.; January 30: "The Fathers of Geology," by F. W. Rudler.

THE *Journal* of the Franklin Institute for December contains several additional addresses delivered on the occasion of the recent celebration of the seventy-fifth anniversary of the Institute. Dr. C. F. Himes describes the history of photographic discovery from the time of Daguerre and Niépce; Mr. C. Kirchhoff surveys the achievements in mining and metallurgy during the past three-quarters of a century; and Mr. J. Fritz gives some reminiscences of the development of iron manufacture in the United States in the same period.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY, 1900.

January 2–3. Epoch of January meteors (radiant 230° + 53°).
3. 4h. Venus in conjunction with the moon (Venus 6° S.).
6. 7h. 12m. to 8h. 10m. Occultation of 19 Piscium (mag. 5·2) by the moon.
8. 17h. 32m. Jupiter's Sat. IV. in conjunction N. of planet.
10. 7h. 1m. to 7h. 59m. Occultation of τ^2 Arietis (mag. 5·2) by the moon.
10. 7h. 55m. to 9h. 1m. Occultation of 65 Arietis (mag. 5·6) by the moon.
11. 10h. 27m. to 11h. 34m. Occultation of κ^1 Tauri (mag. 4·6) by the moon.
11. 10h. 40m. to 11h. 23m. Occultation of κ^2 Tauri (mag. 5·5) by the moon.

January 13. 10h. 1m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc = 0·873.
16. 6h. 50m. Minimum of Algol (β Persei).
16. 17h. 17m. to 17h. 50m. Occultation of α Cancri (mag. 4·3) by the moon.
20. 12h. 46m. to 13h. 46m. Occultation of B.A.C. 4006 (mag. 5·7) by the moon.
21. 11h. 22m. to 12h. 26m. Occultation of q Virginis (mag. 5·7) by the moon.
23. 15h 35m. to 16h. 45m. Occultation of B.A.C. 4722 (mag. 5·5).
26. 1h. Conjunction of Jupiter and the moon (Jupiter 2° 3′ N.).
26. 15h. 40m. Transit of Jupiter's Sat. III. (Egress).

ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.—Prof. E. B. Frost, of the Yerkes Observatory, contributes to *Science* a full account of the proceedings at the first meeting of this new society, which is the permanent outcome of the two congresses of astronomers and astrophysicists held in the past two years. The following notes are from the report:—

Prof. S. J. Brown discussed his measures of the changes in the orbit of the satellite of Neptune, in order to determine the position of the polar axis and flattening of the planet. This flattening is found to be $e = \frac{1}{102{\cdot}2}$, an amount corresponding to only 0″·03 between the polar and equatorial diameters.

The period of the revolution of the pole of the satellite's orbit is 531·75 years.

Prof. A. S. Flint described the new Repsold transit micrometer of the Washburn Observatory.

Mr. Kurt Laves read a paper on the "Determination of the constant of nutation from heliometer measures of Eros." The opposition of this planet at the end of 1900 will offer special facilities for this purpose.

An account was given of a proposed new "Harvard Photometry." In the original work all stars were included of sixth or brighter magnitude, as obtained from the principal catalogues then extant; but it has been found in the course of the work that in this way many have been included which are fainter than mag. 6·2. The stars of the Photometry were again observed in 1892–94, and, including special series of measures, there are now prepared *seven* photometric catalogues, giving measures by different observers with different instruments, but all made on the same plan. It is therefore proposed to issue a catalogue of all the stars from the north to the south pole, showing the brightness given by the meridian photometer in all seven catalogues, and to call the work the "Revised Harvard Photometry." As much reference information to other catalogues will be given as is possible, and it is thought a quantitative measure of the colour will be furnished by giving the type of spectrum and photographic magnitude.

Prof. G. C. Comstock described his experiments of placing a very coarse grating before the object glass of a telescope, and measuring the distance between the mean centres of the pairs of star spectra formed on each side of the central image. He finds incidentally that the mean refrangibility of the light of Mars is marked by *less* than that of any red stars yet examined. He has also examined the satellites of Jupiter in this way, and finds different values from those adopted by Michelson and Hamy.

Mr. F. L. Chase has taken heliometer observations of red stars, &c., in order to determine the possibility of there being a slight difference of refraction between these and white stars, thus introducing a disturbing element into measures of parallax. In all his experience, however, he was unable to detect any difference whatever.

Prof. S. I. Bailey said that out of the 900 stars counted in the cluster M. 5., eighty-five were variable. Detailed examination of the light curves and periods of many of them showed a remarkable similarity both in the magnitude and range of variation. The periods vary from 10h. 48m. to 14h. 59m. The uniformity of period, magnitude, and light curve among so many variables, points to a common origin and cause of variability.

DAY NUMBERS OF "NAUTICAL ALMANAC."—We have received a pamphlet giving the separate day numbers for use with the tables for finding star constants for the years 1900, 1901, 1902. From the past three years' experience, Prof. Turner says that his restriction of the tables to three figures has been followed by no loss of accuracy, and therefore their publication is continued. In accordance with the decisions of the Conference of Superintendents of Ephemerides held at Paris in 1896, the constants of aberration, precession, and nutation have been altered from the commencement of 1901; but, for the convenience of observers still desiring to use the Struve-Peter's constants, both have been included in the present tables.

"POPULAR ASTRONOMY" FOR DECEMBER.—The issue of *Popular Astronomy* for this month contains, among much generally interesting matter, two useful articles by Profs. H. C. Wilson and W. H. Pickering. The former describes a photograph of the nebula of Andromeda obtained by him at Goodsell Observatory, using the 8-inch Clarke refractor, with an exposure of twelve hours given on three nights. Reproductions of the picture accompany the paper, and the minute structure of the many spirals first photographed by Roberts are magnificently shown.

Prof. Pickering writes to keep up hopes of the meteor shower still being observable. He has examined the times of appearance of the maximum from 902 more minutely, and finds they occurred at regular 100 years' intervals until 1698, when there was a perturbation of four years. Since then thirty-four years would appear to more closely satisfy the period, so that 1901–2 may still be the maximum year.

THE SOUTH-WESTERN POLYTECHNIC.

ONE of the best equipped and most intelligently governed of the London polytechnics is that built at a cost of 55,000*l*., and located at Manresa Road, Chelsea. Situated as it is in the midst of a densely-populated district, its work, which a large staff of lecturers and demonstrators, under the able guidance of Prof. H. Tomlinson, F.R.S., the Principal, are year by year steadily accomplishing, cannot be overestimated. The work of the polytechnic is carried on in a fine suite of buildings placed within a stone's throw of the Chelsea Town Hall, and the institution is provided with laboratories and lecture-rooms for each of the many departments of science and technology which its work comprises. It is designed more especially to meet the educational needs of the inhabitants of Chelsea, Fulham, Kensington, St. George's (Hanover Square), and Westminster, though students from other parishes are admitted if accommodation is available and other circumstances permit.

Financial Position.—The financial outlook of the South-Western Polytechnic may certainly be regarded as hopeful. Both the fees received from the students and members and the grants earned last session from the Science and Art Department showed a very large increase. The total annual income received from the Technical Education Board of the London County Council amounts to over 4000*l*., and the annual subsidy from the Charity Commissioners is 1500*l*. The inadequate accommodation which the already extensive buildings offer the increasing number of students to be provided for, has necessitated a further extension, and the governing body are now spending some 7000*l*. on new buildings.

Departments.—The operations of the institution are divided into two distinct portions—day classes and evening classes. In the day classes are included (1) a Day College for men; (2) a Day College for women; (3) a School of Art; (4) a School of Science for boys and girls; and (5) a School of Domestic Economy for girls. The evening classes embrace the following sections: (1) Mathematics; (2) Physics and Electrical Engineering; (3) Mechanical Engineering and Building Trades; (4) Chemistry; (5) Natural Sciences; (6) Languages; (7) Commerce; (8) Domestic Economy; (9) Art; (10) Music; (11) Miscellaneous; (12) Recreation.

