

THURSDAY, MAY 31, 1906.

## FAMILY ABILITY.

- (1) *Noteworthy Families (Modern Science)*. By Francis Galton, F.R.S., and Edgar Schuster. Pp. xlii+96. (London: John Murray, 1906.) Price 6s. net.
- (2) *Mental and Moral Heredity in Royalty*. By Frederick Adams Woods, M.D. Pp. viii+312. (New York: Henry Holt and Co., 1906.)

(1) IN the spring of 1904 a circular was issued to all Fellows of the Royal Society whose names appeared in the year-book for 1904 in which they were asked to give particulars of the achievements of their relatives. A statistical examination of the information thus furnished is made by Dr. Galton in the preface to the volume before us, while Mr. Schuster has selected from the returns particulars of sixty-six families containing at least three noteworthy kinsmen. The prominence given to the latter part of the work suggests that the primary object of the inquiry was not statistical, but was to form an index of those families now represented by men of science among what might be described as "the intellectual aristocracy."

When applying statistical methods to the information furnished Dr. Galton was confronted by several difficulties; only 207 of the 467 persons addressed sent serviceable replies, and of these only about one-half gave complete returns, so Dr. Galton found he had only 100 families to consider. In order to make any comparison between the kinsfolk of Fellows of the Royal Society and the generality it was therefore necessary not only to form a conjecture of the proportion of noteworthy persons in the community, but also to consider the reasons which prompted the large proportion of Fellows who abstained from replying—if, as Dr. Galton suggests, they were of a poorer class than those who replied, weight must be given to this consideration in the comparisons. The much debated question of environment is also referred to, and Dr. Galton gives two tables from which he concludes that if ability and environment are positively correlated, the association between success and ability becomes closer. We are not quite convinced by the tables, as it is hard to see the reason for splitting the nine possible combinations of ability (high, medium, and low) and environment (high, medium, and low) into three grades of success in Table II., which gives "ability independent of environment," while in Table III., showing "ability correlated with environment," the nine groups are distributed into five grades. The average number of relations which each individual has in a stationary community had to be considered, and this affords Dr. Galton the opportunity of giving the interesting note which appeared in NATURE for September 29, 1904 (vol. lxx., p. 529). The conclusion reached after making allowance for the various points mentioned is that able fathers produce able children in a much larger proportion than the generality, but as the statistics cannot be thrown into a form suitable for obtaining the usual co-

efficients of correlation, it is impossible to compare the results with recent statistical work on heredity.

The book is the first volume issued by the Eugenics Record Office of the University of London, a fact that gives it an additional interest, and encourages us to look forward to further work on the interesting subject which the office has—as the result of Dr. Galton's generosity—been established to investigate.

(2) This book gives us the result of an attempt to study some of the problems of heredity with the help of statistics drawn from the Royal Families of Europe. Dr. Woods has collected information from various sources, and whenever possible he has considered the view taken by more than one authority in the hope of eliminating the personal element which most people connect closely with historical work. The method adopted was to record every individual in every degree of relationship and also everything which could assist an estimate of the mental or moral status of any historical character considered. Dr. Woods then decided into which of ten groups showing grades of intelligence each person in his royal population should be put, and in order to give readers the opportunity of verifying his particulars he has given a list of the persons in their grades of intelligence. A similar plan was followed for morality.

The various Royal Houses are then examined in turn; a genealogical table of each is given showing the grades assigned to each person whose name occurs, and Dr. Woods points out the recurrence of marked characteristics in successive generations such as the Bourbon insanity or the Hapsburg "lip," though the latter is the only physical characteristic examined at any length. Throughout this, the main part of the work, an attempt is made to show that heredity can account for the total or partial recurrence of the type of mind exhibited by an ancestor, and although at times Dr. Woods seems to try to explain too much, he has certainly succeeded in giving a clear impression of his opinion of the statistics he has collected. He frequently suggests when discussing family traits, that inheritance seems alternative rather than blended, but if this leads the reader to expect an illustration of Mendel's laws in the statistical part of the volume he will be disappointed by Dr. Woods's footnote to p. 274, in which he says that he has not been able to detect the existence of "dominant" and "recessive" types, and adds:—

"Although the mind seems in its inheritance to roughly obey the principle of alternative inheritance and thus indicate segregation in the germ-cells, I do not feel that this is sufficiently clearly defined to enable one to classify according to hard and fast types, as is possible in dealing with the features of certain plants and animals like the colours of mice, whether albino or gray; or the shapes of peas, whether round or angular."

Dr. Woods points out that the large amount of inbreeding which has taken place in some of the Royal Families has certainly not led to sterility, though it is, we think, probable that it has helped to accentuate in offspring some of the noticeable characteristics on which the author dwells.

In the statistical treatment Dr. Woods first examines the interesting question of whether there is any connection between mental and moral qualities, and by means of Pearson's "fourfold-table" method finds the high value of  $0.3403 \pm 0.0419$  for the coefficient of correlation, and he then proceeds to show that the average number of adult children increases with the higher grade of morality of the parent. It is a pity that no correlation table is given in this last case, as the result is interesting. It is, of course, a conclusion that would be expected from general considerations; for the dissolute members of any community tend to die at an early age, which leads one to expect them to have few children, while the fact of their being dissolute generally means that the children born are less healthy and therefore more often die in childhood. The other statistical results can be conveniently summarised as follows:—

	Coefficients of correlation between		
	Offspring and fathers	Offspring and grandfathers	Offspring and great-grandfathers
Mental qualities ...	0.301	0.161	0.153
Moral qualities ...	0.298	0.175	not calculated

The first four of these agree closely with the 0.3 and 0.15 expected by the Law of Ancestral Heredity. In comparing the figures given with those obtained from other sources it should be borne in mind that assortative mating is probably very slight among members of Royal Families, while elsewhere it plays an important part. We think it would have been well to give some information about the correlation between brothers, and also between offspring and mothers; the maternal lines have in fact been neglected almost entirely in the statistical work.

Dr. Woods states as his reason for using the "fourfold-table" method for finding coefficients of correlation, that his grades do not necessarily represent quantitative measurements, "for we do not know that grade (4) is twice as intellectual as grade (2), &c." This is incorrect; the ordinary method merely requires the groups to be equidistant, and the remarks on pp. 19 and 20 on the distributions of the people in their grades of intelligence or morality leave the impression that Dr. Woods attempted to make them so. In his correlation tables he always divides the offspring and parents into "below the mean" and "above the mean," instead of saying "grades (1) to (5)" and "grades (6) to (10)." The latter represents the real division, as the mean cannot be fixed without knowing the relative distances between the grades.

The book would be the better for a good index, and one or two misprints such as Frederick Harrison and homogeneity and father for brother on p. 235 have been allowed to pass, while we think the description of the condition of Portugal during the reign of Alfonso IV. as "progress, especially against the infidels," an unhappy one.

The conclusions reached in the two books are much alike, as the authors find a few centres about which the intelligence seems to collect rather than a chance-distribution of highly intelligent individuals through the population. We cannot help feeling, however, that there is some doubt as to whether the collection of

information among special groups is as satisfactory as the investigation of random samples of the population. This objection can be urged against the "Noteworthy Families" rather than against the "Royalty," because in the former work we do not know for certain how many very able persons spring from the general public, but a similar question does not arise in dealing with Royalty, and the only point is how far we may apply results obtained from one class to persons in another.

We are inclined to think that both books may find readers among those who have not made a special study of the statistics bearing on heredity, for both give information in a clear and interesting manner, and the lists of families in the one case and the discussion of Royal personages in the other will attract many who would never look at a work containing nothing but statistical investigation. Is it too much to hope that some of these readers may be led to appreciate that the ultimate proof of historical or biological theories must have a statistical basis? That they will appreciate the painstaking energy of the authors is beyond doubt.

I.

#### TOPOGRAPHICAL SURVEYING.

*Text-book of Topographical and Geographical Surveying.* By Major C. F. Close, C.M.G., R.E. Pp. iv+288. Printed for H.M. Stationery Office. Price 3s. 6d.

THE art of topographical surveying was almost invariably known in this country until recent years as "military topography," a phrase which may be taken to mean not that the topography of a region presented special features to the soldier, but that little attention was paid to topographical surveying of any sort until military necessity arose. The fact that interest in and knowledge of surveying of this kind is no longer confined to the Army is largely due to the active influence of the Royal Geographical Society in London and in the Universities of Oxford and Cambridge, as a result of which an increasing number of intending travellers, explorers, naturalists, and colonists go through some training in surveying before setting out for distant parts, but it is scarcely less due to the work of the Royal Engineers in constantly developing and testing new instruments and methods in the field, and in making the results of trial and experiment generally accessible.

That the extent of the field before the topographer is great is abundantly evident from Major Close's statement in an introductory paragraph that "excluding Canada, Australia, New Zealand, and India, the total unmapped area of the British Empire amounts to about 3,700,000 square miles." Now we cannot expect that the whole of this area will be mapped for purely military purposes. It is to be hoped that sooner or later Government surveyors will lay down a primary triangulation over it for the benefit of the topographer who may follow, but we can scarcely expect more. The topographic map must in the end be made by the civilian who is to use it; the most he can look for

from outside is a number of fixed points upon which to "hang" his own surveys.

Thus we arrive at the conclusion that more provision must be made for the training of civilian topographers in this country, and we are at once confronted by great difficulties. Students learning surveying are usually studying other subjects at the same time, and in the more open parts of these islands where alone it is easy to do small-scale work extending over any considerable area, opportunities of studying other subjects are necessarily limited. The question of time also becomes troublesome, much of what is available being soon spent in getting to and from the scene of operations; and the climate, difficulties connected with trespass, setting up marks, getting unskilled assistance, and so on, are all against the student. Work with ordinary "classes" is for the most part restricted to mapping on a scale of at least three inches to a mile, with "demonstrations" of the nature of secondary triangulation, and bicycle expeditions for practice in rapid sketching over larger areas; beyond this it is necessary to depend on "vacation courses" extending over a week or ten days in the summer. The expedients, however, are more or less of the nature of makeshift, and the student cannot hope to acquire the eye for country, and the facility in representing it, which is characteristic of skilled surveyors in constant practice, like the native topographers in the survey of India.

But the difficulty does not end here, for it affects the civilian teacher as well as the student. However great the skill and experience of the latter may be, it is scarcely possible for him to keep "up to date" without direct contact with actual modern survey work, and this is difficult to achieve. The importance of this is clearly shown in Major Close's book, in which, as he says, "the field methods described are, for the most part, those in use by the Survey of India; but advantage has been taken of recent experience in mapping and exploring various territories in Africa and elsewhere to include useful methods which are not commonly employed in India."

Hence, for many reasons, it is to the advantage of all topographers in this country to keep up as close acquaintance as possible with the service work in all its branches, and amongst the many efforts which military surveyors have always made to render this easy, few have been more entirely adequate than the publication of this book. There are few subjects in which books by themselves are of less assistance than topographical surveying, but Major Close has succeeded fully in doing what can be done by this means.

The body of the book consists of seventeen chapters on instruments and methods, sketching, map projections, the reproduction of maps in the field, field astronomy and the determination of positions, and the theory of errors as applied to topographical work. Some of these chapters have been partly written by officers who have given special attention to the subjects treated of, others are drawn from published papers, and the sections on field astronomy have been revised by Mr. A. R. Hinks, of Cambridge Observa-

tory. The eighteen tables giving the quantities usually required for plotting graticules, computing astronomical results, and so on have been specially revised, and in some cases recalculated. Ten appendices give various useful lists, explanations, and formulæ. The thirty-four plates, which include admirable examples of sketch maps of different kinds, specimen sheets of British and foreign topographical maps on different scales, and four new star charts, are almost the best features of the book. It would be difficult to suggest a better exercise in map reading for the student than a study of the reproductions of maps executed by the Ordnance Survey.

Taking the book for what it is, we find, as might be expected, little or nothing to criticise; it would be easy to criticise it for what it is not, and does not profess to be. As a text-book, experience has proved its excellence, but it must be fully realised that it is true to its name, and that while it supplies the text, the teacher must preach the sermon. Many chapters are distinctly of the "pemmican" order, and would prove extremely difficult to a reader altogether unacquainted with the subject. The difficulty is no doubt got over to some extent by the excellent lists of references given. These lists might perhaps be made more complete, but in some cases satisfactory books are still to be written. We may take as an example the chapter on map projections—largely reprinted from Major Close's "sketch" of the subject—and venture to express the hope that the author will one day give us an authoritative text-book on this alone. Another chapter about which the same remark might be made—indeed the author himself makes it—is that on the adjustment of errors, a subject we have always found of great value and interest even to elementary students dealing with comparatively rough observations. It is true that a good deal of help can be obtained here from the methods ordinarily employed by engineers, but for topographical purposes many useful results can be got by graphic extensions of these methods.

H. N. D.

#### GARDEN SHRIMPS.

*The British Woodlice, being a Monograph of the Terrestrial Isopod Crustacea occurring in the British Islands.* By Wilfred Mark Webb and Charles Sillem. Pp. x+54; with 25 plates and 59 figures in the text. (London: Duckworth and Co., 1906.) Price 6s. net.

AT present in England there are only two dozen species of these little land crustaceans on record. The number, combined with their love of obscurity, may remind us of the regal feast at which four-and-twenty blackbirds were served up concealed in a pasty. When the pie was opened, the birds began to sing. In correspondence with the daintiness of such a dish, the apostles of oecology are now earnestly trying to persuade society that all nature is tuneful. Those who are afflicted with toneless ears may assume a haughty indifference towards the resounding harmony, while they are themselves the objects of pity rather than of pride. The bright little volume under review

is an excellent example of what can be done under the new impulse given to the old practice of "nature-study." It shows how members of our fauna, that have long suffered from negligent and contemptuous treatment, may in friendly hands receive their proper meed of appreciation. Though, out of deference to tradition, the book goes by the unprepossessing name of "The British Woodlice," its subtitle redeems the subject from prejudice by assigning it to its true place in classification. The many scurrilous colloquial terms that have been applied to these terrestrial isopods have, to the ordinary observer, obscured the fact that they are really made of one flesh and blood with the epicure's cherished treasures, the lobster and the prawn. Their use medicinally in old times would probably have been robbed of half its charm had this been understood, since in those days curative agencies seem to have been valued in proportion to the pain and disgust they inflicted on the patient. So lately as 1883, W. G. Black, in his "Folk Medicine," writes:—

"A relation of mine was in the cottage of a wise woman at Penzance about two years ago, and found that she was still in the habit of prescribing in scrofulous cases grammar sows, sow-pigs, millepedes or woodlice, to be swallowed as a pill. According to the Penzance woman, the sufferer must himself secure his medicine, but she had a corner in her little garden where nothing was grown but mint and thyme, and there the sow-pigs were reared. As a concession to modern feelings, patients are now allowed to wear this disagreeable medicine in a little bag round the neck, if they shrink from the heroic remedy of swallowing it."

One may wonder whether the man who first ate a shrimp thought himself a hero! It will be noticed that the wise woman of Penzance had to foster her colony of animated pills. Mr. Webb also recounts the efforts of industrious research on the part of himself and others by which the present small total of British species has been slowly ascertained. Some of the species, indeed, are known to be widely distributed, and in places to be very abundant. But there is little proof that even those which have the worst repute for depredation do any serious amount of harm in our gardens. They are chiefly to be found in rubbish heaps or nests of garden pots, or under flat, neglected stones. Many of the species are the rare prizes of diligent collectors. Mr. Webb has given a very full and faithful record of published captures, the only work of importance which he does not appear to have thoroughly examined being the Transactions of the Devonshire Association. Ireland, with a list of species not quite equal to that of England, still in *Trichoniscus vividus* (Koch) keeps one form exclusively to herself. In the very large number of European species all of ours are included, and twenty of them have been described by Prof. G. O. Sars in his admirable work on the Crustacea of Norway.

The authors of the present volume are most scrupulous in acknowledgment of assistance they have received from various sources. They are to be congratulated on their own accuracy and diligence. The results of their good work in the field, with the

microscope, and in the study of the available literature on the subject are presented in a compendious and excellently illustrated treatise. Marine isopods are sometimes found with the front half of the body much narrower than the after part. Light is thrown upon this odd appearance by one of the incidents of exuviation. The animal sheds the hind part of its skin first, while the more dilatory front remains still incapable of expansion in its old armour. Messrs. Webb and Sillem explain that this is just what happens with our garden shrimps, there being an interval of three days or so between the two strippings. Their authority on this point, Mr. J. B. Casserley, has also observed that the thrifty creature eats the skin which it has shed. What fortunes there are to be made out of waste products! The habit is no doubt widely diffused among crustaceans, otherwise their innumerable cast skins would be more frequently met with.

The well-drawn plates of this commendable volume are not coloured, but the student whom it inspires to take up the subject may find exceptional attraction in the specific names of *Armadillidium pulebellum*, the beautiful little Armadillo, *Porcellio pictus*, the painted Porcellio, and above all *Trichoniscus roseus*, the rose-tinted Trichoniscus.

T. R. R. S.

#### AUSTRALIAN ETHNOLOGY.

*Ethnological Notes on the Aboriginal Tribes of New South Wales and Victoria.* By R. H. Mathews. Pp. xiv+183. (Sydney: F. W. White, 1905.)

