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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 1, 1890.

THE APPLICATION OF THE MICROSCOPE TO PHYSICAL AND CHEMICAL INVESTIGATIONS.

Molekularphysik, mit besonderer Berücksichtigung mikroskopischer Untersuchungen und Anleitung zu Solchen, sowie einen Anhang über mikrochemische Analyse. Von Dr. O. Lehmann, Professor der Electrotechnik am kgl. Polytechnikum zu Dresden. 2 Volumes, pp. 852, 697, with 624 Woodcuts and 10 Plates. (Leipzig: W. Engelmann, 1888–89.)

VERY soon after the first invention of the microscope, attempts were made to apply the new instrument to solve some of the remarkable problems of crystallogenesis. The early volumes of the Royal Society Transactions contain in the papers of Boyle, Hooke, and Leeuwenhoek, published between the years 1663 and 1709, many records of attempts of this kind; and the works of Henry Baker, which appeared between 1744 and 1764, are also largely concerned with the study of the process of crystallization under the microscope.

In Germany, Ledermuller in 1764 and Gerhardt in 1780 showed the value of the microscope in studying the internal structure of crystals; while in France a long succession of enthusiastic investigators, Daubenton, Dolomien, Fleurian de Bellevue, Cordier, and others, were busily engaged in laying the foundations of the science of microscopical petrography.

Early in the present century, we find the English investigators once more taking a leading part in applying the microscope to the study of crystallized bodies. Between the years 1806 and 1862, Brewster published a long series of memoirs, dealing with the microscopical characters of natural and artificial crystals, and the inclusions which they contain. About the year 1850, too, Mr. Sorby commenced his important investigations on the subject, availing himself of the method of preparing transparent sections of rocks and minerals which had been, shortly before this time, devised by William Nicol. Mr. Sorby's epoch-making memoir "On the Microscopical Structure of Crystals, indicating the Structure of Minerals and Rocks" made its appearance in 1858.

While one group of investigators, following the lines of the early work of Brewster and Sorby, have sought to make the microscope an efficient instrument for the determination of minerals, even when present in rocks as the minutest crystals or fragments; others have no less diligently pursued the methods which the same pioneers in this branch of research have initiated for solving physical and chemical problems connected with the formation of crystallized bodies.

In the hands of Des Cloizeaux, Tschermak, Zirkel, Von Lasaulx, Fouqué and Michel-Lévy, Rosenbusch, and other workers, the microscope has gradually been developed into a splendid instrument of mineralogical research; and the determination of the minutest particles of a mineral is now becoming no less easy and certain than that of the largest hand-specimens.

But, at the same time, Brewster and Sorby's early attempts to solve physical and chemical problems by the aid of the microscope have not failed to exercise an important influence on subsequent workers in these branches of science. Link, Frankenheim, Klocke, Harting, and especially Vogelsang (whose early death was a very severe loss to this branch of science), have done much towards establishing the science of crystallogenesis upon a firm basis of accurate observation; and their labours have been continued in more recent times by H. Behrens and Dr. Otto Lehmann, the author of the work before us.

As the well-known treatises of Rosenbusch, and of Fouqué, Michel-Lévy, and Lacroix, give us an admirable *résumé* of the present state of determinative mineralogy, as improved by the application of the microscope, so does the work before us contain a perfect summary of the contributions of the microscopist to the sciences of physics and chemistry.

It will only be possible, within the limits of an article like the present, to indicate briefly the plan of the very comprehensive, and, indeed, almost exhaustive work, in which Dr. Lehmann has embodied the observations of himself and his predecessors in this field of inquiry.

The first division of the book deals with the construc-

tion and use of the microscope; especial attention being given to forms of the instrument, like those devised by Nachet and by the author of this work, for the special purpose of studying crystallization and other physical and chemical processes.

The second division of the book treats of those physical properties of matter which are presented by all bodies, whether in the solid, liquid, or gaseous state. Such questions as the polarization and absorption of light, the conduction of heat, and the electric and magnetic relations of various substances are here dealt with by the author.

The next division relates to the peculiar properties presented by solids. Elasticity and plasticity are considered, and, under the latter head, the remarkable phenomenon of the production of twinned structures in crystals by mechanical means is fully discussed. Under the head of cleavage we find a treatment of such phenomena as the production of mathematical figures in certain crystals by pressure, percussion, &c.; while under the heads of "Enantiotropie" and "Monotropie" are classified the consequences which follow from heteromorphism among crystalline substances, and the tendency of the heteromorphous forms to pass one into the other.

The division dealing with liquids and their peculiar properties contains discussions on fluidity, surface-tension, diffusion, capillarity, and crystal-growth, with the origin of structural anomalies. The problems of solution and precipitation, with those of solidification and fusion, are also treated of in this part of the treatise.

The second volume of the work commences with the discussion of the properties of gases and their relations to solids and liquids. This division of the subject, which is very exhaustively treated, extends to 335 pages.

The work concludes with critical remarks upon different molecular theories. The chapters dealing with the theories of crystal structure, of allotropy, of heteromorphism, and of isomerism, with several others, in the same division of the book, are full of interest and suggestiveness.

A supplement of about 150 pages is devoted to what the author calls "crystal-analysis," or what is generally known to geologists and mineralogists as "microchemical analysis." Very minute particles of an unknown substance may often be determined by being treated with appropriate reagents and studied under the microscope; in this way they are made to yield crystals of various compounds which can be recognized by their characteristic forms and habit. An admirable summary is given by the author of the work of Bořický, Streng, Behrens, Haushofer, and others, who have gradually perfected this branch of research, and made the method one which is of the very greatest service to the students of microscopical mineralogy and petrography.

While the physicist and chemist will find in this work a perfect mine of interesting and ingenious experiments (many of which are suited to class-demonstrations by projection methods), the mineralogist and geologist will hail the appearance of the book as one that completes and supplements the well-known treatise of Vogelsang—a work that has exercised the most important influence on the development of petrological theory.