Numbers of Students.—The most notable fact, and one of the most encouraging features of the work of the South-Western Polytechnic, is the regular and substantial increase from year to year in the numbers of students attending the different departments. The number of students in the day classes during the session 1897–8 was nearly half as many again as that during 1896–7. Taking all the day classes for both sexes together, the number of individuals attending during the present session is about 30 per cent. greater than for the last school year, the number undergoing instruction at the present time being about 900.

The number of individual students in all evening classes together is about 2000 for the current session, during 1897–8 it

was 1844, and the preceding year, 1896-7, 1520. The relative popularity of the different departments among evening class students can be seen at a glance from the number of class entries during the session 1897-8, which was as follows :—

Mathematics	85
Physics and Electrical Engineering... ...	578
Mechanical Engineering and Building Trades	942
Chemistry	185
Natural Sciences	137
Languages	246
Commerce	342
Domestic Economy	233
Art	287
Music	455
Gymnastics	306
Miscellaneous	233

The trades and industries of the evening class students show great variety, and indicate graphically the widespread influence which a polytechnic is able to exert. Of the 1844 students attending evening classes during 1897-8, 304 were clerks, 192 teachers of one kind or another, 183 were salesmen and shop-assistants, 175 apprentices, 65 servants, 59 carpenters and joiners, 42 artists, 37 electricians, 37 painters, 34 builders' clerks, 32 civil servants, and 31 telegraphists. In addition to these, rather smaller numbers of bricklayers, plumbers, fitters, engineers, draughtsmen, dressmakers, milliners were in attendance, while doctors, architects, and merchants were represented ; one or two postmen, porters, and others were also reaping the benefits of education.

FIG. 1.—The Chemical Laboratory, South-Western Polytechnic.

DAY COLLEGE FOR MEN.

This college is intended for males above the age of fifteen, and is at the present time attended by over a hundred students, whose ages range from fifteen to forty. It comprises two departments—one technical, the other general. The courses of instruction in the former are arranged to occupy at least two years. On entering, the student is expected to state whether he wishes to be trained as a mechanical or electrical engineer, whether he wishes to be educated with a view to some branch of chemical industry or of the building trade, or whether he desires to study applied art. Except in the last contingency, complete courses of study have been arranged, involving laboratory instruction, tutorial work, attendance at lectures, mathematical exercises, drawing, and workshop instruction.

The general department of the day college, on the other hand, aims at giving either a good all-round education or special training in each of its various sections.

Students admitted to a regular and fully prescribed course of study in the technical department are first required to pass an elementary examination in mathematics and to give evidence of possessing a fair knowledge of English. In the general department the students are not required to pass any entrance examination. Students in the technical department who successfully work through the second year's course may compete for a college diploma.

A few words about the different courses of instruction in the technical department will best indicate the nature of the work in this part of the day college for men. The full scheme of work is :—

(*a*) *The Mechanical Engineering and Architecture Section* is spread over two years, and aims at providing progressive instruction of a theoretical and practical nature, suitable for students just leaving school and who intend in the near future entering the works of an engineer or the office of an architect. At the same time it is designed to be of service to those who have already spent three or more years in a workshop, and who require a course of technical instruction to fit them for positions of greater responsibility.

(*b*) *The Civil Engineering and Surveying Section* also takes up two years, and trains young men who will hereafter be engaged in surveying, civil engineering, constructional work of any kind, or who propose to proceed to the colonies.

(*c*) *The Electrical Engineering and Applied Physics Section* is intended to familiarise students with methods of accurate measurement and observation, as well as to give a sound know-

ledge of physical laws and their application to industrial and engineering operations. The laboratories are capable of accommodating fifty students at one time, and are equipped throughout with the most recent apparatus for the study of physics.

(*d*) *The Chemistry Section* is arranged to assist students who intend carrying on work involving the applications of chemistry as industrial, consulting, or analytical chemists. The course includes other subjects required by technical chemists, and students who wish to do more advanced work can only complete the course in three years.

Day College for Women.

This college is the counterpart of the day college for men, and the Principal is aided in its direction by a lady superintendent. It is at the present time attended by 200 students. The aim of the college is to provide women with a thorough and liberal education, not only in art, science, literature, and commerce, but also in domestic economy and physical training. While it is a little difficult to make selections where the whole work is so satisfactory, the training offered for lady secretaries and the training college for gymnastic teachers call for special mention. The growing demand for ladies to act as secretaries or confidential clerks renders the question of the competent training of candidates for such posts one of great practical importance, and there is no doubt that the arrangements which have been made at Chelsea to provide a complete course of study for those wishing to obtain employment as secretaries or clerks will have a very beneficial effect.

The training college for gymnastic teachers is under the direction of Fräulein Wilke. The complete course of training extends over two years, and the fee for the whole time is seventy-two guineas. A noteworthy feature of the method of instruction adopted is that the candidates are taught each of the systems of gymnastics, German, Swedish, and English, and are consequently not handicapped like students in many similar colleges where one system only is taught. The instruction is both practical and theoretical, and the most careful precautions are taken to ensure the physical well-being of the embryo instructors.

Evening Classes.

The time table of the evening classes at this polytechnic gives the impression that it would be difficult to name a subject which is not included. There are classes in all branches of pure and applied science, languages and literature, domestic science, commercial subjects, art, music, and many other subjects. The fees are low, and the classes well attended, while the examination results show that the students make substantial progress.

Higher Scientific Instruction and Work in Research.

A special characteristic of the work of the South-Western Polytechnic is the higher instruction in science and the interesting development of education in the methods of research, to which reference has already been made in these columns (No. 1523, p. 236). Both in the day and evening classes great attention is given to electrical engineering. The following table shows the number of individual students attending the more important classes in this section :—

Advanced Electrical Engineering	58
Elementary Electrical Engineering	55
Alternating and Polyphase Currents	24
Calculus for Electrical Engineers	21
Electric Wiring and Fitting	69
B.Sc. Physics for London University	20
Telegraphy	14

The equipment of the laboratories for this work contains some interesting apparatus and machines. The polyphase generator, which consists of three small alternators of identical construction mounted on one bed plate and coupled together with graduated couplings, which admit of any given phase difference being produced between any of the alternators, deserves particular mention. There are also examples of the most recent continental three-phase and induction motors, on which careful tests