THE author of this work has published numerous articles on Australian anthropological subjects during the past ten years, but they have either been ignored or dismissed in a footnote by experts such as Dr. Howitt and Prof. Baldwin Spencer. A careful examination of his contributions does not give a high opinion of the author's qualifications for his task. The present volume contains a bibliography of the author's articles and some assertions as to the importance of this new contribution, of which the following sentences are specimens:—"Those portions of my book dealing with sociology," at pp. 5-15 and 84-103, will completely revolutionise all the old school notions respecting the organisation of Australian tribes "which have been published up to this date" (p. 4). "I have adopted none of the opinions nor followed any of the methods of other Australian authors, but have struck out on my own lines" (p. 2). "Since the time of Mr. Ridley and Mr. Bridgeman down to the present day, nothing important has been added to our knowledge of the Kamilaroi organisation" (p. 13).

It requires self-assurance to make the last of these three assertions, for Mr. Mathews can hardly expect his readers to be so ignorant as never to have heard of Dr. Howitt, whose "Native Tribes," published the year before last, contains much information on the subject, even if we neglect "Kamilaroi and Kurnai," published by him nearly five-and-twenty years ago in collaboration with Dr. Fison. In the work before us the main novelty in the way of sociological information appears to be the statement

that the Ngeumba tribe is divided into "castes" and "bloods" as well as kins and phratries. The Ngeumba, whom another writer seems to have termed Nyamba, are near neighbours of the Euahlayi on the Narran River, and the names for the "blood" divisions in the Ngeumba tribe are virtually identical with those given as phratry names by Mrs. Langloh Parker for the Euahlayi. That being so, we have the choice of three theories:—(1) that both authors are correct; (2) that Mr. Mathews has confused two tribes; or (3) that Mrs. Parker's information is incomplete. In view of the fact that she resided twenty years among them and gained the full confidence of the Euahlayi, the latter seems improbable; we are therefore left to choose between a superposition of organisations or a confusion created by Mr. Mathews. He does not work out how the "blood" organisation affects the ordinary social organisation.

The "castes" are stated to have reference to the manner of camping and to denote the shade of various parts of a tree; our confidence in this explanation is not increased by the discovery that one of the words, *nurai*, is the ordinary name for the black snake totem in two or three adjoining tribes. It is to be hoped that some anthropologist of reputation will turn his attention to the tribe. If Mr. Mathews's information turns out to be correct, he will have done something towards establishing his reputation.

N. W. T.

#### THE BREEDING INDUSTRY.

*The Breeding Industry.* By Walter Heape, F.R.S. Pp. xii+154. (Cambridge: University Press, 1906.) Price 2s. 6d. net.

THE author of the present volume has long been distinguished for his investigations in vertebrate embryology and the physiology of vertebrate reproduction. He has also paid considerable attention to the practical aspects of the subject, in so far as they concern the methods adopted by the animal breeder and the needs of the breeding industry. In the light of the special knowledge and experience which he has thus gained, Mr. Heape has become firmly convinced that the breeder will derive "inestimable advantage from the right application of science to the industry with which he is concerned," while it is no less his strong belief "that the field of scientific biology will be broadened, the number of workers therein increased, and the means available for their work augmented, as the result of . . . more intimate relations between scientific and practical biologists." Those who read this volume, and all others who are familiar with the nature of the questions discussed therein, can have little difficulty in realising that Mr. Heape is right.

The first chapter, which is introductory in character, deals with the present position of the breeding industry in our own country. The scientific man and the breeder are too frequently antagonistic, and tend to distrust one another. This antagonism, which

is quite unnecessary, is as much the fault of the man of science as of the practical man, and it is to be partly ascribed to the unsympathetic attitude of the former towards many of the facts and problems of practical breeding, as well as to the general neglect by professed biologists of that wide field of investigation comprised within the physiology of reproduction. All this is pointed out in somewhat different language by the author, who lays great stress on the enormous advantages to be gained by the introduction of scientific method into the industry of breeding, just as it has proved invaluable to other industries.

The second chapter consists of a concise, clear, and eminently business-like calculation of the value of the breeding industry to the country. As a result of this calculation Mr. Heape arrives at the truly remarkable conclusion that the total sum invested in live-stock in the British Islands is scarcely less than 450,000,000.—an estimate which does not appear to err on the side of excess. Added to this the capital invested in various accessories—vehicles, machinery, housing, &c.—the total becomes still more gigantic. And yet, in the words quoted from Mr. Bateson, the breeding industry is one "to which science has never yet been applied."

In a further chapter the author deals with the nature of the work required for the advancement of the breeding industry. This is comprised under three heads—(1) the keeping of records, (2) the carrying on of research, and (3) the work of administration—all of which are shown to be of the utmost importance. Under the heading of research the author alludes to the special nature of certain of the problems which require elucidation, and particularly those relating to the physiology of the generative system. He might have added that proper facilities for carrying out this kind of research are at present practically non-existent. Such as do exist are due almost entirely to private enterprise and generosity. In order to conduct on any considerable scale investigations upon questions involving the maintenance of animals under reasonably natural conditions and for prolonged periods of time, as well as for the study of the phenomena of inheritance and variation, the creation of some sort of experiment station or biological farm has become a matter of urgent necessity. For carrying on the work of administration Mr. Heape advocates the institution of a State department of animal industry, which would form a section of a new Board of Agriculture.

In the final chapter the management and work of the present Board of Agriculture are discussed, and it is pointed out that there is a want of confidence in its methods and an inadequacy about its organisation which compare unfavourably with those of the corresponding American department.

Mr. Heape's book is well calculated to arouse public interest, for the problem with which it deals is the concern, not only of the man of science, but of all who have regard for the welfare of one of the greatest industries of the nation.

FRANCIS H. A. MARSHALL.

## OUR BOOK SHELF.

*The Elements of Geology.* By Prof. W. H. Norton. Pp. x+461. (Boston, New York, and London: Ginn and Co., n.d.) Price 6s. 6d.

THIS is a further addition to the well written and well printed introductions to physical geography and geology which have been produced of late years for American schools. We do not quite agree with the author as to the novelty of the arrangement of his material, but it is certainly effective, and the questions attached to many of the illustrations are such as will draw out the reasoning powers of the pupil. Chemical and mineralogical considerations are kept in the background, and rocks are very broadly dealt with, as when syenite is defined (p. 274) as consisting of "feldspar and mica," and diorite as being "still less siliceous, composed of hornblende and feldspar—the latter mineral being of different variety from the feldspar of granite and syenite."

The book, however, hardly suffers from this, as explanations are brought in at the proper points, and a certain chemical knowledge seems to be presupposed. Zoological definitions are given from time to time in the stratigraphical portion, but we still think that the study of geology is held in too light estimation when it is thus regarded as elementary and independent, and not to be preceded by an outline of other branches of natural history. The geographical study of surface-features may, of course, be linked with geological considerations quite early in the curriculum of a school, and the portion of Prof. Norton's book that deals with the shaping of the earth's surface strikes us as especially admirable. It is confessedly and worthily based on the methods of Prof. W. M. Davis, who contributes a note of introduction.

The illustrations, moreover, are well selected throughout, and, where they have been borrowed, acknowledgment is made in most cases of the source. Mr. Welch's famous pot-hole in Glenariff, which was introduced to geologists in an English work in 1895, does duty here for the fourth or fifth time; but the numerous photographs of American scenery will prove of special interest to readers on this side of the Atlantic. The book is modern and very carefully thought out. On p. 246 volcanic phenomena are "extra illustrated" by the ruins of St. Pierre; on p. 306 the latest views are expressed on the gneisses of the "fundamental" Archæan complex; the Mesozoic reptiles receive attractive treatment on pp. 385-392; while on p. 446 a "restored" head of *Pithecanthropus* finds a place among relics of primitive man. This last instance errs, however, in showing much that is prophetic of future discoveries. Prof. Norton still translates *roches moutonnées* as "sheep backs," but the mention of this detail is only a tribute to his general accuracy. G. A. J. C.

*Letters from the Dead to the Dead.* By Oliver Lector. Pp. 101. (London: Bernard Quaritch, 1905.) Price 6s. net.

THE fact that the letters attributed to Bacon, Shakespeare, Napier, Henry Briggs, and Guy Fawkes have dates attached to them about the years 1904 and 1905 should convince most readers that the book ought to be regarded in the light of a practical joke, in fact, a "take off" of the antique. As another example we may take the "Notes to Henry Briggs's letter," in particular the supposed proof (p. 75) that Napier's true base is the reciprocal of  $e$  and not  $e$  itself. As the difference depends entirely on whether  $\log \sin 45^\circ$  has a plus or minus sign attached to it, it is interesting to speculate on how many readers will be deceived by what is, after all, a somewhat clever hoax.

*Atlas colorié des Plantes et des Animaux des Côtes de France.* By Dr. M. Langeron. Translated and adapted from P. Kuckuck's work. Pp. vii+67; with 24 coloured plates. (Paris: J. B. Baillière et Fils, 1906.) Price 7.50 francs.

THIS attractive publication is an adaptation, so far as the marine flora and fauna of France are concerned, of the well-known work of M. Kuckuck. It consists of three parts, dealing respectively with the phanerogams living in the neighbourhood of the sea, marine algae, and marine fauna. The book is intended for the use of young students with a love of natural history, and should prove a useful companion during seaside holidays. The plates are instructive and well produced.

## 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.]

## Osmotic Pressure.

AT Prof. Armstrong's request, published in NATURE of May 24 (p. 79), I willingly summarise the electrical evidence on which the theory of ionic dissociation seems to me to rest, though a full discussion of that evidence would, I fear, be too long for a letter in this place. Perhaps Prof. Armstrong will allow me to refer him to two papers in which I have written more fully what follows; one paper is in the *Philosophical Magazine* for February, 1903, and the other in the *Electro-Chemist* for July of the same year.

It will, I think, be admitted that we must accept the general view of electrolysis which we owe to Faraday and Kohlrausch, and imagine that opposite parts of the electrolyte move in opposite directions through the liquid. Such a view seems necessary to explain the appearance of the products of chemical change at the electrodes only, and may be verified by direct visual observation, as in the experimental measurements of the velocity with which those parts travel. It need involve no further assumption if, for convenience, we agree to call the moving parts ions. Controversy begins when we attempt to explain how and by what mechanism the ions move. The dissociation theory represents the ions as free from each other (though probably combined with the solvent) during that fraction of their lives in which they are concerned actively in conveying the current. Prof. Armstrong, on the other hand, rejects the idea of any kind of permanent or semi-permanent dissociation, and holds that the electrolyte exists in solution as combined molecules of, let us say, potassium chloride. On the latter theory the mobility of the ions must be secured by some mechanism which involves a series of interchanges between the opposite parts of the molecules. Grotthus pictured the molecules arranged as the links of a chain extending all the distance from one electrode to the other. This particular hypothesis would be exempt from the following criticism, but I suppose it would not be upheld by anyone at the present day. It conflicts too clearly with our knowledge of other phenomena. From our modern kinetic point of view, we should regard the molecules as in continual irregular motion, and suppose the ionic interchanges to occur at the instants when two molecules come within each others' sphere of influence.

Such, I imagine, is the alternative to the theory of ionic dissociation; let us trace its consequences. The greater the frequency with which molecular collisions occur, the more often can ionic interchanges take place, and the faster will the ions work their way through the liquid. Thus the ionic velocities will depend upon and increase with the frequency of collision—a frequency which, on the kinetic theory, varies as the square of the concentration. Thus, on the hypothesis we are considering, the velocities of the ions will increase with the concentration, and be

proportional, approximately at any rate, to the square of the concentration. The conductivity, which is measured by the product of the number of ions and their mutual velocity, will then vary approximately as the cube of the concentration. But the facts are quite at variance with these conclusions. The velocities of the ions are found to be constant in dilute solutions, and to decrease slowly with increasing concentration when the solutions are stronger, while the conductivity of a dilute solution is proportional at most to the first power of the concentration.

We must, therefore, it seems to me, abandon the theory of ionic interchanges at the instants of molecular collision, and turn to the rival hypothesis. There are several pieces of positive evidence in favour of the view that the ions migrate independently of each other through the solution. Of these pieces of evidence I may mention three:—(1) the calculated velocity of an ion, as calculated from the conductivity and the migration constant, is independent of the nature of the other ion present when the solution is dilute—the velocity of chlorine is the same whether the other ion be potassium, or lithium, or sodium; (2) the difference of potential observed between two solutions of different concentrations can be calculated numerically on the assumption that the ions migrate independently of each other until the electrostatic forces of attraction prevent further separation; (3) it is possible to explain satisfactorily the curious relation between the valency of the metallic ion of a salt and its specific coagulative power on certain colloid solutions on the assumption that coagulation is due to the effect on the surface conditions produced by a certain minimum electric charge brought together by the chance conjunctions of isolated ions (*Phil. Mag.*, 1899).

The evidence sketched above has been obtained by observations on aqueous solutions. It remains a further question whether similar relations hold for solutions in other solvents and for such electrolytes as fused salts. In the latter case, at any rate, the conditions may be fundamentally different, and it seems necessary to wait for further investigation.

Such, it seems to me, is the present case for the theory of ionic dissociation when put in brief form and restricted to direct evidence. The indirect evidence, based on the success of similar ideas in coordinating and explaining the conduction of electricity through gases, however, must now be taken into account in any full discussion of the subject. I confess that to me the cumulative evidence seems overwhelming. But I hold no brief for the theory, as Prof. Armstrong seems to imagine, and if ever it ceases to be the best hypothesis in the field I shall willingly abandon it. Consistency always seems to me to be the meanest of the virtues, and in matters scientific it may become the most deadly of the vices.

I have endeavoured, as well as the exigencies of space admit, to comply with Prof. Armstrong's request. May I ask him in return to state his own view of the mechanism of electrolysis, to explain, in effect, what is the alternative he proposes to the theory of ionic dissociation?

I am glad to have given an opportunity for Mr. Norman Campbell to explain in public his interesting views on the subject of thermodynamics—views which we have discussed more than once in private without coming to an agreement, though, for my part, I have learnt much by Mr. Campbell's clear-sighted criticism. He will know what my answer to his letter must be, though I have no hope that he will be convinced thereby.

I do not wish to discuss the whole question of the theory of thermodynamics; I am not entitled to do so. But Mr. Campbell holds that, even if general thermodynamics be sound, its application to osmotics is not justified. Now it is here that we do not agree, and I should like to explain the grounds of my belief that not only is the application of thermodynamics to osmotics successful, but that the success is one of the strongest arguments we possess for the general validity of reversible thermodynamics as an ideal towards which practical arrangements may approximate.

Referring to the concordance between the theoretical value of the osmotic pressure of dilute solutions and that observed experimentally, Mr. Campbell says:—"It must be remembered that there is not perfect agreement. . . . The errors are larger than those involved in the direct

measurement of the pressure and the other quantities involved; there is a systematic error. But this is due, say the thermodynamicists, to the imperfection of the membrane." I am not sure that I like to be called such a bad name, even by Mr. Campbell, but may I point out that Mr. Campbell has not put forward the whole of the evidence?

The direct measurement of osmotic pressure may not be a very accurate performance, though experience shows that as our membranes become more and more perfect the observed values more nearly approach that indicated by theory as the ideal case. But let us pass that by for a moment, and consider the relation between the osmotic pressure of a solution as defined theoretically and its freezing point. To do so we must use again thermodynamical reasoning, and introduce its necessary assumptions. But most of the assumptions will be the same as we made in deducing the theoretical value for the osmotic pressure, and they, at any rate, do not really add to the total number. Having obtained the well-known relation between osmotic pressure and freezing point, let us calculate numerically what the freezing point of the solution would be if the osmotic pressure possessed the theoretical value. With the most probable number for the latent heat of fusion, the molecular depression of the freezing point of water by the solution in it of a small quantity of any substance should be  $1^{\circ}.857$  C. Mr. Griffith's experiments, made with all the refinements of platinum thermometry, gave for the molecular depression of solutions of cane-sugar (from a concentration of 0.0005 to 0.02 gram-molecules per litre) the number  $1^{\circ}.858$ . The limiting number for solutions of potassium chloride was  $3^{\circ}.720$ , half of which is  $1^{\circ}.860$ . Now these numbers agree with astonishing closeness; the opposite errors on Mr. Campbell's hypothesis must balance each other to within very little more than one part in a thousand. I cannot disprove his contention, but I think the balance of probability is against him, and, after all, any evidence which involves experiment must be merely a question of less or greater probability.

Now it seems to me that in this concordance we have a very strong piece of evidence in favour of the existence of an effectively reversible operation in the process of freezing—an operation much more nearly truly reversible than any it is possible to obtain with the rough and crude arrangements of even the best practical heat engines. Hence my present opinion is that, not only is the application of thermodynamics to osmotic phenomena in their theoretical aspect justified, but that it gives one of the most valuable confirmations we possess of the general validity of thermodynamic reasoning as a means of discovering an ideal limit towards which practical processes may tend.

In conclusion, may I point out the great interest of Mr. Campbell's argument that it may be "the swifter molecules which escape into the vapour and the slower which escape into the solid." The contention seems reasonable; and, though I feel that the strength of the case I have stated above is so great as to indicate that such a sifting of molecules cannot affect appreciably the thermodynamic result, it is clear that Mr. Campbell's point should be considered. Has Mr. Campbell really caught a Maxwellian demon? If so, all the world will crowd to study the specimen. But this letter is too long already, and I must leave the discussion to some one more learned than I am in this particular branch of demonology.