In conclusion, it may be pointed out that, not only are the numerous observations of the author on crystallogenesis that are described in memoirs in *Groth's Zeitschrift* included in the work before us, but many others that have never before been published find a place in these volumes. The work is very fully illustrated both with woodcuts and coloured plates, and constitutes a complete synopsis of all that is known on a number of questions of great importance and interest to workers in many different branches of science.

BERTRAND ON ELECTRICITY.

Leçons sur la Théorie Mathématique de L'Électricité, professées au Collège de France. Par J. Bertrand. (Paris: Gauthier-Villars.)

THIS book contains lectures on electricity given by M. Bertrand at the Collège de France. In his preface the author states that he has confined himself to the mathematical principles of the subject; but this hardly expresses the limitation he has imposed upon himself, for a great many results which English students of electricity are accustomed to find in text-books on this subject are omitted from this work. A brief description of the contents of the book will suffice to show this. The first chapter contains an investigation of the attractions of spheres and spherical surfaces when the law of attraction is inversely as the square of the distance; the second and third are devoted to the properties of the potential; the fourth contains an investigation of the conditions under which the method of lines of force can be used; the fifth, which has the comprehensive title "Électricité Statique," contains a short discussion of the electrical distribution on two spheres which mutually influence each other, the reciprocal theorems, and a discussion of the properties of the Leyden jar so far as they can be discussed without introducing the idea of specific inductive capacity; the sixth chapter contains some remarks upon magnets; the seventh treats of Ohm's law, and contains Kirchhoff's equations for the distribution of currents amongst a network of conductors, without, however, any applications even to such an important case as that of Wheatstone's bridge; the eighth, ninth, and tenth chapters contain, respectively, investigations of the magnetic forces produced by linear currents, the laws according to which such currents act on each other, and simple applications of these laws; the eleventh chapter contains some account of the induction of currents, and, amongst other things, some well-founded reasons for not deducing the laws of induction from the principle of the conservation of energy alone, but no hint is given of the possibility of regarding a system of currents as a dynamical system, though the introduction of this idea by Maxwell has thrown new light over the whole subject and enabled many of the properties of currents to be recognized at once as those belonging to any dynamical systems; the twelfth chapter contains some account of the application of the results of the previous chapters to dynamo-electric machines; and the thirteenth and last chapter discusses units.

There are two views which have been taken as to the relation between the mathematics and the physics, which ought to exist in a text-book on mathematical physics: the one is, that it is the province of physics to supply the

laws of action between particles charged with electricity, elements of current, and the like; then its function ceases, and the rest is a mere matter of mathematical symbols; by this method the physics and the mathematics are sharply divided—the physics occurs in the first few lines of the chapter, the rest of which is mathematics. In the other method the physics and mathematics are kept as closely connected as possible, so that by knowing from physics the kind of results we may expect errors in the mathematical investigations may be detected; while, on the other hand, our physical conceptions may be extended, and perhaps even the point of view changed, by the results of mathematical transformations. Thus, as Maxwell points out, the two sides of the equation which expresses Green's theorem might have suggested the two ways of regarding electrical phenomena—the one when we confine our attention to the electrified bodies; the other when we look upon the dielectric as the seat of the phenomena. In the department of physics in which mathematical analysis has won perhaps its greatest triumphs, that of gravitational attraction, the first method is perhaps the most natural; but in an intricate subject like electricity, where so much remains to be discovered, and which it is so important to regard from as many points of view as possible, the second method seems infinitely the more likely to lead to an extension of our knowledge.

M. Bertrand's work is a most favourable example of the first method: it is clearly and gracefully written, and the mathematical part often extremely elegant; yet, in spite of all this, we must confess to a feeling of disappointment on reading the book. We had thought from the publication of Mascart and Joubert's "Leçons sur l'Électricité et le Magnétisme," and the excellent translation of Maxwell's "Electricity and Magnetism" by MM. Seligman-Lui, and Cornu, that the ideas introduced by Maxwell, von Helmholtz, and others, were spreading in France; yet here we have a work written by one of the first scientific men of that country, in which the subject is treated in fundamentally precisely the same way as that in vogue twenty or thirty years ago; and in fact, with the exception of some results due to M. Marcel Deprez, in the chapter on electro-magnetic machines, there is no reference to any investigation made within the last twenty years. The names of Maxwell and von Helmholtz are not even mentioned in the book itself—though, to be quite accurate, that of Maxwell occurs in the table of contents in connection with a particular case of Green's theorem.

M. Bertrand seems to exact more from the science of electricity, before he deems it worthy to be discussed mathematically, than is exacted from any other science; thus, for example, he omits all consideration of the effect of the dielectric because there is no satisfactory molecular theory of specific inductive capacity, such as Mossotti attempted by supposing the dielectric to contain conducting spheres, the specific inductive capacity depending on the ratio of the volume of the spheres to that of the rest of the dielectric. It seems to us that if M. Bertrand were to write a book about optics, he would, if he were consistent, leave out everything connected with either refraction or reflection, since no complete molecular theory of these phenomena have been given. The way in which the dielectric affects the lines of force is as definite and simple as the way in which a refracting medium affects the rays of light, and the one is quite as capable of receiving mathematical treatment as the other.

Again, M. Bertrand, in treating of magnetism, points out that on the theory of magnetic fluids the behaviour of a magnetized body will depend upon the shape of the molecules, and as this is not known he refuses to investigate the magnetic properties of bodies; he never mentions magnetic permeability, the idea of which, by introducing a new property of bodies, enables us to investigate mathematically their magnetic properties, and express the results of the investigation in terms of quantities which can be measured in a physical laboratory.

