THURSDAY, FEBRUARY 27, 1908.

MAN AND NATURE IN SOUTH-WEST AFRICA.

Aus Namaland und Kalahari. By Prof. Leonhard Schultze. Pp. xiv+752. (Jena: Gustav Fischer, 1907.) Price 60 marks.

THE scope of this admirable work on Namakwaland and the Kalahari has not any knowledge of political boundaries. Neither is it confined to ethnology or biology. Its range extends over a portion of British Bechuanaland and northern Cape Colony, and it deals slightly with the northern parts of German South-West Africa—Damaraland and the Ovambo countries. It is such a book as can as yet only be published in Germany. The reproduction of Dr. Schultze's photographs of human types, landscapes, birds, and beasts is simply perfection, the photographs themselves being without blemish. Where it has been necessary to make and reproduce drawings in lieu of photographs, these are of great beauty and accuracy, and their reproduction is of a quality apparently unattainable in England.

To summarise the principal subjects of the book. The geological features of the south-west coast of Africa are illustrated with many photographs, diagrams, and a careful verbal description. This, though thoroughly scientific, may appeal likewise to the eyes and intelligence of the unlearned. The set of the currents, the growth or diminution of the sand-bars along the coast, the caves (once, perhaps, inhabited by the primitive tribes of Strandloopers), the barren, rocky coast, with its beaches strewn with whalebones, the rocky capes with great maned sea-lions *in situ*, the islets, thick with cormorants, gannets (literally in millions), and penguins, are graphically depicted. An interesting record of the species of whales recorded on this coast, as well as of the principal sea fish, molluscs, and other water animals, is given on pp. 30 to 41. The author supplies the Hottentot names for all creatures or features recognised by the natives.

Though vegetation is not the strong point of this desolate region, such as is found there is of great interest to the botanist owing to its special adaptation to arid conditions of life. The Zygophyllums (characteristic of the northern desert from Senegal to Scinde), the soap bushes (Salsola), the Mesembrianthemums, with their cactus-like flowers and thick segmented stalks, the stumpy euphorbias, gouty, branched aloes, and that extraordinary plant the *Welwitschia mirabilis*—almost every example of this strange desert vegetation is represented by photographs of remarkable clearness and beauty. The camera also shows us the large-eared, chamois-like Raphicerus antelopes, perched on the jagged summits of honeycombed gneiss; vast river plains surrounded by monotonous ranges of table-top mountains, but exhibiting some relief from the universal desert in the acacias, Boscias, Bauhinias, Baphias, Combretums, gourds, lilies, rushes, and euphorbias they nourish. (One exquisite picture opposite p. 604 shows an erstwhile desolate stretch of the Kalahari Desert temporarily lovely with thick masses of the Brunsvigia lilies.) The black-backed jackal, the Chakma baboon, the ostrich, Cape hartebeest, porcupine (the South African species), the steenbock (Raphicerus), the white-tailed gnu, zebra, springbock, giraffe, lion, and all important members of the mammalian fauna, past and present, are illustrated by photographs from the living animal. From p. 268 to p. 288 a great deal of information is given about the existing mammalian fauna of the interior. The elephant is included, though it is practically extinct in this region, and only remains in the traditions of the Hottentots. The white rhinoceros is known by name, but is now extinct. The same fate has also probably reached the common black rhinoceros, and the quagga likewise only lingers in traditions. (The last quagga of South-West Africa appears to have been killed in 1880.) The strangely archaic dog form—Otocyon—with its four molar teeth on either side of the lower and sometimes of the upper jaw, is fairly common in Namakwaland and the Kalahari Desert. Dr. Schultze observes that it never goes in packs, but leads a solitary existence. The brown hyæna (*H. brunnea*) is apparently found in South-West Africa, as well as the spotted hyæna, but the Hottentots do not seem clearly to distinguish in nomenclature between the two forms.

The supreme interest of this work lies in the descriptions and illustrations of the Hottentot, Bushmen, and Berg-damara peoples. Portraits of the Herero and of the Barolong-Bechuana are also given to contrast the Bantu type with the very distinct Hottentot and Bushman. There are also pictures and descriptions of the Masarwa Bushmen, which would suggest that these last are due to some slight intermixture with the intruding Bantu.

Opposite p. 420 there are two photographs of the Berg-damara. This is a mountain people found in the northern part of Namakwaland. They speak a language which is obviously Hottentot, but in physical type they are entirely unlike the Hottentot, except that both are widely divergent forms of the negro species. The Berg-damaras are a tall people compared to the Hottentots, and hairy about the body, with abundant head hair, and, in the males, full beard and moustache. In shape of head and degree of prognathism they exhibit a good deal of variety. There are old photographs in the possession of the Royal Geographical Society (dating from the Palgrave expedition of 1873) which exhibit types of Berg-damara of quite a simian aspect, strongly reminiscent of the most primitive tribes of forest negroes in the Congo basin. On the other hand, the Berg-damara people seen by the writer of this review in South-West Africa in 1882, and illustrated in this book, represent a fairly good-looking type of Bantu negro, and might be matched easily among the Bantu tribes of the southern and eastern Congo basin.

Any doubt as to the ape-like faces of the pure-blood Bushmen is dispelled by a glance at the pictures opposite p. 322. On the other hand, some of the Hottentot types herein illustrated suggest what is no doubt the obvious solution of their origin—an ancient hybrid between the pure Bushman stock and some Nilotic negro race in the east of Africa, with a dash

here and there of the forest negro. There has also been an obvious intermixture of blood between the eastern Hottentots and the incoming Bantu, and some of the pictures of Hottentot boys are singularly reminiscent of the Nyanja populations of western and southern Nyasaland, regions that certainly once possessed a Hottentot or Bushman population. The extraordinary steatopygy developed by the Hottentot women, and occasionally the men, to a degree not met with in any other part of Africa (though by no means unknown among Nilotic or Sudanese negroes, and apparently characteristic of a primitive negroid population of Egypt and the Mediterranean basin) is also illustrated by photographs and verbal description.

What strikes one markedly in the Bushman types and some of the Hottentots is the superficial resemblance they bear in features to the peasant population of parts of central Europe, eastern France, and—if one may dare to say so—some parts of Ireland.[1] It is quite possible that the Bushman type of negro once ranged from central and western Europe, across the Mediterranean, and down the east side of Africa to his present habitat. It is curious that these types do not recall any reminiscences of the Congo pygmy or the West African negro. One is only able to match them in the eastern Sudan and in Europe. The author directs attention to the fact that the Bushmen and Hottentots, where they are uninfluenced by the Bantu, do not practise circumcision.

They are scarcely in an age of stone; indeed, Dr. Schultze does not seem to record the use of any stone implements. But they are living in an age of bone, wood, and skins. The arrow-heads of the Bushmen are usually made of bone. So are many other implements of Bushman and Hottentot. Wood and leather, gourds, thorns, and sticks are the materials out of which utensils, ornaments, and receptacles are made.

Among the many aspects of the life of these primitive peoples so completely illustrated in this work are the domestic animals—sheep, goats, and cattle. The dog no doubt migrated south with the Bushman and Hottentot, after a previous sojourn in the Mediterranean basin. But obviously, the goat first, then the ox and the sheep, were brought to them from the north by Bantu or Nilotic negroes. The Hottentot root word to express cattle (*goma-*) is probably derived from the southern Bantu *-komo,* and *biri-*, for goat, may be the early Bantu *buri, budi.* Even the vocable for sheep, *gu-*, can be traced to a Bantu source.

The cattle of these regions, whether belonging to Hottentot or Bantu peoples, are apparently a mixture between breeds introduced two and three hundred years ago by the Portuguese and the Dutch and the two more or less indigenous breeds of Central Africa, that is to say, the humped ox (*Bos indicus*) and the Gala or Egyptian ox (*Bos aegyptiacus*), with its enormous horns. Nowhere amongst the herds of any of the southern Bantu or of the Hottentot does one meet with the typical African ox that formerly ranged from Egypt across the Sudan to Senegambia, and which has penetrated to the mountain regions of the Nile and Congo basins. In this ox of pure breed the horn cores are never set horizontally and curved forward over the face; they grow out at right angles from the frontal line, and then upwards and backwards. It is evident that the cattle introduced from western and northern Europe considerably modified the stock of the South and South-West African breeds.

The Hottentot language is profoundly studied in the volume under review. There is a vast deal of information about folklore, rainfall, and temperatures, lists of plants, the musical notation of Hottentot songs, chemical analyses of Hottentot medicines, and a bibliography.

If this is the way in which Germany is going to illustrate her colonies, the world of science would gladly install her in possession of all the backward and little-known regions of the world.

H. H. JOHNSTON.

[1] Anthropologists hardly need to be reminded that Ireland contains at least half-a-dozen distinct anthropological types, ranging from the handsomest to the ugliest of European peoples.

ALCOHOL AND ITS EFFECTS.

Alcohol and the Human Body. By Sir Victor Horsley, F.R.S., and Dr. Mary D. Sturge, with a Chapter by Dr. Arthur Newsholme. Pp. xvi+370. (London: Macmillan and Co., Ltd., 1907.) Price 5*s.* net.

THE importance of the alcohol question to the well-being of the race can scarcely be exaggerated, and in many respects this book will be very useful, but it is questionable whether the authors do not go too far in ascribing to alcohol ill effects only and no useful properties. The book, in fact, is a partisan one, and any evidence favourable to alcohol has been completely suppressed.

In the first chapter the action of alcohol as a drug is considered, and it is shown how the use of alcohol has declined in hospitals. The chemistry of alcoholic beverages is then briefly discussed. The effects of alcohol on protoplasm, on the various tissues of the body, and on mental and physical work, are subsequently described in language which can be understood by all, technical terms being avoided, and in the final chapter Dr. Newsholme discusses statistically the influence of the drinking of alcoholic beverages on the national health and wealth.

In venturing to make some criticisms on the book as a whole, we would remark that we are in complete sympathy with the object of the authors, which is, we take it, to emphasise the disastrous consequences which may result from indulgence in alcohol.

The first criticism we would offer is that no distinction is made between alcohol and alcoholic beverages. It may be true that alcohol, as alcohol, does not possess all the virtues and properties which are so often attributed to it; but surely there is a consensus of opinion that the moderate use of good, well-matured spirit or wine is frequently beneficial in some disease conditions, and many of the ills attributed to alcohol may well be due to the by-products present in cheap beverages. Alcohol has been shown to occur in small quantities in the tissues; it is a result of normal metabolism; and we therefore question whether the moderate use of alcoholic beverages does any harm. The difficulty is, of course,

to define what is meant by "moderate use"; probably a quantity of a beverage equivalent to 1 to 1½ fluid ounces of absolute alcohol is as much as can safely be consumed *per diem*. If this be admitted it must be confessed that a large proportion of so-called moderate drinkers exceed the mark; the man who takes four or five whiskies a day is probably consuming 2 to 3 ounces of absolute alcohol *per diem*, and is therefore exceeding what may be considered to be a safe limit. The experiments quoted, in which even weak solutions of alcohol are shown to be protoplasmic poisons, are hardly convincing as to the deleterious action of alcohol on the organism as a whole, for are not distilled water, 3 per cent. salt solution, and beef-tea similarly protoplasmic poisons? A good deal is made of the supposed disastrous effects of alcohol on the nervous system, and it is stated that alcohol is accountable for 20 per cent. of the cases under care in our asylums. Dr. Mott,[1] however, says—and he has made the subject one of special study—that "alcohol does not *per se* produce a permanent mental derangement, such as constitutes our definition of insanity," and he points out that in an American inquiry into the subject, total abstinence was found to be more frequently an antecedent of insanity than was intemperance. These quotations show how difficult it is to associate cause and effect.

Dr. Newsholme deduces from the statistics of the consumption of alcoholic drinks in 1904 that each adult of the working class spends 2*s*. 2½*d*. a week on alcoholic beverages; and, assuming that each family spends 5*s*. a week, this, if placed as an insurance premium, commencing at the age of 25, would mean that the husband would have saved the sum of 422*l*. at the age of 55, which, invested as an annuity, would yield 12*s*. 6*d*. a week. These are certainly figures of grave import, and we would commend them to the politicians, for here surely is the basis for a scheme of old age pensions!

We doubt, however, if there would actually be anything like this saving, for a majority would certainly spend the money on substitutes for alcoholic beverages—tea, coffee, cocoa, milk, and temperance drinks—on better food and clothing, and on amusements, and the actual gain would principally be in the well-being of the people. Finally, incidence of sickness and the percentage death rate among abstainers and non-abstainers is contrasted; among the former the death rate is 3·557, among the latter 6·532. Dr. Newsholme remarks:—"We are compelled to conclude that what is commonly described as moderate drinking has a most injurious effect on health and life." We feel convinced that the whole story is not told by these figures. No doubt many drunkards were included among the moderate drinkers (as Dr. Newsholme suggests), and probably a large proportion were not moderate drinkers according to our definition; and may it not be that a considerable proportion of naturally delicate persons, persons whose stamina is poor and who suffer from various ailments and tend to die young, are moderate drinkers, while the abstainers include a large proportion of robust individuals who do not feel the need for any alcohol?

On the other hand, a number of so-called abstainers are certainly really moderate drinkers, for many temperance drinks contain some alcohol. Thus, in the year ending March 31, 1907, of 1133 samples of beverages sold as temperance drinks examined in the Government Laboratory, 71 contained 3 per cent. of proof spirit, 37 contained 4 per cent., and 8 contained 6 per cent. or more. Herb beer and dandelion stout contained respectively 10·5 per cent. and 12·3 per cent. of proof spirit. That is to say, 10 per cent. of temperance drinks contain nearly as much alcohol as a mild ale!

The book is well got up, and contains a number of coloured and black-and-white illustrations and diagrams.

[1] *British Medical Journal*, 1907, ii., p. 797.

VAN DER WAALS AND HIS SUCCESSORS.

Die Zustandsgleichung der Gase und Flüssigkeiten und die Continuitätstheorie. By Prof. J. P. Kuenen. Pp. x+241. (Brunswick: F. Vieweg und Sohn, 1907.) Price 6.50 marks.

PROF. KUENEN'S monograph will be welcomed by a large circle of readers who have felt the fascination of van der Waals's equation in its simple but marvellous exposition of the critical phenomena, and who desire to become acquainted with the results of recent investigations in this important field of work.

As the author is able to show in his first four chapters, the equation of state affords a complete qualitative explanation of the behaviour of gases under varying conditions of temperature and pressure, including those which cause liquefaction. The whole description is admirably clear, but it may be permitted to direct special attention to three points which are not usually discussed; these are (1) the demonstration of the way in which the labile equilibrium (in which pressure and volume increase together) must collapse in such a way as to give rise to two layers of different density (p. 24); (2) the fact that in the metastable region the pv curves for low temperatures intersect and cross the axis of volume, corresponding with the experimental observations of Helmholtz and others that liquids may exist under considerable negative pressures without vaporisation (p. 28); and (3) the fact that the liquid in a capillary tube out of contact from air is under a pressure less than the normal vapour pressure, and is therefore metastable, and might even become labile if the capillary height were sufficiently great.

In spite of its wonderful qualitative accuracy, van der Waals's equation almost invariably breaks down when accurate quantitative tests are applied (chapters vi. to ix.). Thus, if the values of the critical constants are filled in, the expression RT/PV should have the value 8/3=2·67 for all gas; actually argon appears to give a normal value, and hydrogen the value 2·94, but a group of eighteen hydrocarbons and simple derivatives gave values ranging from 3·4 to 3·9 (p. 60), whilst polymerised liquids gave values between 4 and 5. Similar results are observed in reference to the

ratio of the temperature of inversion to the critical temperature; in a number of cases the ratio has the value 2·98, but this figure, though substantially constant, differs considerably from the theoretical value 27/8=3·37 (p. 68). In a third table (p. 83) are given the minimum volumes for a series of gases under extreme pressure and at low temperatures, as compared with the volumes at the critical point of each gas; the actual values:

O_2	Cl_2	CO_2	SO_2	C_2H_4	CCl_4	$C_4H_{10}O$	C_6H_6
0·278	0·282	0·269	0·243	0·243	0·260	0·255	0·258

are nearly constant at 0·26, but differ widely from the theoretical value 1/3=0·33. A fourth table (p. 71), in reference to the minima in the pv/v curves, shows a precisely similar result—the four constants which are given for each of three gases agree closely together, but differ widely from those calculated from the equation of state.

In view of the failure of van der Waals to give an exact quantitative explanation of the behaviour of liquids and gases, it is natural that many attempts should have been made to correct and improve the original equation. These attempts are described in chapters xii. and xiii., but the fact that the author has found it necessary to discuss something like a dozen different equations is in itself sufficient evidence that the goal has not yet been reached.

A part of the difficulty which arises in applying equations such as that of van der Waals is due to the fact that in compounds such as water and the alcohols liquefaction is accompanied by the formation of molecular aggregates (chapter xi.); attention has therefore been directed in recent years mainly to the study of hydrocarbons and similar substances in which this tendency is at a minimum. In most cases the polymerisation is instantaneous, but the author is incorrect in supposing (p. 52) that this is always the case; thus the recent observations of Bamberger and Seligman have shown that in the case of nitrosobutane the association and dissociation (unlike those of nitrogen peroxide) proceed quite gradually. There can be little doubt, however, that he is right in attributing the anomalous densities observed by de Heen and others to the presence of impurities rather than to slow changes of molecular aggregation as postulated by Traube; on this point the evidence afforded by the author's own experiments, supplemented by the recent discussion of Verschaffelt, appears to be conclusive.

T. M. L.

AMERICAN FORAGE CROPS.