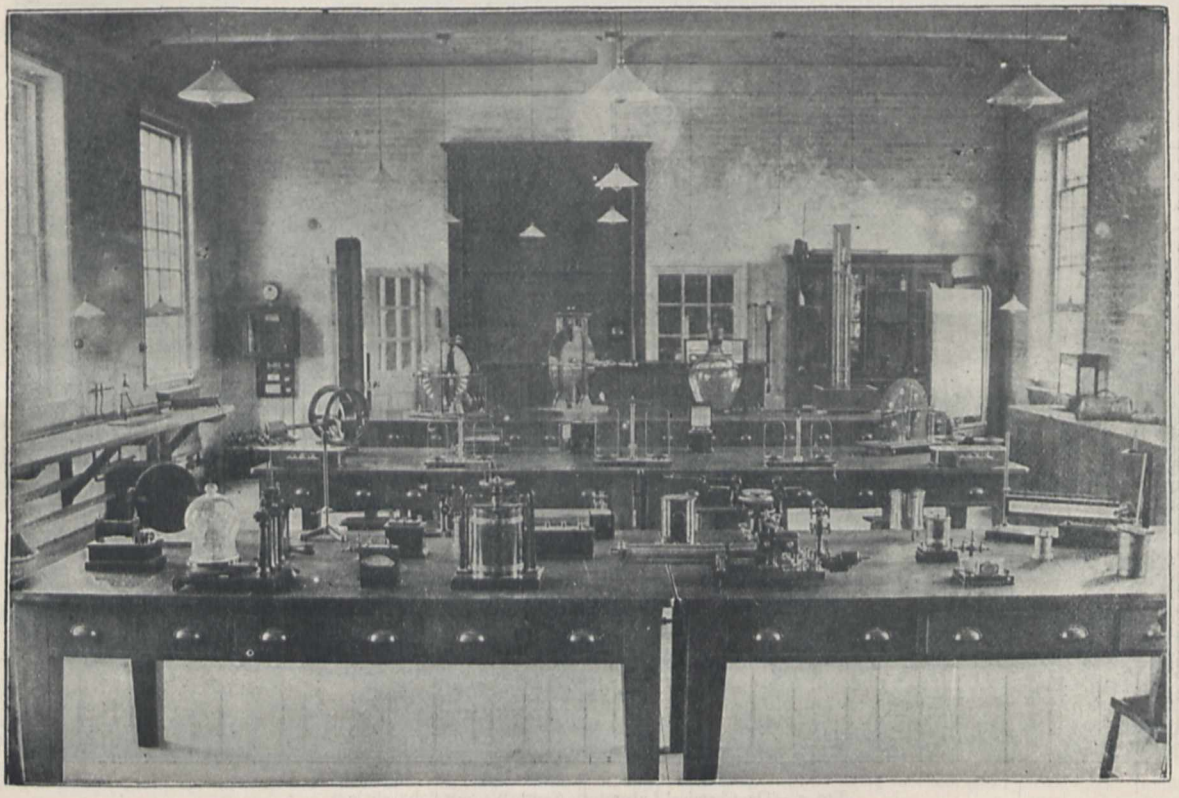


Fig. 2.—The Physical Laboratory, South-Western Polytechnic.

are now being made. There is an ingenious combination of motor generators, which can be driven either mechanically or electrically. The switchboard and starting appliances for this combination of motor generators were designed and made in the institute.

A small workshop, with electrically driven tools, affords a good scope for the construction of original apparatus. Only typical instruments and standards have been purchased for the physical and electrical laboratories; the great bulk of the instruments and fittings have been both designed and made up in the polytechnic itself. Among the more recent pieces of original apparatus of home manufacture may be mentioned (1) a modified form of Michelson's interferometer, and another adaptation of the same for measuring to a millionth of an inch, and (2) an electro-magnetic speed indicator for use with dynamos and motors. Examples of original apparatus made at the South-Western Polytechnic have been exhibited at the Royal Society, the Royal Institution, and the Institution of Civil Engineers.

Good research work has been accomplished, including a series of tests on insulating materials, investigations on selenium cells, the effects of repeated heating and cooling on the magnetic properties of wrought iron, the relation between the thickness of metallic surfaces and the phase change of the reflected beam, tests with the Nernst lamp, and the negative resistance offered by certain metallic oxides. The results in the last piece of work have been published in the *Electrician*.

Other Points of Interest.

Several general considerations must be taken into account before the educational position of the South-Western Polytechnic can be rightly estimated. The recreative side of the polytechnic is not considered of prime importance, and the tendency seems to be to minimise its influence. In this respect it departs somewhat from the general type of polytechnic in the metropolis. There is also a laudable desire to initiate new departments as the need for them becomes evident, so that the institution may keep in touch with all the needs of the inhabitants in its neighbourhood. In this connection may be cited the work now being done on the women's side of the institute in the direction of offering ladies of the middle classes such instruction in domestic science as will make them independent of servants. Finally, it should be borne in mind that in more than one department the work being done is of quite as advanced a character as that in some university colleges.

A. T. SIMMONS.

PRIZE LIST OF THE PARIS ACADEMY OF SCIENCES.

AT the Annual Meeting of the Academy, held on December 18, M. von Tieghem gave his Presidential Address, and announced the prizes awarded for 1899. In his address, the President reviewed the scientific progress for the year, and then gave a short account of the life-work of the Members, Foreign Associates, and Correspondents who have died during the past year, MM. Naudin, Friedel, Frankland, Bunsen, Richards, Wiedemann, Marsh, Flower, and Riggenbach.

The prizes were awarded as follows: in Geometry—the Bordin Prize is not awarded, but M. Jules Drach receives an honourable mention, the Francœur Prize to M. Le Cordier, with an honourable mention to M. Le Roy, the Poncelet Prize to M. Cosserat, for the whole of his contributions to geometry and mechanics.

In Mechanics: the Extraordinary Prize of 6,000 francs to M. Bailles for his treatise on the Geometry of indicator diagrams, MM. Charbonnier and Galy-Aché, and Perrin, receiving supplementary prizes, the Montyon Prize to M. Partiot, the Plumey Prize to M. Bonjour for his inventions in connection with steam engines, and the Fourneyron Prize to M. A. Rateau for his theoretical and experimental researches on the theory of pumps.

In Astronomy: the Lalande Prize is awarded to Mr. W. R. Brooks for his important discoveries in connection with comets, and the Valz Prize to M. Nyrén, of Pulkova, for his work in sidereal astronomy.

In Physics: M. Blondlot receives the La Caze Prize for the whole of his researches in experimental physics.

In Statistics: the Montyon Prize is divided equally between the Office central des Œuvres de Bienfaisance, for the memoirs entitled "La France Charitable" and "Paris Charitable," and MM. Dumesnil and Mangenot, for a complete economic study of the trades, income, and mode of living of the inhabitants of Pointe d'Ivry.

In Chemistry: the Jecker Prize is given to M. Maurice Hanriot for the whole of his contributions to organic chemistry, the Wilde Prize to Dr. P. Zeeman for his important discoveries of the relations between the magnetic field and the nature and polarisation of light rays, and the La Caze Prize to M. Engel.

In Mineralogy and Geology: the Delesse Prize is awarded to M. Kilian for his studies in the French Alps, and the Fontanne Prize to M. Émile Haug for his palæontological studies.

In Botany: M. l'Abbé Hue receives the Desmazières Prize for his work on the anatomy and classification of the Lichens, M. Leuduger-Fortmorel an honorable mention for his memoir on the diatoms of the East Coast of Africa, MM. Jules Cardot and Hériband Joseph Montagne Prizes, the Thore Prize being divided between MM. Parmentier and Bouilhac.

In Anatomy and Zoology: the Grand Prize of the Physical Sciences is not awarded; the Bordin Prize is accorded to M. Viré for his memoir on the subterranean fauna of France, and the Savigny Prize to M. Guillaume Grandidier for his researches in Madagascar.

In Medicine and Surgery: Montyon Prizes are given to MM. Nocard and Leclainche for their book on microbial diseases, to Prof. Mayet for his "Treatise on Medical Diagnosis," and to M. A. B. Marfan for his work on the treatment and feeding of young infants. MM. Lejars, Fournier and Garnier receive mentions, and MM. Guillemonat and Labbé citations. The Barbier Prize is divided between MM. Houdas and Joanin, Lapicque, and Schlagdenhauffen. Since no work has been received meriting the Bréant Prize for cure or treatment of Asiatic cholera, the Commission has decided to divide the sum accumulated (6000 francs) between M. Vaillard, and MM. Courmont and Doyon for important work on the pathogeny and pathology of tetanus, MM. H. de Brun, Ch. Besnoit, and J. Guillé receiving mentions. The Godard Prize is awarded to M. Pasteau, the Serres Prize to M. Roule, with honourable mention to Prof. J. Beard, M. Maurice Caullery, and M. Félix Mesnil, the Chaussier Prize to M. Charrin, the Mège Prize to MM. Félix Terrier and Marcel Baudoin for their memoir on intestinal suture, the Baron Larrey Prize to MM. Arnaud and Lafeuille for their memoir on Tuberculosis in the Army, the Bellion Prize being divided between M. Cestan and MM. Crespin and Sergent.