W. C. D. WHETHAM.

Trinity College, Cambridge, May 26.

#### A New Vesuvian Mineral.

AMONG the ejected masses that strew the flanks of Vesuvius many minerals of known species are to be recognised, and will be referred to in a publication now in preparation.

Perhaps the most interesting among a large number of blocks that I broke open after the eruption were two containing fine crystals of halite associated in spots with a canary-yellow mineral. This latter occurs in crystals up to several millimetres in diameter, and, so far as I have yet examined it, appears to be in rather flat rhombohedra. It is somewhat deliquescent, and therefore requires special

attention for its preservation. This is, no doubt, due to the small proportion of magnesium chloride.

A preliminary analysis affords the following result:—

Moisture ... ..	0.12	MgCl <sub>2</sub> +6H <sub>2</sub> O ... ..	0.22
Insoluble matter ..	0.65	Na <sub>2</sub> SO <sub>4</sub> +10H <sub>2</sub> O ...	1.95
MnCl <sub>2</sub> +4H <sub>2</sub> O ... ..	38.97	Fe <sub>2</sub> O <sub>3</sub> ... ..	traces
KCl ... ..	57.71		
NaCl ... ..	0.32	Total ... ..	99.94

From this analysis it appears that we have to do with a double chloride of manganese and potassium for which I propose the name of *chlormanganokalite*, at any rate provisionally until more complete studies can be made of this undescribed species and proper proportions attributed to the combined molecules.

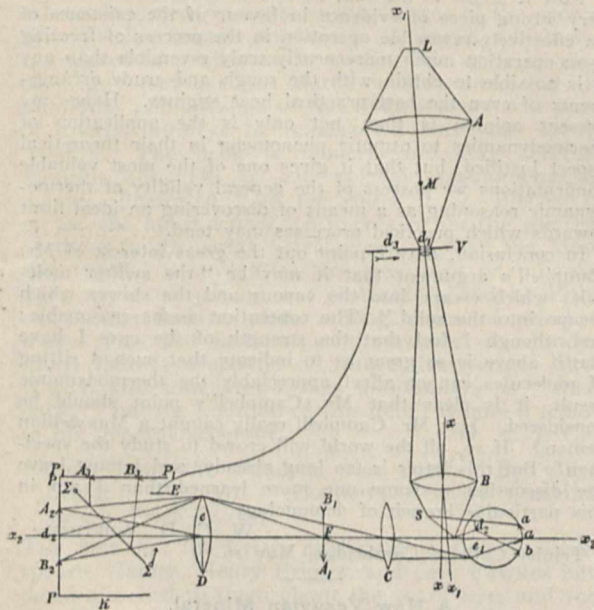
The associated minerals have been deposited as sublimates in the interspaces of scoriaceous masses forming the upper part of the great cone.

The halite probably is rich in potash, but I have not yet had time to make an analysis.

H. J. JOHNSTON-LAVIS.

THE PHOTOGRAPHY OF THE FUNDUS OCULI.

IT is not surprising that the idea of photographing the fundus of the eye followed quickly upon the discovery of the ophthalmoscope by von Helmholtz in 1851. The many attempts made by Noyes (1862), Rosebrugh, Dor, Howe, Bagneris, and others on animals met with only partial success, whilst Gerloff, Thorner and others, who attacked the more difficult problem of the human eye, obtained very inferior results. The best photographs of the human fundus have been taken by Prof. Dimmer, of Graz, who records his experiments in the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften zu Wien*,



[ FIG. 1.—Diagram of apparatus.

*Math.-Naturwissensch. Klasse* (Bd. cxiv., Heft ix., 1905).

The chief difficulties which have to be contended with are (1) that of keeping the eye immobile; (2) the necessity for very powerful illumination, which may have a deleterious effect upon the eye; (3) the reflexes

formed by the surfaces of the dioptric media—corneal, lenticular, and fundal. Of these the complete abolition of reflexes has as yet proved insuperable. Prof. Dimmer has succeeded in reducing the corneal and lenticular reflexes to a minimum, but the shimmering reflexes at the fundus, which vary so much in different eyes, have resisted all efforts. Nevertheless, an encouraging degree of success has been attained.

The method adopted was as follows:— The source of light was a 20-30-ampere arc lamp (L). The light was concentrated on a small diaphragm (*d*<sub>1</sub>), which may be regarded as the immediate source of illumination. A second condenser system (B) formed an image of the diaphragm at the level of the pupil of the eye (*d*<sub>2</sub>). The light and condenser systems were centred on an axis at right angles to the optic axis, the cone of rays being reflected into one half of the pupil by an oblique mirror (s) immediately in front of the eye. This arrangement has the advantages of illuminating a maximum field of the fundus, of reducing the corneal and lenticular reflexes to a minimum, and of leaving the other half of the pupil free for the emergent rays. The last device is that adopted by Bagneris, and by Wolff in his electric-light ophthalmoscope.

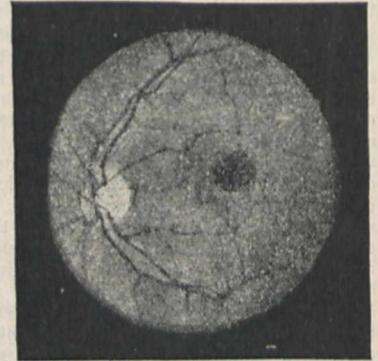


FIG. 2.—The normal fundus.

The image of the fundus is that of the ordinary indirect method of ophthalmoscopic examination. A convex lens (c) forms a real inverted image at or near its principal focus (F), according to the refraction of the eye. A second convex lens (D) is used to form an erect image upon the sensitive plate (PP). An oblique mirror (ΣΣ) in the camera reflects the image on to a ground glass screen (P<sub>1</sub>P<sub>1</sub>) at right angles to the position of the plate until the moment of exposure; this facilitates focusing, &c.

Fixation is maintained by an object (M) in the axis of illumination, the diaphragm being covered by a smoked glass. At the moment of exposure, which is instantaneous, a blank diaphragm (*d*<sub>3</sub>) is shot into position by a simple electromagnetic arrangement. Orthochromatic plates are, of course, used to minimise the inopportune colour of the image.

Prof. Dimmer has photographed several normal and pathological eyes. No evil effects have apparently ensued, owing to the shortness of the exposure required. The results are better than any previously obtained, but they are far from perfect. Those who saw the original photographs at the International Ophthalmological Congress at Lucerne in 1904 will, however, condole with the author for the inferior half-tone reproductions of the Imperial Academy.

We are forced to admire Prof. Dimmer's pertinacity in this research, at which he has been occupied since 1899. Considering the well-known dangers of very bright illumination upon the retina, the mediocre results obtained, and the doubtful utility in ophthalmic surgery, we cannot but hope that future experiments will be confined for the present to animals.

J. HERBERT PARSONS.



THE BIRDS OF THE ISLE OF MAN.<sup>1</sup>

THE present volume forms an addition to the now considerable list of those well-known and trustworthy "Faunas" of counties or special areas which have from time to time issued from the publishing house of David Douglas in Edinburgh. It is not an unworthy companion to them. The majority of its predecessors, however, have included the complete vertebrate fauna of the region dealt with, and, remembering the limited area of the Isle of Man, the present volume might well have done the same without increasing very seriously the labours of the author or the size of the book. It would then have been a useful complement to the "Vertebrate Fauna of Lakeland," by the late Rev. H. A. Macpherson, in the same series, and would have filled a blank.

It is rather surprising that, amid the numberless local faunas that have been published, we have as yet no complete work on the natural history of the Isle of Man, considering the numerous contributions, scattered, no doubt, through many periodicals, to its botany, zoology, geology, and antiquities that have been made by excellent and systematic observers from the days of Sir William Jardine and Edward Forbes onward. The present very complete volume on the birds is, however, heartily welcome. Its author, Mr. Ralfe, is well known in ornithological literature as one who has devoted much time to the study of the feathered fauna of his native Mona, "in the intervals of daily occupation and in more than usual isolation from the resources of science." He fully acknowledges his indebtedness to Mr. Kermodé, whose name also, as he indicates, might well be bracketed with his own on the title-page, so intimately have they been associated together in bird-observation and record.

The detailed account of the species frequenting the island is prefaced by an introductory chapter containing sections on, among others, the topography of Man; on the history of Manx ornithology, in which the chief writers and their contributions are referred to; on Manx bird-names, so often expressive and musical; and on migration in Man. The latter is very disappointing. From so competent an ornithologist as Mr. Ralfe, with his residence on the island, which is a special rest-place on the main west coast fly-line, we might have looked for that chapter on the autumn and spring movements of the migratory stream which has yet to be written.

Nesting in the large north-western bight between England and Scotland, the Isle of Man has relationships with Lancashire, Lakeland, the three southernmost Scottish counties on its northern side, as well as with Ireland. Mr. Ralfe has carefully noted this relationship, where possible, by reference to the work of Service, of Gray and Anderson, of Macpherson and Mitchell, of Aplin, Coward and Oldham, and of Ussher and Warren. If we compare the number of species of birds recorded from Lancashire,

as a neighbouring, accurately defined and well-worked area, with that from Man, we have 269 species from the several-times-larger county, against 183 from the smaller isle, indicating a fairly rich avifauna, notwithstanding its disadvantageous isolation, its bare heights, and its poverty in woodland and shrubberies. There are 75 residents and 18 summer visitors among the 93 nesting species of Man, against the 93 residents and 43 summer visitors comprising the 136 breeding birds of Lancashire. "Almost all birds generally distributed through the British Isles, at least as far as our latitude, are present. . . . Man agrees with Ireland and differs from the opposite counties of England in the absence or rarity of various small summer migrants," such as the garden warbler, redstart, tree-pipit, woodpecker, and others. The island, however, "is rich in rock-breeding coast birds, but rather lacking in shore-frequenting waders." Such is a summarised account.

The author has narrated concisely all that is worthy of record about the commoner species, reserving his space for fuller details in the history of others of special interest to the island. We find in regard



Photo

F. S. Graves.

FIG. 1.—Nesting-place and eggs of Arctic Tern (amid drift of highest tides). From "The Birds of the Isle of Man."

to the carrion crow that it is the grey-headed form which is resident in Man, while the black race is practically absent, and, therefore, the island follows Scotland and Ireland and differs from England in the distribution of this bird. The following problem has often presented itself to us:—When the dimorphic forms (*cornix* and *corone*) of this species interbreed in considerable numbers on the border-line (i.e. along the line from the Firth of Clyde to the Adriatic) of their defined areas, and rear families of, say, three individuals of the *cornix* and three of the *corone* race in each nest, what induces the "grey-necks" on the approach of the breeding season to hurry off to their proper side of the line, while their black nest-fellows feel constrained to reside to the southward of it? Ornithologists will be gratified to have Mr. Ralfe's assurance that the crouch is not diminishing in numbers, but displays its scarlet beak and legs "abundantly on the steep brows which fall from the rocky hill-tops to the . . . luxuriantly

<sup>1</sup> "The Birds of the Isle of Man." By P. G. Ralfe. Pp. lv+321. Edinburgh: David Douglas, 1905. Price 18s. net.

foliated sea-cliffs"; and that the peregrine falcons still occupy the ancient eyries in which they were protected for 300 years, although now their names are, strangely enough, not among those scheduled in the Wild Birds Protection Act. On the other hand, they will note with regret the extinction of the rock-dove and of the shearwater (which derives its name from the island), which were once so abundant among its cliffs.

This volume, if not perhaps quite up to the standard of some others of the series, is a conscientious and careful contribution to the natural history of Man. It is beautifully illustrated by two maps, as to the excellence of which no more need be said than that they are by Bartholomew, of Edinburgh, and by fifty full-page blocks of Manx scenery (most of them of favourite nesting-places of different species), a specimen of which, by the publisher's courtesy, is here reproduced. F.

### THE BEAUFORT SCALE.<sup>1</sup>

ABOUT a hundred years ago, Admiral Beaufort, having felt the want of some scheme by which the winds could be classified according to their force, devised a plan which has been in uninterrupted use ever since. In the absence of mechanical anemometers he had to trust to personal experience and the observed effects of wind on the objects moved by it. As a sailor, he naturally selected ships as the objects moved. Calling a calm zero, and representing a hurricane, or a wind in which no ship could carry any canvas, by 12, he endeavoured to assign the intermediate numbers to winds the force of which could be gauged by the amount of sail that a well-conditioned ship of specified rig could carry. In the lapse of time sailing ships altered their rigging or disappeared altogether, with the result that the gallant Admiral's nomenclature became obsolete or unmeaning. Anemometers depending upon the application of some mechanical principle came into general use, and from the fact that these instruments gave a continual record, right or wrong, their register tended to supersede a plan, which relied simply on tradition and probably varied in individual observers. But it has always been felt that there existed some relation between the records of the anemometer and the Beaufort Scale, and various authorities have attempted from time to time to bring the two into accord, or to supply the means of expressing any given number in the Beaufort Scale as velocity reckoned in miles per hour. These well-meaning attempts have not enjoyed the unquestioned confidence of meteorologists, nor have they ensured uniformity in practice. Of late the Meteorological Office has instituted a rigorous inquiry into the estimates of wind force as made in the Beaufort plan and as recorded by anemometers, and have now issued their report.

A preliminary question presents itself to which it is difficult to give a completely satisfactory answer. Is the Beaufort Scale worth preserving? or, in other words, relying as the scale does on personal experience, is it capable of being reproduced with sufficient accuracy to ensure the maintenance of constancy in all circumstances and in all localities? This question must have presented itself to the Meteorological Office and been answered in the affirmative. The decision taken is probably justified. In many positions at sea

it is not possible to use mechanical anemometers. In lawsuits and Board of Trade inquiries the vocabulary of the Beaufort Scale is in frequent use, and nautical assessors have to attach a definite meaning to it. On the other hand, are we sure that the automatic registration by anemometers has been correctly interpreted? Dr W. N. Shaw himself raises the question whether the hourly velocity is a suitable element for comparison. It is probably the best that can be done, but it may be that we are trying to compare a scale of doubtful utility with a record that is only imperfectly understood.

The anemometers in use in this country are of two kinds, that known as the Robinson, which gives us with accuracy the number of times that a system of hemispherical cups rotates in any specified interval, when mounted in a particular manner. The error, or possible error, in the use of this apparatus enters when we pass from the velocity of the cups to that of the wind. For years it was assumed that the wind velocity was three times that of the cups, a round number which of itself suggested that it was a rough approximation. The factor 2.1 or 2.2 is now proposed as more appropriate. But there is this further difficulty: that while the velocity of the wind in an hour is not constant, the method of registration smooths out the irregularities, so that the variations in the velocities become indistinguishable in the record. The other form of anemometer, known as the Dines Pressure Tube, shows the variation in the wind velocity by recording a succession of oscillations of considerable magnitude. The trace is such as results from a pen moving vertically with comparative rapidity over paper moving more slowly horizontally. To determine the mean velocity from this trace is a matter of some uncertainty. The eye naturally selects a line which may be taken as representing the mean velocity during the interval under examination. But the number of miles per hour indicated by the position of this line can only be known from experimental inquiry. These experiments have been conducted by Mr. Dines in an exhaustive manner, but the results must nevertheless be considered as empirical. It is upon these experiments that the constant for the Robinson anemometer has been changed. Finally, therefore, the problem resolves itself into reading the results derived from the experiments of Mr. Dines into the phenomena observed by sailors and others in deciding on the numbers used in the Beaufort Scale.

But assuming that the hourly wind velocity is correctly known at any moment, it would seem a tolerably simple matter to assign to each of the Beaufort numbers the corresponding wind velocity. We have simply to take the mean value of the velocities for all winds estimated as being of a given Beaufort number to get a scale equivalent in miles per hour. This has been done more than once, and a table of such equivalents has been issued under the sanction of the Board of Trade. Such a simple solution, however, by no means disposes of all the difficulties. Prof. Köppen pointed out that a different scale of equivalents was obtained, when the mean value of all the velocities assigned by estimate as of a given Beaufort number was taken, from that which resulted from taking the mean of the Beaufort numbers corresponding to given velocities. The first method of treatment may be described as that of Curtis, the second as that of Köppen. To explain the cause of the difference between the two methods was the problem submitted to Mr. G. C. Simpson, and very ably he has dealt with it. Unfortunately we cannot follow him in his details; we can only point out some of his results. The following table shows the relation between the Beau-

<sup>1</sup> "Report of the Director of the Meteorological Office upon an Inquiry into the Relation between the Estimates of Wind-Force according to Admiral Beaufort's Scale and the Velocities recorded by Anemometers belonging to the Office; with a Report by G. C. Simpson, M.Sc., and Notes by Sir G. H. Darwin, W. H. Dines, and Commander Hepworth." (Printed for His Majesty's Stationery Office. London, 1906.)

fort Scale numbers and the wind velocity measured in miles per hour as derived from the methods of Curtis and Köppen.

Beaufort		Miles per hour		Beaufort		Miles per hour	
No.	Curtis	Köppen	No.	Curtis	Köppen	No.	Curtis
0	3'0	0'0	6	24'5	28'0		
1	5'0	2'0	7	30'0	34'5		
2	8'0	6'0	8	36'0	42'0		
3	11'0	10'5	9	44'0	50'0		
4	15'0	16'0	10	53	59'0		
5	19'5	22'0					

Mr. Simpson not only shows the reason for the discrepancy between these two sets of numbers, but discusses the special problems to which each set is applicable. This part of the report is particularly interesting, since it displays the intricacy of the problems connected with anemometry. Besides the difficulties of a theoretical character, there is the additional fact that the scale is not sufficiently definite, nor the estimates sufficiently accordant, to warrant the presentation of an authoritative table of equivalents applicable to each number of the Beaufort Scale, and the Director contents himself with offering a less detailed statement which for practical purposes expresses the relation between Beaufort numbers and hourly velocities.