Forage Crops for Soiling, Silage, Hay and Pasture. By Dr. Edward B. Voorhees. Pp. xiii+384. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1907.) Price 6*s.* 6*d.* net.

THIS book is one of the Rural Science Series, edited by L. H. Bailey, and designed to give the American farmer simple but accurate instruction in scientific agriculture. Some of the series, *e.g.* King's "Soil," are of general interest, and are well known here; the others refer mainly to American conditions, and appeal less to English readers.

Forage crops are those which are fed in the green state to animals instead of being left to ripen and produce seed: turnips, mangolds, and "temporary" grass are all examples. They play a highly important part in every scheme of general farming; indeed, their introduction into England in the seventeenth and eighteenth centuries not only revolutionised our agricultural practice, but had a considerable indirect effect on the social life of our ancestors.

The author deals with practically all the fodder crops grown in the United States, giving details of cultivation and manuring, and, in some cases, summaries of the results obtained with the crop at the various experiment stations. These summaries are perhaps the best part of the book, and will be appreciated both by the student and the farmer; we should like the author to have extended them by including short descriptions of the soil and climatic conditions. The cultivation and manurial details are treated mainly from the empirical standpoint, and here we cannot help feeling that the author has missed an opportunity. Details are of very great importance in agriculture, but they should hardly be given the chief place in a text-book like the present one. Neither the student nor the practical man can make much of them; there is an endless variety about them, and a scheme that works well on one farm may not prove suitable on another close by. What is wanted is a clear statement of the general requirements of the crop, followed by a few well-chosen detailed illustrations. In this way the student gets a real picture that will be of service to him, and the practical man is put in a position to see whether or not he can profitably grow the crop. Unfortunately, the author does not quite give us this, and if the schemes he suggests fail, the farmer is not in possession of the principles which would aid him to frame a modification suited to his land.

A perusal of the book brings out very clearly the differences between English and American practice in regard to fodder crops. The difference depends not only on climate, but also on labour supply, for in the latter respect the American farmer is worse off even than his English cousin. We learn, for instance, that one of our best root crops, the mangold, is not widely grown because of the labour required. Its place is taken by green maize, which is partly fed green and partly made into silage.

The author also deals with the different ways of using fodder crops—soiling, ensilage, and conversion into hay. Soiling was introduced into the States from Europe in the middle of the last century by Josiah Quincy, whose writings on the subject are so good that it is a pity the author makes no mention of him. The practice consists in cutting and carrying green crops to the animals, which are kept in stalls all the year round instead of going out to grass in summer. It has proved to be economical in places where land is dear and labour cheap, but is not likely to displace ensilage in America, notwithstanding the prominent place assigned to it in the book. Indeed, one hardly sees how silage could be improved upon for the American farmer; he has learnt how to make it, and as a

labour-saving device for the dairyman it has been ranked with the separator.

Certain statements will want correction in a future edition. We are told, for instance, that "the covering of land in summer prevents the temperature from rising so high as to destroy the organisms of the soil." E. J. R.

OUR BOOK SHELF.

Astronomischer Jahresbericht, Vol. viii. Die Literatur des Jahres 1906. By A. Berberich. Pp. xxxvi+671. (Berlin: Georg Reimer, 1907.) Price 21 marks.

ASTRONOMERS are fortunate in the matter of having their literature catalogued, for, in addition to the volume published by the Royal Society for the International Council, we have this very excellent annual, instituted by the late Dr. Walter F. Wislicenus, which has now reached its eighth volume.

The contents of the present issue deal with the literature of the year 1906, and it only requires a cursory glance to indicate how important it is that such a catalogue is in existence, considering the great mass of work that is being turned out every year and published, not only in all sorts of journals, but in various languages.

The very arduous task of collating and cataloguing is now annually being successfully accomplished by Dr. Berberich and his co-workers, and an important feature about the publication is its early issue.

In the present volume, which contains no less than 1961 separate brief abstracts of published papers, accompanied by a complete name-index, some minor changes have been made.

Thus all references to publications with regard to minor planets are brought together under one section number, and the tabular statement of their observation is here omitted, as it appears in full in the Berlin Astronomical Year-book.

The literature relating to comets is now divided between two sections, while one section includes the whole of meteor-astronomy.

In spite of the above and other alterations, the volume is not reduced in size, for longer abstracts are given of works of greater importance.

The value of this publication to astronomers cannot be overestimated, and it behoves everyone interested in this science to support it, so that the continuation of future issues may be assured.

Lehrbuch der theoretischen Elektrochemie auf thermodynamischer Grundlage. By J. J. van Laar. Pp. xii+307. (Leipzig: W. Engelmann; Amsterdam: S. L. van Looy, 1907.) Price 6 marks.

THE present volume differs greatly in character from those to which we are accustomed from the pen of Dr. van Laar. His "Thermodynamik in der Chemie" and his "Lehrbuch der mathematischen Chemie" are so formal in their nature, so mathematical in their dress, and so slightly connected with the facts of observation, that the majority of chemists can have derived little benefit from them, excellent though they may be of their kind. Here the author adopts a different method; the mathematical deductions have the clearness and conciseness which might be expected, but everywhere the experimental data are brought into the foreground, so that the electrochemist with a modest mathematical equipment may hope to gain a clear view of the thermodynamical theory of his science.

The book is divided into twelve chapters, of which the first deals with electrical units, chapters ii.–iv. with conductivity, chapter v. with diffusion, chapters vi.–x. with electromotive force, chapter xi. with polarisation, and chapter xii. with capillary electric phenomena.

A good account of the work of Kohlrausch is given in chapter iii., and the recent researches of Walden and others on the conductivity of non-aqueous solutions, and of Lorenz on fused electrolytes, are well summarised in chapter iv. Chapter vii., on the partition equilibrium of electrolytes, contains much that is novel.

Altogether it may be said that the book is readable, original, and suggestive.

Coal. By James Tonge. Pp. vii+275. (London: Archibald Constable and Co., Ltd., 1907.) Price 6*s*. net.

THE author recently published an excellent little work on coal-mining for the use of students. It is disappointing, therefore, to find that in writing a book on coal for the general reader he has been less successful. The work appears to have been hastily compiled, and the proofs carelessly revised. For example, the Ruhr appears as "Rurh," Courrières as "Courrieries," Anzin as "Auzin," Resicza as "Kesicza," and Karwin as "Kirwin."

There is a useful chapter on the preparation of coal for the market; and the chapter on the botany of the Coal-measure plants is excellent, though somewhat technical for the general reader. Both these chapters are admirably illustrated. The chapters on the British and foreign coalfields, on the valuation and uses of coal, on the production of heat from coal, and on the waste of coal, contain, however, little that is not better set forth in the report of the Royal Commission on Coal Supplies, in the valuable digest of that report published by the *Colliery Guardian*, in Prof. Flux's revised edition of Jevons's work, or in other works dealing with coal. Of such works many have recently been published, for we cannot agree with the author that "it is now many years since a work on coal was presented to the public."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Speed of Racing Animals.

IN NATURE, March 14, 1907, p. 463, there is an article giving the results obtained by Prof. Kennelly, of Harvard, from an examination of racing records. There is no harm in again directing the attention of your readers to these results. Prof. Kennelly's paper was sent July 6, 1906, to the American Academy of Arts and Sciences, and published in the Proceedings in December, 1906. It is entitled "An Approximate Law of Fatigue in the Speeds of Racing Animals." His general result is given in a question set by me in an examination in practical mathematics, January, 1907. Here is the question:—

If t seconds is the *record* time of a race of y yards; the law $t=cy^n$ seems to be wonderfully true for all record races of men and animals excepting men on bicycles; n is the same number in all cases. c has a special value in each case, men walking, running, skating, swimming, or rowing; horses trotting or galloping or pacing.

(1) For any particular kind of race it is found that when y is increased by 100 per cent., t is increased by 118 per cent.; find n.

(2) For men running, when $y=600$, t is 71; find c in the above formula. Express s, the average speed of each race, in terms of y.

(3) Assume that an animal has a certain amount of endurance E which is exhausted at a uniform rate during

the race, and that $E=E_0+kt$, where E_0 and k are constants. Calling E/t the rate of fatigue f, express this in terms of s.

Assuming that an animal going at s_0 miles per hour feels no fatigue, or when $s=s_0$, $f=0$; find f in terms of s.

(1) Contains the general result; the law is that t is proportional to $y^{3/8}$ or $y^{1\cdot125}$. It may be stated in various other ways; for example, that the average speed in each race is inversely proportional to the eighth root of y, or a race 256 times as far is done at half the average speed.

In short races there is increase of speed at the beginning and almost always increase near the end; and it may be that there is continuous change of speed during all record races. We have only average speeds recorded, unfortunately, but still I must consider this wonderful general law to be worthy of the attention of biologists. (3) Contains a poor speculation of my own, good enough for such an examination; the answer to it is that f is equal to $E_0c^8(s^9-s_*^9)$. There is nothing extraordinary in the fact that record bicycle races do not follow the law; they have been run on machines of varying quality.

The values of c found by Prof. Kennelly are, his distances y being in metres:—trotting horse, 0·0295; pacing horse, 0·0291; running horse, 0·0236; man running, 0·0588; man walking, 0·0861; man skating, 0·0385; man swimming, 0·381. Men rowing, four oars, 0·0628; two oars, 0·0768; singles, 0·0824.

JOHN PERRY.

Royal College of Science, S.W.

The Isothermal Layer of the Atmosphere.

THE investigation of the upper air which has been in progress during recent years has revealed conditions for which it is very hard to find an explanation. When Mr. Rotch first inaugurated observations on temperature and humidity by means of kites, it was hoped that the results obtained would solve many problems connected with meteorology, and this hope was strengthened when M. Teisserenc de Bort greatly extended the height to which observations could be made by his system of *ballons sondes*. It has not, however, been realised, and we seem to be as far as ever from knowing the cause and mechanism of the cyclonic storms that are so common in the oceanic parts of the temperate latitudes.

Since last June some forty balloons have been sent up in Great Britain, carrying with them a small instrument which draws automatically a pressure temperature diagram, and of these more than thirty have been recovered. The results confirm those previously obtained on the Continent, and no doubt can now remain about the existence of the curious isothermal layer in the atmosphere.

Briefly, the more important phenomena are these. As we ascend the temperature of the air decreases, at first often irregularly, with breaks and inversions, but after the first 10,000 feet (3 kilometres) have been passed with fair regularity, the usual decrease being about 3°·3 F. per 1000 feet (6° C. per kilometre). This continues to a height that varies, as a rule, from 30,000 feet to 40,000 feet. Nearly always at somewhere about this height the decrease suddenly ceases. Above this point the air in most cases gets a little warmer; occasionally, however, it continues to get cooler, but at a totally different rate, and we may take the remaining air to be at one practically uniform temperature in so far as change of height is concerned. This isothermal layer, as it has been called, has been reached in England more than thirty times. On the average its height is about 35,000 feet (10·7 kilometres), but the extreme values found were 25,500 feet and 49,000 feet. As a rule, it is higher than the mean when the barometer is high, and conversely. Its mean temperature was found to be −53°·6 F. (−47° C.), and the extremes were −22° F., at Ditcham Park, Hants, on July 24; −24° F., at Crinan, on July 26; −78° F., at Pyrton Hill, Oxfordshire, on September 12, 1907, and also on February 5, 1908; and −74° F., at Manchester, on November 7, 1907.

This mean value is considerably higher than the Continental one for previous years, but as thirty observations do not suffice to give a true mean, this may be accidental. Balloons have been sent up from five stations on the same day, and the temperatures over the stations have been found to differ widely. Thus on November 11 Mr. Cave's balloon from Ditcham Park reached the isothermal layer at 36,000 feet, and its temperature was −42° F. Over Oxfordshire the height was 38,500 feet, and the temperature −58° F., while at the same time, which was a little after sunset, Mr. Petavel, at Manchester, found it at 37,000 feet, with a temperature of −74° F. This is not an isolated instance, and although the heights given may be uncertain to an extent of perhaps 5 per cent. or even more, it is very unlikely that the error in the temperature can exceed three or four degrees F. It may be accidental, but the temperature over Ditcham Park, which is near the sea, shows a tendency to exceed that over the Midlands. The balloons mostly drift to the eastward, the centre of their falling points being thirty-four miles E., 23° N., of the starting point. Doubtless several of the unfound balloons fell in the North Sea, as some have been returned from France and Holland.

Various suggestions have been made to account for these results. There is, of course, no difficulty about the general decrease of temperature with height, but why should the fall suddenly cease when from one-third to one-fourth of the mass of the atmosphere remains above? In general, the transition point is perfectly sharp and distinct. It is said that the vertical circulation ceases at this point, and no doubt the statement is true, but why should it cease? There is a further difficulty. The absence of vertical motion implies a condition of equilibrium, but how can there be equilibrium with such large horizontal differences of temperature? At the height of 40,000 feet the pressure is small, and therefore trifling changes of pressure produce large changes of volume and temperature; hence large changes of temperature might be expected if we could assume some horizontal force, comparable with gravity, and capable of producing changes of pressure without producing vertical motion. The horizontal acceleration due to centrifugal force in a curvilinear path and that produced on a moving body by the earth's rotation are too small; also it seems to me that these forces, being due to motion of the air, must produce some vertical circulation, which apparently does not exist.

The problem is one of the most interesting presented at the present time to physical science, and it is not unlikely that its solution might clear up many other puzzling questions.

W. H. DINES.

The Inheritance of "Acquired" Characters.

MR. ARCHDALL REID in his previous letter said (p. 293) "innate characters arise inevitably as the child develops, whereas some acquirements are more or less rare, but this is *only* because the stimulus of nutriment is inevitably received, whereas the stimulus of a particular *use* or *injury* may not be received. If, however, the latter be received, *the acquirement arises just as inevitably as the innate characters.*" This latter statement seemed to me particularly incorrect for the reasons which I stated; and now Mr. Reid practically admits (p. 342) that it cannot be accepted as it stands, in face of the fact that the inherent tendencies of the germs of different human beings vary so much, and must therefore react variously to the stimulus of use.

My chief objection, however, to Mr. Reid's view was that contained in his statement that "in man the main difference between the infant and the adult is due to use acquirements made by the latter during development." His whole case in the discussion hinges upon this statement, by which he seeks to establish a purely arbitrary distinction between the causes leading to the development of the human being anterior to birth and subsequent to birth—the stimulus in the one case, he says, being nutriment, and in the other use. As an illustration of his position, Mr. Reid said (p. 293):—"Thus, if the limb of an infant be paralysed it grows comparatively little, and the muscles atrophy." But this is by no means to be taken as a simple illustration of the fact that the muscles will not develop except under the stimulus of use, because the illustration ignores the fact that what happens in the way of retarded growth of the paralysed limb, together with actual atrophy of muscles, is, quite apart from the lack of use, largely due to a severance of the normal relations between the limb and the great nerve centres, and the

consequent cutting off of the "trophic influence" exercised by the latter.

Again, it is a part of Mr. Reid's doctrine, as he tells us, to regard the power of walking and the power of speaking as use acquirements, while I, on the contrary, hold that the effects of use-exercise *seem* to be predominant in these cases simply because the efforts made to walk or to talk take place *pari passu* with the development of the nerve centres concerned with such accomplishments.

As I have said elsewhere ("The Brain as an Organ of Mind," p. 562), "the helpless condition of the infant monkey and of the human infant at birth are similarly to be ascribed, in great part, to the immature condition of their great nerve centres. Many of the movements which they slowly learn to perform are doubtless rendered possible by, and acquired coincidently with, *the actual development of those nerve cells and fibres in the spinal cord and medulla which are instrumental in the execution of such movements*. Thus, when we say that the young child 'learns' to perform these movements, it should be understood that this word is here applicable only in a very qualified sense. . . . But for the existence of this organic *nisus* (in the form of an inherited tendency to develop in certain modes and directions) the human infant could never so readily as it does acquire the power of executing the excessively complex movements which are concerned in standing, in walking, or in articulate speech."

In illustration of these views I have cited cases in which walking was an untaught act in a child at the end of her second year, as there had been no previous trials and failures; and also a case (*loc. cit.*, p. 607) in which a child who had been absolutely dumb up to the end of his fifth year suddenly began to speak under an emotional stimulus. Another very similar modern case, as well as two cases recorded by ancient writers, of untaught acts of speech are also cited in my work on "Aphasia and other Speech Defects" (1898, pp. 6–8).

No explanation of such facts seems possible except on the supposition that speech has now become a truly automatic act for human beings. Such untaught acts of speech would not, however, be possible unless cerebral development had been taking place in a normal manner, and unless the auditory sense and intelligence were unaffected.

These are some of the reasons why I dissent from Mr. Reid's view that "in man the main difference between the infant and the adult is due to use acquirements made by the latter during development," and why I say that post-natal growth and development are essentially due to the same inherent causes as pre-natal growth, notwithstanding the fact that use-exercise comes in as a powerful aid during the former period.

As to the extraordinary power of memorising shown by Chinese and Mohammedan children to which I referred Mr. Reid, in accordance with his views he would deny that any influence is to be ascribed to the practice in memorising carried on by ancestors of the children through very many previous generations; and in that case he must suppose that English children, as a class, should be capable of showing similar feats of memory, even though their ancestors had not been accustomed to any extraordinary exercise of their memorial faculty.

For the rest, that Mr. Reid's views do not suffice to close the controversy as to the inheritance of "acquired" characters may be easily seen by any of your readers who will refer to Herbert Spencer's "Principles of Biology," revised edition, 1898, App. C, pp. 692–695, and to his "Facts and Comments," 1902, pp. 92–96. I might even venture to refer your reviewer, "A. D. D.," to a consideration of the facts and arguments set forth in these works.