In spite of the clearness and elegance of this book, we are afraid that a student who learnt his electricity from it would think, if he read any modern memoirs on the subject, that they dealt with some new and unknown science; for the mode of regarding the phenomena would probably be entirely different, and many quantities would be introduced of whose existence M. Bertrand had given him no hint.

OUR BOOK SHELF.

Sundevall's Tentamen [*Methodi naturalis avium disponendarum tentamen*]. Translated into English, with Notes, by Francis Nicholson, F.Z.S., &c. (London: R. H. Porter, 1889.)

THE practice of translating into English memoirs by leading foreign naturalists that may be considered classical is to be highly commended. English ornithologists who are not conversant with German may thus study such important works in their branch of science as Nitzsch's "Pterylographie" and Johannes Müller's "Voice Organs of Passeres," of both of which excellent English translations exist.

It is, however, a question whether Sundevall's "Tentamen" comes into the category of classical memoirs, or is worth translating if it does. In our opinion it might have been allowed to drop peacefully into oblivion in the obscurity of the original Latin. No particular object is gained by helping to perpetuate a scheme of bird-classification like that of Sundevall, with the details of which no one nowadays can agree. Even the translator has nothing to say for it, except the very general statement that "every serious scheme of classification contains some items of progressive knowledge towards the attainment of a complete natural arrangement of the class of birds." It would be very difficult, however, to say what these items are, and the translator gives us no help in the matter. On the other hand, if ornithologists believe that this, the last work of Sundevall, is really important, then it can be certainly said that Mr. Nicholson's translation is good and accurate.

The introduction, which occupies the first twenty-five pages, is interesting, and so are the notes interspersed through the volume; but it is clear that the book must be entirely judged by the merits or demerits of the scheme of classification. Prof. Newton (article "Ornithology," in "Encyc. Brit.," ninth edition) has subjected Sundevall to a searching criticism, which seems to us to be perfectly justified. Some of the worst features of the classification—in addition to those mentioned by Prof. Newton—are to associate *Serpentarius* with any other birds of prey, to place the American vultures near the American kites (an error which is constantly cropping up in spite of the obvious anatomical differences), *Glareola* among the goatsuckers, &c. Prof. Sundevall's classification is, in fact, most reactionary in every particular; it is difficult to believe that it was published in the year 1872—after the appearance of so many important papers upon bird classification and structure, such as those of Profs. Huxley and Parker.

Mr. Nicholson very justly remarks in a footnote to p. 43, that since the publication of the "Tentamen," much has been done in the way of improvement in the classification of birds. In order to assist the student a few references are added to recent publications.

These do not seem to be very well chosen; for example, it is probably much better to arrange the Turdidæ in two sub-families, as has been suggested later, than to retain Sundevall's arrangement. But this seems a very trifling matter in comparison with such serious errors as we have referred to, about which there can be no question, and which are left altogether unnoticed by the translator. F. E. B.

The Flowering Plant: as illustrating the First Principles of Botany. By J. R. Ainsworth Davis, B.A. (London: Charles Griffin and Co., 1890.)

DIFFERENT opinions may be held as to what constitutes an elementary science text-book dealing with first principles, and we are inclined to think that Mr. Davis has given the work before us too modest a title. This little book, of 160 pages, contains enough facts and "hard words" to fill a small Encyclopædia, although "no previous knowledge is assumed"; and we fear that any beginner who limited his studies to this work would run more danger of developing into a kind of living abridged botanical dictionary than of mastering the first principles of the science.

The introduction, which deals with "the scope and subdivisions of the subject," "differences between plants and animals," and "differences between living and non-living matter," is condensed into 5½ pages. The following 137 pages are devoted to morphological and physiological botany; these are succeeded by an appendix on practical work, in which directions for the description of flowering plants, a summary of the various classes and orders, and directions for the study of anatomy, histology, and physiology, are condensed into 15 pages. One cannot help being struck by the author's power of *précis*-writing.

We cannot, therefore, recommend Mr. Davis's book to beginners, for whom a judicious selection of facts from which main principles may be deduced is, in our opinion, necessary. It is no easy task to write a book on "first principles," and this can hardly be accomplished by anyone who has not devoted much time to actual observation in the subject in question.

In his preface the author states that "no attempt has been made to 'write up' (or 'down') to any syllabus;" but the title-page informs us that the book is "especially adapted for the London Matriculation, South Kensington, and University Local Examinations in Elementary Botany." This, we take it, explains the real object of the work, which is also indicated by an appendix, consisting of 153 questions selected from South Kensington and London University examination papers. The appearance of the present work is, in fact, a natural result of our present system of examinations.

Looked upon as a set of condensed notes, recapitulating what has been learnt in lectures which (as doubtless many at the present time *have* to be) are "specially adapted for the requirements" of various examinations, the book may certainly prove useful to many, and from this point of view much might be said in its favour. Moreover, as no specific types are taken, it will probably (for examining bodies do fortunately change their "types" occasionally) have a longer life than the author's "Text-book of Biology."

It is impossible here to criticize the work in detail, and we will only call attention to the insufficient account of growth contained in the introduction: such condensation cannot but result in inaccuracy.

Sixty figures are included in the text, most of which are very well known; some half-dozen are original, but most of these might have been omitted with advantage.

Cycles of Drought and Good Seasons in South Africa. By D. E. Hutchins, Conservator of Forests, Knysna. With Cyclical Diagrams. Pp. 137. (London: William Wesley and Son, 1889.)

MR. HUTCHINS'S little book consists of two lectures (subsequently amplified) which were delivered at King William's Town and Grahamstown in 1886 and 1887. Their subject-matter is fairly indicated in the title, and the author's views are succinctly set forth in the opening words of his second lecture:—"We know that the climate of South Africa varies in cycles, that the climates of other countries similarly placed, such as Australia, South America, and India, also vary in cycles. This cyclical variation is probably due to more causes than one."