Beaufort Scale Nos.	Corresponding Wind	Limit of hourly velocity
0	Calm	Under 2
1-3	Light breeze	2-12
4-5	Moderate wind	13-23
6-7	Strong wind	24-37
8-9	Gale	38-55
10-11	Storm	56-75
12	Hurricane	Above 75

This table shows that 12 was too high a number, or the steps of the scale too small. The difference of velocity must be considerable before it becomes apparent to rough methods of observation.

W. E. P.

#### PROF. METSCHNIKOFF'S HARBEN LECTURES.

THE Harben lectures of the Royal Institute of Public Health have just been delivered by Prof. Elie Metschnikoff, of the Pasteur Institute, Paris, and Foreign Member of the Royal Society. The lectures, which contained matter of the greatest interest, and were admirably delivered, attracted large and appreciative audiences.

In the first lecture, delivered on May 25, Prof. Metschnikoff directed attention to the fact that persons may harbour disease germs without themselves manifesting any ill effects. A notable instance of this is the case of a woman, the proprietress of a bakery, who suffered from typhoid fever ten years previously, and whose employees always suffered from more or less gastro-intestinal disturbance, two of them dying from typhoid fever. Investigation proved that this

woman was excreting numbers of typhoid bacilli. Why should such an infected person remain apparently well? Undoubtedly because she had acquired an immunity, the result of modifications of living parts of the body, in all probability of the phagocytic cells. All the evidence points to the phagocytes being the great line of defence against disease germs. Recently Dr. Wright advanced the hypothesis that the fluids of the body prepared the microbes for ingestion by the phagocytic cells by means of substances named *opsonins*; but experiments were quoted suggesting that phagocytosis takes place without any addition of opsonins. All observations lead to the conclusion that immunity against infective agents is the result of phagocytic action, is a function of the cells.

Persons addicted to alcohol are far less resistant to infective diseases than abstemious individuals, and experiments show that animals subjected to the influence of alcohol become more sensitive to harmful microbes, because the alcohol has a deleterious action on the phagocytes. It was therefore suggested that it might be wise to eschew alcohol (and other drugs) in the treatment of infective diseases. On the other hand, normal blood-serum and weak saline solutions increase the resistance towards pathogenic microbes, and cases were quoted showing the beneficial action of these substances in grave cases of disease and in major operations.

The second lecture, delivered on May 28, was on the hygiene of the alimentary canal. In all probability microbes frequently gain access to the circulation through the intestinal wall, and Prof. Metschnikoff supported the view that the virus of tuberculosis frequently gains access to the body by this portal. Parasitic worms are also a source of danger, and many cases of appendicitis can be ascribed to this cause. The data collected indicates that it is high time to undertake a campaign against the entozoa. To obviate the risk of intestinal infection, much may be done by taking cooked food only—boiled water and milk, boiled vegetables, cooked and not raw fruit, and no raw salads. The precautions suggested may appear difficult to carry out, but, once accustomed to them, they enter into practice without difficulty.

The third lecture, delivered on May 30, was devoted to a consideration of hygienic measures against syphilis. It was pointed out that the sufferers from this malady are very largely innocent victims. The subjects of anti-syphilitic sera and of anti-syphilitic vaccination were considered, and it was shown that both of these are at the present time impracticable. It has been shown that apes can be inoculated with the syphilitic virus, which gives a means of testing prophylactic measures, and as a result of experiment it has been found that the application of a calomel ointment well rubbed into the seat of inoculation will prevent infection if applied within twenty hours of inoculation. The results obtained on lower monkeys and on anthropoid apes agree so well as to justify the conclusion that the same method may also serve for the prevention of syphilis in man. It has been tried with successful results in the case of a medical student who volunteered for the experiment.

No considerations of a moralising tendency should be opposed to the prevention of so disastrous a calamity as syphilis. True morality should rather contribute as much as possible to the prophylaxis of this and many another disease.

The lectures will be published in full in the forthcoming numbers of the *Journal of Hygiene*.

## NOTES.

BARON C. R. VON DER OSTEN SACKEN, author of numerous books and papers on the classification of Diptera, died at Heidelberg on May 20 in his seventy-eighth year.

NOTICE has been received that the title of the Field Columbian Museum, Chicago, has been altered. The institution is now designated the Field Museum of Natural History.

THE death is announced of Dr. Ernst Schellwien, professor of geology and palæontology, and director of the Amber Museum, Königsberg University, in his fortieth year.

DR. E. V. DUNGERN, professor of bacteriology and hygiene in the University of Freiburg (Baden), has been appointed director of the scientific section of the Krebsinstitut, Heidelberg.

PROF. ROBERT KOCH has written to the Berlin Medical Society resigning his position on the presidential board on the ground that he expects to remain at least two years in Africa in order to continue his investigations on sleeping sickness in conjunction with the German Imperial Expedition, of which he is the head.

DR. K. PAPE, formerly professor of physics in the University of Königsberg, died at Steglitz on May 9. He was born in Hanover in 1836, and held the professorship of physics in the agricultural academy in Proskau from 1866-1878, that is, until his appointment to the Königsberg chair, which he held until 1904.

IN No. 41 of the *Chemiker Zeitung* is a very useful résumé of the experimental advances made during 1905 in the subjects of physics and physical chemistry in so far as they appeal to the chemist. The report deals chiefly with radio-activity, stoichiometry, chemical dynamics, thermochemistry, photochemistry, and electrochemistry.

THE third International Conference on Plant Breeding, whether by hybridisation or by cross-fertilisation, will be held in London on July 30 to August 3 under the auspices of the Royal Horticultural Society. Successful conferences on this subject were held in London in 1899 and New York in 1902. The president of the forthcoming conference will be Mr. W. Bateson, F.R.S.

THE German Bunsen Society for applied physical chemistry held its annual general meeting in Dresden under the presidency of Prof. Nernst on May 20-23. The business of the meeting included some thirty-five papers, in a group of five of which the value and methods of the fixation of nitrogen for industrial and agricultural purposes were discussed, in another group colloidal bodies were considered, whilst other subjects brought forward were such as technical methods for examining explosives, radiation laws, &c.

THE hygienic exhibition in Vienna was opened by Duke Leopold Salvator in the presence of a distinguished company, including some of the chief representatives of Austrian and foreign science, industry, and commerce. Although originating from a private source, the exhibition has, under the support of the municipal and Imperial authorities, and the keen interest displayed by many European exhibitors, proved a great success; the practical results of the more important chemical, hygienic, and medical investigations of the last ten years are well brought out by the numerous exhibits, which have been divided

into nine groups:—(1) domestic hygiene; (2) personal hygiene in health and sickness; (3) public hygiene; (4) general industrial hygiene; (5) chemistry, pharmacy, and investigations of foods; (6) hygienic precautions necessary in the liquor and food industries; (7) clothing industries and laundries; (8) travel and association with strangers; (9) hygiene of sport.

ON the recommendation of the Home Secretary, a Royal Commission has been appointed to inquire into the health and safety of miners. Lord Monkswell is chairman of the commission. Science is represented by Dr. J. S. Haldane, F.R.S., university lecturer in physiology, Oxford, and mining engineering by Sir Lindsay Wood, Bart., past-president of the Institution of Mining Engineers. The remaining six members of the commission are politicians and officials of eminence. The secretary of the commission is Mr. S. W. Harris, of the Home Office. Among the questions referred to the commission is whether any change is desirable in the present system of examination for managers' and under-managers' certificates of competency; whether the managers of metalliferous mines should be compelled to hold such certificates; and whether certificates granted by colonial Governments should not be accepted in this country. In view of the great importance of this branch of the inquiry, it is perhaps to be regretted that the commission does not include some recognised authority on mining education. Not any of the commissioners appear to have passed any examination in mining.

DR. L. A. BAUER, who has been in charge of the magnetic survey and observatory work of the United States under the auspices of the Coast and Geodetic Survey since 1899, has accepted an offer, made to him by the Carnegie Institution of Washington, of the post of permanent director of its department of terrestrial magnetism. Since the establishment of this department in 1904, Dr. Bauer has filled the duties of director in conjunction with his official duties in the Coast and Geodetic Survey, but soon after July 1 he will devote his entire time to the Carnegie Institution work, which has developed into what practically amounts to a general magnetic survey of the globe. The annual grants to the department are sufficient to keep in progress continuously an oceanic magnetic survey, besides the sending of expeditions to land areas where no magnetic surveys have as yet been made, and also for conducting various auxiliary investigations. An attempt is to be made to secure the completion of a general magnetic survey of the globe within a period of about fifteen years. During Dr. Bauer's administration of the Coast and Geodetic Survey magnetic work, covering a period of seven years, he has organised and trained a corps of observers, has put in operation five magnetic observatories, has inaugurated magnetic work on the Coast Survey vessels, has practically completed the general magnetic survey of the United States (the three magnetic elements having been observed at about 2500 stations distributed over the United States and outlying territories), and has issued various publications relating to the work.

A PAPER by Mr. Edgar Schuster, on the inheritance of deafness (*Biometrika*, vol. iv., part iv.), was referred to in NATURE of May 17 (p. 63). It was stated in the abstract supplied with the journal that an important point brought out in the paper is "the normal, or even more than average, fertility of deaf-mutes," and this point was mentioned in the note in NATURE. Mr. Schuster writes to say that the meaning can be better expressed by the conclusion "deaf-

mutes have on an average the normal or rather more than the normal number of brothers and sisters, although they appear to have considerably less than the normal number of children."

We have received from Mr. T. P. Mallock, the well-known taxidermist and anglers' outfitter at Perth, an excellently illustrated catalogue of apparatus connected with salmon and trout fishing.

THE crawfishes of the genus *Cambarus* inhabiting Mexico, Central America, and Cuba form the subject of a paper by Mr. A. E. Ortmann published in the Proceedings of the Washington Academy of Sciences (vol. viii., pp. 1-24), in the course of which several new forms are described.

THE various modes in which insects are naturally protected—whether by mimicry, by resemblance to their surroundings, or by the offensive weapons with which they are furnished—form the chief subject of discussion in the May issue of *Museum News*. We note that the next number of that periodical will not make its appearance until October.

MR. E. J. SPITTA records some experiments relating to the compound eyes of insects (*Journ. Quekett Microscopical Club*, April). From these it is suggested that the facets of the insect cornea may be nothing but little holes, filled with some non-refractive medium, by which images may be formed in the same way as a pin-hole forms them. Many difficulties presented by the current theories of insect vision would on this hypothesis be obviated.

THE articles in part v. of the fifth volume of *Annotationes Zoologicae Japonenses* comprise one by Dr. A. Oka on a new genus (*Aphanibranchion*) of ascidians from Japan; a second on variations in toads and in an isopod crustacean, by Mr. S. Goto; and a third, by Mr. A. Izuka, on collateral budding in an annelid. In the case of the toad the variations consist of the fusion of the seventh and eighth vertebrae, and of the formation of the sacrum by the tenth instead of by the ninth vertebra.

NO. 3 of the Philippine Journal of Science (vol. i.) contains the second part of an article by Mr. C. S. Banks on the principal insects attacking the cocoanut palm, and another by the same author on some new Philippine insects. Messrs. W. R. Brinkerhoff and E. E. Tyzzer contribute an elaborate study of experimental variola and vaccinia in quadrumana, in which it is shown that vaccinia protects against variola and *vice versa*, and that the structures described by Councilman, Magrath, and Brinkerhoff as intracellular parasitic protozoa (the *Cytoryctes variolae*) are present in the lesions.

THE April number of the *Emu* opens with an account of a visit to an ibis "rookery" in a swamp in the Casterton district, Victoria, during the breeding season. The species breeding in the swamp are the straw-necked and the white ibises (*Carphibis spinicollis* and *Ibis molucca*). The firing of a shot reveals the enormous numbers of birds frequenting the rookery. "In a moment there is a wild commotion and the air seems whistling with the sounds of hundreds and thousands of wings, and then in one mighty cloud the whole assembly takes flight, making the sky look black and white; the effect being heightened by the long bills, outstretched necks, and general peculiar appearance of the birds." The coachwhip bird (*Psophodes crepitans*) and its nest form the subject of two excellent reproductions from photographs.

THE work done on the insect-collection of the Oxford University Museum during the past year, and the condition and extent of the collection itself, receive special attention in the report of the delegates of the museum for 1905 (issued as a supplement to the *Oxford University Gazette*). Prof. Poulton lays great emphasis on the value of the services of Mr. R. Shelford, who has gained wide experience and knowledge as curator of the Sarawak Museum. Mr. Shelford's efforts have been chiefly directed to reduce to order the collection of Orthoptera, which, although one of the finest in the world, has hitherto been of little use to entomologists on account of want of proper arrangement and classification. In several sections of the collection—notably the one made by Burchell in South Africa—the insects were altogether unnamed, but this serious deficiency is being rapidly put right by Mr. Shelford's labours. In the course of handling the collection a large number of type-specimens have been identified. Many important additions have been made during the year to the collections generally, the curator of the Pitt-Rivers Museum reporting the acquisition of a number of specimens illustrating the ethnology of many parts of the world.

HAS the Federal Government of the United States power to take remedial measures to prevent the spread of noxious insects, like the cotton-boll weevil or the gipsy-moth, in cases when individual States in the Union are not doing all in their power in this direction or are unable to do sufficient? Such is the question asked by Prof. E. D. Sanderson in the May number of the *Popular Science Monthly*, and from precedents derived from other legislation answered in the affirmative. It is, however, not only in the case of States that refuse to do their duty that the interference of the supreme Government is invoked. A case in point is afforded by the visitation of the gipsy-moth in Massachusetts. At the present time New Hampshire is able to defend its frontier from the pest, but a time will come when action in Massachusetts will alone prevent an invasion of the neighbouring State. Is it fair, it is asked, that one State should be thus heavily penalised for the common good? Individual adaptation to environment forms the subject of an article in the same issue by Prof. J. H. Blair; while Dr. R. W. Shufeldt communicates an illustrated paper on bird-photography in Norway.

IN accordance with instructions of the Government of India, a Bombay correspondent of the *Pioneer Mail* reports, a provincial research laboratory has been established in connection with the existing plague research laboratory at Parel. The main objects of the laboratory are:—(a) To afford assistance to all Government medical officers in the discharge of their duties by fulfilling the functions of a "pathological diagnosis institute," to which specimens of all sorts may be sent for opinion. (b) To train hospital assistants and others in elementary clinical pathology, performance of inoculations and hypodermic injections, the preparation and use of disinfectants, and other duties they may be called upon to perform in connection with their duties as public health officials. (c) To afford opportunities to medical men who may wish to do original work for themselves or to practise or be instructed in new methods of diagnosis.

A REPORT of the fruit conference held in October of last year under the joint auspices of the Royal Horticultural Society and National Fruit Growers' Federation is contained in the April number (vol. xxx.) of the journal of the former society, just issued. The volume includes much

information of value to all who are interested in the cultivation of fruit.

In the Trinidad Bulletin (April) Mr. J. H. Hart gives a list, with descriptions, of fourteen varieties of orange of which well-established plants can be supplied from St. Clair experiment station. The Pineapple and Jaffa are especially recommended; the list also includes Homosassa, Parson Brown, and Washington Navel; in fact, all the varieties have been carefully selected. A new edition of the guide-book to the Trinidad Gardens is to be published shortly, in which there will be special references to the features depicted by Kingsley in "At Last."

THE North American species of *Festuca* are collated by Mr. C. V. Piper in vol. x., part i., of the Contributions from the United States National Herbarium. In North America twenty-two perennial and twelve annual species are recognised, as compared with twenty-eight perennial and twenty-six annual species in Europe. In addition to the sheep and red fescues, *Festuca altaica* and *Festuca viridula* are regarded as excellent fodder grasses, and *Festuca octoflora* is valuable in semi-arid districts. The term "lemma" is adopted to signify the outer or lower palea. A number of plates accompany the text, and a tentative list of Mexican species is appended.

BOTANISTS who have attempted to classify the different varieties of such plants as rice, cotton, &c., that are extensively cultivated in India have noted the extraordinary power of discrimination manifested by the peasant cultivators. In a Bulletin (No. 55) recently published by the Madras Department of Agriculture on the great millet, *Sorghum vulgare*, a plant grown very widely as a food and fodder crop, Mr. C. K. Subba Rao enumerates with comparative notes more than sixty forms referable to seven botanical varieties. Three of these varieties are represented in other parts of India, and in addition there are the forms that would be grouped under fifteen varieties that are not represented in the presidency.

THE latest number, vol. xix., part i., of the Transactions of the Royal Scottish Arboricultural Society contains, as usual, a number of interesting papers on forestry subjects. A working plan for the Alice Holt woods in the east of Hampshire has been prepared by Dr. Schlich. In 1812 an Act was passed providing for the cultivation of navy timber in the forest, but owing to the low standard of the oak trees that occupy 95 per cent. of the area it is proposed to plant certain portions with beech, larch, and Douglas fir, and others with spruce and pine. Dr. R. S. MacDougall reports the discovery of larvæ of the chalcid species *Megastigmus spermotrophus* in seed of the Douglas fir received from Aberdeenshire, and adduces evidence to prove that the larvæ are really plant parasites. Mr. G. Brown provides some figures in connection with the natural regeneration of Scots pine at Beauly, and Prof. T. Hudson Beare points out a few of the difficulties in obtaining accurate results when testing timbers.