H. CHARLTON BASTIAN.

The Athenæum, London, February 15.

I SAID that acquirements are just as "innate" as "inborn" characters. Dr. Bastian read this—I am sure I cannot imagine why—as implying a denial of the occurrence of variations. I repudiated his interpretation, and this he now terms an admission! The muscles of a limb atrophy equally when they are rendered useless by joint disease as when there is "severance between the limb and the great nerve centres."

The Lamarckian doctrine is founded on two unproved assumptions:—(1) that use causes development in all characters, and (2) that parental acquirements tend to affect the germ-cells in such a way that the traits which arise in the parent under the stimulus of use are reproduced by offspring under the stimulus of nutriment—that is, when the parent acquires one thing the child is supposed to "inherit" something inherently different and much less useful. The second assumption was formerly universal, but has now been abandoned by the vast majority of biologists. Most of us know, or think we know, how great an obstacle it was to the attainment of truth and how much deeper and clearer has become our knowledge of nature since its abandonment. We suppose it was held merely because men tend to accept current beliefs without bestowing on them that critical and sceptical thought which is one of the essentials of real scientific work.

The first assumption is still very generally made, and I think for the same reason. Unsupported by an iota of evidence and obscuring the fact that a principal feature of the evolution of the higher animals has been the evolution of a power of developing under the stimulus of use, it is as great an obstacle to the recognition of truth as the other. Many human structures are plainly incapable of developing under the stimulus of use, for example, hair, teeth, external ears, and memory. These are wholly "inborn" (*i.e.* developed under the stimulus of nutriment). The evidence seems massive that many lower animals, for example, the Coleoptera and Lepidoptera, owe little or no part of their physical and mental development to use. Hence their lack of individual adaptability. But higher in the animal scale, memory (the power of profiting by mental experience, of growing mentally under the stimulus of use) becomes apparent, and increases until it bestows on man all that makes him preeminently the educable, rational, and adaptable being. *Pari passu* with this increase of the power of growing mentally under the stimulus of use has occurred an equally great evolution of the power of growing physically under the same stimulus. In my view, then, (1) while memory and the homologous power of growing physically are "inborn," all that arises from the exercise of them is "acquired"; (2) not all human characters are capable of developing under the stimulus of use, but only a majority of them; and (3) in the case of the latter all, or nearly all, that separates the infant from the adult is due to the stimulus of use.

Either Dr. Bastian is putting the cart before the horse or I am. I believe, for example, that use develops body and mind until we are able to walk, talk, and so forth. He believes, apparently, that we would develop physically and mentally into mature men, and would walk and talk and get a knowledge of Latin and so on even if we never used body and mind. The blessed words "trophic influences" and "organic nisus" afford him complete satisfaction. Surely his assumption is made "in the face of multitudinous difficulties." To him man's adaptability, the vastness of his memory, the great development in him of the instincts of sport, curiosity, and imitativeness, which impel him to make precisely the physical and mental acquirements which bring him into harmony with his own individual environment, tell no tale. He is in a position as unhappy as those investigators who, before defining what they mean by "inheritable," spend years of labour in ascertaining exactly what is "inherited."

Mr. Cunningham says, "innate characters are those which develop without any stimulus except what Dr. Reid calls the stimulus of nutrition," or nutriment as I prefer to term it. But is not nutriment "external"? A scar cannot develop under this stimulus, and I imagine it would puzzle Mr. Cunningham to explain in what sense nutriment is more innate than injury or use. Obviously all characters develop under the influence of some *external* stimulus, and the distinctions between characters are due, not to greater or lesser innateness, but to the kinds of stimuli that cause them to appear. Acquirements arise for precisely the same reason that all inborn characters arise—because evolution has created the power of responding in quite definite ways to quite definite external stimuli; clearly, then, they are innate in precisely the same sense as inborn characters.

February 21. G. ARCHDALL REID.

MR. CUNNINGHAM says (p. 367) that my article was as dogmatic as it could possibly be. It was meant to be. It was meant to stir up those who continue to use the old terms "acquired" and "innate" without really bothering much about their signification. It has achieved its object admirably.

He also says that I assert that there "is no sense in the distinction between acquired characters and innate ones with regard to inheritance" [which I did not say], "that all characters are both acquired and innate" [which I did]; he continues:—"This in the accepted meaning of the words is simply untrue." Well, of course it is. My point was that the accepted meaning of the terms was vague, that it had led to confusion, and that it ought to be dropped.

Mr. Cunningham does not follow me. I am willing to admit that that may be my fault. I fully recognise, as he does, that the characters of organisms may be divided into two big categories, which have for a long time been called "acquired" and "innate." But I hold that the difference between these two classes of characters is very inadequately expressed by the terms "acquired" and "innate," and that a much better, though, of course, provisional, classification of characters is into (*a*) those which owe their existence to the interaction between some innate factor and the stimulus (for want of a better term) of nutrition, and (*b*) those which owe their existence to the interaction between some innate factor and the stimulus of use or injury.

The view that all characters are acquired during ontogeny as the result of a definite stimulus acting on an innate factor was expressed by Weldon (*Biometrika*, vol. i., p. 367), who has also described (*loc. cit.*) how he succeeded in preventing the appearance of the amnion in the hen's egg by withholding the necessary stimulus.

A full answer to Mr. Cunningham's letter is quite out of the question, because it would involve a discussion on all the meanings of the terms "innate" and "acquired" and a history of their use, which could not be compressed within the limits of a single number of NATURE. But reference must be made to one of the things "innate," as opposed to acquired, certainly does not mean. Whatever it means, it does not mean what it literally means. It does not mean the kind of character one is born with. Before it was known that all organisms develop from a single cell it may have meant that, but now that we know that they do, we regard classifications of characters into those which appear before the act which separates intra-uterine from extra-uterine, and those which appear after it, as interesting from a historical point of view only. Yet in this year 1908 we actually read in a letter to NATURE (I am not quoting from memory) that a Negro "is brown (not black) when he is born; that is an innate character." The facts are true, of course, but not relevant. The fact that a negro is brown when he happens to be born does not matter. The fact we have to face is that the ovum which gave rise to Booker T. Washington was probably not browner than that which gave rise to George. The statement that the colour of the former is innate does not in the least help us to understand the causes to which the difference between the colours of the two men is due. A. D. D.

[FURTHER space cannot be devoted to this correspondence. —ED.]

The Possibility of Life in Mars.

THE perseverance with which Prof. Lowell has prosecuted his investigation of the surface markings of Mars compels admiration; the evidence he has brought forward for the objective reality of much of the detail he has shown in his sketches serves to convince many reluctant minds; but the interpretation he has put upon these markings, in terms of phenomena associated with life as we know it on our own planet, requires stronger evidence than he has yet brought forward in view of the considerations that follow.

The blue-green coloration he attributes to vegetation; its change to chocolate-brown to the fading of verdure with the change in the season. If we grant that the conditions on Mars have been possibly such as to allow of the development of living organisms from inorganic matter, is it likely that the course of evolution has been so exactly similar to that on the earth that a chlorophyll-bearing organism has resulted? Like conditions produce like results—granted; but when one considers the quasi-fortuitous nature of the conditions determining the characters of those organisms that survive in the process of evolution, the remoteness of the probability that the development of the power of forming chlorophyll should happen twice, in two independent evolutionary systems, seems overwhelming.

Again, Prof. Lowell attributes the markings which he considers irrigation systems to intelligent beings. It is possible that that high degree of adaptability to environment, which we call intelligence, might have evolved independently on two planets, but it seems in a very high degree improbable.

Similarly, other points in his scheme of interpretation may be conceivable, but highly improbable. But the probability of the whole is the continued product of all the independent probabilities! The evidence, then, in favour of Prof. Lowell's views will require to be of a much more overwhelming character to claim the assent of those who appreciate their extreme improbability.

Opposition to the views of Prof. Lowell has generally been based on difficulties regarding the physical condition of Mars. It is the object of this letter to emphasise the far greater improbabilities involved in the biological aspect.

Prof. Lowell attributes the reluctance of many to accept his position to the emotions of men. I venture to think that emotions are in his favour; it is the human desire for an anthropomorphic interpretation of nature—in this case perhaps one should rather say a geomorphic interpretation—that has prompted his views, and but for which they would receive small consideration. C. O. BARTRUM.

12 Heath Mansions, N.W., February 17.

IN Dr. William Lockyer's review of Dr. Russel Wallace's book on the habitability of Mars he refers to Dr. Johnstone Stoney's contention that aqueous vapour cannot exist on a planet of that size because the velocity of the molecules would be too great for its attraction to retain them. I do not know what temperature was assumed in the calculation, but a dozen miles above the surface of the planet the temperature of its atmosphere must approach absolute zero—a condition of things in which even hydrogen would not have the necessary velocity to escape.

The question is an important one for those who are interested in the history of the earth, for, whether we choose the nebular or planetesimal view of its origin, there must have been a time when the attraction it exercised on the outer portion of its atmosphere was far less than at present, and if Dr. Johnstone Stoney were right there would be some difficulty in understanding how any water-vapour remained. J. W. EVANS.

Imperial Institute, S.W., February 15.

The Stresses in Masonry Dams.

PROF. PEARSON'S letter in NATURE of February 20 requires little in the way of reply from me, since my essential point is now admitted, viz. that the stresses $\widehat{xx}$ and $\widehat{zz}$ are practically the same in a slab, whether it be free or form part of a complete dam. I should, however, like to point out to Prof. Pearson, *re* his comparison between a parabola and an equivalent sine curve, that at 5° the ordinate is only one-twelfth the maximum ordinate, so that an error of 30 per cent. in this ordinate is one of but 2½ per cent. on the maximum, which would be, accordingly, absolutely negligible in practical engineering. As regards the remainder of his letter, engineers have the support of many eminent elasticians in their refusal to accept his and St. Venant's dictum that the maximum stretch is the proper criterion of the safety of a structure. In any case, the true criterion is a question for the engineer and the physicist, and not for the mathematician. The most recent experiments, I may add, negative Prof. Pearson's views on this head. H. M. MARTIN.

83 St. James's Road, Croydon.

THREE ANIMAL BIOGRAPHIES.[1]

MR. LONG is always interesting and original, and he is especially so in the daintily illustrated little volume standing first on our list, of which individuality in animals seems to be the keynote. Premising that no species breeds true in all its individuals, the author urges that analogous differences in temper, disposition, and mind reveal themselves to those who take the trouble to observe closely. All who make pets of cats, dogs, horses, and other domesticated animals are fully convinced of the existence in them of individual traits and idiosyncrasies; and the apparent absence of these in wild species seems due merely to the want of careful and minute observation of their habits. That such individualities do exist the author demonstrates, for example, in the case of the American lynx, which, although normally a cowardly and slinking creature, will on occasion follow the trail of a hunter with as mischievous intent as a panther. As usual, Mr. Long discusses members of widely different groups, and in the present volume we have delightful peeps into the life-histories of the black bear, the wolf, the wild goose, the trout, and other denizens of the forest and the stream. Where all is good, it is difficult to make a selection; but we have personally found special interest in the chapter on the bear. Describing the actions of a bear when ant-hunting, the author tells us that "he just knocks the top off the hill, stirs up the nest, and lies down quietly, placing his fore-paws where the ants are thickest. At first he makes no effort to pick up the hurrying insects, workers and fighters, which swarm out of their tunnels. . . . 'Moorween' waits till they crawl over the big black object that rests over the nest, and then he begins to lick his paws more and more greedily as he tastes the acid things. . . . So he gets all he wants, cleanly from his own paws, instead of filling his mouth with dust and chaff, as he must do if he attempted to catch them in any other way." Many other passages in this attractive volume bear equally eloquent testimony to the closeness with which its author has observed the habits of the creatures he loves so well and describes so graphically.

In the volume standing second on our list, Mr. Graham Renshaw brings to a close his long series of articles on mammals, interesting either from their rarity or from peculiarities in their structure or habits. The four-and-twenty species here discussed include a very varied selection, ranging from the musk-ox and the European bison to the Pacific walrus, the Tasmanian devil, and the platypus. As in the case of the earlier essays, the author deals specially with the historical aspect of his subject, and furnishes his readers with a large amount of detail connected with specimens exhibited in menageries and museums. Several of the illustrations are taken from specimens in the British Museum, and among these special attention may be directed to the one of the Congo buffalo, as an example of what may be accomplished in the way of photographing animals as they stand in the cases of the exhibition galleries. We may, however, venture to take exception to the photograph of a very tame-looking park bull being made to do duty for the extinct aurochs; and we should also like to know why the author, in defiance of Herberstain's evidence, states that the latter animal was mainly white. The assertion that all typical sheep have a lacrymal gland (p. 114) seems also to be contrary to fact, while the statement (p. 105) that two Greenland musk-oxen exhibited in 1900 were the first examples of their race known to science is contradicted on the following page by a reference to calves received in England in 1899.

The author has evidently devoted a large amount of time to working out the history of the various species, and he has certainly succeeded in producing a very attractive volume.

Bearded Titmouse and Young. From "Home-Life of some Marsh Birds."

[1] (1) "Whose Home is the Wilderness; some Studies of Wild Animal Life." By W. J. Long. Pp. xxi+230; illustrated. (Boston, U.S.A., and London: Ginn and Co., 1907.) Price 5s. net.
(2) "Final Natural History Essays." By Graham Renshaw. Pp. xii+228; illustrated. (London and Manchester: Sherratt and Hughes, 1907.) Price 6s. net.
(3) "Home-Life of some Marsh-Birds." By Emma L. Turner and P. H. Bahr. Pp. 62; 32 plates. (London: Witherby and Co., 1907.) Price 2s. 6d.

One of the objections to the employment of photography as a means of illustrating natural history books is that very frequently the animals are taken in postures which do not display their leading characteristics, and thus render the pictures more or less completely useless for the purpose of specific identification. The same thing applies in the matter of characteristic attitudes and the nature of the habitat; and, in the case of birds, to the form of the nest and the appearance and growth stages of its occupants. To remedy these shortcomings in the case of the feathered denizens of British marshes has been the main object of the authors of the charming little volume standing third in our list. They have set themselves the task of portraying marsh-birds in positions and attitudes which will render the pictures of real service to the scientific ornithologist; and we venture to think that the verdict of their readers will be a pronouncement of unqualified success in this respect. As a specially good example of their work we may cite Miss Turner's photograph of a bearded titmouse, showing the black face-marks of the cock from which the species takes its name. This would not print satisfactorily in the pages of NATURE, but we are able to give another illustration showing the bird feeding its young. The book does not, however, depend entirely on its illustrations, and even in such a hackneyed subject as the life-history of British birds, the reader will find much of interest in the brightly written biographies which accompany the plates.

R. L.

STUDIES IN NATIONAL DEGENERATION.[1]

THE several aspects of study which the statistics deal with in this memoir are chiefly parental and fraternal heredity, the fertility of tuberculous stocks, and the distribution of pulmonary tuberculosis in tubercular families. Prof. Pearson's observations are admittedly, from a numerical standpoint, wholly insufficient, but if his deductions are thereby rendered inconclusive, he has pointed the way and laid the foundation for further study of an all-important subject.

Prof. Pearson discusses only pulmonary tuberculosis, that is, phthisis, or, as it is popularly termed, consumption; yet even with this limitation it is uncomfortable reading that about 10 per cent. of the inhabitants of the British Isles are affected by pulmonary tuberculosis. Unfortunately, other organs besides the lungs become the seat of tuberculosis, and their disorganisation is attended by as serious results as when the lungs alone are considered. It may be that tuberculosis of the lung is, from the point of possible national deterioration, not the most deadly form of the ailment. Tubercular diseases of the bones of the joints, of the lymphatic system, and of several of the organs other than the lungs, prevail to an extent little appreciated as being of an equally deadly nature, with the more evident lesions in the lungs. They all indicate a diathesis, and give rise to types of infirmities well known to medical men. These evils of tuberculosis, therefore, are much more widely spread than pulmonary tuberculosis or consumption would give us to understand, and being less manifest to the public scrutiny are more insidious and more apt to be neglected in the reckoning of tuberculous disease generally.

That heredity plays an important part in tuberculous disease is, in Prof. Pearson's opinion, undoubted. Recent beliefs point rather to infection as being the major element in rendering the disease so prevalent, and it is noteworthy that Prof. Pearson inclines to the older belief of heredity. He finds that tubercular lung trouble is chiefly prevalent amongst those who inherit a predisposition, that is, a phthisical or consumptive diathesis. It is impossible, however, owing to insufficient data, to assume that the tendency to any disease is inherited in the same sense as are physical and mental characteristics, but did inheritance not explain the matter it is difficult to understand how anyone escapes the disease, seeing that, in urban districts especially, the tubercle germ is so prevalent that "few individuals who lead a moderately active life can escape an almost daily risk of infection."

Such being the case, the tubercle germ can thrive best in the suitable soil to be met with in lung tissues which are prepared by hereditary predisposition, or, in some cases, by what may be termed accidentally acquired predisposition in the lung tissues themselves, by previous local lesions. That the predisposition to the lung becoming the seat of tuberculous disease is to be statistically ranged alongside well-established inherited characteristics, such as physical and mental traits are known to be, can only be proved by obtaining complete histories of multitudes of families and family stocks. This, however, is at present a long way off being established, and until this gap is filled any deductions we make at present can only be speculative for the most part.

The period of life during which tuberculosis is most likely to show itself in the lungs is between the ages of twenty and thirty. The mean age of onset in men is set down at the twenty-ninth year, and in women at the twenty-fifth year. The actual danger zone cannot, however, he said to be passed until the fortieth year, or perhaps the forty-third year, is passed.