Of these cycles, one only, that of the sun-spot period, is already familiar to meteorologists. The others are—a cycle of 9 or 10 years, or, more accurately, 9·43 years as a mean, which Mr. Hutchins terms the "storm cycle," and appears to have been suggested to him by the rainfall register of Cape Town Observatory, extending over 48 years; and one of 12 or 13 years, which he terms the "cyclical mitigation" of the droughts which otherwise prevail in the intervals of the maxima of the two previous cycles. The physical cause of this last is not indicated. Allowing for an occasional delay of a year in the occurrence of the sun-spot rainfall maximum, the vicissitudes of the Cape Town Observatory rainfall are thus fairly reduced to rule. For other stations some modifications are found necessary, and it appears that at certain inland stations and on the east coast a wet year occurs two or three years after that of maximum sun-spots, which Mr. Hutchins terms the "lag rain" of sun-spot maximum. In the register of the Karoo rainfall we also notice a year of "irregular mitigation," and another year of high rainfall not reducible to any cycle, but which is not so annotated.

Perhaps, indeed, we are wrong in assuming that some of the above cycles are new and unfamiliar, since Mr. H. C. Russell, in a paper communicated to the Royal Society of Sydney in 1876, tells us that cycles of 2, 3, 5 or 6, 6 or 7, 9, 10, 11, 12, 13, 17, 19, 30, and 56 years, have been advocated as regulating the rainfall of different places, and we might, of our own knowledge, add others to the list. But with the exception of the sun-spot cycle, all of them seem to be evolved from the rainfall statistics dealt with in each case, and to have no other physical meaning.

It does not seem to have occurred to Mr. Hutchins that, however ingenious as an arithmetical exercise, such analyses of a series of statistics have no more claim to rank as physical inquiry than the solving of acrostic puzzles. He has evidently no misgiving on this head, and is certainly not open to the reproof conveyed in Montrose's well-known lines. He does not fear the fate of his system too much to put it to the touch of a definite and detailed forecast; and under its guidance he has constructed tables showing year by year the occurrence of drought or of average or excessive rain, in some cases for the next half-century. Those therefore who may live to the year 1938 will be in a position to form a definitive judgment on the merits of the system. H. F. B.

Science in Plain Language. By William Durham, F.R.S.E. (Edinburgh: A. and C. Black, 1890.)

MR. DURHAM thinks that there are many intelligent persons who have not time, and may not have the inclination, to read regular scientific works, but who would be glad to know the general results of scientific investigation if these results could be set forth in plain language without too much detail. For this class he has written the present volume, which consists of articles that were originally printed in the *Scotsman*. The subjects are divided into four groups—natural selection, protoplasm, colour, and movement. Under "Natural Selection" there are essays on the origin of species, evolution, the evolution of man, the origin of man's higher nature, the

antiquity of man, primæval man, and ancient lake-dwellings. The section on "Protoplasm" includes papers on the origin of life, the basis of life, bacteria, disease germs, and fermentation. Under "Colour" we find articles on the colour of flowers, the colour of animals, and warning colours and mimicry. "Movement" takes in essays on movements in plants, the sleep of plants, climbing plants, and carnivorous plants. Discussing so many subjects, the writer is, of course, obliged to content himself with the statement of very wide views; but his expositions are so clear and fresh that the book ought to be of considerable service to the readers to whom he specially appeals. It will give them at least a general conception of the nature and direction of some of the lines of modern research, and may induce them to seek elsewhere for fuller knowledge.

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.*]

Panmixia.

I REGRET that I was led to doubt the sincerity of Mr. Romanes when he professed to have formed the conclusion that my words meant the reverse of their plain significance. I had not supposed that there was any one capable of making such a mistake.

I should be glad to terminate this discussion by a brief statement of the divergence of view between Mr. Romanes and myself as to the original matter in question, from which Mr. Romanes has led the correspondence by raising a variety of collateral issues. At the same time I should like to take the opportunity of saying what I believe Mr. Romanes would reciprocate, viz. that there is no ill-feeling but only a divergence of opinion between us.

Mr. Romanes definitely states that when an organ has become useless it will decrease in successive generations as a result of "cessation of selection" to about half its original size, without the co-operation of any such cause as economy of growth. He has repeated in effect this statement in his last letter. The result attributed by him to mere cessation of selection is, it must be noted (because he shows a tendency to waver and to substitute "degeneration" for "decrease in size"), a *decrease of size:* a mere failure in the exact adjustment of the parts of a complex organ is *not* the result in question. Of this I have a few words more to say below.

Mr. Romanes not only attributes the decrease in size of a useless organ to the cessation of selection pure and simple, but he calls that condition "a causal principle," and claims to have discovered it.[1] He has also stated that, whilst (to use his own words) "inherited decrease" of an organ *must* be due to this principle, it is "remarkably strange" that Mr. Darwin had overlooked it, and that it was unfortunate that he (Mr. Romanes) only gained the idea of this novel principle just after the appearance of the last edition of the "Origin of Species."

On the other hand, I consider that Mr. Romanes, by these contentions, obscures the theory of organic evolution, and that he presumes to censure Mr. Darwin without cause. There is nothing unfortunate in the date of Mr. Romanes's idea, because the idea is entirely erroneous; and it was no strange oversight of Mr. Darwin not to attribute the decrease of useless parts to "the principle of cessation of selection," or, in other words, to their uselessness alone—for the simple reason that he would have made a blunder had he done so. It is this blunder which Mr. Romanes places before us as his own contribution to the theory of panmixia: it is this blunder which Mr. Darwin not only did not make, but rendered *almost* impossible for others by his discussion of the matter ("Origin of Species," p. 401).