In Physiology: the Montyon Prize for Experimental Physiology is given to Prof. Le Hello for his studies on the locomotion of the horse, M. Quinton receiving honourable mention, the La Caze Prize (Physiology) to Prof. Morat for his contributions to Experimental Physiology, and the Pourat Prize to MM. Weiss and Carvalho for their paper on the specific characters of muscular contraction in the animal series, the Philipeaux Prize not being awarded this year. In Physical Geography, M. Albert Vayssière receives the Gay Prize.

Of the General Prizes, the Arago Medal was awarded to Sir G. G. Stokes on the occasion of his jubilee at Cambridge. The Montyon Prize (unhealthy trades) is given to M. E. Collin for his memoir on the microscopy of foods of vegetable origin, M. P. Razous receiving a mention. M. Louis Ducos de Hauron is awarded the Trémont Prize for his invention of photography in colours by the method of superposed coloured images, M. Vaschy, the Gegner Prize, M. Moutard, the Petit D'Ormoy Prize (Mathematics), M. Alfred Giard, the Petit D'Ormoy Prize (Natural Sciences), M. Verbeck, the Tchihatchef Prize, M. Maurice Leblanc, the Gaston Planté Prize, M. René Metzner, the Cahours Prize, M. Lecaillon, the Saintour Prize, the Pasteur Institute, the Jean-Jacques Berger Prize, M. J. P. Siegler, the Prize founded by Mme. la Marquise De Laplace, the Prize founded by M. Félix Rivot being divided between MM. Siegler, Heurteau, Aron, and Becquerel.

RESULTS OF RECENT SOUNDINGS IN THE PACIFIC.[1]

CAPT. MOSER and I decided not to make any soundings nor do any deep-sea work until we had passed beyond the lines of soundings already run by the *Albatross* and *Thetis* between California and the Hawaiian Islands.

[1] Abridged from a letter received by the U.S. Fish Commission from Prof. Alexander Agassiz, and published n *Science* of December 8.

In latitude 31° 10′ N., and longitude 125° W., we made our first sounding in 1955 fathoms, about 320 miles from Point Conception, the nearest land. We occupied 26 stations until we reached the northern edge of the plateau from which rise the Marquesas Islands, having run from station No. 1, a distance of 3800 miles, in a straight line.

At station No. 2 the depth had increased to 2368 fathoms, the nearest land, Guadeloupe Island, being about 450 miles, and Point Conception nearly 500 miles distant. The depth gradually increased to 2628, 2740, 2810, 2881, 3003, and 3088 fathoms, the last in lat. 16° 38′ N., long. 130° 14′ W., the deepest sounding we obtained thus far in the unexplored part of the Pacific through which we are passing. From that point the depths varied from 2883 to 2690 and 2776, diminishing to 2583, and gradually passing to 2440, 2463, and 2475 fathoms, until off the Marquesas, in lat. 7° 58′ S., long. 139° 08′ W., the depth became 2287 fathoms. It then passed to 1929, 1802, and 1040 fathoms, in lat. 8° 41′ S., long. 139° 46′ W., Nukuhiva Island being about 30 miles distant. Between Nukuhiva and Houa-Houna (Ua-Huka) islands we obtained 830 fathoms, and 5 miles south of Nukuhiva 687 fathoms. When leaving Nukuhiva for the Paumotus we sounded in 1284 fathoms about 9 miles south of that island. These soundings seem to show that this part of the Marquesas rises from a plateau having a depth of 2000 fathoms, and about 50 miles in width, as at station No. 29 we obtained 1932 fathoms.

The deep basin developed by our soundings between lat. 24° 30′ N., and lat. 6° 25′ S., varying in depth from nearly 3100 fathoms to a little less than 2500 fathoms, is probably the western extension of a deep basin indicated by two soundings on the charts, to the eastward of our line, in longitudes 125° and 120° W., and latitudes 9° and 11° N., one of over 3100 fathoms, the other of more than 2550 fathoms, showing this part of the Pacific to be of considerable depth, and to form a uniformly deep basin of great extent, continuing westward probably, judging from the soundings, for a long distance.

I would propose, in accordance with the practice adopted for naming such well-defined basins of the ocean, that this large depression of the Central Pacific, extending for nearly 30° of latitude, be named Moser Basin.

The character of the bottom of this basin is most interesting. The haul of the trawl made at station No. 2, lat. 28° 23′ N., long. 126° 57′ W., brought up the bag full of red clay and manganese nodules with sharks' teeth and cetacean ear-bones; and at nearly all our stations we had indications of manganese nodules. At station No. 13, in 2690 fathoms, lat. 9° 57′ N., long. 137° 47′ W., we again obtained a fine trawl haul of manganese nodules and red clay; there must have been at least enough to fill a 40-gallon barrel.

The nodules of our first haul were either slabs from 6 to 18 inches in length and 4 to 6 inches in thickness, or small nodules ranging in size from that of a walnut to a lentil or less; while those brought up at station No. 13 consisted mainly of nodules looking like mammilated cannon balls varying from 4½ to 6 inches in diameter, the largest being 6½ inches. We again brought up manganese nodules at the Equator in about longitude 138° W., and subsequently—until within sight of Tahiti—we occasionally got manganese nodules.

As had been noticed by Sir John Murray in the *Challenger*, these manganese nodules occur in a part of the Pacific most distant from continental areas. Our experience has been similar to that of the *Challenger*, only I am inclined to think that these nodules range over a far greater area of the Central Pacific than had been supposed, and that this peculiar manganese-nodule bottom characterises a great portion of the deep parts of the Central Pacific where it cannot be affected by the deposit of globigerina, pteropods, or telluric ooze; in the region characterised also by red-clay deposits. For in the track of the great equatorial currents there occur deposits of globigerina ooze in over 2400 fathoms for a distance of over 300 miles in latitude.

Manganese nodules we found south of the Marquesas also, where in 2700 fathoms we obtained, perhaps, the finest specimens of red clay from any of our surroundings. As we approached close to the western Paumotus, and rose upon the plateau from which they rise, globigerina ooze passed gradually to pteropod ooze, then to fine and coarse coral sand. In the channel south of the Paumotus to Tahiti the coral sand passed to volcanic sand mixed with globigerinæ in the deepest parts of the line, and towards Tahiti passed to volcanic mud mixed with globigerinæ, next to fine volcanic sand, and finally, at the last sounding, off Point Venus, to coarse volcanic sand.

We made a few hauls of the trawl on our way, but owing to the great distance we had to steam between San Francisco and the Marquesas (3800 miles) we could not, of course, spend a great deal of time either in trawling or in making tows at intermediate depths. Still the hauls we made with the trawl were most interesting, and confirmed what other deep-sea expeditions have realised: that at great depths, at considerable distances from land and away from any great oceanic current, there is comparatively little animal life to be found. Where manganese nodules were found the hauls were specially poor, a few deep-sea holothurians and ophiurans, and some small actiniæ which had attached themselves to the nodules with a few other invertebrates, seemed to be all that lived at these great depths, 2500 to 2900 fathoms, far away—say from 700 to 1000 miles—from the nearest land.

The bottom temperatures of the deep (Moser) basin varied between 34·6° at 2628 and 2740 fathoms, to 35·2° at 2440 fathoms, and 35° at 2475 fathoms; about 120 miles from the Marquesas. At station No. 23, off the Marquesas, in 1802 fathoms, the temperature was 35·5°.

On our way to Tahiti from the Marquesas we stopped a few days to examine the westernmost atolls of the Paumotus.