The observation that there is but an insignificant difference between the time of onset of the disease when some member of the household is the subject of tuberculosis and when no member is thus afflicted is rather against the infection theory pure and simple; for with the constant possibility of infection in the immediate environment, phthisis should, according to infection beliefs, appear at an earlier age than statistics seem to show.

After discussing the part played by parental and fraternal heredity, Prof. Pearson concludes that the tuberculous diathesis is inherited in the same way and with the same intensity as the physical characters are inherited in man.

Concerning the fertility of tuberculous stocks, Prof. Pearson shows that the pathological conditions do not tend to reduce fertility, but, on the other hand, that such stocks appear to be quite as fertile, and in all probability are more fertile, than normal stocks of the same class in the community at large. The fact, however, that tuberculosis is a disease of youth and early middle life distinctly lowers the marriage rate and limits the child-bearing period of such stocks, and thus reduces the total number of offspring born to tuberculous people; there can be no doubt that by the inbreeding of purely tuberculous persons the stock would become in time extinct.

The question of order of birth, that is, whether the child belongs to the early or late portion of a given tuberculous family, is of considerable interest. Are the elder or the younger members of the family the more liable to develop tuberculosis and to possess a tuberculous diathesis? The children of old people, of, say, a man over sixty and a woman of forty-seven, are popularly believed to be handicapped in the struggle for life owing to inherited physical defects. There is no

[1] Drapers' Company Research Memoirs, II. A First Study of the Statistics of Pulmonary Tuberculosis. By Prof. Karl Pearson, F.R.S. Pp. 26. (London: Dulau and Co., 1907.) Price 3s.

real evidence that this is the case, as many instances for and against the contention can be given. Whether the child of elderly parents is healthy or not depends not so much upon the age as upon the health of the parents; for a man with, say, Bright's disease—the prevalent ailment of men over sixty—will certainly not beget a healthy offspring. It would seem, however, from a general study of constitutional defects which are inherited, that the elder members of the family are more liable to suffer than the younger. In the case of tuberculous families, as well as with stocks giving no parental tuberculous history, the elder offspring, especially the first and second, appear subject to tuberculosis at a very much higher rate than the younger members.

This observation is of especial interest when the modern notion of the limitation of families is considered. There are few "younger members" to the small and limited families of to-day. The two or three children born to a couple of parents would represent the elder branches only of the "old-fashioned family" of a dozen of some fifty years ago. We have just seen that Prof. Pearson declares that the first and second child are endowed with all forms of pathological heritage, and if there are only two children in the family, the limited family of the present day is producing a community of persons highly endowed with a pathological heritage, uncorrected in its national deteriorating effect had there been later children of the marriage—that is, children less likely to have inherited in a marked manner the pathological tissues or diathesis of their parents.

If we are to believe the above statement, and there is no evidence against its being logically acceptable, we are brought face to face with the question of the benefit or otherwise of the law of primogeniture which so largely obtains all the world over. From a racial standpoint the first and second children, as we have seen above, are the worst members of the family to beget a stock free from pathological taints; yet it is to the eldest son that the preservation of the family, and its possessions, its titles, or its wealth, is entrusted. To push this point to its seemingly logical conclusion, it would come about that the eldest son of one family marrying the eldest daughter of another family would in time lead to an effete progeny and the extinction of the power of rearing children. As a prophylactic agency in this scheme of pathologic inheritance, it would appear essential, to correct the deteriorating effects of intermarriage between elder members of different families, that the eldest child of one family should marry with a younger child of another family.

The limitation of families to one or two children is therefore a highly detrimental factor in national eugenics, for not only is there no allowance for what appears to be the inevitable waste attaching to child life, but the progeny, if thus produced only during the early years of married life, is calculated to add in time more affected individuals to the community, seeing it is the first-born children especially that inherit family traits of physique and diathesis.

The predominance of race depends on the preservation of the mentally and physically fitter stocks. In the struggle for existence amongst primitive peoples this is "naturally" provided for by the exigencies of life, but amongst a highly civilised race, such as our own, the fitter stocks appear likely to be weakened "by the lessened intensity of the intraracial struggle and the differential limitation of the family."

It is scarcely necessary to state that Prof. Pearson has handled this subject, as he handles all the problems he deals with, in a manner at once logical, unbiased and rigidly scientific. We are willing to accept Prof. Pearson's conclusions from the basis he starts from; but until the basis is widened a hundred fold it would be rash to formulate definite and incontrovertible deductions in regard to the effects of the inheritance of any pathologic diathesis for any given ailment.

SIR RICHARD STRACHEY, G.C.S.I., F.R.S.

ON Wednesday, February 12, there passed away, at the advanced age of upwards of ninety years, a distinguished son of a distinguished Anglo-Indian family, Lieutenant-General Sir Richard Strachey, R.E., G.C.S.I., LL.D., F.R.S. To give any adequate impression of a career which extended from 1836, when Richard Strachey left Addiscombe to join the corps of engineers of the East India Company, to 1907, when he retired from the chairmanship of the East Indian Railway Company, would be in any case a difficult task, and when, as in this case, a life of nearly ninety-one years is more remarkable for the versatile activity of the spirit that animated it than for its length the task becomes insuperable.

He was elected a Fellow of the Royal Society in 1854 for scientific work in botany, geology and physical geography, carried out while he was stationed at Nani Tal, in the Kumaon Himalayas, whither he was transferred from engineering work in connection with the Ganges canal on account of repeated attacks of fever. In 1897, the year in which he was appointed Knight Grand Commander of the Star of India, a Royal medal was conferred upon him for his investigations in physical and botanical geography and meteorology. "Two of the most recent of these," quoting from the award, "are recorded in his report, published in 1888, on the barometrical disturbances and sounds produced by the eruption of Krakatoa and in his paper in the *Phil. Trans.* of 1893, entitled 'Harmonic Analysis of Hourly Observations of the Temperature and Pressure at British Observatories.' These, while important in themselves, are but the last of a long series of valuable memoirs. He was the first to treat scientifically of the physical and botanical geography, geology, and meteorology of the Western Himalaya and Tibet. He also first observed the occurrence of a regular series of fossiliferous rocks, from the Silurian upwards to the north of the great snowy axis of the Himalaya. His numerous papers on these subjects, dating from the year 1847, are published in the Journals of the Royal Asiatic, Geological, and Royal Geographical Societies' Proceedings, and in the reports of the British Association."

In 1873 he had returned home and was appointed a member of the meteorological committee of the Royal Society which controlled the Meteorological Office, established in 1867; he was a member of Sir William Stirling Maxwell's committee which revised the constitution of the governing body of the office, and was a member of the council which replaced the committee in 1876. After a further period of absence in India on special duty, he resumed his place on the council; in 1883, upon the death of Prof. H. J. S. Smith, he was appointed chairman and filled the office for twenty-two years. He was president of the Royal Geographical Society from 1887 to 1889. He received the Symons medal of the Royal Meteorological Society in 1906.

His scientific activity, although closely interwoven with the rest of his work, was only a part of his life. He won distinction as an engineer in the conduct of irrigation works and as a soldier in the Sutlej campaign. His greatest claim to remembrance is based upon his achievements as head of the Indian Public

Works Department, and the various successful organisations which he initiated in that capacity. It is not too much to say that he and his younger brother John, who died about two months ago, were for many years the principal figures in the administration of the Indian Empire. "The Finances and the Public Works of India," the title of a book which they published, is not inapt as a description of the position of the two brothers under Lord Mayo. Between 1871, when Richard Strachey returned to England, and 1879, when he finally retired from India to resume his place on the Indian Council, he held various appointments in connection with the India Office or in India, including the chairmanship of the Madras Famine Commission of 1878. In 1889 he became chairman of the East Indian Railway Company, and added to his reputation for business capacity by the successful administration of that undertaking. As a financier he represented India at the Monetary Conference at Brussels in 1892, and as a geographer he was one of the delegates of Great Britain at the Prime Meridian Conference at Washington in 1884.

My personal recollection of Sir Richard Strachey goes back to 1880, when I was engaged upon some work for the Meteorological Council. He was keenly interested in questions about the distribution of water vapour in the atmosphere. The vertical distribution was the subject of a paper in the Proceedings of the Royal Society in 1862. My recollection is that he had a good deal to do with disposing of an idea that I have seen attributed to Herschel, that in reckoning the pressure of the atmosphere, water vapour did not count. I write vaguely on this point, because to reconstitute the physical conceptions upon which meteorology was based before the 'sixties is to place oneself in the age when heat was still regarded as material, and the conservation of energy was an imperfectly formulated idea.

As president of the Royal Geographical Society he endeavoured to promote the teaching of geographical science, and he came to Cambridge to give lectures on geography, a missionary effort undertaken to show that geography was not really beneath the attention of a university. The distribution of vapour pressure in the atmosphere as determined by his own observations up to 18,000 feet in the Himalaya was again discussed. At that time the university recognised his contributions to the advancement of science by conferring the LL.D. degree. He returned to the subject of aqueous vapour in the atmosphere again in the determination of the heights of clouds by photographic observations at Kew, a preliminary report on the measurements was contributed to the Proceedings of the Royal Society in 1891, and there still exists a great store of unworked material.

From 1897 onwards I was closely associated with Strachey in the management of the Meteorological Office, and I speak without hesitation for his colleagues, Galton, Wharton, Buchan, Darwin, Field, and Scott, in saying that association with him was not the least among the privileges which attached to membership of the council. His clear insight into the questions at issue, his perfect lucidity in thought and expression, the logical marshalling of facts in the official documents which he wrote as chairman, will always be memorable. He had not much patience with people who were imperfectly acquainted with the facts of a case under discussion, and he never cared to argue with them, but difference of opinion on lines of policy, even when ill expressed, never ruffled his serenity in the conduct of business. From time to time while he was chairman, the office was subject to criticism, which was not always fair, but he never complained. He was always content to attribute the criticism to want of knowledge of the facts. He would not even let us indulge in the semi-official pastime of abusing the Treasury. Their responsibility had to take account of an aspect of the matter with which we were not cognisant, namely, where the money was to come from, and we must be content to accept a judgment that had to reckon with public opinion in its executive form as well as with scientific aspirations. Speaking for myself, as one accustomed for many years to the details of business of college meetings and university syndicates, Strachey's methods of transacting corporate business were a revelation.

As regards his later contributions to the science of meteorology, some words of explanation are necessary. He had watched, and indeed had been largely instrumental in providing the facilities for, its study both in India and in this country, on the new lines of the comparison of results for different parts of the country or of the world. He was conscious that the new science required a new method, that the method of the physical laboratory, which aims at elucidating a physical process by experiments specially directed thereto, was inapplicable to the case of the free atmosphere. Those who are critical of the vast accumulation of meteorological data which is going on are apt to be unaware of the fact that data have to be collected in advance, and that, to this day, nearly every attempt to deal with a meteorological problem of any importance is baffled by the want of data; they are equally unmindful of another noteworthy fact, namely, that in meteorology comparison is of the essence of the science. The meteorologist is absolutely dependent upon other people's observations; his own are only useful in so far as they are comparable with those of others. Thus the time, trouble, and money spent upon organisation are not the expressions of limited scientific ambition, but a primary condition for securing indispensable facilities. Strachey's scientific judgment was extraordinarily acute. He was quite prepared to carry on investigation to a speedy issue when circumstances permitted, as in the investigation of the Krakatoa eruption already alluded to, which led to the recognition of a drift from east to west in the upper air of the equatorial regions as a primary meteorological datum. In dynamical meteorology he was convinced that the most promising mode of attack was not to look for a direct dynamical explanation of the striking features, the eccentricities of the day's weather, which are the almost fortuitous result of many causes combined in various phases, but to seek for the relations between regular sequences and their causes underlying the apparently arbitrary variations. For this reason the methods of harmonic analysis specially attracted him, and he was disposed to regard anything less general than five-day means as unmanageable. He never completed the work on harmonic analysis that he had in hand. He attached particular importance to the third Fourier component of diurnal variation, because the length of the day in these latitudes oscillates between one-third and two-thirds of the twenty-four hours. A few years ago he took up again the investigation of the question, and he has left a considerable amount of unfinished material.

He was not to be driven from a position of modest optimism about such matters, and always explained that for a new science the progress made in the last fifty years is quite as great as could fairly be expected.

But he was no friend of the unnecessary compilation of data or of the unlimited extension of mean values. Almost the last contribution that he gave me was a

computation of the number of years necessary to reach a mean value for temperature within the limits of the probable error of the mean value for a single year, based upon some tables published in 1902 for the extrapolation of mean values. He was always more concerned to present meteorological data in a form amenable to computation than to increase their volume or detail. When the weekly weather report was initiated in 1884, he provided formulæ for computing the true daily mean from the maximum and minimum temperatures for the day, and for computing the amount of effective and ineffective warmth as referred to a base temperature of 42° F., which are still in use. He once astonished me by pleading for graphical representation as being easier to read than columns of figures, for he could extract the meaning of a page of figures with a facility that made the discussion of results with him an indispensable part of any piece of work that was in hand. Yet he was more than eighty years of age when we had to transact this kind of business together. He never lost his appreciation of new methods which were sound, or of new projects which were promising. Throughout his administration of the office he held to a high scientific ideal while maintaining the efficiency of such daily work as was required for public use and for international cooperation. His scientific horizon was a wide one. With Stokes and Balfour Stewart, he was largely instrumental in providing means for the organised study of the sun, which had been commenced in this country and in India by Sir Norman Lockyer, in order to trace the primary causes of those great meteorological fluctuations which exhibit themselves in alternations of drought and plenty in India, a study which, pursued for many years at the Solar Physics Observatory at South Kensington and at Kodaikanal, in India, has recently taken its place among the greater international organisations. As head of the Public Works Department in India, he transferred meteorological work in that dependency from a provincial to an Imperial basis under Blanford and Eliot, and laid the foundation for the admirable organisation of which the Government of India and its scientific staff now enjoy the advantage. At the same time, he initiated the forestry department and the application of botanical science to the service of the public in that department.

Probably no single person had clearer views of the future that lies before meteorological work as a matter of practical influence upon everyday life, or was more fully conscious of the long years of observation, organisation and study that are necessary to secure the advantages which will ultimately more than reward the long years of patient inquiry.

Above the mantelshelf of the unpretentious room over a piano shop in Victoria Street, which for more than forty years has been the chief centre of meteorological work in this country, there is a clear-cut profile of an old but by no means aged man, giving an unmistakable presentment of intellectual strength altogether undisturbed by side-issues and petty difficulties. Such indeed was Strachey. Beneath the portrait over his characteristic signature are the last words of a letter written about an office balance sheet that I thought more than usually depressing. "On the whole there is nothing to complain of." For meteorologists this is, at times, a hard saying; but to me at least it is entirely characteristic of the spirit with which he insisted upon meeting the difficulties that confronted us. "A heart that is established and will not shrink," a keen appreciation of the practical services which science can render in the present and in the future, a simple determination to regard the whole, to make the most of the means at his disposal without grumbling—these are the abiding recollections of the ten years of our association at the close of a long life devoted, with untiring energy, to the service of his country.

W. N. SHAW.

NOTES.

DR. C. CHREE, F.R.S., has been elected president of the Physical Society of London for the ensuing year.

THE annual congress organised by the Prehistoric Society of France will be held this year at Chambéry from August 24 to August 30.

M. BOUQUET DE LA GRYE has been elected president of the Bureau des Longitudes for 1908, M. Poincaré vice-president, and M. Bigourdan secretary.

PROF. W. J. SOLLAS, F.R.S., was elected president of the Geological Society of London at the anniversary meeting on February 21.

THE director of the Royal Meteorological Observatory at Agram, Hungary, informs us that the founder and former director, Prof. Ivan Stožir, died on February 12 after a short illness.

DR. H. F. OSBORN, one of the vice-presidents of the American Museum of Natural History and curator of vertebrate palæontology, has been elected president of the museum in succession to the late Mr. Morris K. Jesup.

IT is reported from Berlin that Mr. Andrew Carnegie has given half a million marks (25,000*l.*) to the Robert Koch fund for the campaign against tuberculosis. The amount collected so far for carrying out research work in connection with the disease amounts to 800,000 marks (40,000*l.*).

AN exhibition and sale of farm and garden produce, organised by the Women's Agricultural and Horticultural International Union, will be held in the gardens of the Royal Botanic Society, Regent's Park, N.W., on Wednesday, July 15. All communications should be addressed to the secretary, Miss Eileen Johnson, c/o Mrs. T. Chamberlain, 5 Priory Mansions, Drayton Gardens, S.W.

THE American Society of Naturalists has made arrangements to celebrate the one hundredth anniversary of Charles Darwin, in cooperation with the American Association for the Advancement of Science, on the occasion of their meetings in Baltimore in 1908. The Society of Naturalists, we learn from *Science*, will be represented on the committee of arrangements by the president, the secretary, and several members.

ON Thursday next, March 5, Sir John Rhys will begin a course of two lectures at the Royal Institution on "Early British History and Epigraphy," and on March 7 Prof. J. J. Thomson will commence a course of six lectures on "Electric Discharges through Gases." The Friday evening discourse on March 6 will be delivered by Prof. John Milne on "Recent Earthquakes," and on March 13 by Chevalier G. Marconi on "Transatlantic Wireless Telegraphy."

REPLYING to a question in the House of Commons on Tuesday, Mr. Churchill said:—"It is impossible to obtain accurate statistics regarding the mortality from sleeping sickness in Uganda, but, in a recent despatch, the Governor has estimated the number of deaths at 200,000 during the past seven years. Every effort is being made by the

Government to combat the disease by scientific investigation under the direction of the Royal Society, by local administrative measures, and by international cooperation with the other Powers whose possessions in Africa are similarly afflicted."