It is an incontrovertible mathematical fact that *the only effect of promiscuous breeding or panmixia* (considered apart from all other influences) *upon an organ or part which presents variations round an average mean will be to increase the number of individuals near the average mean, in proportion to the number of generations in which the panmixia is operative.* The notion that the haphazard interbreeding of "variations about a mean," must by itself lead to a shifting of the mean in the direction of diminished size—without the assistance of any special cause favouring reduction in size—is, to put it plainly, absurd.

It is, I believe, a mi take on the part of Mr. Romanes to say that Galton, Weismann, and Poulton agree with him in this astonishing fancy. But, were this the case, the mathematical fact would remain as it is.

Given a race of organisms in which a part has become useless, it is only (as Mr. Darwin pointed out) when some cause (such as economy of growth) favouring diminished size is operative, that the average mean of the size of the part will in successive generations shift in the direction of decrease. Mr. Darwin saw this, and explained it. Mr. Romanes not only failed to appreciate the considerations advanced by Darwin, but actually now charges him with oversight for not having made the blunder which he carefully avoided.

In conclusion, I have a few words to say in regard to the possibility of an organ consisting of several nicely adjusted parts losing that adjustment in a state of panmixia without the co-operation of economy of growth. Mr. Romanes erroneously declares that if we admit this we must also admit that decrease in size must similarly result. I am not surprised to find that he thinks so, and do not doubt his sincerity. But really the two cases present very different problems. Suppose the organ in question to be represented by fifty independent variables; then we have to consider not the probability of the average mean of each kind of variable being maintained but the probability of the production of the necessary *combinations* of fifty of them with the specific initial proportions of each of the fifty elements. Whether it is or is not probable that the complex adjustment and interaction of parts would be maintained in the absence of all interfering causes in a state of panmixia is a difficult question. It is one which is hardly worth further discussion, since it is impossible that the results of panmixia without such interfering causes should ever present themselves in organic nature.

It is, moreover, quite certain that any conclusion we may adopt in regard to that matter will not alter the mathematical fact that, given a numerous race and a long series of generations, the average mean round which the variations in size of a useless organ are distributed will not ultimately shift in the smallest degree either towards increase or decrease of size, as the result of the promiscuous interbreeding of the variations.

April 26. E. RAY LANKESTER.

[1] The erection of a negative condition—a cessation—into the position of a causal principle is an artifice which is very likely to obscure the view of the related facts. The "causal principle of non-existence" and "the reversal of being," would be worthy of the author of the artifice who professes also to have extracted an essence from an idea—the idea of promiscuous breeding, or panmixia!

The Inheritance of Acquired Characters.

IT surprises me to find that anyone who has looked into the evidence can doubt that acquired characters, as distinct from congenital ones, may, like congenital characters, become hereditary, and produce physiological effects. The instance mentioned in Herbert Spencer's letter in NATURE (vol. xli. p. 511), of domestic varieties of animals losing the power of erecting the ears, appears as nearly conclusive on the subject as such an instance can be.

On the habits or instincts of domesticated varieties, Darwin says:—"It may be doubted whether anyone would have thought of training a dog to point, had not some one dog naturally shown a tendency in this line. . . . When the first tendency to point was once displayed, methodical selection and the inherited effects of compulsory training in each successive generation would soon complete the work" ("Origin of Species," 4th edition, p. 256).

I quote another instance from Carpenter's "Comparative Physiology" (p. 987):—"Sir C. Lyell mentions that some Englishmen, engaged in conducting the operations of the Real del Monte Company in Mexico, carried out with them some greyhounds of the best breed to hunt the hares which abound in that country. It was found that the greyhounds could not support the fatigues of a long chase in this attenuated atmosphere, and before they could come up with their prey they lay down gasping for breath; but these same animals have produced whelps which have grown up, and are not in the least degree incommoded by the want of density in the air, but run down the hares with as much ease as do the fleetest of their race in this country."

Mr. Gulick's letter in NATURE (vol. xli. p. 536), insisting that the first and only absolutely essential factor in the

production of new varieties or species is the isolation of a portion of the race, appears very luminous. On this subject, let me again quote from Darwin :—

"Youatt gives an excellent illustration of the effects of a course of selection, which may be considered as unconsciously followed, in so far that the breeders could never have expected, nor even have wished, to produce the result which ensued—namely, the production of two distinct strains. The two flocks of Leicester sheep kept by Mr. Buckley and Mr. Burgess, as Mr. Youatt remarks, 'have been purely bred from the original stock of Mr. Bakewell for upwards of fifty years. There is not a suspicion existing in the mind of anyone at all acquainted with the subject that the owner of either of them has deviated in any one instance from the pure blood of Mr. Bakewell's flock, and yet the difference between the sheep possessed by these two gentlemen is so great that they have the appearance of being quite different varieties'" ("Origin of Species," 4th edition, pp. 37, 38).

JOSEPH JOHN MURPHY.

Belfast, April 24.

THE fifth caudal vertebra of a tortoiseshell cat at the Sussex County Hospital is dislocated and attached at right angles to the long axis of the fourth. The sixth and last vertebra is also affixed at right angles to the fifth. The cat is able to wag the terminal phalanx of the tail, and the distortion has always been considered to be due to an accident when the animal was a kitten. Within the last week the cat has had a litter of several kittens, two of which were born almost tailless, one possessing (as far as I could ascertain by external manipulation) two caudal and the other three caudal vertebræ only. Whether the original distortion is due to accident or not, I think these facts may interest some readers of NATURE.

W. AINSLIE HOLLIS.

Brighton, April 28.

P.S.—Since writing the above note I have had an opportunity of examining the two remaining kittens of the litter, and I find that only one of these has a normal tail. The other is docked of one or two of the terminal vertebræ, and the tail has a slight twist on itself towards the end.

W. A. H.

April 30.

Variation in the Nesting-habits of Birds.

IN considering the interesting question of instinct, one naturally turns to the nesting-habits of birds as affording an apparently good instance of habit acquired and perpetuated so as to become fixed, and, as we say, instinctive. It would be interesting, however, to find exactly how far the art of nest-building is really inherited, and how much uniformity exists among the nests of birds of identical specific characters.