AN excess of rain is again shown by the weekly weather report of the Meteorological Office to have occurred over the entire country for the period ending May 26. The heaviest rains were experienced in the south-west of England, the measurement for the district being 1.64 inches, which is more than three times the average. The rainfall was about double the average in different parts of the kingdom. The aggregate rainfall for the spring months is deficient in the Midland counties and in the south and east of England, as well as in the Channel Islands, but

mostly in excess in other parts of Great Britain. The total measurement since the commencement of the year is everywhere considerably in excess of the average.

THE eighth Bulletin of North Queensland Ethnography is entitled "Notes on Government, Morals, and Crime," but the four plates and part of the text deal with message sticks. Dr. Roth takes the view that they are merely mnemonic, and convey no communication properly so called. This statement seems to require qualification outside the area with which he deals; for instance, among the Mundainbura of Durham Downs certain marks have recognised meanings, and indicate the marriage classes; in a case reported by Dr. Howitt another tribe with the same classes interpreted correctly a stick sent to put this question to the test. The ordinary use of the stick is, however, mnemonic, and it also guarantees the *bona fides* of the messenger. In North Queensland the stick is sometimes carried at the end of a rod, as shown in NATURE of April 26 (vol. lxxiii., p. 610), but held vertically; the object of this is unknown. In addition to being figured in the plates, the thirty-three specimens are elaborately described. The purely mnemonic character of Dr. Roth's specimens is shown by the accompanying figures, which are alternative forms of stick for the same message. Interesting information is also given on customs of inheritance, a remarkable feature being the succession of females only to property in certain edible plants.

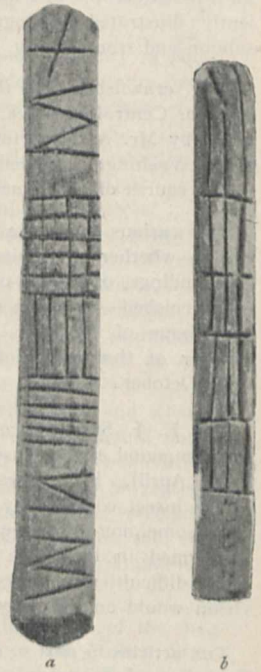


FIG. 1.—So-called "letter" or "message" sticks, Boinjé tribe, Bouliá. (a) Length,  $6\frac{1}{2}$  in.; breadth,  $\frac{3}{8}$  in. (b) Length,  $5\frac{1}{2}$  in.; breadth,  $\frac{3}{8}$  in., made in place of (a), which was stated to have been lost, in order to ascertain whether the same message necessitated similar markings, which it clearly did not.

WE have received a copy of the meteorological report of the Survey Department of Egypt for the year 1903, containing hourly observations at Abbassia Observatory (Cairo), monthly summaries at eighteen climatological stations in Egypt and the Sudan, and some additional rainfall results. The value of the work is much enhanced by graphical representations of the Abbassia observations. In a preliminary examination of some of the data, the superintendent points out that the rainfall at Abbassia and the southern Delta generally is small and irregular, but that it was thought worth while to see whether it showed any signs of periodicity such as that assigned to it in India or Mauritius by Sir Norman Lockyer. A smoothed rainfall curve for the years 1888-1900 shows some resemblance to the inverse sun-spot curve, especially in the coincidence of the maximum of the sun-spots and the minimum of the rainfall in the year 1893.

DR. W. N. SHAW's lecture at the University of London on May 24 brought this most interesting series to a close. The audience no doubt shared the lecturer's views as to the difficulty of dealing sufficiently with the subject in the space of four hours; we hope that the matter will not

be allowed to drop, and that the example set by the London University will be followed by other institutions. The subjects specially dealt with in this last lecture were the variations in the several elements from year to year, the relation of the yield of wheat to rainfall in the British Isles, and illustrations of sequences in seasonal variations in various parts of the globe. Some slides lent by Dr. Lockyer showed very clearly the opposite variations of the pressure curves for different localities, and the similarity between the march of rainfall and inverted pressure curves. The lecturer pointed out that several such relations were beginning to be detected, but that more work was wanted; some of the results could only be considered as temporary at the present time. Some very remarkable illustrations were given of the apparent dependence of the yield of wheat on the rainfall of the previous autumn, although other factors, e.g. temperature and spring rainfall, undoubtedly exert an influence on the general result. The values seemed to show an unmistakable relation to an eleven years' periodicity. Diagrams were also shown exhibiting an apparent notable connection between the south-east trade wind velocity in the Atlantic and English rainfall (see also NATURE, December 21, 1905).

THE Maryland Geological Survey has established a permanent State mineral exhibit in the old House of Representatives at Annapolis. We learn from *Science* that the materials forming this exhibit have been gradually collected by the survey during the last few years, the nucleus being the Maryland mineral exhibit at Buffalo in 1901. This was materially added to in the preparation of the State's exhibit at Charleston the following winter, and was still further increased for the Maryland exhibit for the Louisiana Purchase Exposition at St. Louis in 1904. The latter display has again been much enlarged for the present purpose, and is intended to illustrate thoroughly the mineral resources and industries of the State.

WE have received a copy of the report issued by the Home Office (Cd. 2911, price 1s. 9d.) on statistics relating to persons employed, output, and accidents at mines and quarries in the British colonies and in foreign countries in 1904. The number of persons employed at home and abroad was about five millions, of which one-fifth were employed in the United Kingdom and one-third in the British Empire. More than half the total were employed in getting coal, of which the world's production was 886 million tons, valued at 295 million pounds sterling. Of the world's gold output, 16,593,856 oz., valued at 67,000,000l., the British Empire supplied 60 per cent., the Transvaal contributing 22½ per cent., Australia 22½ per cent., and Canada 4½ per cent. The United States contributed 23½ per cent. In coal mines the death-rate from accidents per 1000 employed was 1.24 in the United Kingdom, 1.24 in the British Empire, 1.90 in Germany, and 3.35 in the United States.

THE *Pioneer Mail* states that the establishment of permanent wireless telegraph stations at Frasersgunj and Akyab is now under the consideration of the Government of India.

THE April and May numbers of the *Journal of the Franklin Institute* are devoted almost entirely to a report of the proceedings on the occasion of the 200th anniversary of Franklin's birth. An address delivered by Prof. Edwin J. Houston, on Franklin as a man of science and an inventor, is printed in full, and gives an extended

account of the life-work of the great discoverer. An account is also given of the Benjamin Franklin trust funds to the cities of Boston and Philadelphia. The *Journal of the Society of Arts* for April 27, referring to the bicentenary celebration, of which an account was given in NATURE of May 10 (p. 36), provides interesting particulars of Franklin's relations with the Society of Arts.

MESSRS. DICKINSON AND SHIELDS, Alliance Mills, Stoke Newington, have sent us a short pamphlet with respect to their bubble fountain, the chief fault of which is that it does not contain any description of how the bubble fountain is formed. However, assuming it to be formed, the bubble fountain consists of a series of soap bubbles, made even at the rate of 20,000 per minute, which may be blown with coal gas, and sent up by day or by night, when, if illuminated by the sun or artificially, it affords an interesting and beautiful phenomenon. At night, further interest may be given by firing the fountain, when the flame will run up the stream of bubbles. Intermittent groups of bubbles are suggested as an excellent target for gun practice, cheaper than glass or clay, and obviously it is more humane than the murder of live pigeons. It is stated that a large example may shortly be seen at the Crystal Palace.

ON the British Association journey to and from South Africa a careful watch was made by many members of the party for the "green ray" visible for an instant just at the time of disappearance of the setting sun below a clear horizon. A note has been contributed on this subject to *Symons's Meteorological Magazine* for March and April by Prof. Rambaut, F.R.S., who was one of the party. Prof. Rambaut finds that the phenomenon can be entirely accounted for by the generally received view of the chromatic dispersion of the atmosphere combined with selective absorption. It is not necessary to make elaborate experiments or to go a sea voyage in order to observe the "green ray." By fixing a screen half covering the focal plane of a telescope, or, better still, a diaphragm with a narrow diametral slit, a green or blue flash can be seen at the top of the sun's disc and a red fringe at the bottom any time that the sun is near the horizon, and the observation can be repeated as often as desired.

"THE Grape Curculio" is the title of the 100th Bulletin of the West Virginia University Agricultural Experiment Station at Morgantown, in which Mr. F. E. Brooks deals with the damage inflicted on vineyards by the weevil *Craponius inaequalis*. For several years past complaints have come from vine-growers in Virginia in regard to insects that "sting" grapes, causing them to become "wormy" and to drop from the vines while unripe. The insect is the above-named weevil, and careful experiments have been conducted with the view of mitigating the damage caused by its attacks. Spraying and protecting the clusters by enclosure in bags are recommended as the most effectual remedies.

THE first division of the third part of the catalogue of the Indian decapod crustacea in the collection of the Indian Museum has been received. Part iii. deals with the Macrura, and in the section just issued Dr. A. Alcock, F.R.S., describes the prawns of the *Peneus* group.

IN the notice of the okapi in our last week's issue (p. 88) the description of the animal's habitat should have been attributed to Captain Gosling instead of to Captain Alexander.

MESSRS. PHILIP HARRIS AND CO., LTD., have just issued an illustrated catalogue of instruments for practical work

in geography. The catalogue includes descriptions of simple instruments for map making and other field work, determination of position, and meteorological observations.

In the notice of "Oologia Universalis Palæarctica" in NATURE of May 24 (p. 79) reference was made to the shortcomings of the English text. Messrs. Williams and Norgate ask us to state that arrangements have been made with Mr. Oliver G. Pike to revise the English text, so that in future the work may not suffer from imperfections of expression due to poor translation.

THE "Statesman's Year-book" (Macmillan, price 10s. 6d. net) continues to grow in size and value. The 1906 issue is some 150 pages larger than its immediate predecessor. Separate notices of the States included in the American union have this year been introduced for the first time. Recent important events have led to other changes in the year-book, and among these may be mentioned the dissolution of the union between Sweden and Norway, the peace between Russia and Japan, the mission to Tibet, and the last general election. The maps and diagrams, which are always an attractive feature of the publication, this year deal with the economic development of the United States, the new provinces of Canada, the division of Bengal, the Anglo-Portuguese Barotse boundary, the political changes in the Far East, the races of Russia, and the tariff chart of the world. The volume now runs to lxiv+1604 pages. The editor, Dr. J. Scott Keltie, is to be congratulated upon the forty-third issue of this indispensable work of reference.

### OUR ASTRONOMICAL COLUMN.

#### ASTRONOMICAL OCCURRENCES IN JUNE:—

- June 2. 15h. Conjunction of Venus and Neptune. (Venus  $2^{\circ} 24' N.$ .)
7. 10h. 45m. to 11h. 51m. Moon occults  $\mu$  Sagittarii (mag. 4.0).
10. 3h. Jupiter in conjunction with the Sun.
- „ 13h. 43m. to 14h. 46m. Moon occults  $\iota$  Capricornii. (mag. 4.3).
12. 18h. Saturn in conjunction with the Moon. Saturn  $0^{\circ} 56' N.$ .)
15. Venus. Illuminated portion of disc = 0.849. Of Mars = 0.997.
16. 10h. 19m. Minimum of Algol ( $\beta$  Persei).
21. 21h. Sun enters Cancer. Summer commences.
24. 10h. Venus in conjunction with the Moon. (Venus  $2^{\circ} 29' N.$ .)
26. 5h. 3m. Moon approaches very near to  $\alpha$  Leonis (Regulus).
28. 16h. Uranus in opposition to the Sun.
- „ Saturn Outer major axis of outer ring =  $41'' 47$ .  
Outer minor axis of outer ring =  $2'' 31$ .

PHOTOGRAPHING THE CORONA WITHOUT A TOTAL ECLIPSE.—Numerous experiments have been devised and carried out in the attempt to obtain photographs of the solar corona during ordinary sunlight, without waiting for the rare occasions on which the sun is totally eclipsed. Hitherto no decided success has rewarded these efforts, but another attempt is to be made by MM. Millochou and Stefanik with an equipment mounted on the summit of Mont Blanc.

These observers propose to employ a spectroheliograph such as is now used at several solar physics observatories to obtain monochromatic images of the chromospheric clouds and prominences, but, instead of using one of the calcium or hydrogen lines on the second slit, they propose to isolate the chief corona line, at  $\lambda$  5303, and to eliminate the light of other radiations by means of an appropriate green screen.

Preliminary experiments with this apparatus at Meudon

have given encouraging results, and the observers hope that, in the clear atmosphere of the mountain summit, indubitable success will be attained (*Comptes rendus*, No. 17, 1906).

TERRESTRIAL TEMPERATURES AND THE SOLAR RADIATION.—In the report of the Smithsonian Institution for the year ending June 30, 1905, Mr. C. G. Abbot, who has charge of the Astrophysical Observatory, discusses the recent observations of solar radiation and its connection with terrestrial temperatures.

This matter was discussed by the late Prof. S. P. Langley in the *Astrophysical Journal* for June, 1904, who then arrived at the conclusion that the evidence available indicated that the total solar radiation may vary in comparatively brief periods, and that the irregular variations were frequent and large enough to produce considerable changes of the earth's mean temperature.

In the present communication Mr. Abbot summarises the results obtained since 1902, and, by comparing the values found for the transmission of the solar envelope, and the consequent transmission of the solar radiations to the earth, with the variations of temperature at a number of stations situated in the terrestrial north temperate zone, he has deduced evidence which strongly supports Prof. Langley's theory.

High values of solar radiation and solar transmission appear to precede and to accompany high temperatures in the north temperate zone, and *vice versa*.

The tables and curves which appear in the report substantiate this view, and Mr. Abbot expresses the hope that the study of the solar radiation will soon prove a valuable aid in forecasting climate.

THE DISTRIBUTION OF THE STARS.—In No. 7 of the Publications of the Groningen Astronomical Laboratory Prof. Kapteyn published the material on which he based his studies on the distribution of the stars in space, the distribution of cosmical velocities, &c., and also gave the results of five separate computations based on three different values of the precession and three different positions of the apex of the solar motion.

In this publication 2640 stars of Bradley's catalogue were grouped in ten degrees of declination, and the results given in two tables, the first of which contained the stars having spectra of Secchi's second type, the second the stars of type i. and unknown spectra.

No. 9 of the same publications contains the results of a sixth computation based on more refined data and arranged in a different manner. Instead of grouping the stars according to declination, Prof. Kapteyn has arranged them in zones of Galactic latitude, because, in considering the structure of the universe, it is obviously desirable to take the Milky Way as the fundamental plane. Also, instead of including the stars having unknown or peculiar spectra with those of type i., he has placed them in a table by themselves. In this way he has discussed the distribution and proper motions of 1093 stars belonging to type ii., 1144 stars belonging to type i., and 381 stars the spectra of which have not yet been recognised as belonging to either of Secchi's groups.

The complete catalogue should prove of exceptional interest and usefulness to anyone engaged in any discussion on cosmical evolution, and it would be exceedingly interesting to see what modifications might be necessary if the stars were divided into subgroups according to their ascending and descending temperatures as given in Sir Norman Lockyer's classification.

OBSERVATIONS OF COMETS.—The results of a number of observations of various comets, made at the Chamberlin Observatory (Denver) by Prof. H. Howe during the period November, 1904, to June, 1905, appear in No. 4091 of the *Astronomische Nachrichten*.

Six comets are included, of which comet 1905 i. (Encke) was observed from November 11 to December 27, 1904, and at times appeared to have a faint nucleus and an eccentric, fan-shaped tail. At 6h. 20m. (local M.T.) on December 5 a star of mag. 9.0 shone so lustroously through the comet that the nucleus was invisible.

Half an hour later the nucleus, which was near the following end of the comet, was plainly visible.



THE TARPAN AND ITS RELATIONSHIP WITH WILD AND DOMESTIC HORSES.<sup>1</sup>

SO much progress has been made during recent years in working out the origin and history of domesticated horses that the time has now come when inquiries may be profitably pursued along certain definite lines.

In the first place (assuming that horses have had a multiple origin), inquiries should be instituted with the view of ascertaining so far as possible the characteristics of the post-Glacial species and varieties which have taken part in forming the present domestic races and breeds; in the next place, inquiries should be instituted with the view of ascertaining to which of the lower Pleistocene species the more immediate ancestors of the living horses are most intimately related; and, in the third place, an attempt should be made to determine from which of the ancestral forms the various domesticated breeds have inherited their more striking characters, *i.e.* to ascertain to which ancestral types the Shire, Clydesdale, Percheron, and other heavy breeds, the Barb, Arab, thoroughbred, Kattiawar, and other slender-limbed breeds, are indebted for their chief peculiarities.

In this paper I shall not attempt to show that either Prejvalsky's horse, the Celtic pony, or the Libyan variety recently described by Prof. Ridgeway<sup>2</sup> is genetically related to pre-Glacial species, or entitled to be regarded as an ancestor of one or more domestic breeds.

Sufficient data for a discussion of this kind is not yet available. I propose now, by way of clearing the ground for the investigations mentioned above, to inquire whether the Tarpan (long regarded as the wild progenitor of the common horse of Europe) deserves a place amongst the ancestors of living races and breeds.