THE council of the Royal Society of Arts has awarded the gold medal offered by the society, under the Shaw trust for industrial hygiene, to Prof. W. Galloway, "in recognition of his valuable researches into the action of coal dust in colliery explosions, the outcome of which researches has been the provision of means by which the risk of such accidents is materially diminished, and a consequent great saving of human life effected."

IN connection with the International Congress on Tuberculosis, which will be held in Washington on September 21 to October 12, a prize of 300*l.* is offered for the best treatise that may be submitted to the congress on the relation of atmospheric air to tuberculosis. The prize is offered by the Smithsonian Institution out of the Hodgkins fund. The treatises may be written in English, French, German, Spanish, or Italian. They will be examined, and the prize awarded, by a committee appointed by the secretary of the Smithsonian Institution in conjunction with the officers of the International Congress on Tuberculosis.

WE learn from the Berlin correspondent of the *Times* that on February 20 the Reichstag passed the second reading of the Bill for the regulation of wireless telegraphy, in accordance with the decisions of the International Congress in Berlin in 1906, and conferring a monopoly of wireless telegraphy upon the Government. The German Government desires to maintain an attitude of neutrality towards all systems of wireless telegraphy, and in particular to secure intercommunication on the part of ships and land stations without regard to the system employed. Germany has accordingly declined to bind herself to any one system, upon the ground that the efficiency of the system adopted is of far greater importance than its technical character. The special committee of the Reichstag to which the Bill was referred was informed that messages by the Marconi system would be accepted by German ships and stations if the company conformed to the obligation to exchange communications with other systems.

LAST year some opposition was shown in the American Congress to the usual vote of funds to the Biological Survey, certain members of the committee on agriculture suggesting that this branch of the agricultural department was more ornamental than useful. Accordingly, a paragraph was inserted in the Appropriation Bill directing the Secretary of Agriculture to investigate the work of the survey, and particularly to inquire into the value of the work done by the Government ornithologists. A report of this investigation has now been issued, and a whole column of the New York *Evening Post* is occupied by a summary of the services which Secretary Wilson finds that the Biological Survey has rendered to American farmers and horticulturists. Not only has this bureau issued valuable bulletins and other publications, but it has prepared the way for important legislation for protecting useful birds and for preventing the importation of such as would be injurious. A typical example is the success of the bureau in preventing the importation of the kohlmeise, the introduction of which was advocated through misapprehension in the apple-growing districts of the Pacific Coast and the North-West, where it might have done enormous damage.

TWO striking examples of the best style of modern taxidermic art are displayed in the central hall of the natural history branch of the British Museum in the shape of a male and female Californian sea-elephant from Guadalupe Island. The specimens are the gift of the Hon. Walter Rothschild, and probably represent some of the last survivors of their species. They have been mounted by Rowland Ward, of Piccadilly, in whose establishment may now be seen a walrus set up for the Edinburgh Museum, which is likewise practically a revelation in the matter of mounting as compared with the bloated mummies by which the species has hitherto been represented in our exhibition galleries.

A DISCOVERY of exceptional interest is announced in vol. vi., part iii., of *Annotationes Zoologicae Japonenses* (December, 1907), namely, the occurrence of a fresh-water medusa, referred to the genus Limnocodium, in the Yang-tsi-kiang about 1000 nautical miles from its mouth. Limnocodium, it will be remembered, has hitherto been known solely by *L. sowerbyi*, discovered in 1880 in the Victoria water-lily tanks at the London Botanical Gardens, and subsequently observed in similar tanks at Lyons, but never yet found in its native home. According to its describer, Dr. Asajiro Oka, the new Chinese species, for which the name *L. kawaii* is proposed, differs from *L. sowerbyi* in certain points, which are, however, insufficient to admit of its generic separation, although rendering necessary some slight modifications in the definition of the genus. The home of the typical species is generally supposed to be Amazonia (not the West Indies, as Dr. Oka states), and it is hence possible that the genus may have a distribution analogous to that of tapirs, alligators, or spoonbill-sturgeons. It may, however, be found that Limnocodium is widely spread in the rivers and lakes of Asia. The Yang-tsi species was discovered in April last by Captain Kawai, of the steamboat service, near Ichang, in the province of Hupi, ten specimens having been obtained. The muddy condition of the waters of the river accounts for the medusa having previously escaped observation.

MR. JOHN BROGDEN, of 28 Colville Square, London, has sent us a copy of a catalogue of natural history specimens, in which is included biological material of almost all kinds other than skins of vertebrates. Among the specimens catalogued we notice a series of models of whales and dolphins, on a scale of 1 inch to the foot.

LANCELETS and lampreys form the subject of a paper by Mr. H. W. Fowler in the issue of the Proceedings of the Academy of Natural Sciences of Philadelphia for December, 1907. Of lampreys, the author describes, under the name of *Occanomyzon wilsoni*, a new genus and species on the evidence of a specimen a foot in length from the Atlantic. It is regarded as connecting the true lampreys, Petromyzon, with the deep-water Bathymyzon; it may occur at some depth.

THE first part of *Sitzungsberichte Natur. Verein der preuss. Rheinlande und Westfalens* for 1907 contains an account of the scientific results of a journey recently undertaken by Dr. Borgett to East Africa and the Nyanza. Although the expedition was mainly undertaken for the purpose of studying the plankton (of which certain new forms are described), the author furnishes some interesting information with regard to the big-game fauna of the Athi Plains and Nairobi, where he is of opinion that the protective laws enforced by the British Government are working satisfactorily. Giraffe, kudu, and eland were seen

in numbers in several places, while hartebeest, gnu, waterbuck, Thomson's and Grant's gazelles, and, above all, bonte-quagga, occurred in enormous herds, and rhinoceroses and hippopotamuses were by no means uncommon. The extinction, or decimation, of the fauna is, according to the author, not likely to occur for many a long day. Such testimony from an impartial and unprejudiced observer is as satisfactory as it is valuable.

FOR some years a difference of opinion has prevailed among palæontologists with regard to the systematic position of the group of Upper Tertiary mammals typified by the European genus Chalicotherium. In these mammals, it may be mentioned, the cheek-teeth are of the general type of the Perissodactyla, whereas the feet are of an unguiculate character, the latter feature having long led to the belief that these mammals were members of the Edentate order. Since the date of the association of the teeth with the foot-bones (when the ungulate affinities of the group could no longer be doubted), Mr. Lydekker has persistently maintained that there is no justification for separating the chalicotherioids from the Perissodactyla, whereas American palæontologists have with equal confidence asserted that they should form a subordinal (or ordinal) group by themselves. In an article contributed to the *American Naturalist* for December, 1907, Mr. O. A. Peterson, from the evidence of specimens referable to the genus Moropus, concludes "that Moropus is, excepting its unguiculate feet, essentially a perissodactyle in structure. That the laterally compressed and cleft condition of the terminal phalanges is quite distinct in some of the early Perissodactyla, and that by adaptation . . . the unguals of Moropus were specially modified, and should not . . . be regarded as of ordinal importance."

M. GASTON BONNIER records in the *Comptes rendus* of the Paris Academy of Sciences (vol. cxlv., No. 27) some interesting observations on what he terms the *raisonnement collectif* of bees. In one of his experiments he placed in his garden several lumps of sugar; these were visited by bees, which, however, were unable to bite off its particles on account of the weakness of their mandibles. The bees were marked by the experimenter, and were seen to fly off to their hive; in one to two hours they returned with other workers, but this time they flew, not from the hive, but from a fountain of water. On settling on the sugar they were seen to pump water from their crops on to the sugar, and then suck up the syrup so formed, finally flying back to the hive. Other observations convinced M. Bonnier that individual bees were able to communicate news of their discoveries of fresh sources of honey to the colony, and he has reason to believe that the number of workers summoned is always proportional to the supply of honey that has been found.

THE *Bio-Chemical Journal* for January (iii., Nos. 1 and 2) contains several interesting papers, notably one by Prof. Moore and Dr. Roaf on the equilibrium between the cell and its environment in regard to soluble constituents, with special reference to the osmotic equilibrium of the red-blood corpuscles, in which the conclusion is formulated that the difference in composition of the electrolytes within and without the cell, and the physiological effects of perfusion or irrigation of cells by media defective or excessive in certain electrolytes normally present in the cell receive a simple explanation, on the basis of the formation of adsorpates or chemical combinations between cell protein (or protoplasm) and other constituents.

THERE are two essential factors with others required for the success of a nature-study course, the one that the course should be seasonal, the other that the instructor should manifest a continuous and keen interest in his subject. The first point has been effectively brought out in a pamphlet by Prof. J. A. Thomson, issued from Aberdeen University, wherein he indicates suitable lines of study for various courses. The notes refer to physical, botanical, and zoological studies. A careful perusal of the pamphlet cannot fail to supply teachers with suggestions and stimulate interest.

THE January number of *Tropical Life* contains information with reference to a rubber exhibition that is already arranged to be held at the Royal Horticultural Hall in September this year, and an International Rubber Exhibition that it is proposed to hold in London a year or two hence. In the same journal useful information with regard to methods of cultivating and curing tobacco in Porto Rico is contributed by Mr. D. W. May, and the value of manures for cacao plantations forms the subject of one of a series of articles dealing with the cultivation of cacao.

A CONTRIBUTION by Mr. F. Ramaley on the silva of Colorado, dealing with the woody plants of Boulder County, is published in vol. v., No. 1, of the University of Colorado Studies. The flora provides an interesting study in altitudinal distribution, since the elevation of the county varies from about 5000 feet to 10,000 feet at the foot of the main range, while the highest peak exceeds 14,000 feet. Grass lands rise up to 6000 feet, when open forest of rock pine, *Pinus scopulorum*, and Douglas spruce, *Pseudotsuga mucronata*, is found. A zone of lodge-pole pine, *Pinus murrayana*, mixed with rock pine and limber pine, *Pinus flexilis*, reaches to 10,000 feet, above which the Engelman spruce is dominant. Higher again in the Alpine zone, the only woody plants are dwarf willows.

A NUMBER of the *Philippine Journal of Science* (vol. ii., No. 5), devoted to the descriptions of commercial Philippine woods, has been prepared by Mr. F. W. Foxworthy. It contains a general discussion of their structure and properties, a key for their identification, and notes on the species. The key is elucidated by means of a series of fifty-five photographs representing transverse sections. Of timbers well known on the European market, only teak and ebony are found; the former is very scarce, and the ebony is chiefly derived from *Maba buxifolia*, with less valuable timber from *Diospyros pilosanthera* and other species. "Narra" is a first-class timber yielded by *Pterocarpus indicus* and allied species, therefore related to Indian "padouk"; also the tree known in India as "poon," *Calophyllum inophyllum*, provides a timber that is employed for construction and furniture. Other valuable species are *Homalium luzoniense*, *Illipe betis*, *Pithecolobium acle*, species of Lagerstroemia, Intsia and Vitex, and *Pahudia rhomboidea*.

A PAMPHLET on the geology of the Roberts-Victor diamond mine has been published by Mr. J. P. Johnson (Johannesburg). This mine, which is situated in the Boshof district, Orange River Colony, presents many points of geological interest, and the author's observations lead him to believe that kimberlite, the rock in which the diamonds occur, is not an igneous rock, but a purely fragmental one, simulating in parts an igneous structure owing to changes induced by hot water or steam, and that it is to these factors that the extreme alteration of the mineral constituents of both the peridotite and pyroxenite boulders and of the matrix in which they lie is due.

A DETAILED description of the geology and mineral resources of Lawlers, Sir Samuel, and Darlot (East Murchison goldfield), Mount Ida (North Coolgardie goldfield), and a portion of the Mount Margaret goldfield is given by Mr. C. G. Gibson in Bulletin No. 28 of the Geological Survey of Western Australia. The report, which covers seventy-three pages, and is accompanied by three large folding maps and five mining plans, shows that rocks of the district comprise granites and greenstones, the payable gold quartz veins occurring in the latter. The granites are seen almost everywhere to be intrusive into the greenstones. The quartz veins appear to be of later origin than the granite, and in most cases they occur at no great distance from its junction with the basic rocks. The district under review had returned, up to the end of 1906, 581,104·61 ounces of gold.

THE Records of the Geological Survey of India (vol. xxxvi., part ii.) contain the report on the mineral production of India during 1906 compiled by Mr. T. H. Holland, F.R.S. Compared with the previous year, there was an increase of 10·9 per cent. in the value of the total production. The production included 581,545 ounces of gold, 9,783,250 tons of coal, 140,553,122 gallons of petroleum, 495,730 tons of manganese ore, and smaller quantities of salt, saltpetre, mica, ruby, sapphire, jadestone, graphite, iron ore, tin ore, chromite, diamonds, magnesite, and amber. In the same issue Mr. E. W. Vredenburg describes the ammonites of the Bagh beds, and there are several interesting brief miscellaneous notes. Amongst these there is a description of the occurrence of wavellite, which has apparently not been previously recorded from India, in the Singhbhum district, Bengal.

DR. GUSTAV BRAUN, of the Geographische Institut, University of Greifswald, announces that he is anxious to collect information as to "Bodenbewegungen," which he defines as movements taking place on restricted areas of the earth's surface as the result of gravitation (*Jahresbericht der geographischen Gesell. zu Greifswald*, 1908). He does not propose to include mountain-folding, though this might attract Herr E. Reyer and Dr. Ampferer, to name no others; but he seeks cooperation from those who have the opportunity of observing slow or sudden movements of the soil, landslides and rock-falls, flows of peat, and all kindred superficial phenomena. The results of human operations are to be included. Dr. Braun issues forms to those who can assist him, on which exact details of each case studied can be entered, and he is even willing to collect extracts from newspapers. Surely he cannot be acquainted with the reckless treatment of natural phenomena by the popular American and English Press. Yet his circulars will probably bring to his notice certain carefully studied examples of rock-creep, bog-sliding, and so forth, which will afford material for comparison with those examined by himself.

IN part i. of *Aus dem Archiv der deutschen Seewarte* for 1907, Mr. A. Paulus discusses the duration of the passages of German sailing vessels in 1893–1904. This laborious investigation, which should be of practical utility as well as interesting from a general point of view, deals with the three large oceans (the outward and homeward voyages being separately discussed), and shows the average duration and the times of the longest and shortest passages in the period mentioned. The tables also give the duration of the shortest passages from about 1870, including the results obtained from a somewhat similar discussion by Dr. Schott prior to 1893, and observations from other sources. From the latter it is seen that a fair number of the shortest voyages has occurred in the more recent period, and this result, we think, may be reasonably ascribed to the dissemination of useful information in American, English, and German charts. We note that Mr. Paulus is able to say that there are only a few German sailing vessels which do not keep a meteorological log for the Seewarte.

THE hydrographical researches carried on in connection with the international fishery investigations continue to lead to the issue of a number of useful monographs and reports. Amongst those now before us are the current issues of the *Bulletin des Résultats acquis pendant les Croisières periodique*, which has recently been enlarged in scope, with great advantage, to include observations taken during three-monthly periods, as well as those taken on the regular quarterly cruises. The number of charts and sections illustrating the results arrived at has also been increased. In *Publications de Circonstance*, No. 40, issued by the International Council, Mr. Johan Gehrke discusses the mean velocity of the Atlantic currents running north of Scotland and through the English Channel. These two currents constitute the sources of supply of Atlantic water to the North Sea. Mr. Gehrke calculates that the whole water volume that yearly passes round the north of Scotland (within certain defined limits) is about 61,000 cubic kilometres, and has a mean salinity of 35·15 $^{o}/_{oo}$, whilst the annual water supply to the North Sea through Dover Straits is 2036 cubic kilometres, and its mean salinity 35·07 $^{o}/_{oo}$. In *Publications de Circonstance*, No. 38, Mr. Martin Knudsen points out that in certain areas the determination of the salinity of the surface water may be of very great service to the navigator in helping him to fix the position of his vessel at sea.

A NOTE on certain Maori carved burial-chests, by Mr. T. F. Cheeseman, is published in the Transactions of the New Zealand Institute, vol. xxxix. Although it had been recorded that manoa trees, *Dacrydium colensoi*, were reserved by the Maoris for making coffins, there is little or no information regarding such coffins in which the bones were placed. The burial-chests recently discovered, and now stored in the Auckland Museum, are carved into the rough similitude of a human figure, except two of a different shape. So far as evidence is forthcoming, they may be two hundred years old.

To the January number of the Journal of the Gypsy Lore Society Mr. A. B. Sinclair contributes an article on the Oriental Gypsies. His view that there are no Indian Gypsies, that the recent find of Oriental books at Turfan, with other evidence, shows that the civilisation and phonetics we have been wont to consider special to India flourished at one time north of the Himalaya, and that therefore there is no need to seek the origin of the Romani speech in India, is startling, and not likely to be accepted without further proof than that furnished in the present article. The revived society, which has its headquarters at 6 Hope Place, Liverpool, deserves the support of all who are interested in this remarkable race.

Two papers, one by Mr. Edgar Buckingham in the Bulletin of the Bureau of Standards (U.S.A.), iii., 2, and another by Mr. J. D. Hamilton Dickson in the *Philosophical Magazine* for January, show that there is still material for discussion in the already much discussed "Joule-Kelvin" experiments on the determination of absolute temperature by the flow of gases through a porous plug. Mr. Buckingham introduces the subject with a short discussion of the fundamental equation,

which, as he points out, affords a direct comparison between the constant pressure scale of any gas and the absolute scale, but which cannot be applied directly to the constant volume temperatures without knowing the isothermal equation of the gas. He discusses the various empirical assumed formulæ for the "cooling effect," and the conclusions deducible from them. The relations of actual gas scales to the thermodynamical scale are set forth, but the author considers that the time is approaching when a mere reference of temperatures to "the gas scale" will be insufficient. Mr. Dickson's paper deals with the inversion temperature of the Joule-Kelvin effect both for small and for finite differences of pressure, with special reference to Olszewski's experiments.