It is premature from the examination of the western extremity of the Paumotus to base any general conclusions regarding the mode of formation of these atolls; certainly as far as I have gone there is absolutely nothing to show that the atolls of the Paumotus have not been formed in an area of elevation similar to that of Fiji. The evidence in Rairoa and in the atolls of the western Paumotus is very definite. Makatea is an elevated mass of coralliferous limestone similar in all respects to masses like Vatu Vara, Thithia, and others in Fiji. Like them Makatea is surrounded by a comparatively narrow shore platform cut out from the base of the limestone cliffs and on the seaward extension of which corals grow abundantly to depths of seven to eight fathoms, when they appear to become very much less numerous. So that it is not unnatural, as I am inclined to do, to look upon the area of the Paumotus as one of elevation, the raised and elevated land of which has been affected much in the same way by denudation and erosion as have the masses of elevated coralliferous limestone of Fiji. Only there seems to have been, from the evidence thus far presented, a far greater uniformity in the height of the elevation of the Paumotus. This would render the explanation I have given less evident had I not the experience of the Fiji group to guide me. I am informed that there are other islands and atolls in the Paumotu group, showing traces of this elevation, so that I am at any rate justified in denying that the Paumotus as such are situated in an area of subsidence and that subsidence has been the great factor, as is maintained by Darwin and Dana, in the formation of the characteristic atolls of the group.

It may be well to point out also that the Paumotus, like the Marquesas on one side and the Society Islands on the other, are situated upon a plateau similar to that upon which the last-mentioned groups are placed—this plateau having a depth of from 1200 to 1500 fathoms, and rising from the general oceanic basin which surrounds them, and which has a depth of from 2300 to 2500 fathoms. Furthermore, evidence of this elevation is found at the two extremities of the Paumotu plateau at Makatea, an elevated island consisting of tertiary coralliferous limestone, and at the Gambier Islands, which are volcanic islands of considerable height.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. T. E. STANTON, of University College, Liverpool, has been appointed professor of engineering in University College, Bristol, in succession to Prof. Ryan.

DR. EDWARD TAYLOR JONES has been appointed professor of physics in the University College of North Wales, in succession to Prof. A. Gray, F.R.S. The Drapers' Company has made the College a grant of £200 a year for a period of three years towards the maintenance of the department of electrical engineering, pending the establishment of the department on a permanent footing.

SCIENTIFIC SERIAL.

Bulletin of the American Mathematical Society, November.—Dr. G. A. Miller gives a short account of the meeting of the American Association for the Advancement of Science (held August 21–26) as it bore upon the Society, with a short abstract of some of the mathematical papers. A hope is expressed that the Society and the Society for the Promotion of Engineering Education may meet next year with sections A and D respectively of the Association.—Prof. Oskar Bolza reviews Harkness and Morley's introduction to the theory of analytical functions, and Prof. A. S. Hathaway discharges a like office for MacAulay's Octonions. Prof. Bolza considers the former work to be not only of high scientific and pedagogical value, but at the same time of a singular beauty and elegance. A certain freshness and originality pervade the whole, even in places where the authors follow along beaten tracks, and give at every turn evidence of the complete mastery of the subject with which the book is written.—Dr. Lovett gives a *résumé* of five recent theses in mathematics presented for the doctor's degree at the University of Paris. They are: Sur quelques points de la théorie des fonctions, by M. L. Desaint; Sur une classe particulière de groupes hyperabéliens, by M. H. Bourget; Sur l'intégration des équations de la chaleur, by M. E. LeRoy; Les équations différentielles linéaires de la théorie des groupes, by M. F. Marotte; and Essai sur une théorie générale de l'intégration et sur la classification des transcendantes, by M. J. Drach. In the copious mathematical "Notes," an account is given of the mathematical courses of lectures in the winter semester of several Continental and other universities.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—"The Medusæ of Millepora." By Sydney J. Hickson, F.R.S.

The male medusæ were discovered in specimens of Millepora from Torres Straits in 1891. Since then no medusæ were seen in any specimens examined except in some from Funafuti collected by Mr. Gardiner, but these were also males and resembled in all essential respects the medusæ previously described. Last year Mr. Duerden sent to the author two consignments of preserved Millepora, one bearing immature and the other mature female medusæ. The immature female medusæ were about 0·4 mm. in diameter; the umbrella is a thin membrane slightly swollen at the margin containing no canals nor cavities of any kind. There is no velum and no tentacles. The umbrella cavity is almost entirely filled with a swollen manubrium bearing a centrally placed mouth and a broad band of ova. The mature female medusæ are 0·6 mm in diameter; three or four ova attain to a size of 0·2 mm. in diameter, the others undergo degeneration or become absorbed into the substance of the large ova. The endoderm of the manubrium is still very thick and vacuolated, but the mouth is usually closed. After the discharge of the medusæ from the corallum the ova become more vacuolated and increase in size to 0·25 mm. in diameter, the general appearance of the eggs being similar to that of the floating eggs of other Cœlenterates.

The medusæ were observed in the living state by Mr. Duerden, who describes them as being sluggish in their movements, feebly pulsating only now and again. Soon after they are set free the eggs are discharged one by one. The whole process, liberation of the medusæ and extrusion of the ova was completed in five or six hours.

Royal Society, December 14.—"The Piscian Stars." By Sir Norman Lockyer, K.C.B., F.R.S.

The classification of the Piscian stars (those in the spectra of which there are dark flutings of carbon) was arrived at nearly ten years ago from the observations of Dunér. The investigation indicated that these stars could be grouped into several distinct species, in the same way as those of Group II. (Antarian stars) which the author had already classified (*Roy. Soc. Proc.*, vol. xliv. p. 65, 1888).

Owing to the want of definite information regarding the line spectrum, the publication of the classification was postponed. Facts bearing on the line spectrum have now been furnished by the recent photographic work of McClean and Hale, and as these do not disturb the classification at which the author had previously arrived, it is unnecessary to further delay the publication of the memoir, which in the main stands as it was written. The original paper is supplemented by reference to the more recent work. The general conclusions arrived at are as follows:—

(1) The undoubted presence of carbon flutings in the sun, including that near *b*, and of solar lines in the Piscian stars, indicates that the Piscian stars are next in order of development to the Arcturian stars.

(2) The stars observed by Dunér may be divided into seven species, beginning with the hottest and ending with the coolest stars.

(3) The reported presence of bright lines in the Piscian stars must be received with caution, as similar evidence of bright lines might be adduced in the case of other classes of stars in which the spectrum is fully explained by dark lines alone.

(4) The redness of the stars increases as we pass from the earlier to the later species of the group.

(5) The variability in this group is less marked than in the Antarian stars, and may perhaps be accounted for by the revolution of secondary bodies of the nature of comets round the stars themselves.

(6) The place on the temperature curve assigned to these stars on the meteoritic hypothesis is fully confirmed by the more detailed inquiry, and the hypothesis is thereby strengthened.