The "blackbird" of this region, *Scolecophagus cyanocephalus*, is rather noteworthy in this connection. Goss, in his "Birds of Kansas," says this bird breeds in trees and bushes, from three to thirty feet from the ground. In Colorado, as observed by Mr. Morrison and myself, it breeds sometimes on the ground, and sometimes in low trees or bushes. In Custer County, Colorado, I find it breeding on the ground, sometimes at the very edge of creeks, in places where arboreal nests might have been made, and also better concealed ones. Captain C. E. Bendire, who inclines to the opinion that this bird breeds diversely in all parts of its range, where opportunities offer, writes (*in litt.*) :—"I have found them nesting abundantly both on the ground and in bushes in the same locality and close together in Oregon. One thing struck me as peculiar: the nests when placed on the ground were almost always to be found on the extreme edge of a creek bank, when they could have selected far more suitable places, better concealed ones at any rate, a few feet away from the bank." This selection of creek banks, noticed both in Colorado and in Oregon, is remarkable. It had occurred to me that in Colorado the habit might have been formed to lessen the risk of being trampled upon by the herds of buffalo which used to inhabit this region, but Captain Bendire tells me the habit is observed also in regions where there never were any buffalo, which throws doubt upon my explanation.

Captain Bendire, who has so excellent a knowledge of the nesting-habits of American birds, kindly gives me a few notes on the subject, which it may be permissible to quote.

"Birds in the selection of their nesting-sites will adapt themselves to circumstances, as is well known, but as in the case just mentioned [*Scolecophagus*] it is hard to arrive at an entirely satisfactory conclusion. It is, for instance, easy to account for, why the *Archibuteo ferrugineus* should breed on the ground in Dakota, in many cases at any rate, and why *Falco peregrinus anatum* in trees in Kansas, but there are a number of other such departures from the old established rules, which cannot be so easily accounted for" (C. E. Bendire, *in litt.*, January 21, 1890).

Captain Bendire also cites *Buteo swainsoni* and *Archibuteo ferrugineus* as birds which sometimes nest on the ground in places where there is plenty of suitable timber, which one might have expected them to make use of.

These variations in habit are certainly puzzling: probably the important factors in deciding the terrestrial or arboreal nesting-habits of a bird are four :—

(1) *Ability to build arboreal nests.*—If this varied in a locality where arboreal nests were not greatly preferable to terrestrial ones, we can see how a minority of clever birds might build in trees, and a majority of duffers on the ground. The slight disadvantage to the ground-builders might be counterbalanced by their numbers.

(2) *Danger of falling.*—In regions where the trees are not suitable for holding nests, or where very high winds prevail, a terrestrial nest might be preferable; though the same species in another part of its range might do well to build arboreally.

(3) *Dangers of nesting on the ground.*—Such dangers would arise from terrestrial enemies, floods, &c., and would vary greatly no doubt in different regions. Where things were otherwise fairly balanced, a slight difference in this respect might decide the nesting of a bird.

(4) *Means of defence.*—Some birds, with special means of defence or of escaping observation, might build on the ground where others would take to trees.

T. D. A. COCKERELL.

West Cliff, Custer Co., Colorado.

Russian Transliteration.

I AM afraid the authors of the "new system" of transliteration have misunderstood my letter in yours of April 10 (p. 534), advocating "the tabulation of the system of transliteration which has been so long in use in this country" in preference to the adoption of the unnecessary novelties they propose to introduce. By the "system in use" I meant that for transliteration from Russian into *English*, and certainly did not include the transliterations from Russian into *German* which have been copied from books or memoirs in that language into English catalogues or journals. As practically all the examples the authors adduce in defence of their "new system," including both the atlases and the works with which they associate my name, are of this kind—*i.e.* merely copies of transliterations from Russian into *German*—I fail to see what bearing they have on the question of transliteration into *English*, however useful they might be in constructing a system for transliteration from Russian into German.

Another misapprehension is, they seem to imagine that I have propounded a system of transliteration of my own. I sincerely hope I shall never be guilty of doing anything so rash. I merely offered some friendly criticisms on the new system which the authors had devised, and I may supplement my remarks by here giving in tabular form the principal points in which this system differs from that which I conceive to be the English use :—

	English Use.	New System.
в	*v*	*v*
вь	*ff*	*v*
г	*h* before *e* or *i*, otherwise *g*	*gh*
ж	*j*	*zh*
кс	*x*	*ks*
у	*ou*	*u*
х	*ch*	*kh*
ч	*tch*	*ch*
щ	*shtch*	*shch*
ъ	*é*	*ye*
ы	*y*	*i'*
ю	*u*	*yu*

I have already given a few examples of names which look uncouth when transliterated according to the new system, and I here add one more. It is

SKRZHIPSKIĬ.

When I wrote it down and observed its hieroglyphic appearance, there arose somehow in my mind a vision of a new system of chemical nomenclature devised many years ago by Laurent,

and his proposal to give to "alum" the name *atolan-telmin-ajafin-weso*. CHARLES E. GROVES.

Chemical Society, April 14.

P.S.—I need scarcely say how cordially I concur with Mr. W. F. Kirby's exceedingly apposite remark that no system of transliteration should be adopted offhand without full discussion.