THE *Physikalische Zeitschrift* for February 1 contains a description, by Dr. C. W. Lutz, of the filament electrometer invented by himself and Dr. M. Edelmann, jun. The filament consists of a Wollaston platinum wire of about 0·001 mm. diameter suspended vertically between two narrow vertical plates, one of which can be put into electrical connection with the wire, while the other may be connected either to earth or to some source at constant potential. The repulsion of the filament from the former plate when both are charged is observed through a small microscope magnifying eighty times, and by suitably adjusting the tension of the filament the range of the instrument may be made to extend from 2 volts to 1000 volts. It is very compact, and its electrical capacity is less than 10 cm.

MR. C. W. BURROWS, of the United States Bureau of Standards, after extensive experiments on the various methods in use for demagnetising iron in magnetic testing, comes to the conclusion that the following is the best method of procedure:—the current should be reversed about twice a second, and diminished at such a rate that the decrease of induction is as nearly as possible the same each second, the process to last about ninety seconds. In obtaining the magnetisation curve of the specimen, the magnetisation current should be reversed about the same number of times, and near the end of the series two throws of the ballistic galvanometer about twenty-five reversals apart should be observed. If they agree, they may be taken as representing the normal induction. The next observation may be made by this method without its being necessary to again demagnetise the specimen (Bulletin for January).

A NEW and cheap edition (price 5*s.* net) of Mr. Benjamin Kidd's "Principles of Western Civilisation" has just been published by Messrs. Macmillan and Co., Ltd. The original work was reviewed at length in NATURE of April 24, 1902 (vol. lxv., Supp., p. vi). In a long introduction, which appears for the first time in the new edition, Mr. Kidd replies to points raised by his critics, and refers to some differences between the evolution of the individual and of a social organism. Mr. Kidd has been appointed to deliver the Herbert Spencer lecture for 1908 before the University of Oxford in May or June next. Three lectures have already been given, namely, in 1905 by Mr. Frederic Harrison, in 1906 by Mr. Auberon Herbert, and in 1907 by Mr. Francis Galton, F.R.S.

OUR ASTRONOMICAL COLUMN.

SATURN'S RINGS.—The January number of the *Astrophysical Journal* (vol. xxvii., No. 1, p. 35) contains an article by Prof. Barnard in which he describes and discusses his recent observations of Saturn's rings with the 40-inch refractor of the Lick Observatory. On July 2, 1907, Prof. Barnard found that, although no direct sunlight was falling on its earthward side, the entire surface of the ring was distinctly visible. On each ansa were two prominent condensations symmetrically placed with respect to the ball. On October 4—when the earth again passed back to the shadow side of the ring—and for some days after, the ring was perfectly linear, and the condensations, which, if they were real masses on the ring system, should then have been best seen, had disappeared.

From his observations Prof. Barnard concludes that it is not merely the illuminated edge of the system which we see when the earth is on the shadow side, but the feebly luminous surface of the ring itself viewed very obliquely. The luminosity is caused by the transmittance, by repeated reflections from the particles comprising the ring, of sunlight. Adopting this interpretation, the condensations are produced by the outer brighter part of the inner ring, the higher illumination of which, as seen ordinarily by directly reflected light, or, as during these observations, by light which had by successive reflections passed through the ring, is probably due to the denser agglomeration of its particles.

THE OBJECTIVE PRISM IN SOLAR SPECTROSCOPY.—A device by which double equatorial refractors, as employed for stellar photography, may be adapted to serve as objective-prism spectroscopes in solar observations, is described by M. E. Schaer in No. 4233 of the *Astronomische Nachrichten* (p. 137, February 15). The solar rays, passing through the first objective, are, by two reflections by plane mirrors, projected along the axis of the second telescope. Before reaching the second tube the reflected image is, however, intercepted by a slit plate, so that only the narrow beam which passes through the slit traverses the tube to the object glass. On passing through the latter the light falls upon the objective prism, which is silvered on the posterior face, so that after two dispersions and one reflection it passes again through the object-glass and down the tube. The solar spectrum thus produced may be viewed with an ocular, or an arrangement for photographing it may be substituted. By the interposition of a second slit in front of the photographic plate and mechanical movements this instrument may be used as a photospectroheliograph.

UNIFORMLY DISTRIBUTED DARK SPOTS ON JUPITER.—In an article which appears in the January number of the *Bulletin de la Société astronomique de France*, Mr. Scriven Bolton describes a number of Jovian phenomena observed by him in recent years, and pays particular attention to a series of dark markings which are symmetrically distributed along the northern edge of the south equatorial and the southern edge of the north equatorial bands. As these spots occur in the same longitudes on each band and partake of a common motion, Mr. Bolton concludes that they have an objective existence. Generally, the alternate spots on the opposite bands are joined by festoons of dark material which cross the equatorial regions obliquely at angles of 45°. The spots on the southern band present the more marked uniformity, there being twenty-four of them at regular intervals throughout the whole length of this band. Drawings made on June 15, 1899, November 4, 1903, and February 23, 1907, respectively, are reproduced to illustrate Mr. Bolton's description.

DOUBLE-STAR OBSERVATIONS.—Finding that the published magnitudes of the components of double stars are generally only given approximately, Dr. Joel Stebbins, director of the Urbana Observatory, Illinois, U.S.A., decided to make a number of systematic photometric observations of them, and he now publishes the results in the Bulletin of the University of Illinois (vol. iv., No. 25, 1907). After describing the instruments employed and the system of observation, Dr. Stebbins gives a catalogue of the 107 double stars which he observed, and discusses the probable errors and the differences from the Harvard observations of the same objects. On comparing the results with other available observations, no evidence of variability could, with certainty, be detected, and in the case of θ^1 Orionis —the Trapezium stars—it appears certain that no change greater than 0·08 magnitude has taken place since the Harvard observations were made in 1878.

PLANETARY PHOTOGRAPHY.

THE recording on photographic plates of the canals of Mars is as significant from a technical point of view as it has proved of widespread interest in its result; for the method which alone rendered success possible had first to be developed, previous celestial photographic processes being inadequate to the task. At the request of the editor of NATURE, I propose to give some account of the method pursued, and the more gladly in that it is evident from attempts to follow it that its principles are as yet as much a *terra incognita* as have for so long remained the canals themselves. The process is the outcome of four years' study by Mr. Lampland, who, to a knowledge of the end desired, acquired from visual work on the planet, added experimental research on the means to attain it. Of the difficulty of the subject the best testimony are the words Schiaparelli wrote the writer on receiving in 1905 the first prints from the plates:—"I would never have believed the thing could be done."

The fundamental distinction between planetary photography and photography of the stars is that with the former definition, not illumination, is the primary point. To imprint upon the plate such delicate tracery as the canals of Mars requires a definition so far beyond celestial photography in general as to constitute a class of work by itself. For one is here concerned with quantities of the second order of minuteness.

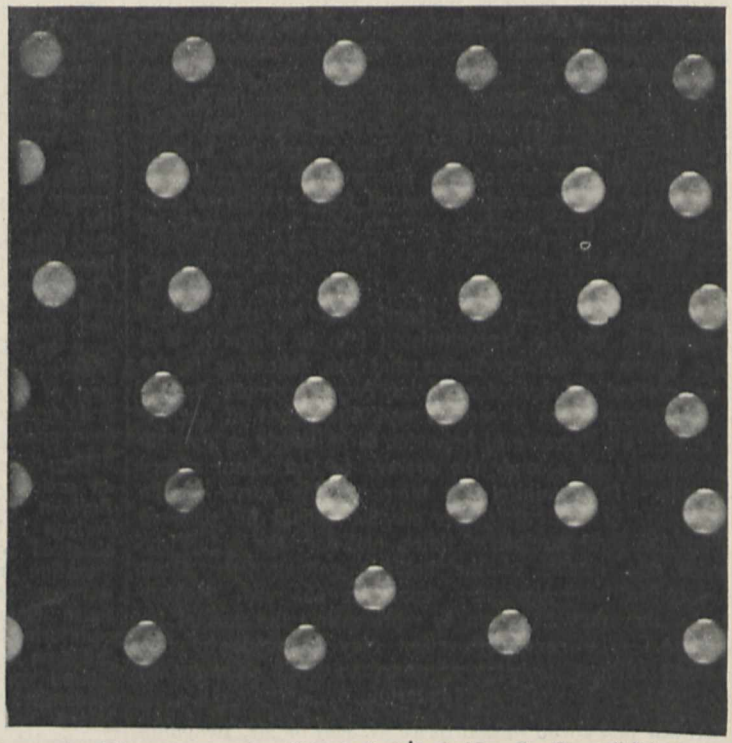
Definition, therefore, had to be studied. The chief disturber of the image is the atmosphere. A knowledge of how this conditions the seeing is, then, the first requisite to success. Living as we do under a gaseous ocean in constant turmoil, no image from beyond it stays perfect for long, soon being either distorted or displaced by the shifting refraction of differently dense layers of air. The effect we notice every day in the twinkling of the stars. To educate the eye to sift the fleeting impressions it receives is thus the first step to becoming an observer of Mars. Distrust of its own revelations because of their short-livedness is one chief cause of failure to see the canals. More, not less, is a like handicap true of the camera; for the eye is some thousands[1] of times as sensitive as the films we can employ. So that at first it would seem hopeless to attempt to part the good moments of definition from the bad, and thus to prevent the superposition of a poor or shifted image upon a clear-cut one, to the resulting disheartenment of a general blur.

To catch the planet's fugitive expressions of itself, speed of exposure becomes imperative; and that as many such as possible might be seized, a special camera had to be devised, something which should realise the demon-machine of Clerk-Maxwell for images in place of molecules, to let the good ones through and stop the bad. The mechanical part of this Mr. Lampland contrived by a plate-holder fitted with a lateral ratchet motion worked by a bulb, and capable of being pushed up and down after each line of images had been secured. At the opposition of 1905 this camera was worked without guiding, as the exposure time seemed not to necessitate it, but for that of 1907 Mr. Lampland suggested the use of, and fitted on, the 6-inch as a finder. In spite of the very short exposure possible, the guiding thus introduced turned out an improvement.

The next difficulty in definition lies with the glass. In spite of its name, no achromatic lens is achromatic. Though the departure from perfection is practically imperceptible to the eye, such is not the case with the sensitised film; for the rays of different colours form their images in different focal planes. Of these, the eye selects what it will attend to, while the camera cannot, and so, on the plate, if an image made by one colour be in focus, it must perforce be surrounded by others that are not. A reflector, of course, avoids this blur of superposition, since all the rays are brought to one focus, but, on the other hand, it introduces more serious errors of spherical aberration; for not only does any want of figuring or of sag in the mirror, but any disturbance in the air produces three times the distortion it does in the glass. It is thus problematic whether a reflector can ever be used for such fine work, though we intend to give it a trial with a 3-feet mirror.

To secure approximate monochromatism, and thus a more clear-cut image, a screen or filter of coloured glass, or of a coloured solution between glass, had to be used to cut off certain of the rays. This device is the same that was used visually by Schiaparelli, and that has been used at Flagstaff in like research, though it has not been found there so effective as a neutral-tinted glass, because, as mentioned above, the eye does its own sifting for the rays it elects to observe. Photographically it was first employed by Ritchey in his photographs of the moon, and here its value is inestimable. The general method of making the screens is to determine first the colour-curve of the objective, that is, the curve in which the abscissæ represent the wave-lengths of the rays of differing refrangibility and the ordinates their focal lengths. From this curve it becomes possible to select what rays shall be allowed to pass to secure a sufficient approximation to monochromatisation, and the screen is then coloured to attain the result. In the construction of such screens Mr. R. J. Wallace is preeminent, and by him in this manner were made those for the Flagstaff glass.

The next crux entered with the plates. In consequence of the greater relative deviation in focal length suffered by the blue rays, which are the ones most actinic, and those to which the ordinary plates are sensitised, such plates cannot be used for interplanetary photography. To get enough light with them to approach instantaneity the



Photographs of Mars; Ganges region. Taken by Prof. Percival Lowell at Flagstaff, July 28, 1907.

[1] With the Flagstaff objective diaphragmed down to 12 inches, and with a power of 393 further weakened by a screen that takes off at least three-quarters of the light the eye sees on Mars' canals in less than the twentieth of a second which it takes the plate two seconds to register with a magnification of 150 and under the full aperture of the 24-inch glass.

blue rays would have to be made use of, and they would irretrievably blur the image. Plates sensitised to other parts of the spectrum must be employed, and as it has not been possible to make such adapted only to the yellow and orange rays, a coloured screen must be used in connection with them. Only when more restricted emulsions shall have been produced will it become feasible to dispense with the sifter.

The plates most nearly giving us what we wanted proved to be Cramer's isochromatic instantaneous plates. They are neither instantaneous nor isochromatic, but their two negatives nevertheless combine to the best affirmative it is now possible to obtain; for beyond their mountain mass of reaction in the violet and blue, to speak figuratively of their curve of sensitiveness, they have a hillock in the yellow with sides of great abruptness. By Mr. Lampland, who carefully experimented with every kind of plate, these were found, and for the above reason, to yield the best results in the way of speed *with* definition. Their chief drawback consists in their not being so finely grained as one could wish.

This brings us to another difficulty that had to be encountered. In the sensitising of plates speed is inevitably associated with coarseness of grain, and *vice versâ*. Finely grained emulsions are necessarily slow. To avoid the Scylla of over-exposure is to fall into the Charybdis of under-definition. As speed must be got at all hazards, the images of Mars are not so fine in texture as those securable of earthly scenes, as, for example, by lantern-slide plates. This is to be remembered in scanning the images. Anything beyond a slight magnification of the original negatives results in perceptible, though not always perceived, blurring of the details due to the showing of the grain. Photographic experts will thoroughly appreciate this, and trace the linearity of the canals clearly through its partial disguise.

After all other points have been attended to, there still remains the question of aperture; for the smaller the aperture the sharper the definition for the same sized magnification, the gain from the point of view of the air-waves vastly exceeding the loss due to a larger spurious disc. Thus with an image magnified to four hundred diameters, a 12-inch gives ninety-nine times out of a hundred more clear-cut detail than a 24-inch. This, which is so decided a gain in visual work, is partially offset in photographic work by the necessary increase in exposure time, and the consequent greater chance of mixing poor moments with the good. As the exposure time decreases inversely as the square of the radius of the glass, while the improved definition increases inversely as that radius, Mr. Lampland, in 1907, used only the full aperture of the 24-inch. In this decision I quite concur from the results at the last opposition, merely adding the gloss that with the larger aperture one is more certain of a good image; with the smaller, one will score an even greater success on exceptional occasions. This, of course, is to be taken within limits.

By the general method I have outlined Mr. Lampland secured the first photographs of the canals at the opposition of Mars in 1905. Some fifty of the canals show upon his plates. This success was entirely due to his exhaustive study and attention to all the factors I have formulated. During the time between 1905 and 1907 Mr. Lampland continued his research, and in June, 1907, took his first plates at the opposition just passed. The images showed a marked advance. In 1905 he had registered the Nilokeras double (12° apart). In June, 1907, the Gihon (5°·0 apart) stood duplicate in his photographs, while the Euphrates (4° apart) pretty certainly showed in the same manner, though from principles of conservatism I was not willing to commit myself to its announcement. At the same time plates were taken by me showing in like manner a great number of single canals, and the double Gihon and almost unquestionably the double Euphrates appear. For the same opposition an expedition was undertaken by the Lowell Observatory to the Andes under the charge of Prof. Todd, Mr. E. C. Slipher, of the Lowell Observatory, being detailed upon it armed with a duplicate of our apparatus, and thoroughly coached beforehand by Mr. Lampland in its employ. Mr. Slipher, by whom all the work of the expedition on Mars, both photographic and delineatory, was done, secured plates in July at Alianza, Chile. The place had been chosen primarily because of its lying in the solar eclipse belt, Prof. Todd being desirous of observing the annular eclipse there, but it proved, although but 4000 feet above sea-level, probably the best locality that could have been selected. By a skill and assiduity deserving of the highest praise, Mr. Slipher obtained some 10,000 images of the planet in the course of a couple of weeks. Owing to the remarkable steadiness of the air and the high altitude of the planet, his plates show a wonderful amount of detail. The doubling of the Gihon and of the Euphrates previously registered at Flagstaff were also exhibited on them, besides canals and oases in profusion. As an instance of the latter I may mention the distinct showing of the two little oases in the Trivium. His drawings were no less remarkable. As an example, the double Ganges, which for two oppositions now the writer has observed stronger on its right or western side than on its eastern, appears with this same differentiation in Mr. Slipher's picturing, although he had no previous acquaintance of the fact. Having discovered that he has an eye for planetary detail, he is to continue such study in the future.