Linnean Society, December 7.—Dr. A. Günther, F.R.S., President, in the chair.—Dr. Otto Stapf, exhibited specimens of Malayan and African species of *Kickxia*, Blume, to show the differences which exist between the two forms. These differences were noticeable in the shape and size of the corolla, the insertion and general relation of the stamens to the tube of the corolla, the placentation, the structure of the fruit, and the general habit of the plants. As the name *Kickxia* would have to be retained for the Malayan species, he proposed the name *Funtumia* for the African species, from *Funtum*, a vernacular name for *F. elastica*. He further pointed out, by means of flowering and fruiting specimens of *F. africana*, Stapf (*Kickxia africana*, Benth.), and of *F. elastica* (*Kickxia elastica*, Preuss), that the latter, and not the former (as was originally assumed), was the source of the so-called Lagos rubber, thus confirming the conclusion to which Dr. Preuss had come with regard to the origin of this rubber.—Dr. Stapf also showed, on behalf of the Director of Kew Gardens, a large infrutescence of *Musa Ensete*, Gmel., lately received from the Azores.—Mr. Gilbert Christy exhibited a preparation of india-rubber by a new process from *Castilloa elastica*, and also specimens of rubber obtained from *Kickxia elastica*.—Mr. A. D. Ferguson exhibited a series of photographic views taken in Demerara.—Mr. J. W. Fawcett read a paper on some vegetable poisons used for the capture of fish by the Aborigines of Australia.—Mr. B. Daydon Jackson pointed out how widespread was the practice of obtaining fish in this way, and gave a brief review of the literature bearing on the subject.—A paper was read by Mr. G. M. Thomson on some Schizopod Crustacea from New Zealand, in which a new genus (*Tenagomysis*) and some new species were described.—Mr. O. A. Walker, in criticising the paper, made some remarks on general distribution, and, in view of the paucity of material which existed, deprecated any attempt being made at present to draw general conclusions.—Mr. H. M. Bernard read a paper on the structure of *Porites*, the smallest of the stony corals.—In a former paper (*Linn. Soc. Journ., Zool.* vol. xxvii. p. 127) he had endeavoured to show that the genus could be deduced from Madreporids as fixed young forms, so young that the skeleton was immature. The small size of the animals, and the fine reticular texture of the skeletal mass, may both be adaptions to their surroundings, for they are most frequently found at the outer edges of the reef and have to bear the full force of the breakers. Since reading his previous paper the author had been fortunate enough to discover the directive plane and the bilateral symmetry of the calicles in *Porites*—very difficult to see, but when once seen recognisable in nearly every specimen. By means of diagrams the variations of the septal system within the genus were described, and the pali were shown to appear in a regular system dependent upon the the fusions of the septa, which fusions always occurred in a definite order.

Mathematical Society, December 14.—Prof. Elliott, F.R.S., Vice-President, in the chair, and subsequently Dr. Macaulay and Dr. Larmor, F.R.S.—The following papers were

communicated, in part, by their authors, viz. : (1) A method for extending the accuracy of mathematical formulæ ; (2) Central difference formulæ, by Mr. W. F. Sheppard ; Circular cubics, by Mr. Basset, F.R.S. ; the theorem of residuation, being a general treatment of the intersections of plane curves at multiple points, by Dr. Macaulay.—The remaining papers were communicated by their titles, viz. : The genesis of the double Gamma functions, Mr. E. W. Barnes ; on the expression of spherical harmonics as fractional differential co-efficients, Mr. J. Rose-Innes ; and sums of greatest integers, by Mr. G. B. Mathews, F.R.S.

Royal Meteorological Society, December 20.—Mr. F. C. Bayard, President, in the chair.—Mr. Baldwin Latham read a paper on the climatic conditions necessary for the propagation and spread of plague. The bubonic plague is primarily due to a specific organism or microbe of infinitesimal size—so small that probably 250 millions of them would be required to cover a square inch of surface. Plague is infectious and contagious, and is greatly influenced by pestilential emanations from polluted and waterlogged soils. The author gives accounts of various outbreaks of plague in this and other countries, including the great plague of London in 1665, when 7165 deaths were recorded in one week in September. Plague is undoubtedly a disease of the poor, and attacks most readily those living on a low diet. The conditions which are conducive to the spread of plague are identical with those which give rise to the escape of malaria from the ground. That the ground itself exercises an enormous influence upon plague is shown by the fact that in all the epidemics persons living on the ground floors suffer to a much greater extent than those who live in the higher storeys of the houses. Mr. Latham says that there cannot be a doubt that the conditions which ordinarily produce evaporation from water or land surfaces are identical with those which produce exhalations from the ground ; and these exhalations consist largely of vapour of water carrying matters injurious to health with them. Mr. Latham has discussed the meteorological observations (including the temperature of the soil at the depth of 9, 20, 60 and 132 inches), made at the Colaba Observatory, Bombay, and has compared them with the number of deaths from plague during the recent epidemics in Bombay. He says that if the temperature of the air increases beyond the temperature of the ground, so that its dew-point is above the temperature of the ground, condensation takes place instead of evaporation. To this increased high temperature may be due the sudden stoppage of plague after a certain high temperature has been reached, which, by raising the temperature of the dew-point, stops all exhalation from the ground and may cause condensation to take place instead of evaporation. So also a sudden fall of temperature causes plague to arise ; for a fall of temperature means that the temperature of the dew-point must fall, and the tensional difference between a low dew-point and a high ground temperature would at once lead to exhalations escaping in large quantities from the ground, and so lead to the liberation of the plague bacillus from the ground, accompanied with the exhalations necessary for its development.—Dr. R. H. Scott, F.R.S., communicated a note on a remarkable dust haze which was experienced at Teneriffe, Canary Islands, on February 16 to 19, 1898. The haze during this period was exceptionally dense, so much so that a steamer was two days and three nights on a voyage from Teneriffe to Las Palmas, a distance she usually covered in five hours ; while the *Tintagel Castle*, of the Donald Currie line, was delayed for thirty hours, and the *Roslin Castle*, homeward bound, had the dust so thick that for 900 miles the sun and stars were obscured, and the ship was delayed two days.

Zoological Society, December 19.—Dr. Henry Woodward, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of November 1899, and called special attention to two snake-fishes (*Polypterus senegalus*) from the River Gambia, obtained by Mr. J. S. Budgett, F.Z.S., during his recent expedition to the Gambia, and presented by him on November 22. These were believed to be the first examples of this fish ever brought alive to Europe. —On behalf of Mr. G. S. Mackenzie, a photograph was exhibited of two remarkably large tusks of the African Elephant. They each measured, on the outside curve, 10 feet 4 inches in length, and weighed respectively 235 lbs. and 225 lbs.—Mr. Sclater exhibited, on behalf of Mr. Alfred Sharpe, C.B., a portion of the skin of a giraffe which had been shot on the east bank of the Great Loangwa River, British Central Africa, in latitude 13° south, and which, according to Mr. de Winton, who had examined it, was undoubtedly referable to the southern form of this mammal.—Mr. Sclater also exhibited photographs of two young male musk-oxen (*Ovibos moschatus*), now living in the Duke of Bedford's park at Woburn. The animals were stated to have been obtained in Eastern Greenland. They were believed to be the first examples of this species that had reached Europe alive.—Mr. W. E. de Winton exhibited and made remarks upon a specimen of a new mouse of the genus *Dendromys*, obtained by Lord Lovat at Managasha in Southern Abyssinia, for which he proposed the name *Dendromys lovati*.—Mr. R. E. Holding exhibited a series of the horns of the Siberian roebuck (*Capreolus pygargus*) from the Obb River, and made remarks upon the characteristic variation in the horns of this species. Mr. Holding also exhibited a pair of the horns of a stag, from the same district, probably *Cervus eustephanus*, in which the third tine was absent in both horns.—Dr. Forsyth Major exhibited the fœtal skulls of various Malagasy lemurs, showing the development of the osseous tympanic bulla, in which the tympanic ring did not participate. The tertiary *Adapis* in this and other features closely approached the Malagasy lemurs.—He also exhibited an almost complete skull of a new species of *Nesopithecus* (*Globilemur*).—Mr. W. L. Sclater made some remarks on a forthcoming series of volumes which he proposed to issue under the title of "The Fauna of South Africa." The first volume, which was now nearly ready, and would deal with the first half of the Passerine birds, had been undertaken by the late Dr. A. C. Stark. The volume on the mammals, by Mr. Sclater himself, was now in the printer's hands, and would also shortly be issued.—Mr. W. P. Pycraft read the fourth part of his "Contributions to the osteology of birds," which dealt with the grebes and divers (*Pygopodes*). The author considered that the grebes and divers were closely related *inter se*, that they could not be associated with the auks, as had been done by some ornithologists, but were more nearly allied to the tubinares, impennes, and steganopodes. The author also stated that he was of opinion that *Hesperornis* undoubtedly belonged to the suborder pygopodes.—Mr. F. G. Parsons read a second portion of a paper "On the myology of the edentata," prepared by Prof. B. C. A. Windle, F.R.S., and himself. It dealt with the muscles of the hind limb, and also contained a summary of the conclusions that the authors had arrived at respecting the musculature of the order.