The first account of the Tarpan<sup>3</sup> we owe to Gmelin, who came across a troop near Bobrowsk during his journey through Russia between 1733 and 1743. He describes them as mouse-coloured, with a short, crisp mane; the tail always shorter than in domestic horses, sometimes full, sometimes only furnished with short hair; the legs dark from the knees and hocks to the hoofs; and the head thick, with the ears sometimes long, sometimes short.

Since this description appeared, some Continental naturalists have regarded the Tarpan as a true wild species; others, like Dr. Nehring, considered it the last survivor of the ancient prehistoric horses of Europe modified by an infusion of domestic blood; while not a few agreed with Pallas that the Tarpan herds might very well be the offspring of escaped domestic horses.

English naturalists have, as a rule, adopted the view of Pallas.

Notwithstanding all that has been written on the subject since Gmelin's time, hippologists agree with Salensky that the relationship of the Tarpan with wild and domestic horses has not yet been cleared up.<sup>4</sup>

During the nineteenth century very little was done towards determining the systematic position of the Tarpan; but in 1866 a Tarpan foal was captured in the Zagradoffe Steppe and reared by a domestic mare. When about eighteen years old this specimen was sent to the Moscow Zoological Garden, and eventually described in a paper published by Schatloff.

This, like Gmelin's specimen, had a somewhat coarse head, was of a mouse colour, with legs black below the knees and hocks. The mane, however, instead of being short and crisp, as in Gmelin's specimen, was 48 cm. in length and hanging to one side of the neck.

As clearly realised some years ago by Gray, of the

<sup>1</sup> By Prof. J. C. Ewart, F.R.S. Abridged from the Proceedings of the Royal Society of Edinburgh, Session 1905-6, vol. xxvi., part i.

<sup>2</sup> "Origin and Influence of the Thoroughbred Horse" (Cambridge, 1905).

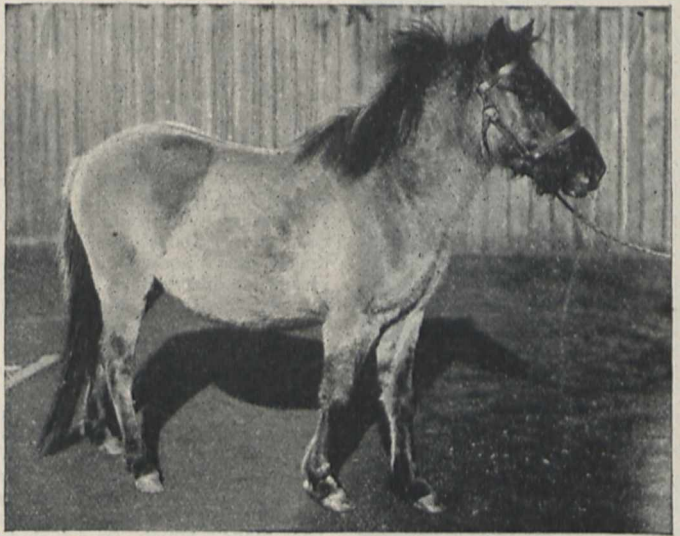
<sup>3</sup> By the Tarpan I mean the mouse-dun horse of Russian and other Continental naturalists, not the so-called "true" Tarpan of Hamilton Smith ("Naturalists' Library," vol. xii., 1841).

<sup>4</sup> The chief papers on the Tarpan are mentioned by Salensky, "Monograph on Prejvalsky's Horse" (St. Petersburg, 1902).

British Museum, certain vestigial structures, known as callosities, warts, or chestnuts, are of considerable taxonomic value. Warts or chestnuts, as is well known, are present on both the fore and hind limbs of the common horse, and they also occur on the hind as well as the fore limbs of Prejvalsky's horse; while in the Celtic pony, as in asses and zebras, the hind chestnuts are completely absent. It is especially worthy of note that though the hind chestnuts were not invariably present in Tarpans (they were absent in a Tarpan described by Krymsch), they were present in the Moscow specimen.

It thus appears that the Moscow Tarpan agreed in its colour with the specimens referred to by Gmelin and Pallas, but differed in the mane and tail, in both of which, as in its callosities, it resembled the common horse, *Equus caballus*. Two Tarpan skeletons have been preserved. The chief point of interest about these skeletons is that, as in the kyang and Prejvalsky's horse, and in certain Arabs, there are only five lumbar vertebræ.

In having only five lumbar vertebræ these Tarpans differed from the common horse of Europe, at least from



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FIG. 1.—The mouse-dun Tarpan-like cross between a Shetland mare and a black Welsh pony. This pony, though a cross, looks as if it belonged to an old-established race. It has a striking, well-formed, massive head, well-placed ears, full eyes, good quarters, and excellent limbs. The mane is, however, short and semi-erect, while the tail consists of three kinds of hair which differ in structure, thickness, colour, and arrangement. From a photograph taken September, 1905.

the forest variety *E. caballus typicus*, in which I have invariably found eighteen pairs of ribs and six lumbar vertebræ.

From this striking difference in the skeleton it follows that, even should the Tarpan turn out to be a true wild species, it cannot be regarded as the sole ancestor of the common horse of Europe.

As to the skull of the Moscow skeleton, Czarski came to the conclusion that it has, on the one hand, all the characteristics of Oriental horses, while on the other it approaches the Scottish breed to which belongs the pony.

The skull of the Tarpan in the St. Petersburg Museum resembles skulls of immature specimens of *E. prejvalskii*, but the bones of the limbs and limb girdles are decidedly more slender, and have less pronounced muscular ridges than in the wild horse of Central Asia.

It may here be mentioned that for more than a century all the horses living in a wild state in Europe, which happened to be of a mouse-dun colour, seem to have been regarded as Tarpans.

Seeing that herds of mouse-dun wild horses no longer occur in Europe, and have not during recent years been met with in even the most remote parts of Central Asia, it might perhaps be assumed that the Tarpan's place in nature must for ever remain a mystery.

This was the conclusion I arrived at when my attention was first directed to the subject. But having ascertained that, by crossing carefully selected forms, remote types are sometimes restored in all their original purity, I thought it worth while to make some experiments.

I selected for my Tarpan experiments a mouse-dun Shetland pony mare, which seemed to me to be a blend of at least three varieties—in its head it suggests the wild horse; in its mane, tail, and trunk it takes after the forest variety; while in the limbs and hoofs it approaches the Celtic pony. This mare was crossed with a black Welsh pony, which belongs to an ancient British race, and doubtless has in its veins not a little Celtic blood.

The first foal, black like the sire, but Celtic in make, failed to throw any fresh light on the question at issue.



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FIG. 2.—Tail and hind quarters of the Scottish Tarpan from a photograph taken at the same time as FIG. 1. As in the wild mare the hair of the tail consists of three portions. The basal portion only essentially differs from the corresponding portion in FIG. 3 by being of less extent and lighter in colour; the middle portion is also lighter in colour and more plentiful than in the wild mare, while the hair growing from the end of the dock in the Tarpan very closely agrees in colour and amount with the terminal portion of the tail in Prejvalsky's horse.

35 cm. In the Scottish Tarpan the mane, from 15 cm. to 27.5 cm. in length, is either nearly upright, or, as already mentioned, arches outwards well clear of the neck (FIG. 1), whereas in a Fetlar (Shetland-Arab) pony of the same age the mane reaches a length of 45 cm. and clings to the side of the neck. The tail of the new Tarpan (FIG. 2) is even more remarkable than the mane. The dock, which is 27.5 cm. in length, is furnished with three kinds of hair. The basal portion for 6.5 cm. carries fine hair nearly circular in section, which, except in the part continuous with the dorsal band, is almost colourless; the middle portion of the dock—about 13.75 cm.—carries thicker hair, slightly oval in section, with a thick cortex containing in some cases a considerable amount of pigment; from the terminal part of the dock—about

7.5 cm.—spring coarse black hairs, which are now long enough to reach the ground. These long hairs are oval in section, have a very thick cortex, and only a small central axis or medulla.

The fine, short, light-coloured hairs (7.5 cm. to 15 cm. in length) at the base of the tail form a conspicuous somewhat lozenge-shaped bunch (FIG. 2); the thicker hairs growing from the middle section of the dock reach a length of 30 cm. They emerge from under the light-coloured root hairs and expand to form a sort of fringe, from which escape the relatively few long black hairs of the distal part of the dock.

In having a limited number of long hairs growing from the distal end of the dock, this cross-bred pony decidedly differs from the Celtic as well as from the forest types of horses. The interest of the tail in the Scottish Tarpan is not so much that it suggests a mule as that it has a very striking resemblance to the tail of Prejvalsky's horse (FIG. 3). The only difference is that in the true wild horse the upper or light-coloured section of the tail is longer than in the Shetland-Welsh cross, which has, in fact, the kind of tail one would expect in a Prejvalsky hybrid in which the wild blood was dominant.

A study of the mane and tail of the Shetland-Welsh cross, and of certain other crosses and breeds, strongly suggests that we must include amongst the ancestors of our domestic horses a species having a mane and tail such as we find in the wild horse still living in Central Asia. In the body hair and the foot-locks the Scottish Tarpan closely resembles the wild horse. Further, it resembles the wild horse in having a very short flank feather, but differs in having the face whorl situated above the level of the eyes, as in the Celtic pony; in Prejvalsky's horse, as in the kyang, this whorl lies well below the level of the orbits.

In the Shetland mare the dorsal band is nearly as narrow as in the Celtic pony; the right hind chestnut measures 1.5 cm. by 0.4 cm., while the left is only 0.5 cm. in diameter; the front ergots are absent, and the hind ergots are very small. In all these points the Shetland mare approaches the Celtic type. In the Scottish Tarpan the front ergots are small, the hind normal; the front chestnuts are oval as in the wild horse, but decidedly smaller, while the hind chestnuts are only one-fifth the length of those in the wild horse. Finally, in the head, ears, form of the limbs and hoofs, the Tarpan-like Shetland-Welsh



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FIG. 3.—Hind quarters and tail of a three-year-old wild mare (*E. prejvalskii*) from a photograph also taken in September, 1905. In the upper part of the tail the hair, light in colour and relatively fine, grows obliquely outwards from the caudal portion of the dorsal band; the hair of the middle part of the tail, darker and stronger than that of the root, lies nearly parallel with the dock and reaches to the level of the hocks; the hair of the tip, black, coarse and scanty, but long enough to reach the ground, emerges from within the hair forming the middle part of the tail. Like the hair at the root of the tail is shed annually.

cross is as nearly as possible intermediate between a wild horse and a Celtic pony. Of the skeleton it is, of course, impossible to speak, but, judging by the shortness of the trunk, the form of the head, and the conformation of the limbs, the probability is that there are only five lumbar vertebrae, as in the Moscow and St. Petersburg skeletons, and that the skull and limb bones resemble those of a young Prejvalsky horse. After very full consideration, Salensky some years ago came to the conclusion that the Tarpan is a type specialised more to the side of *E. caballus* than to *E. prejvalskii*.

When all the facts now available are taken into consideration, there seems no escape from the conclusion that the Tarpan, once common in the east of Europe, cannot be considered as a true wild species.

Further, it may be assumed that the Tarpan herds were derived from at least three primitive stocks, viz.:—(1) from a variety or species identical with or closely related to the wild horse (*E. prejvalskii*) still surviving in Central Asia; (2) from a variety having the characteristics of the Celtic pony—*E. c. celticus*; and (3) from a variety resembling the forest horse—*E. c. typicus*. It is only by assuming the multiplex origin of Tarpans that it is possible to account for some of them having a heavy head, long ears, a nearly upright mane, a mule-like tail, and five lumbar vertebrae, thus suggesting *E. prejvalskii*; for others, wanting the hind chestnuts and possessing a skull like that of certain Scottish ponies, thus suggesting *E. c. celticus*; and for others having a thick head, full mane and tail, and hind as well as front chestnuts, thus suggesting *E. c. typicus*.

By experiments now in hand I hope to settle what part Prejvalsky's horse has taken in forming the Tarpan. If I succeed in showing that crosses between Prejvalsky's horse and either the forest, Celtic, or Libyan variety are practically identical with the cross between the Shetland mare and the Welsh pony stallion, I shall prove that at least certain of the domesticated breeds are indebted to Prejvalsky's horse for some of their characteristics, and at the same time bring additional evidence in support of my view that domesticated races have had a multiple origin, and include plain as well as striped forms amongst their less remote ancestors—have not, in fact, as Darwin thought, descended from a single dun-coloured more or less striped primitive stock.

#### THE FIGURE AND STABILITY OF A LIQUID SATELLITE.<sup>1</sup>

MORE than half a century ago Edouard Roche wrote his celebrated paper on the form which a liquid satellite will assume when revolving, without relative motion, about a solid planet.<sup>2</sup> As far as I know, his laborious computations have never been repeated, and their verification and extension form a portion of the work contained in the present paper.

Two problems involving almost identical analysis, but very distinct principles, are here treated simultaneously. If we imagine two detached masses of liquid to revolve about one another in a circular orbit without relative motion, the determination of the shapes of each of them is common to both the problems; it is in the conditions of their secular stability, according to the suppositions made, that the division occurs.

The friction of the tides raised in each mass by the attraction of the other is one cause of instability. If now the larger of the two masses were rigid, whilst still possessing the same shape as though liquid, the only tides subject to friction would be those in the smaller body. It amounts to exactly the same whether we consider the larger mass to be rigid or whether we consider it to be liquid, and agree to disregard the instability which might arise from the tidal friction of the tides generated in it by the smaller body. Accordingly I describe secular stability in the case just considered as "partial," whilst complete secular stability will involve the tidal friction in each mass.

The determination of the figure and partial stability of a

<sup>1</sup> By Sir G. H. Darwin, K.C.B., F.R.S. Read before the Royal Society on February 8.

<sup>2</sup> Mém. Acad. Sci. de Montpellier, vol. i., 1847-50, p. 243.

liquid satellite is the problem of Roche. It is true that he virtually considered the larger body or planet to be a rigid sphere, but in this abstract the distinction introduced by the fact that I treat the planet as ellipsoidal may be passed over. It appears that, as we cause the two masses to approach one another, the partial stability of Roche's satellite first ceases to exist through the deformation of its shape, and certain considerations are adduced which show that the most interesting field of research is comprised in the cases where the satellite ranges from infinite smallness relatively to the planet to equality thereto.

The limiting partial stability of a liquid satellite is determined by considering the angular momentum of the system, exclusive of the rotational momentum of the planet. This corresponds to the exclusion of the tidal friction of the tides raised in the planet. For any such given angular momentum there are two solutions, if there is any. When these two solutions coalesce for minimum angular momentum, we have found a figure of bifurcation; for any other larger angular momentum one of the solutions belongs to an unstable series and the other to a stable series of figures. Thus, by determining the figure of minimum partial angular momentum, we find the figure of limiting partial stability.

The only solution for which Roche gave a numerical result was that in which the satellite is infinitesimal relatively to the planet. He found that the nearest possible infinitesimal satellite (which is also in this case the satellite of limiting partial stability) has a radius vector equal to 2.44 radii of its spherical planet. He showed the satellite to have an ellipsoidal figure, and stated that its axes were proportional to the numbers 1000, 496, 469. In the paper the problem is solved by more accurate methods than those used by Roche, and it is proved that the radius vector is 2.4553, and that the axes of the ellipsoid are proportional to 10,000, 5114, 4827. The closeness with which his numbers agree with these shows that he must have used his graphical constructions with great care.

For satellites of finite mass the satellite is no longer ellipsoidal, and it becomes necessary to consider the deformation by various inequalities, which may be expressed by means of ellipsoidal harmonic functions.

The general effect for Roche's satellites of finite mass in limiting partial stability is that the ellipsoidal form is very nearly correct over most of the periphery of the satellite, but at the extremity facing the planet there is a tendency to push forth a protrusion towards the planet. In the stable series of figures up to limiting stability this protrusion is of no great magnitude, but in the unstable series it would become strongly marked. When the unstable figure becomes much elongated, we find that it finally overlaps the planet, but before this takes place the approximation has become very imperfect.

Turning now to the case of complete secular stability, where the tidal friction in each mass is taken into account, we find that for an infinitely small satellite limiting stability occurs when the two masses are infinitely far apart. It is clear that this must be the case, because a rotating liquid planet will continue to repel its satellite so long as it has any rotational momentum to transfer to orbital momentum through the intervention of tidal friction. Thus an infinitesimal satellite will be repelled to infinity before it reaches the configuration of secular stability. As the mass of the satellite increases, the radius vector of limiting stability decreases with great rapidity, and for two equal masses, each constrainedly spherical, the configuration is reached when the radius vector is 2.19 times the radius of either body.

When we pass to the case where each liquid mass is a figure of equilibrium, the radius vector for limiting stability is still infinite for the infinitely small satellite, and diminishes rapidly for increasing mass of the satellite. When the two masses are equal the radius vector of limiting stability is 2.638 times the radius of a sphere the mass of which is equal to the sum of the masses of the two bodies. This radius vector is considerably greater than that found in the case of the two spheres, for the 2.19 radii of either sphere, when expressed in the same unit, is only 1.74. Thus the deformations of the two masses forbid them to approach with stability so near as when they were constrainedly spherical.

In all these cases of true secular stability, instability supervenes through tidal friction, and not, as in the case of Roche's problem, through the deformation of figure.