The future promises even more than the past has fulfilled. Several improvements have been effected, or are in contemplation, which were not put into operation at the opposition of 1907. One of them is a new screen devised by the writer. Though both conceived and constructed before the opposition, it was only tested this last summer, but enough to show an improvement in definition from its use. Its basic principle was the integration of the greatest amount of illumination with the least focal difference of wave-length. To explain the idea, suppose that the light reaching the plate for each ray be weighted according to its proximity for focal length to a given focal distance by an inverse function of such departure, the function becoming negative after a certain discrepancy because the inclusion of the ray then does more harm than good. Suppose this light summed for all the rays between certain limits. The most effective screen will be that for which the integral is a maximum. The point up to which the rays should be cut off, as indicated by an examination of the colour curve of the 24-inch glass, seemed to lie at $\lambda = 5000$, and for this, accordingly, I asked Mr. Wallace to construct a special screen. The result, though for some reason not so effective practically with bathed plates as was theoretically to be expected, proved successful with Cramer's isochromatic instantaneous plates, owing to the insensitiveness of the plate for the red and ultra-red rays, and to the fact that $\lambda = 5000$ marked a minimum in its action followed by a rise.[1]

Other devices which should improve the process are also to be practised, and these, with the increased presentation of the planet's disc, should result in another decided advance in photographic presentment; for the planet will in 1909 be more advantageously placed for Flagstaff on three counts:—

(1) A larger disc.

(2) A greater altitude.

(3) A more developed condition of the canals due to the advance in the Martian season.

In spite of the interest which the taking of such photographs has caused, it must be remembered that after all the eye remains our most potent instrument of research. So thoroughly was this realised at Flagstaff that the photographs were originally undertaken simply with a view to their educational value. Inasmuch as these photographs in good air are superior to untrained eye observations in a poor one, they serve to dispel directly a modicum of doubt, though they cannot at present equal what the trained eye can see under similar conditions. But indirectly they do more; for they corroborate completely, so far as they go, visual observations which have been so extensively denied, and establish, therefore, a very strong presumption that those visual detections are true also beyond what the photographic plate has power to portray. In this connection it is interesting to note that more than one astronomer who has seen the canals from a middle ground of definition neither good nor bad has

[1] For a more detailed account of the device, see the Lowell Observatory Bulletin, No. 31.

adduced the photographs as he interprets their features as corroborating his own observations, forgetting that this implies that he sees the originals only a fraction as well as he should.

Yet even so the photographs have surpassed our hopes, for they disclose more than one could have ventured to imagine. An eye versed in photographic perception and interpretation will easily see in them the canals as lines and the little spots, the oases, at their junctions. Indeed, the camera has shown itself capable of rising beyond the confirmatory into the discovery stage; for one of the plates of the writer was instrumental in the detection of a new canal. A stranger appeared on the plate which when searched for visually in consequence proved to be there. At the next opposition, with our newly devised improvements and with the planet so much nearer the zenith for northern observers, it is confidently to be expected that we shall do still more.

PERCIVAL LOWELL.

HYDROLOGY IN THE UNITED STATES.

IN some of the more recent reports on the hydrology of the United States, the book is prefaced by a general statement as to the intention and scope of the surveys that are being carried out by the geological department of the Government relating to the water resources of the country.

Water supply is regarded as one of the principal national assets, and of more importance to the life and pursuits of the people than any other natural resource. In the arid States the limit of agricultural development is determined by the amount of water available for irrigation. In other States, where the rainfall is greater and more evenly distributed throughout the year, the lack of rain at the proper season often reduces a crop to one-half what it would have been with one additional wetting at the time most needed. Storage, providing water for use when most wanted, will in such a case be as beneficial as where irrigation has to be depended on exclusively. This is especially the case in those districts where market gardening is one of the most profitable agricultural pursuits. Here irrigation is a necessity for making the business profitable.

The increase in the population of cities and towns makes necessary additional water supplies for domestic and industrial uses, in procuring which both the quantity and quality of the water that can be obtained must be considered.

The location of manufacturing plants may depend largely on the water-power facilities and the character of the water. Electric transmission of power has led to the utilisation of water-power for the operation of manufacturing establishments and lighting plants. Water-power is also largely used in some States for log driving, lumbering, and saw-mills, and also for the manufacture of paper from wood pulp and straw.

For all or any of these purposes a knowledge of the flow of the streams and of the conditions affecting that flow, based on trustworthy data, and of the underground resources is essential. For the want of this many schemes for water supply have ended in failure, the plans being made without sufficiently trustworthy information.

The United States Geological Survey has therefore, by means of appropriations by Congress, for several years systematically been engaged in obtaining records of stream flow, the number of stations at which streams were under observation in 1906 being 700. Records are also obtained in regard to floods, precipitation, the relation of the rainfall to run-off of water, evaporation, water pollution, the flow of underground streams, the use of artesian and surface wells, and generally all matters relating to water supply.

The reports relating to the above matters, and also as to the water resources of different States and districts, are issued from time to time, upwards of 200 reports having already been issued.

Notices of these reports, directing attention especially to those papers which are of general interest, have appeared in NATURE at various times.

The most recent reports of which we have received copies,[1] eleven in number, relate to the water resources of Georgia, New England, and other districts, the information contained in them being principally of local interest, except Paper No. 201, which has an introduction dealing with the system followed in obtaining the discharge of streams.

THE TESTING OF MATERIALS.

THE official report of the proceedings of the fourth Congress of the International Association for the Testing of Materials was recently issued. The congress was held at Brussels in September, 1906, and the report contains a condensed account of the reports presented and a summary of the discussions upon the reports and papers. The congress met in three sections, one dealing with papers on metals, another with papers on cement and artificial stones, and the third dealing with miscellaneous investigations, such as protection of metals against rust, testing of timbers, rubber, &c. Before the sections began their proceedings, Prof. Schüle delivered an address dealing with the life and work of the late president and founder of the association, Ludwig von Tetmajer.

One of the most important matters discussed in the metal section was the method of testing notched bars; after a lengthy discussion the congress eventually adopted the following resolution:—"The congress recognises that the method of testing notched bars appears capable of giving extremely interesting results." The congress did not, however, adopt a resolution which was moved to the effect that the method should be experimentally introduced into certain specifications.

In regard to the subject of ball-pressure tests, the congress eventually adopted the following resolution:—"The present congress desires that in the acceptance of metallic materials tests of tenacity should be supplemented as often as possible by a determination of the Brinell hardness number, the latter test being performed for the object of collecting information."

During the meeting of the association a metal-testing laboratory was installed at Brussels in order to show in action the various modern processes employed in the testing of materials. The tests made were micrographic, determination of the critical points, impact tests on notched bars, Brinell ball tests, and shearing tests. The congress has published a small illustrated pamphlet descriptive of the various testing appliances which were at work in this metal laboratory, with a brief note on the results obtained.

T. H. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor gives notice that the election of a professor of agricultural botany will take place on Monday, March 16. Candidates for this professorship are requested to communicate with the Vice-Chancellor on or before Wednesday, March 11.

Sir Ernest M. Satow, G.C.M.G., has been appointed to the office of reader on Sir Robert Rede's foundation for the present year. The lecture will be given in the Senate house on Saturday, June 13.

LONDON.—In connection with the supplementary vote of 6000*l.* for the Imperial College of Science and Technology at South Kensington, being part of the annual Government subvention of 20,000*l.* to the college, Sir Philip Magnus inquired last Friday in the House of Commons whether the 20,000*l.* was in excess of the cost of maintenance of the Royal College of Science and the Royal School of Mines, which had been incorporated in the Imperial College. In reply, Mr. Lough explained that the grant of 20,000*l.* was arranged by the Board of Education under the late Government; in addition, the Imperial College would have the fees paid by students, including fees paid by the Board of Education for scholars nominated by the Board. In reply to a further inquiry by Sir Philip

[1] Water Supply and Irrigation Papers. (Washington: Government Printing Office.)

Magnus whether the Government intended to appoint a Royal Commission in reference to the relation of the Imperial College to the University of London, no information appears to have been forthcoming.

OXFORD.—The annual report of the delegates for instruction in forestry shows that the average number of forestry students in 1907 was fifty-seven. The forest garden and experimental plantations in Bagley Wood have been much increased during the year, and the lack of accommodation is about to be met by the generosity of St. John's College. A block of buildings for the accommodation of the professor of rural economy was erected in Parks Road during the years 1906–7. It is now proposed to add further accommodation for the forest branch, consisting of a lecture theatre, a class-room, a museum, a library, and a professor's room. The new buildings will be ready by the end of 1908.

The degree of Doctor of Science has been conferred on Mr. E. H. J. Schuster, New College, for his contributions to biometrical science.

WE learn from the *Revue scientifique* that by a decree of February 10, inspectors of technical instruction are to be appointed in France. Ordinary inspectors will be chosen from among the directors and teachers of technical schools, and district inspectors will be selected from competent leaders of industrial or commercial enterprises.

THE Secretary of State for India has appointed a committee to inquire into and report upon the present system of selecting, and of training after selection, candidates for the Indian Forest Service, and to make recommendations. The committee is constituted as follows:—Mr. R. C. Munro Ferguson, M.P., chairman; Sir John Edge, K.C., member of the Council of India; Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S.; Mr. E. Stafford Howard, C.B.; and Mr. St. Hill Eardley-Wilmot, Inspector-General of Forests in India.

THE London Inter-Collegiate Scholarships Board will hold in May a combined examination for twenty scholarships and exhibitions tenable at University College, King's College, and the East London College. Candidates must have matriculated at the University of London or have passed an equivalent examination, and be under the age of nineteen years on October 1 next. The total value of the scholarships offered exceeds 170*l*. Full particulars may be obtained from the secretary to the Board, Mr. A. E. G. Attoe, University College, Gower Street, London, W.C.

WE learn from the *Times* that at the meeting of the council of the University of Paris on February 24, the Vice-Rector presented to that body a loving cup, a gift made by the University of London to the University of Paris as a souvenir of the hospitality it received last summer. The cup is silver-gilt, repoussé and chiselled, and is nearly 3 feet high. The lid is surmounted by an allegorical figure, while the body of the cup bears on its outside the arms of the Universities of Paris and London, two escutcheons emblematic of the French Republic and Great Britain, and three figures symbolic of science, letters, and art.

THE Calcutta University will celebrate its jubilee this year by conferring the following honorary degrees at the Convocation to be held on March 14:—*D.Litt.*, the Hon. Sir A. H. L. Fraser, K.C.S.I., Lieut.-Governor of Bengal and Rector of the University. *D.L.*, the Hon. Sir Subramaniya Aiyar, K.C.I.E., Vice-Chancellor of the Madras University; the Hon. Mr. Justice Chatterjee, C.I.E., Vice-Chancellor of the Punjab University. *D.Sc.*, the Hon. Dr. Justice Mukerjee, Vice-Chancellor of the Calcutta University; Prof. A. Schüster, F.R.S.; the Rev. Father E. Lafont, S.J., C.I.E., late Rector of St. Xavier's College, Calcutta; Mr. T. H. Holland, F.R.S., director of the Geological Survey of India; Dr. G. Thibaut, C.I.E. *Ph.D.*, Dr. R. G. Bhandarkar, C.I.E., late Vice-Chancellor of the Bombay University; Sir Gooroo Das Banerjee, D.L., late judge in the Calcutta High Court; Sir H. H. Risley, K.C.I.E., C.I.E., secretary to the Government of India; Prof. P. C. Rây. *M.D.*, Surgeon-General G. Bomford, C.I.E., Director-General of the Indian Medical Service.

AMONG the gifts to colleges and other institutions of higher education announced in *Science* during the past few months, the following, of 10,000*l*. or more, may be mentioned. By the will of the late Mr. D. Willis James 20,000*l*. was bequeathed to five separate institutions, including Columbia and Yale Universities. Prof. J. H. Hammond, by an additional 1000*l*., has brought his gift to the Hammond Metallurgical Laboratory of Yale University to 25,400*l*. By the will of Mrs. Sarah E. Potter, of Boston, Harvard University received a bequest of 10,000*l*., to be used in connection with the Gray herbarium. Columbia University has received an anonymous gift of 20,000*l*. Yale University has benefited to the extent of 10,000*l*. by the will of the late Mr. Silliman Bladgen. Mr. John D. Rockefeller has added 438,200*l*. to his previous gifts to the University of Chicago, making the total amount of these nearly 5,000,000*l*. Colorado College has completed an addition of 100,000*l*. to its productive funds, towards which Mr. Andrew Carnegie contributed 10,000*l*. According to the daily papers, Bradley Polytechnic, of Peoria, Ill., benefits to the extent of nearly 600,000*l*. by the will of the late Mrs. Lydia Bradley. Mr. Andrew Carnegie has also given 40,000*l*. to Berea College and 15,000*l*. to Illinois College, at Jacksonville.

ANOTHER attempt at a settlement of the controversy relating to religious instruction in public elementary schools was introduced in the House of Commons on Monday in the form of a Bill brought in by Mr. McKenna, President of the Board of Education, "to regulate the conditions on which public money may be applied in aid of elementary education in England and Wales, and for other purposes incidental thereto." The Bill proposes that in future there should be but one type of public elementary school, provided, controlled, and managed by public authority, and the teachers to be appointed without religious tests. Every public elementary school receiving rate aid would thus be of the type of Board or County Council schools, and no child would be compelled to attend any other kind of school. The religious instruction given in these schools would be the same as that given in Board and county schools for the past thirty-eight years. Voluntary or Church schools would not have the support of public money in single-school parishes, for there the State would not recognise any other school than a public elementary school. In other cases, voluntary schools, when recognised as providing efficient instruction in secular subjects, would receive State aid in the form of grants, but no rate aid, the amount of the Government grant in both county and recognised voluntary schools being 47*s*. per annum for each child in attendance. The Bill was read a first time, after it had been vigorously condemned by Mr. Balfour and other members of the Opposition.

AT the prize distribution to students at the Battersea Polytechnic on Wednesday, February 19, Lord Stanley of Alderley remarked that when the polytechnic movement was first started it was a general idea that the work in the institutions was to be largely recreative. But though the importance of the social side and of its influence for the good of the students was recognised, in course of time the educational work asserted itself and became predominant. In the more modern institutions, the value of the day work with its regular courses is being more fully recognised. While the evening work is kept up to as high a standard as possible, the work done in the day classes is more thorough; the students obtain a greater mastery of their subjects, and therefore it is of greater importance than that of the evening side. Remarkable advances have been made in this direction in the great technical institutions, such as those at Sheffield, Bristol, and Manchester. In the management of institutions like the Battersea Polytechnic, there should be a strong local element which knows what are the requirements of the particular districts. It is necessary to separate what may be called the common work of education from that of the particular work of technical instruction as applied to arts and crafts. A comparison between the requirements for domestic economy training a few years ago and those

which are now considered necessary to have any influence on the home life and habits of people shows that a much higher standard has been reached. The work carried on at the polytechnics will bear good fruit, and it is to be hoped that the London County Council will see its way clear to provide the means so that the polytechnics of London may furnish an example to every town in the United Kingdom and in all parts of the world.

THE fifteenth annual general meeting of the Association of Technical Institutions was held on Friday and Saturday last at the hall of the Drapers' Company. Sir Horace Plunkett, the retiring president, occupied the chair during the early part of the proceedings, and was succeeded by Sir Norman Lockyer, K.C.B., who was unanimously elected president for the ensuing year. Sir Norman Lockyer in his address referred to the progress that has taken place in educational methods in recent years, but pointed out that there is a lack of coordination between primary and secondary schools or technical schools. We have now a good system of elementary education, but there is a terrible wastage after the primary school. He pleaded for a fuller recognition of continuity in education and of the high standing of technical institutions in an organic system. At the second day's meeting there was a discussion on trade or craft schools, and eventually the following resolution was adopted:—"That this association, fully recognising the necessity for a comprehensive and graded scheme of technical education, embracing all sections of the community, request the council to make an inquiry with a view to ascertaining the best conditions for the development of technical education in relation to the training of workmen." In opening the discussion, Prof. W. M. Gardner, of Bradford, said that of 1000 boys passing through elementary schools, and ultimately taking positions as industrial workmen, foremen, or managers, probably not more than forty pass through a secondary school and not more than three or four attend a day technical school. The great problem is, therefore, that of the boys who leave the primary schools at thirteen and fourteen, or even earlier, and who constitute 950 out of every 1000 boys of that age. Three courses seem to be open, namely:—(1) to provide specialised technical instruction during the latter portion of the primary-school course, combining it with the general subjects in the time-table; (2) to pass the lads forward from the primary school to specially arranged trade schools for one or two years; and (3) to rely, as hitherto, on evening schools for technical instruction. How far the first plan is practicable, or even desirable, appears doubtful. It is educationally unsound to give technical instruction in a trade without first dealing with the underlying sciences in an elementary manner. The provision of special trade schools seems, the speaker said, to offer a more likely solution of the problem.

SOCIETIES AND ACADEMIES.

LONDON

Geological Society, February 5.—Sir Archibald Geikie, K.C.B., Sec.R.S., president, in the chair.—Antigorite and the Val Antigorio, with notes on other serpentines containing that mineral: Prof. T. G. **Bonney**. It is not certain that the first described specimen of antigorite was really found in the Val Antigorio. The rock probably does not occur there *in situ*, though it is found in pebbles, &c., from tributaries. Other specimens of antigorite-serpentine were described. The origin of the mineral is discussed. Pressure is essential; it can be formed from augite, and there is evidence of its coming from this mineral.—The St. David's Head "rock series" (Pembrokeshire): J. V. **Elsden**. These intrusions are of complex composition. There is a high magnesia percentage. There is no evidence of differentiation *in situ*, but the facts suggest a common origin from a differentiated magma basin. The rocks afford facilities for the study of both rhombic and monoclinic pyroxenes. Rhombic pyroxene generally crystallised earlier than the monoclinic pyroxene. There are two varieties of augite. The relation of these types lends support to the perthitic theory. The probable age of the intrusions is not greater than that of the earth movements which folded the Arenig shales in this district.