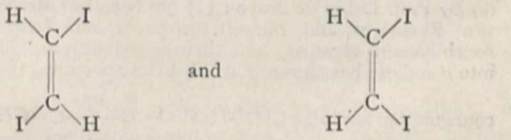
CAMBRIDGE.

Philosophical Society, November 27. — Mr. Larmor, President, in the chair.—On the influence of temperature, and of various solvents, on the absorption spectra of Didymium and Erbium salts, by Prof. Liveing. Prof. Liveing exhibited a number of photographs prepared to illustrate his paper on the absorption spectra of solutions of salts of Didymium and Erbium in various conditions of dilution and temperature, and in various solvents, which was communicated to the Society at the Stokes Jubilee meeting. These photographs showed that dilution produced no increase of the intensity of the absorptions when the thickness of the absorbent was proportioned to the dilution. In strong solutions of the chlorides a diffuse continuous absorption creeps down the spectrum from the most refrangible end and extends further as the solution is more concentrated. This is not seen with most chlorides, not even with that of aluminium, but is shown by strong solutions of hydrochloric acid in water and in alcohol. The nitrates show a somewhat similar general absorption, and also a widening of some of the bands as the solutions become more concentrated. The effect of acidifying the solutions is to make the absorptions generally more diffuse, but not sensibly to weaken them, and to extend the general absorptions at the most refrangible end. A rise of temperature from about 20° C. to 97° or 98°, also makes the bands more diffuse, but does not increase their intensity. It seems to the author improbable that the metallic atoms should maintain such independence in combination as to have the same absorptions in such different compounds as chloride, nitrate and sulphate, and it is more probable that the common absorptions are due to common products of decomposition. These might be the metallic ions, but the facts that neither dilution nor rise of temperature increase the intensity, and that acidifying does not weaken the intensity of the common absorptions are against that supposition. Ionization implies an electrification of the ions, which again implies a communication of energy to the

field, which may probably depend on the circumstances of the encounter when the molecule of salt is broken up, and so some molecules may be broken up without being charged; while there is no reason to suppose that the absorption by a molecule would be altered by its being charged with electricity. The absorptions which are intensified by concentration and also by heat must be ascribed to the condition of the molecules during encounters, which will be more frequent in more concentrated as well as in hotter solutions. The expansion of certain bands with increased concentration by the nitrate, must be ascribed to encounters of molecules derived from the metal with those derived from the acid, which are much more massive than the molecules of water and also than those derived from the chloride. During such encounters the absorbent molecules will be as it were loaded by the influence of the other molecules. This view seems confirmed by the influence which other solvents and other acids have on the absorptions. Didymium chloride in alcohol gives the same bands as the aqueous solution, but generally more diffuse and more or less shifted a little towards the red. The same solution acidified with hydrochloric acid exaggerates greatly these modifications, almost washing out the more refrangible bands and breaking up the very strong band in the yellow into several separate bands. Glycerol as solvent gives modifications similar to, but more strongly marked than, those of alcohol. The acetate in acetic acid and the maleate in water gives similar but much less marked modifications. The tartrate and the citrate in ammoniacal solution also give similar modifications. The borate in solid glass of borax also gives bands which are unmistakably modifications of those produced by the aqueous solution. All these modifications seem to be of the same *character*, though of greater intensity, than the differences between the bands given by nitrate and chloride, and may be attributed to the influence of the comparatively complicated influences of the various molecules during the times of encounter. In such cases as the acid alcoholic solutions there will certainly be at least four chemical compounds mixed in the solvent, which may well produce a complicated modification of the bands without destroying their identity.—"Researches in the Sugar Group," by H. Jackson. A summary is given of the joint researches of Mr. H. J. H. Fenton and the author, which may be conveniently divided into two parts. (α) Oxidation of the more common polyhydric alcohols. The remarkable part which iron plays as a carrier of oxygen was first pointed out by Mr. Fenton in the case of tartaric acid, and has since been extended by him to other hydroxy-compounds. An aqueous solution of the following polyhydric alcohols, glycol, glycerine, erythrite, dulcite, mannite and sorbite, was taken in turn, and after adding a small quantity of ferrous salt to each, hydrogen peroxide was added: in all cases a large evolution of heat took place. The oxidation products in the case of glycol, glycerine and erythrite quickly reduce Fehling's solution in the cold and restore the colour to an alcoholic solution of magenta, which has been decolourised by sulphur dioxide: on treatment with phenyl hydrazine acetate, osazones were obtained which, on analysis, were found to correspond respectively to glycolic aldehyde or diose, glyceric-aldehyde or triose, and erythrose or tetrose. The oxidation compounds of dulcite, mannite and sorbite do not reduce Fehling's solution in cold, but quickly on warming: they do not give the "magenta" test; facts which serve to distinguish the hexoses from the simpler members of the sugar group. On treatment with phenyl hydrazine acetate there was obtained from dulcite the osazone of inactive galactose, from mannite the hydrazone of mannose, and from sorbite an osazone identical with glucosazone. If an aqueous solution of glycol, glycerine or erythrite, to which a very small quantity of ferrous salt has been added, be exposed for a little time to the action of sunlight in the presence of atmospheric oxygen, it can be shown on examination that a certain amount of the sugar has been formed. These experiments may perhaps give a little support to the theory that iron, which occurs in hæmoglobin and is associated so intimately with chlorophyll, may act as a carrier of atmospheric oxygen. (β) Isolation of diose in a crystalline state and its condensation to a hexose. When dioxymaleic acid, suspended in water, is distilled on the water bath under very diminished pressure and the distillate evaporated to small bulk in a vacuum desiccator, a syrup is left which on standing crystallises out in flat plates of the oblique system. On analysis and examination it is shown to be crystalline diose. A determination of its molecular weight by the depression of the freezing point of water shows the crystal to be bimolecular, but on standing and taking frequent determinations the molecular weight gradually becomes normal and corresponds to the single formula $C_2H_4O_2$, and then remains quite constant. If a dilute aqueous solution of diose be treated with a 1 per cent. solution of soda at the ordinary temperature it quickly turns yellow and finally brown. After standing a few hours it no longer reduces Fehling's solution in the cold, but readily on warming: it no longer gives the "magenta" test: in fact, it has lost all the properties of diose and assumed those of a true hexose. This is confirmed on examining the osazone, which corresponds to a normal hexosazone. The melting point and action towards solvents of the osazone prove its identity with β acrosazone, which Fischer and Tafel isolated from the condensation product of glycerose.—On a new mineral by A. Hutchinson. A colourless transparent crystal of the new mineral was found on a specimen of Axinite from Cornwall in the Carne collection recently acquired by the University. The crystallographic and optical constants of the crystal prove it to belong to the Prismatic system. The results of a quantitative chemical analysis agree well with the formula $CaSn(SiO_3)_3.2H_2O$. The mineral has been named Stokesite in honour of Sir George Gabriel Stokes.—On the condition that five lines in space of four dimensions should lie on a quadric, by H. W. Richmond. In order that five straight lines situated in a space of four dimensions should lie on a surface of the second order a condition must be satisfied. It is here pointed out that the known properties of quadrics in space of five dimensions suggest a simple mode of expressing the necessary condition.

ST. LOUIS.