WITH reference to the scheme of Russian transliteration propounded on p. 397 of NATURE (vol. xli.), I should be obliged if the editor of NATURE would allow me the opportunity of suggesting that different principles of respelling foreign languages in English might possibly be adopted with advantage for different purposes. The scheme referred to is one of strict transliteration; in other words, the aim is to represent the letters of a foreign alphabet uniformly by the same letters or combinations of letters in the English alphabet. For the purpose of drawing up lists of titles of books and papers in a foreign language—the purpose obviously kept in view by the propounders of the new Russian scheme—this principle is no doubt the best. It is the only one that makes it easy to consult a Russian dictionary. But it does not follow that the principle of strict transliteration is the best to adopt for foreign proper names occurring in a language different from that to which they belong. The third of the rules adopted by the Council of the Royal Geographical Society for geographical orthography is as follows: "The true sound of the word as locally pronounced will be taken as the basis of the spelling" (Proc. Roy. Geog. Soc., 1885, p. 535). This rule is inconsistent with any scheme of strict transliteration. I can imagine that two views may be held as to its propriety. Unquestionably there are difficulties in applying it, but surely for the purpose for which the rule was adopted it is at least defensible and worthy of serious discussion.

Even if it should be recognized, however, that it is desirable that one principle of conversion into a foreign alphabet should be adopted for one purpose, another for another, it will, I think, be generally admitted to be a matter of the greatest importance that an agreement should be come to among all concerned in such conversions as to those points which might be held in common on either system of conversion. All schemes of transliteration in the strict sense of the term are based on phonetic rules. The aim in all is to render the letters of one alphabet by the letters and signs most appropriately representing their normal sounds in another. It is the departures from the normal sounds that are disregarded. Now a uniform system of representing sounds, so far as it is at all desirable to represent foreign sounds in English, if devised with sufficiently wide regard to the requirements of different languages, would be of great use as a system to be followed for every word or name on the principle of phonetic respelling and to be adopted as the basis of every scheme of transliteration. GEO. G. CHISHOLM.

April 22.

On some Decomposed Flints from Southbourne-on-Sea.

THE curiously decomposed flint-pebbles which occur in the cliffs between Boscombe and Southbourne-on-Sea have not, so far as I have been able to ascertain, yet received the attention they deserve, and, with a view of obtaining other opinions before the completion of a paper on the subject, I venture briefly to offer mine.

I will not now deal generally with all the pebbles in the horizon alluded to, but specifically with some of unusual interest which occur at a certain point in the cliff, as these represent an extreme type of decomposition to which most of the less-altered pebbles may be found gradating. These type-pebbles occur in the cliff a short distance to the east of the pier at Southbourne-on-Sea, and present all the characteristic features of a littoral deposit.

A section of the cliff at this point shows:—

Blown sand	8 feet.
Brown loam, passing down into lighter-coloured sandy gravel containing angular and sub-angular yellow and brown flints without any definite mode of deposition	14 feet.

At the base of this, and resting on pure quartzose sand, free from flints, is a definite and more or less horizontal layer of rounded and decomposed flint-pebbles of about one pebble in thickness, partially embedded in the white sand on which they rest, and covered by the clastic matter of the bed above.

While some of these pebbles are apparently unaffected, most of them are eroded in a remarkable manner, having large portions of their substance removed; and others, though retaining their original form, are completely changed throughout their mass into a soft, white substance (crystalline silica) macroscopically like chalk, and as easily cut or sawn through. The largest wholly-decomposed specimen I have been able to procure measures 14 inches around its greatest circumference.

It is remarkable that these flint-wrecks preserve their original form and detail to such a degree of perfection that in most cases the soft surfaces retain the crescentic markings (mastoid) of incipient conchoidal fracture which resulted originally from the percussion due to wave-action.

As far as I am at present able to judge, the silica originally composing these pebbles was of two distinct kinds—a bluish-black, or more stable form (superior crystalline development), and a light-coloured, or less stable form (inferior crystalline development); for, in the specimens I have procured, the bluish-black variety does not appear to be abnormally affected, while the lighter-coloured variety is nearly always partially or completely decomposed. The wholly-decomposed pebbles would, therefore, have been formed of the unstable variety, while those eroded only would have been formed of a combination of the two, the stable portion now remaining.

My supposition seems to be strengthened by the evidence obtained from the banded flints, which are very plentiful here. These banded flints are formed of alternating zones of the two varieties, and in many cases the unstable form has been so decomposed as to leave only successive zones of the more stable form fitting loosely one into the other like a nest of boxes, and as easily separable. Notwithstanding this fact these unstable zones—before decomposition—are apparently as well able to withstand *mechanical* erosion as the stable zones, a conclusion arrived at through having some of these banded flints subjected to the action of the sand-blast for 15 minutes without any "ridging" taking place.

That the decomposition of these particular flint-pebbles must have taken place prior to the deposition of the superincumbent bed of clastic material is proved, I think, by the fact that none of the flints composing this bed appear to be decomposed, even the smallest chips being comparatively unaffected.

From this and other facts observed, I gather that the decomposition of these pebbles must have taken place when they were exposed to the air, but I do not think atmospheric influences alone would be sufficient to account for the evident rapidity and effectiveness of the process; we must seek a special cause for an unusual effect.

I venture to suggest that the solvent which has in this case removed the colloidal silica was derived from decaying sea-weed, and other organic matter, cast up from time to time by the waves upon this (then) pebbly beach. Large masses of sea-weed cast up by storm-waves take a considerable time to decompose, and during such period is it not possible that they might produce alkaline solutions, or—as has been suggested to me by Dr. Irving—combinations of ammonia and organic acids? Either of these is a well-known solvent of colloidal silica. The action of such solvents might have been accelerated by the mechanical process through which most of these pebbles passed prior to their final state of rest, viz. the action of the sea-waves in producing the mastoid structure already alluded to, this molecular disruption no doubt facilitating the penetration of the solvent to the very heart of the pebble. It is worthy of note, too, that in some of the eroded specimens procured, the remaining unaffected parts are almost entirely free from these incipient fractures, a fact which—if we ignore the supposed variation in the stability of the silica—suggests the necessity for a combination of the chemical and mechanical causes to produce the effects observed.