Linnean Society, February 6.—Dr. A. B. Rendle, vice-president, in the chair.—Specimens and lantern-slides of leaf impressions from the Reading beds: H. W. **Monckton** and O. A. **Shrubsole**.—Fruits and seeds from the pre-Glacial beds of Britain and the Netherlands, especially the Pakefield specimens from the neighbourhood of Lowestoft (Cromer forest bed), and from Tegelen, near Venloo, in the province of Limburg, Netherlands: Clement **Reid**.—The use of large quantities of commercial concentrated soda carbonate when boiling refractory deposits: Mrs. E. M. **Reid**.—A botanical expedition to Central Fokien: S. T. **Dunn**. In April, May, and June, 1905, a botanical expedition was undertaken, with three native collectors and one Chinese herbarium assistant, to the centre of the province of Fokien. The difficult journey from Foochow to Yenping was successfully accomplished, and enough stores deposited at that town to enable a large collection of plants to be made. The central portion of this province, which is as large as England and Wales combined, had never previously been visited by a botanist, and, as might be expected, many novelties were discovered, and are here described, amounting to at least forty new species.—Some new Alcyonaria from the Indian and Pacific Oceans: preliminary notice: Ruth M. **Harrison**.

Royal Anthropological Institute February 11.—Prof. W. Ridgeway, president, in the chair.—An additional note on New Guinea games: Dr. A. C. **Haddon**. The games were of various descriptions, and included a series of string figures.—A new instrument for determining the colour of the hair, eyes, and skin: J. **Gray**. The instrument was a simplified form of Lovibond's tintometer, by means of which hair-, eye-, and skin-colours could be classified by comparison with a series of standard coloured glasses. These standard glasses can be reproduced an indefinite number of times with the greatest precision by Lovibond's method, so that any number of observers can be provided with identical colour-scales. A series of locks of hair, arranged by the naked eye, from blonde to jet black, was exhibited, and curves showing the colour-elements of this series, as obtained by Lovibond's tintometer, were shown on the screen. The curves showed that the locks contained two coloured pigments, namely, orange and a yellow, and a black pigment. The black pigment increased uniformly in amount from blonde to black, and evidently formed the basis of the arrangement of the series by the naked eye, because the amount of orange and yellow pigment was practically constant throughout the whole series. A second series of locks of red hair was exhibited, arranged by the naked eye from light to dark red or auburn. Analysis showed that the orange pigment was predominant, and formed the basis of the classification. A diagram, exhibited to show the correlation between orange and black in the two series of locks, pointed to the conclusion that red hair was derived from dark hair by the conversion of more or less of the black pigment into an equal amount of orange pigment, while fair hair was derived from dark hair by a reduction of both the black and the orange pigments.

Institution of Mining and Metallurgy, February 20.—Prof. W. Gowland, president, in the chair.—The alloys of gold and tellurium: Dr. T. K. **Rose**. An examination of the mixtures of gold and tellurium by means of the Roberts-Austen recording pyrometer, and observing polished sections under the microscope. The main conclusions arrived at were:—(1) A compound, $AuTe_2$ or Au_2Te_4, containing 43·59 per cent. of gold, and corresponding in composition to sylvanite or calaverite, is formed when gold and tellurium are melted together in certain proportion; this compound fuses at 452°. (2) Two eutectic mixtures are formed, containing 60 per cent. and 20 per cent. of gold respectively. These alloys correspond in composition to the formulæ AuTe and $AuTe_6$. Under the microscope they do not show the characteristic banded eutectic structure, but there are certain indications that they are true compounds. (3) All the alloys of gold and tellurium are brittle. (4) All those containing less than 60 per cent. of gold fuse at temperatures between 397° and 452°.—A method of settling slimes, as applied to their separation from solution in cyanide treatment: H. G. **Nichols**. The principle involved is that of removing the

solid matter as it reaches the bottom of the tank in which it is settled by means of a conveyor belt. This process was found by repeated tests to give remarkable results both in the completeness of the separation effected and in the small proportion of liquid carried off by the solid matter.—Two deterrents to the dissolution of free gold in the cyanide process: Duncan **Simpson.** These deterrents are oil and lime, and the author gave examples showing their influence and the method adopted for counteracting it.—A rapid method for the estimation of arsenic in ores: H. E. **Hooper.**—The Indian mint assay of silver bullion: F. T. C. **Hughes.** A description of the methods employed in the Indian mints for the assay of the varying qualities of bullion received for coinage purposes. This process has been in vogue for upwards of fifty years, and has given satisfactory results, being specially suited to the condition of labour, &c., existing in India, and to the varied nature of the bullion operated upon.

DUBLIN.

Royal Dublin Society, January 21.—Prof. A. W. Conway in the chair.—The lines of flow of water in saturated soils, especially peat-mosses: L. F. **Richardson.** The author shows by means of experiments on "Bog of Allen" peat that the general velocity with which the water passes through the peat is proportional to the pressure gradient, and by utilising this fact he deduces the differential equations for the flow of water through peat saturated with water, neglecting capillarity, and assuming the peat to be isotropic in order to facilitate the mathematical treatment of the problem. The differential equations are solved by a freehand graphic method, and the form of the saturated water surface determined, when the tubes of flow are somewhat horizontal. From the diagrams thus obtained it is possible to calculate in a simple manner—the rainfall being given—how far apart drains must be cut in a bog so as to remove just the right amount of water, and conversely what will be the effect of a given cutting. The paper concludes with the description of another method for determining the conductivity of peat for water.—A simple form of apparatus for observing the rate of absorption of oxygen by polluted waters and by other fermenting liquids: Dr. W. E. **Adeney.**

EDINBURGH.

Royal Society, February 3.—Prof. Andrew Gray, F.R.S., vice-president, in the chair.—Sensitive state induced in magnetic materials by thermal treatment: J. G. **Gray** and A. D. **Ross.** When steel is cooled from a high temperature, the first measured susceptibility in a given field is much higher than later measured values after the specimen has been subjected to cyclic magnetisations. This phenomenon, first noticed by Ewing, was studied in detail for steel, cast iron, cobalt, and soft iron. In soft iron the phenomenon is absent or present only to a small degree. In certain specimens of steel the effect was induced to a slight degree when the substance was raised to as low a temperature as 100° C. and then cooled; it increased with increased temperatures to about 700° C., but further increase of temperature had little influence. Mechanical vibrations considerably reduced the effect. The phenomenon was most marked in fields which gave large values of the susceptibility, tending to zero as the saturation point was approached.—The growth and development of the limbs of the penguin: Dr. D. **Waterston** and A. C. **Geddes.** The material had been brought home by Dr. W. S. Bruce, leader of the Scottish Antarctic Expedition. A comparison of the stages of development with the corresponding stages of development of the chick of a duck showed that the limbs of the penguin began at a fairly early stage to diverge in mode of growth from those of the duck, indicating that the adaptation of the fore-limbs for swimming purposes did not imply a degeneration from a form suitable for flight.

PARIS.

Academy of Sciences, February 17.—M. H. Becquerel in the chair.—The properties of pure starch: L. **Maquenne.** Referring to a note by M. Fouard at the last meeting of the academy on the isolation of a new soluble form of starch, the author points out that this soluble starch is in all respects identical with that described by him, in conjunction with M. Roux, in the *Comptes rendus* two years ago. The name amylose was given to this soluble form of starch, and ordinary starch solution consists of a clear solution of amylose thickened with amylopectose.—Isotonic solutions and isoosmotic solutions: Yves **Delage.** A continuation of the controversy with J. Loeb. The author concludes that it is impossible to doubt that the parthenogenesis of the eggs of the sea-urchin can be brought about in solution isotonic with sea-water.—The visibility of Saturn's ring on the side not lighted by the sun, and its reappearance in January, 1908: M. **Amann.** A detailed account of the appearances presented by the ring between October 4, 1907, and January 14, 1908.—The relation between flying shadows and scintillation: Cl. **Rozet.** A definite relation has been established between the shadow bands and the phenomenon of scintillation. The effects have been observed, not only with the sun, but also with Venus, Jupiter, Mars, and some stars of the first magnitude.—A theorem in the theory of integral equations: E. **Goursat.**—The electrolysis of solutions of hydrochloric acid: E. **Doumer.** In the electrolysis of hydrochloric acid, oxygen always accompanies the chlorine, the proportion of oxygen to the hydrogen set free at the other electrode depending on the concentration, and increasing with the dilution of the acid. With an anode of silver or mercury, capable of combining with the chlorine, the proportion of oxygen for the same intensity of current is increased. The author concludes that the electrolysis of both the acid and the water takes place simultaneously. The amount of oxygen produced is not negligible, and must be taken into account in the determination of the transport factor of the ions and in the measurement of the conductivity of these solutions.—Lithium in radio-active minerals: Mlle. **Gleditsch.** Determinations of the copper, lithium, and the radio-activity compared with uranium have been made for the minerals thorite, Joachimsthal pitchblende, Colorado pitchblende, carnotite, chalcolite from Cornwall, and autunite. Lithium was found in all these minerals in amounts varying from 0·00017 per cent. to 0·03 per cent., and copper in all but autunite. These results prove that there is no simple relation between the amounts of copper and lithium in radio-active minerals.—A new method of estimating sulphur in organic substances: Isodore **Bay.** The substance is mixed with sodium carbonate and magnesia, and ignited in a current of oxygen. Test analyses are given showing the accuracy obtainable.—The separation of chloride and iodide of silver: H. **Baubigny.** A solution of ammonium carbonate can be used to effect the quantitative separation of silver iodide and chloride in the absence of bromide.—A method for the complete analysis of vegetable materials: J. M. **Albahary.**—The hydrolysis of perchloride of iron. The effect of the valency of the negative ions: G. **Malfitano** and L. **Michel.**—The reciprocal displacement of hydrocarbon groups in the Friedel and Crafts reaction: H. **Duval.**—The reducing properties of organo-metallic compounds: M. **Letellier.** By the action of ethyl-magnesium bromide upon ethyl oxypivalate, besides the glycol

$$CH_2(OH).C(CH_3)_2.C(OH)(C_2H_5)_2$$

expected, the compound $CH_2(OH).C(CH_3)_2.CH(OH).C_2H_5$ was obtained as a by-product. This is formed by the reduction of the ketone $CH_2(OH).C(CH_3)_2.CO.C_2H_5$, ethylene being evolved. Other instances of the reducing action of alkyl-magnesium compounds are cited.—The simultaneous production of the 1 : 6- and 2 : 7-dimethyl-anthracenes in the action of CH_2Cl_2, or $CHCl_3$, or $C_2H_2Br_4$ upon toluene in the presence of aluminium chloride: James **Lavoux.**—The essence of *Tetranthera polyantha*, var. *citrata*: Eug. **Charabot** and G. **Laloue.** The essences from the bark, leaves, and fruits were examined. That from the bark contained citral, citronellal, and an alcohol, possibly geraniol; the essence from the leaves contained citral, cineol, and the same alcohol as the bark; the essence from the fruits consisted of citral, an ester, and possibly geraniol.—The possible presence of microscopic diamonds on the sea floor and in a specimen of vegetable earth: J. **Thoulet.** The mechanical analysis

of a deposit obtained from the sea floor in the Bay of Biscay furnished some minute crystals many of the characters of which corresponded to those of the diamond, and similar crystals were obtained from a specimen of vegetable earth from the forest of Haye, near Liverdun. The quantities obtained were too small to admit of complete identification.—Contribution to the study of the alkaline rocks of Central Africa: L. **Gentil** and M. **Freydenberg.**—New observations on the anatomy and affinities of the Malpighiaceæ of Madagascar: Marcel **Dubard** and Paul **Dop.**—The formation of the notochord in some larvæ of the Tunicates: Louis **Roule.**—The mechanism of variations in height of the human body and some pathological variations: K. **Robinson.**—The statistical proof of Mendel's law: Angel **Gallardo.** An answer to some criticisms of Prof. K. Pearson.—The reproduction and the variations of development in *Glossina palpalis*: E. **Roubaud.**—The fixation of zinc by *Sterigmatocystic nigra*: M. **Janvillier.** A small proportion of zinc is favourable to the growth of this mould, and in solutions containing four parts per million of zinc or less the whole of the zinc present is fixed by the mould. With increasing proportions of zinc in the culture solution increasing amounts of zinc are found in the mycelium, but the whole of the zinc present is not taken up. The Sterigmatocystis is capable of fixing without injury 1/1100th of its weight of zinc.—The purgative action of phenolphthalein and its disodium derivative: C. **Fleig.**—The frequency of intestinal ulcerations in the course of an attack of influenza: Gabriel **Arthaud.**—Contribution to the study of the calorific radiation of the sun: G. **Millochau** and C. **Féry.**—The predominance of the erosion of the river Sarine on its right bank: Jean **Brunhes** and Cesare **Calciati.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 27.

ROYAL SOCIETY, at 4.30.—The Influence of Temperature on Phagocytosis: J. C. G. Ledingham.—The Glycogenic Changes in the Placenta and the Fœtus of the Pregnant Rabbit. A Contribution to the Chemistry of Growth: J. Lochhead and W. Cramer.—On the Maturation of the Ovum in the Guinea-pig: Prof. J. E. S. Moore and Miss F. Tozer.

ROYAL INSTITUTION, at 3.—Wood: its Botanical and Technical Aspects: Prof. W. Somerville.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Deterioration of Modern Dyed Leathers: M. C. Lamb.—A Note on the Germicidal Value of Petroleum Benzine: F. J. Farrell and F. Howles.

FRIDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 9.—Explosive Combustion, with Special Reference to that of Hydrocarbons: Prof. W. A. Bone, F.R.S.

ROYAL SOCIETY OF ARTS, at 8.—The Removal of Dust and Fumes in Factories: Dr. J. S. Haldane, F.R.S.

PHYSICAL SOCIETY, at 5.—Contact Potential Differences Determined by Means of Null Solutions: S. W. J. Smith and H. Moss.—An Experimental Examination of Gibbs' Theory of Surface Tension as the Basis of Adsorption with an Application to the Theory of Dyeing: W. Lewis.

SATURDAY, FEBRUARY 29.

ESSEX FIELD CLUB (at the Essex Museum of Natural History, Stratford), at 6.—Artesian Wells on Fowlness Island, Essex, Ancient and Modern: W. H. Dalton.—On some Unexplored Fields of Essex Archæology: John French.—Note on a Post-Glacial Deposit on Mersea Island, Essex: W. H. Dalton.

MONDAY, MARCH 2.

VICTORIA INSTITUTE, at 4.30.—The Atlantic Islands, and Origin of Their Fauna: Prof. E. Hull, F.R.S.

ARISTOTELIAN SOCIETY, at 8.—The Idea of Totality: Dr. S. H. Hodgson.

TUESDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—Membranes: Their Structure, Uses and Products: Prof. W. Stirling.

ZOOLOGICAL SOCIETY, at 8.30.—A Comparison of the Neotropical Species of Corallus, *C. cookii*, with *C. madagascariensis*; and on some Points in the Anatomy of *Corallus caninus*: F. E. Beddard, F.R.S.—On a Young Female Kordofan Giraffe: Dr. P. Chalmers Mitchell, F.R.S.—Description of a New Species of Monkey of the Genus Cercopithecus: R. I. Pocock.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Notes on Engineering Works in Austria and Bosnia: A. S. E. Ackermann.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion:* The New York Rapid-transit Subway: W. B. Parsons.

WEDNESDAY, MARCH 4.

ROYAL SOCIETY OF ARTS, at 8.—Modern Dairy Practice: Loudon M. Douglas.

GEOLOGICAL SOCIETY, at 8.—On *Metriorhynchus brachyrhynchus* (Deslong.) from the Oxford Clay near Peterborough: E. Thurlow Leeds.—The High-Level Platforms of Bodmin Moor, and their Relation to the Deposits of Stream-tin and Wolfram: G. Barrow.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of New Species of *Lepidoptera heterocera* from South-east Brazil: E. Dukinfield-Jones.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Volumetric Determination of Reducing Sugars: Part II. The Limits of Accuracy of the Method under Standard Conditions: A. R. Ling and G. Cecil Jones. Part III. The Influence of Cane Sugar: A. R. Ling and T. Rendle.—(1) The Composition of Milk; (2) The Nitrogen Factor for Casein: H. D. Richmond.

THURSDAY, MARCH 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers:*—On the Atomic Weight of Radium: Dr. T. E. Thorpe, C.B., F.R.S.—On the Electrical Resistance of Moving Matter: Prof. F. T. Trouton, F.R.S., and A. O. Rankine.—On the Nature of the Streamers in the Electric Spark: Dr. S. R. Milner.—The Relation between Wind Velocity at 1000 Metres Altitude and the Surface Pressure Distribution: E. Gold.

ROYAL INSTITUTION, at 3.—Early British History and Epigraphy: Sir John Rhys.

CHEMICAL SOCIETY, at 8.30.—The Solubility of Iodine in Water: H. Hartley and N. P. Campbell.—Traces of a New Tin-group Element in Thorianite: Miss C. de B. Evans.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Fuse Phenomena: Prof. A. Schwartz and W. H. N. James.

LINNEAN SOCIETY, at 8.—On the Morphology of Stigmaria in Comparison with Recent Lycopodiaceæ: Prof. F. E. Weiss.—On *Trichomiscoides albidus* and *T. sarsi*: Alexander Patience.—*Exhibits*: Fruit Destroying Flies: W. W. Froggatt.—Mimicry in the Common Sole: Dr. A. T. Masterman.

FRIDAY, MARCH 6.

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

INSTITUTION OF CIVIL ENGINEERS, at 8.—Surveying on Thunder Bay Branch of the Grand Trunk Pacific Railway, Canada: R. V. Morris.—British Practice in Railway Surveying: W. Graham.—Railway Surveying in Great Britain: W. C. Crawford.

SATURDAY, MARCH 7.

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

CONTENTS.