Academy of Science, December 4.—Dr. Edward H. Keiser described some derivatives of acetylene, exhibiting specimens of the new liquid acetylene iodide discovered by him in January, 1899. He described the methods of making the compounds, and gave an account of its chief physical and chemical properties. The liquid acetylene di-iodide solidifies at −21° C. and boils at 185°. It has the percentage composition and molecular weight represented by the formula $C_2H_2I_2$, and is isomeric with the well-known solid acetylene di-iodide. The speaker announced the discovery of a new method of making the liquid acetylene di-iodide, namely, by heating the solid compound to 260° in a sealed tube. The solid compound is thereby partially converted into the liquid compound. Similarly, if the pure liquid di-iodide be heated to 260° in a sealed tube, on cooling down the liquid will be found to have been partially converted into the solid compound. All the facts known indicate that these two iodides of acetylene are stereo-isomers, and that their configuration must be represented by the stereometric formulas



Since Dr. Keiser has found that the solid acetylene di-iodide can be converted into fumaric acid, it would follow that the first of the two formulas would represent the solid acetylene di-iodide and the second one the liquid di-iodide. Further experiments upon these compounds are under way, and the attempt will be made to convert the liquid di-iodide into maleic acid.—Dr. K. Bremer demonstrated some tests for glucose by means of aniline dyes, showing that nearly all of the "alkaline" aniline dyes, when rendered basic by the addition of sodium hydrate, become decolourised, or have their colour greatly modified, on heating, in case glucose is present. The reactions shown were especially pretty in the case of methylene blue and safranine.—Prof. Nipher announced that he had nearly completed preparations for the measurement of wind pressures on the sides of the main building of Washington University. The pressures are to be measured at various points along the west end of the building, having a width of about 50 feet, and along the north front, which is something over 200 feet in length. Simultaneous measurements of wind pressure, and wind velocity and direction will be made. The method used is that tested by him on the trains of the Illinois Central Railroad during the summer of

1897. The method was described in No. 1, vol. viii. of the *Transactions* of the Academy of Science of St. Louis. An invitation was extended to members to visit the University and inspect the apparatus.—Prof. H. Aug. Hunicke spoke briefly on some observations which he had recently made on the boiling temperature of hydrocarbons, from which it appeared that when T is the boiling temperature (absolute scale), ρ is radius of gyration of the molecule, and a is a constant, then $T^2 = a\rho$. This holds for the entire series of saturated hydrocarbons, including all isomers.

AMSTERDAM.

Royal Academy of Sciences, November 25.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. Kamerlingh Onnes read, on behalf of Prof. Lorentz and himself, a report on the treatise by Prof. R. Sissingh, entitled "The general properties of the optical image by central rays in a series of centred spherical surfaces." The conclusion, arrived at in the report, viz., to insert the treatise in the *Transactions* of the Academy, was approved. Dr. Hamburger made a communication concerning the absorption of fat and soap in the large and the small intestine. (1) It may now be considered as settled that the large intestine of the dog possesses the power of absorbing fat. (2) Contrary to what has hitherto been assumed, this power is considerable and not even inferior to that of the small intestine. (3) To bring about such a considerable absorption, it is necessary to take an emulsion which will keep a long time in the intestine. The usual Na_2CO_3 is not suitable for preparing such an emulsion, much less NaCl, because both are absorbed quickly and the emulsion consequently soon ceases to exist. A solution of sapo medicatus, however, appears to answer the requirements. (4) As regards the soap solution itself, it appears that it is absorbed, though much more slowly than Na_2CO_3, and that during the absorption it is, partly at least, converted into fat already in the mucosa. This conversion goes on in the severed intestine, nay, it is even effected when the mucosa has been chopped up. Heating to 80°, however, destroys the above mentioned property. (5) As regards the course, taken by fat during absorption in the large intestine, it is very likely that part of it is carried off by the blood capillaries. At any rate in the case of the small intestine, this has been proved beyond a doubt by the above described experiments.—Prof. Cardinaal made a communication concerning an application of the involutions of a higher degree. —Prof. W. Kapteyn made a communication on certain particular cases of Monge's differential equation. All these communications will be inserted in the *Proceedings*. The following were further presented for insertion in the *Proceedings*. (*a*) By Prof. Bakhuis Roozeboom, two papers, by Dr. Ernst Cohen, entitled respectively: (1) The enantiotropy of tin (III.), and (2) The alleged identity of red and yellow mercuric oxide. (*b*) By Prof. Lobry de Bruyn: (1) On behalf of Mr. W. Alberda van Ekenstein and himself, a paper on *d*-sorbinose and *l*-sorbinose (ϕ-tagatose) and their configuration. The inquiry into *d*-sorbose has shown that this ketose possesses the following configuration formula: $CH_2OH—CO—\overset{H}{\underset{OH}{C}}—\overset{OH}{\underset{H}{C}}—\overset{H}{\underset{OH}{C}}—CH_2OH$. On reduction it yields, besides *d*-sorbite, *d*-idite as well; its osazon is identical with idosazon and gulosazon. ϕ-tagatose, a new ketone, which, besides tagatose, is obtained from galactose, under the transforming influence of alkalis, has been found to be the optical antipode of *d*-sorbose, consequently *l*-sorbose with the configuration $CH_2OH—CO—\overset{OH}{\underset{H}{C}}—\overset{H}{\underset{OH}{C}}—\overset{OH}{\underset{H}{C}}—CH_2OH$. A detailed article on this subject will appear in the *Recueil*. (2) On behalf of Mr. J. J. Blanksma, a paper on the action of sodium mono- and disulphides on aromatic nitro compounds. The inquiry has proved that a nitro group of *o*-dinitrobenzol is easily replaceable, and that dithio combinations are formed (also obtained from chlorine nitrobenzol and bromine nitrobenzol), which on oxidation yield sulphonic acids. (*c*) By Prof. J. C. Kapteyn, on behalf of Mr. S. L. Veenstra, a paper on the results of his inquiries into systematical corrections of the stars' own motions in Auwer's Catalogue of Bradley and the coordinates of the apex of the sun's motion. The computations are founded on data, derived from a still unpublished catalogue, compiled by Prof. Kapteyn, which contains, besides the motions of the Bradley stars, a number of auxiliary magnitudes. The result of the computation of the apex does not point to a relative motion of stars of different spectral types. (*d*) By Dr. J. P. van der Stok, a paper on two earthquakes, observed respectively at Batavia and in Europe. (*e*) By Prof. Van der Waals, on behalf of Dr. G. Bakker, a paper on the potential functions $\phi(r) = \frac{Ae^{-qr} + Be^{qr}}{r}$ and $\phi(r) = \frac{A \sin(qr + a)}{r}$, and Van der Waals' potential formula.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 28.

ROYAL INSTITUTION, at 3.—Fluids in Motion and at Rest: C. V. Boys, F.R.S.

SATURDAY, DECEMBER 30.

ROYAL INSTITUTION, at 3.—Fluids in Motion and at Rest: C. V. Boys, F.R.S.

MONDAY, JANUARY 1.

VICTORIA INSTITUTE, at 4.30.—Sub-Oceanic Terraces and River Valleys: Prof. Lobley.

TUESDAY, JANUARY 2.

ROYAL INSTITUTION, at 3.—Fluids in Motion and at Rest: C. V. Boys, F.R.S.

THURSDAY, JANUARY 4.

ROYAL INSTITUTION, at 3.—Fluids in Motion and at Rest: C. V. Boys, F.R.S.

RÖNTGEN SOCIETY, at 8.—The Interpretation of Skiagrams: Chisholm Williams.

FRIDAY, JANUARY 5.

GEOLOGISTS' ASSOCIATION, at 8.—Our Older Raised Beaches: Address by Sir Archibald Geikie, F.R.S.—A New Rhætic Section at Bristol: W. H. Wickes.

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