When Poincaré announced that there was a figure of equilibrium of a single mass of liquid shaped something like a pear, he also conjectured that the constriction between the stalk and the middle of the pear would become developed until it was a thin neck; and yet further that the neck might break and the two masses become detached. The present revision of Roche's work was undertaken in the hope that it would throw some light on the pear-shaped figure in the advanced stage of development.

As a preliminary to greater exactness, the equilibrium is investigated of two masses of liquid each constrainedly spherical, joined by a weightless pipe. Through such a pipe liquid can pass from one mass to the other, and it will continue to do so until, for given radius vector, the masses of the two spheres bear some definite ratio to one another. In other words, two spherical masses of given ratio can be started to revolve about one another in a circular orbit, without relative motion, at such a distance that liquid will not pass through a pipe from one to the other.

The condition for equilibrium is found to be expressible in the form of a cubic equation in the radius vector, with coefficients which are functions of the ratio of the masses. Only one of the three roots of the cubic has a physical meaning, and in all cases the two masses are found to be very close together; but the system can never possess secular stability.

When the masses are no longer constrainedly spherical the equation of condition for equilibrium, when junction is effected by a weightless pipe, becomes very complicated, and can only be expressed approximately. It appears that in all cases, even of Roche's ellipsoids in limiting stability, the masses are much too far apart to admit of junction by a pipe; but when we consider the unstable series of much elongated ellipsoids, it seems that such junction is possible, although the approximation is too imperfect to enable us to draw the figure with any approach to accuracy. If two ellipsoids are unstable when moving detached from one another, junction by a pipe cannot possibly make them stable. This then points to the conclusion that the pear-shaped figure is unstable when so far developed as to be better described as two bulbs joined by a thin neck.

Mr. Jeans has considered the equilibrium and stability of infinite rotating cylinders of liquid.<sup>1</sup> This is the two-dimensional analogue of the three-dimensional problem. He found solutions perfectly analogous to Maclaurin's and Jacobi's ellipsoids and to the pear-shaped figure, and he was able to follow the development of the cylinder of pear-shaped section until the neck joining the two parts had become quite thin. The analysis, besides, points to the rupture of the neck, although the method fails to afford the actual shapes and dimensions in this last stage of development. He is able to prove conclusively that the cylinder of pear-shaped section is stable, and it is important to note that he finds no evidence of any break in the stability up to the division of the cylinder into two parts.

The stability of Maclaurin's and of the shorter Jacobian ellipsoids is well established, and I imagined that I had proved that the pear-shaped figure with incipient furrowing was also stable. But M. Liapounoff<sup>2</sup> now states that he is able to prove the pear-shaped figure to be unstable from the beginning. For the present at least, I still think it is stable, and this belief receives powerful support from Mr. Jeans's researches.

But there is another difficulty raised by the present paper. I had fully expected to obtain an approximation to a stable figure consisting of two bulbs joined by a thin neck, but although the present work indicates the existence of such a figure, it seems conclusive against its stability. If then Mr. Jeans is right in believing in the stable transition from the cylinder of pear-shaped section to two detached cylinders, and if I am now correct, the two problems must part company at some undetermined stage. M. Liapounoff will no doubt contend that it is at the beginning of the pear-shaped series of figures, but for the present I should dissent from that view.

<sup>1</sup> Phil. Trans., A, vol. cc., pp. 67-104.

<sup>2</sup> Acad. Imp. des Sci. de St. Pétersbourg, vol. xvii., No. 3, 1905.

One question remains: If the present conclusions are right, do they entirely destroy the applicability of this group of ideas to the explanation of the birth of satellites or of double stars? I think not, for we see how a tendency to fission arises, and it is not impossible that a period of turbulence may naturally supervene in the process of separation. Finally, as Mr. Jeans points out, heterogeneity introduces new and important differences in the conditions.

#### THE RUSTING OF IRON.

THE first view taken of the atmospheric corrosion or rusting of iron was that it was due to a simple process of oxidation. In 1888 Prof. Crum Brown suggested, on the basis of experiments described by Crace Calvert in 1871, that the first stage in the rusting of iron is the production, under the influence of carbonic acid, of ferrous carbonate, which is subsequently converted, by atmospheric oxygen in presence of moisture, into ferric hydroxide or rust. In 1898, however, Prof. Dunstan, in a lecture delivered to the Royal Artillery Institution, put forward another explanation; he considered that pure oxygen in presence of water is capable of attacking iron, giving rise to ferrous oxide and hydrogen peroxide, part of the latter then converting the ferrous oxide into rust, while the remainder directly attacks the iron, giving rise to a fresh quantity of ferrous oxide, which in turn is again oxidised in a similar manner.

A detailed account of the experiments made in conjunction with Drs. Jowett and Goulding, and of the theory, which may be called the hydrogen peroxide theory of rusting, was published in October of last year in the Transactions of the Chemical Society (vol. lxxxvii., p. 1548). The theory was based on certain phenomena of oxidation in which hydrogen peroxide was known to be formed, and on the consideration that certain substances which decomposed hydrogen peroxide were found to prevent the conversion of iron into rust by damp air. The older theory, that rusting was due to carbonic acid, was considered "quite untenable, since it has been shown that rusting can take place in the absence of carbonic acid"; the part played by carbonic acid was regarded as "subsidiary and not essential," and it was held to be proven that the "aerial oxidation of iron can take place in the absence of carbonic acid." This view was arrived at as the results of experiments in which the authors failed, by attempting to exclude carbon dioxide, to prevent iron from rusting in presence of oxygen and water.

In the April number of the Transactions of the Chemical Society, however, Dr. G. T. Moody shows that these attempts to prevent iron from rusting were unsuccessful owing to the extreme difficulty of completely excluding traces of carbon dioxide. When very special precautions are taken to eliminate this substance iron may be left in contact with pure oxygen and water for many weeks without undergoing change. In one experiment thirty times the quantity of oxygen necessary to convert the whole of the iron into oxide was passed during the course of five weeks, but not even a speck of rust appeared. On the other hand, by removing the scrubbing arrangement by which the air was freed from carbon dioxide, so as to permit the ingress of this gas with the air, rusting commenced almost immediately, and in seventy-two hours the whole of the surface of the metal was seen to be corroded, and a considerable quantity of red rust was formed. Specimens of iron which had been exposed for several weeks to the action of pure oxygen and water without rusting were exhibited by Dr. Moody at the recent conversazione of the Royal Society.

It is also shown by Dr. Moody that while rust is being formed from iron under natural conditions a large proportion of ferrous carbonate is produced; the composition of rust in the course of formation is thus altogether out of harmony with the hydrogen peroxide theory, since this theory postulates that twice as much hydrogen peroxide is produced by the interaction of iron, oxygen, and water as is necessary completely to oxidise the ferrous oxide to the ferric state. The fact that certain compounds such as the

alkalis, sodium nitrite, and potassium ferrocyanide prevent rusting is due, not to their power of decomposing hydrogen peroxide, but of interacting with carbon dioxide. Some substances, such as potassium iodide, which destroy hydrogen peroxide do not inhibit, but actually accelerate, the rusting of iron.

The facts recorded thus afford no basis for the assumption that iron can be caused to rust by pure water and pure oxygen alone, and give a satisfactory explanation of phenomena which were considered as being explicable only in the light of the hydrogen peroxide hypothesis.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Herbert Spencer lecture will be delivered in the examination schools on Thursday, June 7, at 3 p.m., by the Hon. Auberon E. W. M. Herbert, St. John's College.

Dr. G. C. Bourne, fellow of New College, has been nominated to the office of public examiner in zoology for 1906 in succession to the late Prof. Weldon.

At a meeting of the Junior Scientific Club on May 25 some experiments on "liquid crystals" were shown by Messrs. H. B. Hartley (Balliol) and H. L. Bowman (New College).

The following is the text of the speech delivered by Prof. Love in presenting Captain H. G. Lyons for the degree of D.Sc. *honoris causa* on May 29:—

Magnas profecto gratias hodie debemus Aegypto fluvioque Nilo, quo quotannis campos inundant, orta est ex necessitatibus hominum agellos suos summa cura dimetientium, Geometria, subtilissimae cuiusque scientiae parens. Debitum pro portione solvit Magna Britannia, cum moribus institutisque Europaeis in Aegyptum inducendis, tum viris ingenio et scientia pollentibus eo missis, qui ipsis rei publicae rectoribus quasi moderatores et gubernatores sint. In hoc numero locum insignem obtinet Henricus Georgius Lyons, qui cum decem abhinc annos omnia quae ad agrorum dimetiendorum, ad astrorum observandorum rationem pertinent, intermissa invenisset, non solo operam instauravit, sed etiam ipse nova quaedam commentus est, cum de harenae solique aevo et materia, de varia camporum plantis, de imbrum diversitatibus diligentissime quaereret: quod genus cognitionis quam late pateat nemo non videt. Agrorum quidem irrigandorum causa hoc opus noster suscepit, neque praeclarissimos fructus in hac re non assecutus est: nunc agit ut, custodibus et speculatoribus in ripis Nili tanquam in statione dispositis, his nuntiis fretus fluminis incrementum quantum anno proximo futurum sit ante praedicat: qua de re voce non incerta iam loquitur augur optimus. Neque tamen huic viro satis est scientiae et rei publicae inservire: quin vetustissimis illis monumentis quibus abundat Aegyptus magno opere delectatur. Veluti cum Nili regendi causa maximus ille prope Philas agger aedificaretur verebantur homines ne amplificata fluminis vis templis nobilissimis damnum adferret, huius viri laus est fanorum fundamentis confirmatis stabilisque ita civium commodis consuluisse ut antiquitati venerandae parceretur.

CAMBRIDGE.—The voting on the proposals of the studies and examinations syndicate, which took place last Friday and Saturday, is likely to be misunderstood. The proposals put forward were those suggested by the Bishops of Bristol and Ely and by Mr. S. H. Butcher when the previous recommendations of the syndicate had been rejected. The committee presided over by Dr. Henry Jackson, which exists for the support of the movement in favour of the abolition of compulsory Greek, took no part in the recent agitation; indeed, many of its members voted against the proposals of the syndicate. The committee made no effort to bring up its supporters from the country, and regarded, in fact, the proposals of the syndicate as hardly worth accepting. The studies and examinations syndicate will probably now cease to exist. It has sat for three years and has produced two reports, both of which have been rejected in the main by the clerical vote. It is a well-known fact that in the first contest over compulsory Greek there was a majority of residents in the University

and a majority of laymen in favour of its abolition. It now seems as if nothing but a Royal Commission can remove what to many is an absolute bar to their entrance to the University.

The Hopkins prize of the Cambridge Philosophical Society for the period 1897-1900 has been adjudged to Mr. S. S. Hough, F.R.S., of St. John's College, for his papers on the dynamical theory of the tides, published in the *Philosophical Transactions of the Royal Society*.

The professor of chemistry gives notice that the chemical laboratory of the University will be open for the use of students in the Long Vacation during July and August. Dr. Fenton will give a course of fifteen lectures on general chemistry on Tuesdays, Thursdays, and Saturdays, beginning on July 5. Mr. J. E. Purvis will give a course of lectures and practical demonstrations in pharmaceutical chemistry for the first part of the third examination for the degree of M.B. on Mondays, Wednesdays, and Fridays, beginning on July 4; and also a revision practical course in the chemistry and physics of hygiene.

The Board of Agricultural Studies announces that an examination will be held for one "Surveyors' Institution scholarship" on July 24-27. The scholarship is tenable for three years, and is of the value of 80*l.* per annum.

PROF. F. FRANZ MARTENS, privat docent for physics in the University of Berlin, who, on Prof. Matthiessens's resignation of the physics chair of the University of Rostock was temporarily appointed as his substitute, has been appointed professor of physics in the Berlin Handelshochschule.

At the May meeting of the Columbia University trustees, Mr. J. K. Rees, Rutherford professor of astronomy and head of the astronomical department, was made a professor emeritus. Mr. Harold Jacoby succeeds Prof. Rees; Dr. C. Lane Poor will be associated with him as a professor in the department, and Dr. S. A. Mitchell has been promoted to an instructorship in astronomy.

It is reported, says *Science*, that the University of California will lose 12,000*l.* yearly by the destruction of buildings owned by it in San Francisco, and that it will lose a further sum of 10,000*l.* yearly by the reduction in value of assessable property in the State. Our contemporary hopes, however, that the loss of income on the San Francisco property is only temporary, and that the State will not permit the University to suffer from the decrease in the taxes.

THE Society for the Advancement of Mathematical Scientific Instruction will hold an annual general meeting in Erlangen during next week. Among the papers of general interest will be:—the investigations of glaciers, by Prof. Hess, of Ausbach; the experiment in ancient times and in the Middle Ages, by Prof. Wiedemann, of Erlangen; the proposals of the education commission of the Naturforschergesellschaft (p. 92), by Prof. Pietzker, of Nordheim; and the conception of number and quantity in teaching, by Prof. Wieleitner, of Speyer. Excursions will be made to Nürnberg and the French Switzerland.

An agreement for the mutual recognition of certificates has been arrived at between the Universities of Manchester, Liverpool, Leeds, and Sheffield Joint Matriculation Board and the Universities of Oxford and Cambridge. This Joint Matriculation Board will grant exemption from its matriculation examination to persons who have passed Responsions at Oxford with one additional subject, or have passed parts i. and ii. of the Previous Examination at Cambridge with one of the additional subjects. Under certain conditions as to the subjects taken, exemption will also be granted to holders of higher certificates of the Oxford and Cambridge Senior Local examinations. It will be remembered that a similar arrangement between the Universities of Oxford, Cambridge, and London has been announced already. Holders of Oxford and Cambridge Local certificates or higher certificates of the Oxford and Cambridge Joint Board are, if they have taken certain subjects, given exemption from the London Matriculation. Similarly, the Matriculation examination, in certain circumstances, gives exemption from Oxford Responsions and the Cambridge Previous examination.

An important advance in the development of the forestry branch of Armstrong College has been made by an agreement effected between H.M. Office of Woods and the college authorities, by which the latter take over the local management of Chopwell Woods, in the county of Durham. These woods are within a few miles of the college, extend over an area of nearly 900 acres, and carry crops of larch, spruce, Scotch pine, oak, ash, and other trees, most of which were planted about fifty years ago. The woods will be gradually brought under a proper rotation of cropping by the clearing and replanting of the more mature portions from time to time, and the carrying out of this work will afford favourable opportunities for demonstrating the various operations relating to practical forestry. H.M. Commissioner of Woods, Mr. J. F. F. Horner, has obtained the consent of the Treasury to a house being provided in the woods as a residence for the college lecturer in forestry, Mr. A. C. Forbes, and to continue to pay as heretofore the ordinary working expenses of the woods. The arrangement will facilitate the holding of short courses for practical foresters and others desirous of acquiring a knowledge of the subject, while as a practical demonstration area for the students attending the college forestry class the woods will be invaluable, and should render Newcastle one of the most favourable centres for forestry instruction in the United Kingdom.

In a paper on social conditions in Australia, read at a meeting of the Society of Arts on May 1, the Hon. J. G. Jenkins, Agent-General for South Australia, dealt with the educational advantages of the country. "Generally speaking," he said, "the system of public education is free, compulsory, and secular, the whole expense being met out of the general revenue. The greatest care is taken to provide schools in every part of the country as well as in the thickly populated cities, and in some of the thinly settled districts schools of from ten to fifteen children are established. Fortunately, Australia's educational advancement has not been delayed by sectarian interference. There it is generally considered that a country's advancement rests on the education of its people, and that as national education is a national gain, the nation's treasury should meet the bill. Efforts have been made from time to time by zealous propounders of sectarian beliefs to incorporate religious instruction with the Education Acts of the different States, but the majority of the people are strongly opposed to any form of State aid to religion. They feel that in the bitter strife for sectarian supremacy the efficiency of the schools would become impaired and the practical education of the children neglected. The parents generally take advantage of the public schools for their children, but for those who object, either from class prejudice or religious scruples, good private schools are available."

PROF. J. F. SELLERS, of Mercer University, recently sent out a number of inquiries to forty-four teachers of chemistry in the southern States of the American Union; the answers made by forty of the teachers form a symposium on chemical requirements which was presented to a meeting of the American Chemical Society. The paper is printed in *Science* of May 11. In reply to a question asking if chemistry should be taught in preparatory schools, a majority of five thought it should. Answers to a second question showed that in a small majority of colleges only does chemistry follow a course of physics. Prof. Sellers found that about equal time is given to lectures and to laboratory work, and most teachers consider that individual laboratory work should always form part of a chemistry course. Similarly, there is a consensus of opinion that qualitative analysis should follow general chemistry. The majority of the institutions represented offer graduate work in chemistry. The paper shows that few southern chemistry teachers carry on research themselves, and this is because they are overloaded with instruction or executive duties, and are not supplied with adequate library or laboratory facilities for advanced students. The majority of southern colleges give technical courses, and these are controlled by local demands and natural supplies. The sting of the paper, so far as our universities are concerned, lies in the tail, which is as

follows:—"Once the American universities were replicas of the British system, but now the German university sets the standard. It is this shifting of method and manner that affords us of to-day, in the matter of the practical virtue of our courses in science, an assured guarantee of commercial and industrial progress."

## SOCIETIES AND ACADEMIES.

LONDON.

**Royal Society, March 1.**—"The Specificity of the Opsonic Substances in the Blood Serum." By Dr. William Bulloch and G. T. Western. Communicated by Leonard Hill, F.R.S.

*Conclusions.*—(1) When staphylococci are brought into contact with normal human serum, and are subsequently removed by centrifugalisation, the serum loses its opsonic power for *Staphylococcus*, although the opsonic power of *Bacterium pyocyaneum* is preserved.

(2) Contact of normal human serum with tubercle bacilli leaves the opsonic power of that serum for staphylococcus almost intact, while the opsonic power for tubercle bacillus is completely removed.

(3) Contact of normal human serum with staphylococcus leaves the opsonic power of that serum for tubercle bacillus almost intact, while the opsonic power for staphylococcus is completely removed.

(4) Inoculation of a human being with tuberculin causes quantitative increase in the tuberculo-opsonin, whereas the quantity of staphylococcus opsonin is unaltered.

(5) Inoculation of a human being with staphylococcus vaccine causes a quantitative increase in the staphylococcus opsonin, whereas the quantity of tuberculo-opsonin is unaltered.

March 8.—"On the Relationship between Hæmolysis and the Phagocytosis of Red Blood Cells." By Dr. R. D. Keith.

The conclusion come to is that the phagocytosis of red blood cells does not depend on the presence of the hæmolytic amboceptor, since:—

(1) The substance which induces phagocytosis is partially destroyed by heat, while the hæmolytic amboceptor is entirely thermostable.

(2) The hæmolytic amboceptor may be present in considerable amount in a hæmolytic serum without inducing phagocytosis, notwithstanding prolonged contact of the amboceptor with the red blood cells.

Dean has suggested that phagocytosis may be caused by a complement acting through an amboceptor, and that the partial destruction, of the property in the serum inducing phagocytosis, by heat may be due to the destruction of the complement, while the amboceptor, even in the absence of the complement, may still be capable of inducing phagocytosis. This theory, while it is difficult to disprove directly owing to the complement being destroyed at the same temperature as the thermolabile part of the substance inducing phagocytosis, seems to be an improbable one for the following reasons:—

(1) That it is not an action analogous to that of other amboceptors, e.g. that concerned in hæmolysis. If one destroy the complement of a hæmolytic serum by heat, no hæmolysis takes place, notwithstanding the presence of the amboceptor in large amount.

(2) The hæmolytic amboceptor may be present in large amount in a diluted serum, without that serum having the power of inducing phagocytosis even when Dean's method of testing is employed.

(3) In the dilution experiments recorded in the paper it is shown that one may dilute the complement to such an extent as to abolish hæmolysis, and yet such a serum has a greater "opsonic" power in these dilutions than has the same serum when heated and employed in corresponding dilutions.

"Upon the Properties of an Antityphoid Serum obtained from the Goat." By Dr. Allan Macfadyen. Communicated by Dr. C. J. Martin, F.R.S.

*Conclusions.*—(1) The intravenous injection of the goat with the toxic cell juices of the *B. typhosus* (obtained under

the conditions described) in small and carefully regulated doses resulted in the production of an antiendotoxin.

(2) The antiendotoxin value, as so far tested, reached a point at which 1/50 c.c. of the serum neutralised thirty lethal doses of the toxic typhoid cell juice. This action was not demonstrable in 3 c.c. of normal goat's serum, and was obtained after about four months' treatment of the goat. The results, after a more rapid method of immunisation, are better *qua* goat and rabbit than those obtained by Dr. Besredka in the course of two years with dead and living bacilli *qua* horse and guinea-pig.

(3) The serum was also agglutinative for the *B. typhosus*, the titrate rising to 1/1,000,000.

(4) The serum was also bacteriolytic, 1/10,000 c.c. neutralising ten lethal doses of the *B. typhosus*.

(5) The serum did not give a precipitin reaction with typhoid cell juices.

(6) The serum, whilst neutralising the typhoid, did not neutralise the cholera endotoxin.

**Entomological Society, May 2.**—Mr. F. Merrifield, president, in the chair.—Fourteen examples of both sexes of *Hystrichopsylla talpae*, Curtis, the largest British flea, taken in the nest of a field-mouse in a tuft of grass at Grange, near Gosport, Hants, on March 28: Commander J. J. Walker.—Living specimens of *Apate capucina*, *Deilus fugax*, a *Cryptocephalus (rugicollis)*, two species of Anthaxia, &c., forwarded by Dr. T. A. Chapman from Ste. Maxime, South France: G. C. Champion.—An example of the weevil *Procas armillatus*, F., taken near Dartford, Kent, on April 13: F. B. Jennings. This species appears to be extremely scarce in Britain, and, with the exception of a single specimen taken near Chatham by Commander Walker in 1896, has not been recorded from this country for a considerable period.—Beetles from New Guinea, including *Aesernia meeki*, Jac., *A. costata*, Jac., *A. gestroi*, Jac., and Cetonidae and Lucanidae from South Africa and Borneo: M. Jacoby.—Specimen of *Hydrochus nitidicollis*, Muls., a beetle not hitherto recorded in Britain, taken at Yelverton, in the River Meavy, in April: H. St. J. Donisthorpe.—Lantern-slide photographs (from nature) of the ♀ calcaria postica in Hymenoptera belonging to divers groups, mostly Aculeate, but including also representatives of chrysid, ichneumonids, and sawflies: Rev. F. D. Morice. Mr. Morice submitted that, in all the examples shown, the structure of the calcaria themselves (and also of the parts adjacent to them) clearly indicated that their main function was that of an elaborately constructed instrument for toilet purposes.—Specimens of *Mylothris agathina*, Cram., and of *Belenois thysa*, Hopff.: Dr. F. A. Dixey. The close resemblance between these species obtained chiefly in the dry-season form of the latter, and not in the wet. Dr. Dixey considered this to be a fresh illustration of the special liability to the attacks of enemies experienced under dry-season conditions, leading in some cases to the adoption of a cryptic coloration, and in others, as here, to mimicry of a protected form such as *M. agathina*.—A criticism of the late Prof. Packard's paper on the markings of organisms: H. Eltringham.—The genus *Imma*, Walk. (=Tortricomorpha, Feld.): E. Meyrick.

**Royal Astronomical Society, May 11.**—Mr. W. H. Maw, president, in the chair.—Some points arising out of a discussion of the double stars in Struve's "Mensuræ Micrometricæ": T. Lewis. A memoir upon the subject had just been completed, and was about to be published by the society. Questions concerning the distribution of double stars, and the relation between those relatively fixed and those in motion, were considered. The facts appeared to point to the conclusion that the sun is situated in a cluster, but not centrally.—The orbit and mass of 85 Pegasi: W. Bowyer and H. H. Furner.—Some considerations concerning the number of the stars: Miss W. Gibson. The conclusions were derived from a discussion of seventy-two stars, and the relations between parallax, magnitude, and proper motion were considered.—Observations of Jupiter's sixth and seventh satellites, from photographs taken at the Royal Observatory, Greenwich: **Astronomer Royal**. A large number of plates had been taken for the positions of the satellites with exposures of

five minutes to nearly three hours. Photographs of Jupiter had also been taken, which showed that the tabular errors are very small. The results were confirmed by meridian observations.—Prints from negatives of the solar eclipse of August, 1905: **Astronomer Royal**.—Seismographic records taken at the Royal Observatory, Edinburgh: Prof. F. W. Dyson. The records showed that the trace of the San Francisco earthquake reached Edinburgh in about seven minutes.—Observations of the magnitude and position of Nova Geminorum: E. E. Barnard.—Photographs of the Milky Way taken at Mount Wilson, California, during the spring and summer of 1905: E. E. Barnard.—The president announced that news had been received that no injury had been caused to the Lick Observatory by the recent earthquake.

## PARIS.

**Academy of Sciences, May 14.**—M. H. Poincaré in the chair.—A singular effect of friction: E. Guyou. An explanation of an experiment of M. de Saintignon. A spherical glass globe, filled with water and containing a fine powder, is rotated with a high velocity round one of its diameters as axis. The powder, if lighter than water, collects along the axis of rotation, but if heavier than water the sphere is divided into three zones, separated by two parallels of latitude equidistant from the equator. The upper and lower segments are clear, the powder being distributed in the central zone and mainly on the two boundary lines. A simple explanation is given of this paradoxical effect.—The influence of velocity on the law of deformation of metals: P. Vieille and R. Liouville.—Low temperatures and chemical analysis: MM. d'Arsonval and Bordas. An arrangement is described permitting of the direct determination of water in aqueous solutions by distillation at the ordinary temperatures, the receiver being kept at  $-80^{\circ}$  C. The method is very rapid compared to those in ordinary use.—New researches on diastatic saccharification: L. Maquenne and Eug. Roux. The action of malt on starch has been studied under varying conditions of time, acidity, and nature of the starch, and the experimental results tabulated.—Three toxins of human trypanosomiasis of different origin: A. Laveran. The cases studied came from Gambia, Uganda, and Ubanghi. From the morphological point of view, no difference could be noted between them. Experiments with guinea-pigs, rats, and mice showed slight differences only. All the observations support the view that the three trypanosomes from the different localities belong to the same species.—The centres of gravity of discontinuous systems: Haton de la Goupillière.—A new octane, hexamethylethane: Louis Henry. This hydrocarbon is formed as a by-product in the action between the magnesium compound of tertiary butyl bromide and acetaldehyde, probably by the action of some unchanged butyl bromide upon the magnesium compound. It is a solid, volatile at the ordinary temperature, and possessing a penetrating odour. It boils at  $106^{\circ}$  C. to  $107^{\circ}$  C. under 765 mm.—An account of an earthquake at Bogota on January 31 last: M. Souhart.—A new arrangement for the spectroscopy of phosphorescent substances: C. de Wateville. The phosphorescent substance under examination is illuminated by an electric spark about eighty-two times per second, the interval of time elapsing between the exposure to the spark and exposure to the photographic plate being about 1/3000th of a second. The period of the spark is governed by a rotating disc, and is independent of the speed of the contact breaker of the coil. The phosphorescence of bodies examined with this apparatus is very bright, and in the spectra obtained, which are rich in ultra-violet lines, none of the lines corresponding to the metal of the electrodes are visible.—The measurement of very short intervals of time by means of a condenser: M. Devaux-Charbonnel. The method is based on the measurement of the charge of a condenser through a variable resistance, first during the short interval of time to be measured, and then completely. Experimental results are given showing the accuracy obtainable to be of the order of 0.0001 sec.—The conductivity of ammonium sulphate in mixtures of sulphuric acid and water: G. Boizard.—The complete synthesis of some

camphor derivatives. Isolaurole and isolaurolic acid: G. Blanc. The starting point of these syntheses is *aa*-dimethyladipic acid, the synthesis of which has been described in a previous note. The anhydride of this acid by slow distillation at the ordinary pressure gives 2:2-dimethylcyclopentanone. The tertiary alcohol obtained from this by Grignard's reaction on distillation at ordinary atmospheric pressure splits up into water and isolaurole.—*a*-Chlorocyclohexanone and its derivatives: L. Bouveault and F. Chereau. This substance is obtained by chlorinating either cyclohexanone or cyclohexanol in the presence of calcium carbonate. The chlorine in this derivative is reactive, potassium carbonate solution giving *α*-oxycyclohexanone. Substituted homologues of cyclohexanone are obtained without difficulty by the action of alkyl-magnesium compounds on chlorocyclohexanone; the methyl, ethyl, and isopropyl derivatives are described.—Stereoisomerism in the group of unsaturated *αβ*-acyclic compounds: E. F. Blaise and P. Bagard.—The genus *Mascarenhasia*: Marcel Dubard.—A case of a green organ deprived of assimilating power: Jean Friedel. The ovary of *Ornithogalum arabicum* is green and contains chlorophyll, but is devoid of assimilating power, although the ovary of *Ornithogalum umbellatum*, which is also green, has a well-developed assimilating power. The difference is possibly due to a superficial alteration of the chlorophyll grains.—The diseases of the coffee plant in the Congo Free State: E. De Wildeman.—The replacement of the vibrating muscles of the wing by adipocyte columns in ants after the nuptial flight: Charles Janet.—A new myxosporidium of the common tench: Louis Léger. This species was discovered in looking for the cause of a heavy mortality of the tench, and is named by the author *Chl. cristatum*. The disease of the fish was due to other causes.—Culture of the spirillum of recurrent African fever in man (tick fever): C. Levaditi. Details of the method of culture are given. The virulence of the spirillum was maintained through a long series of cultures.—The pathogeny of tuberculosis: H. Vallée.—The terraces of the Rhone valley below Lyons: M. de Lamothé.—The tectonic and stratigraphical relations of Sicily and Tunis: Émile Haug.—The geology of Calabria: Maurice Lugeon and Émile Argand.—A method of taking samples of sea-water for bacteriological studies: P. Portier and J. Richard. The construction and use of the apparatus are made clear by four diagrams.—The increase in the flow due to the cold season in the Seine and Loire basins: Edmond Maillet.—The mineralisation of subterranean waters and the causes of its variation: F. Dienert.—The Abannets of Nimes, Belgium: E. A. Martel and E. Van den Broeck.

DIARY OF SOCIETIES.

THURSDAY, MAY 31.

ROYAL SOCIETY, at 4.30.—On the Main Source of "Precipitable" Substances and on the *Rôle* of the Homologous Protein in Precipitin Reactions: D. A. Welsh and H. G. Chapman.—The Viscosity of the Blood: A. du Pre Denning and J. H. Watson.—The Affinity Constants of Amphoteric Electrolytes, i., Methyl Derivatives of Para-Aminobenzoic Acid and of Glycine: J. Johnston.—The Affinity Constants of Amphoteric Electrolytes, ii., Methyl Derivatives of Ortho- and Meta-amino-benzoic Acids: A. C. Cumming.—The Affinity Constants of Amphoteric Electrolytes, iii., Methylated Amino-acids: Prof. J. Walker, F.R.S.

ROYAL INSTITUTION, at 5.—Man and the Glacial Period: Prof. W. J. Sollas, F.R.S.

FRIDAY, JUNE 1.

ROYAL INSTITUTION, at 9.—L'Ébullition des Métaux: Prof. H. Moissan, For. Mem. R.S.

TUESDAY, JUNE 5.

ROYAL INSTITUTION, at 5.—Northern Winter Sports, Sweden and its People: Colonel V. Balck.

WEDNESDAY, JUNE 6.

SOCIETY OF PUBLIC ANALYSTS, at 8.

ENTOMOLOGICAL SOCIETY, at 8.—(1) Predaceous Insects; (2) On some Forms of *Papilio dardanus*: Prof. E. B. Poulton, F.R.S.—Notes on the Blattidæ: R. Shelford.—On the Bionomics of some Butterflies from the Victoria Nyanza Region: S. A. Neave.

THURSDAY, JUNE 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Osmotic Pressures of some Concentrated Solutions: The Earl of Berkeley and E. G. J. Hartley.—An Account of the Pendulum Observations made at Kew and Greenwich Observatories in 1903: Major G. P. Lenox-Conyngham.—The Self-induction of an Iron Cylinder: Prof. E. Wilson.

ROYAL INSTITUTION, at 5.—Man and the Glacial Period: Prof. W. J. Sollas, F.R.S.

LINNEAN SOCIETY, at 8.—On Two New Species of *Populus* from Darjeeling: H. H. Haines.—Biscayan Plankton, part viii., The Cephalopoda: W. E. Hoyle.—Part ix., The Medusæ: E. T. Browne.

CHEMICAL SOCIETY, at 8.30.—Ammonium Selenate and the Question of Isodimorphism in the Alkali Series: A. E. H. Tutton.—An Improved Beckman Apparatus for Molecular Weight Determination: J. M. Sanders.—Resolution of Lactic Acid by Morphine: J. C. Irvine.—The Vapour Pressures of Binary Mixtures, part i., The Possible Types of Vapour-pressure Curves: A. Marshall.—Action of Sodium on *aa*-Dichloropropylene: I. Smedley.—Thiocarbamide as a Solvent for Gold: J. Moir.—The Action of Sulphur Dioxide and Aluminium Chloride on Aromatic Compounds: S. Smiles and R. Le Rossignol.

FRIDAY, JUNE 8.

ROYAL INSTITUTION, at 9.—Studies on Charcoal and Liquid Air: Sir James Dewar, F.R.S.

PHYSICAL SOCIETY, at 8.—On the Solution of Problems in Diffraction by the Aid of Contour Integration: H. Davies.—The Effect of Radium in Facilitating the Visible Electric Discharge *in vacuo*: A. E. Campbell Swinton.—Mr. J. Goad's Experiments with a Vibrating Steel Plate, exhibited by Messrs. Newton and Co.—Fluid (liquid) resistance: Col. de Villamil.

ROYAL ASTRONOMICAL SOCIETY, at 5.  
GEOLOGISTS' ASSOCIATION, at 8.—The Higher Zones of the Upper Chalk in the Western Part of the London Basin: H. J. Osborne White and Ll. Treacher.

MALACOLOGICAL SOCIETY, at 8.—Mollusca of the *Porcupine* Expeditions, 1869-70, Supplemental Notes, part iii.: E. R. Sykes.—Notes on the Dates of Publication of the "Mineral Conchology" and "Genera Rec. Foss. Shells": E. R. Sykes.—Description of *Oliva ispidula*, L. var. *longispira*: F. G. Bridgman.—On *Chloritis heteromphalus*: H. A. Pilsbry.

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