I have dealt here with a special case only, in the hope that my suggestions may be found applicable to the many in which we see abnormal decomposition occurring in the flint-pebbles of littoral deposits, and which appears to be distinct from the "weathering" so frequently seen occurring to considerable depths in the exposed flints of deposits other than littoral.

Bournemouth, April 16. CECIL CARUS-WILSON.

Doppler's Principle.

AS a student I should be much obliged to any reader for an explanation of the following difficulty. In considering Doppler's

principle as applied in acoustics, we find four cases: (1) approach of observer, source and medium being at rest; (2) recession of observer, source and medium at rest; (3) approach of source, observer and medium at rest; (4) recession of source, observer and medium at rest.

I have consulted all the standard authorities which have occurred to me, and find they all agree in the 1st and 2nd cases. In (3), Doppler, Lord Rayleigh, Prof. Everett (1st method in "Deschanel"), Jamin, and Ganot have the same result as in (1). Lord Rayleigh in his "Theory of Sound," vol. ii. p. 142, says, "In the case of a periodic disturbance a velocity of approach v is equivalent to an increase of frequency in the ratio $a : a + v$," a being the velocity of sound. In another place the same author says that it is the *relative* velocity of source and observer alone that is important. The above-mentioned authorities appear to hold the same views.

But Prof. Everett has a more rigorous demonstration than the above, which leads to the result—old pitch : new pitch :: $a - v : a$. This result is the same as that given by Mach, "Ton u. Färberänderung durch Bewegung" (1874), and as that used by Balfour Stewart, "Treatise on Heat."

In the 4th case the first-mentioned authors again agree, giving as a result—new pitch : old pitch :: $a : a - v$. Prof. Everett's and E. Mach's results agree in giving $a + v : a$ as the ratio.

It will be readily admitted that the first two cases are simpler problems to attack than the last two. The results of the minority for the cases (3) and (4) seem to me to come from looking at the change in wave-length first, those of the majority from taking into account the number of waves met by the observer. In any case the disagreement among such authorities is naturally beyond me to explain. The motion of the medium does not appear to offer any special difficulty.

G. H. WYATT.

The Relative Prevalence of North-east and South-west Winds.

THE direction of the wind has been noted twice daily at this Observatory (9 a.m. and 9 p.m.) during the past 6 years, with the following mean results:—

N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
56	48	30	25	23	65	45	60	13

The period under consideration is not sufficiently long to make the series of observations of any great value, but as Mr. Ellis asks for comparisons, I am happy to give them for what they are worth.

C. E. PEEK.

Rousdon Observatory, Lyme Regis, April 26.

The London Mathematical Society's List of Papers.

IN NATURE (vol. xli. p. 594) it is stated that "a complete index of the papers printed in the Proceedings of the London Mathematical Society has been issued." It will be in the recollection of some that a previous issue of the Index to the papers contained in the first 17 volumes was announced in NATURE (vol. xxxvi. p. 42): it is a re-issue of this list completed for the first 20 volumes that is now noted. The former edition of 3000 copies was soon dispersed, and resulted in warm expressions of thanks from mathematicians, and also in an increased sale of the Proceedings. If other Societies would, in like manner, issue lists of the titles of papers printed in their Proceedings, they would no doubt meet with a like reward. All mathematicians, and others who are interested in mathematical research, can have a copy on application to the Secretaries (22 Albemarle Street, W.), or to the publisher (Francis Hodgson, 89 Farringdon Street, E.C.).

April 26. R. TUCKER, Hon. Sec.

THE UNITED STATES SCIENTIFIC EXPEDITION TO WEST AFRICA, 1889.

AS the work of the Expedition approaches conclusion, I venture to hope that a brief partial recital of results may be worth notice in NATURE, particularly as, in many of the ports we have visited, English courtesy and English hospitality have contributed in large measure to the facilities for prosecuting our work, not to say also very greatly to the delight of doing it.

I find it a trifle difficult to say just where to begin, but Dr. David Gill, H.M. Astronomer at the Cape, comes first to mind, and surely no one could have devoted himself more unsparingly to the interests of the Expedition than he did during our stay of a fortnight and more at Cape Town: and through his liberal provision for every requirement of the observers, it became possible to swing the pendulums in the Royal Observatory buildings, the same spot occupied in previous gravity-research at the Cape. Had it been expedient to delay the *Pensacola* longer, Dr. Gill's suggestion would gladly have been acted upon, and an additional gravity-determination made at the Kimberley diamond fields, 650 miles in the interior, at an elevation of about 4000 feet; but there was time only for members of the Expedition not engaged in exact measures to proceed as far inland as that; and the movements and operations of the naturalists and others who desired to visit the Cape Colony country as far as Kimberley became feasible through the kind offers of Mr. Difford, the Secretary of the Colonial Government Railways.

Not only at Cape Town had we much occasion to thank His Excellency Sir H. B. Lock, the Governor of the Colony, but two months later, at Ascension Island, through his courteous intervention, and the obliging civilities of Admiral Wells, R.N., all possible preparation had been made; while, on our arrival, Captain Napier, R.N., in charge of Ascension, most thoughtfully smoothed the way by arranging to our entire satisfaction all matters which could in any way facilitate the work we had planned for that interesting island.

Nor am I forgetting the multitude of courtesies at the hands of Governor Antrobus of St. Helena, where all desired assistance was afforded, and where work similar to that at Ascension was undertaken and completed.

In this connection, I must not omit mention of the American Navy, for neither the Expedition in its present form nor its work could have become an accomplished fact but for the enlightened policy of Secretary Tracy, who assigned a man-of-war for its transport to Africa and home again; of Admiral Walker, and later, Commodore Dewey, Chiefs of Naval Bureaux, who devoted their energies ungrudgingly to the regulation of all matters official affecting the welfare of the Expedition; and of Captain Yates, the commander of the U.S.S. *Pensacola*, who has done everything in his power to forward the prosecution of the scientific work.

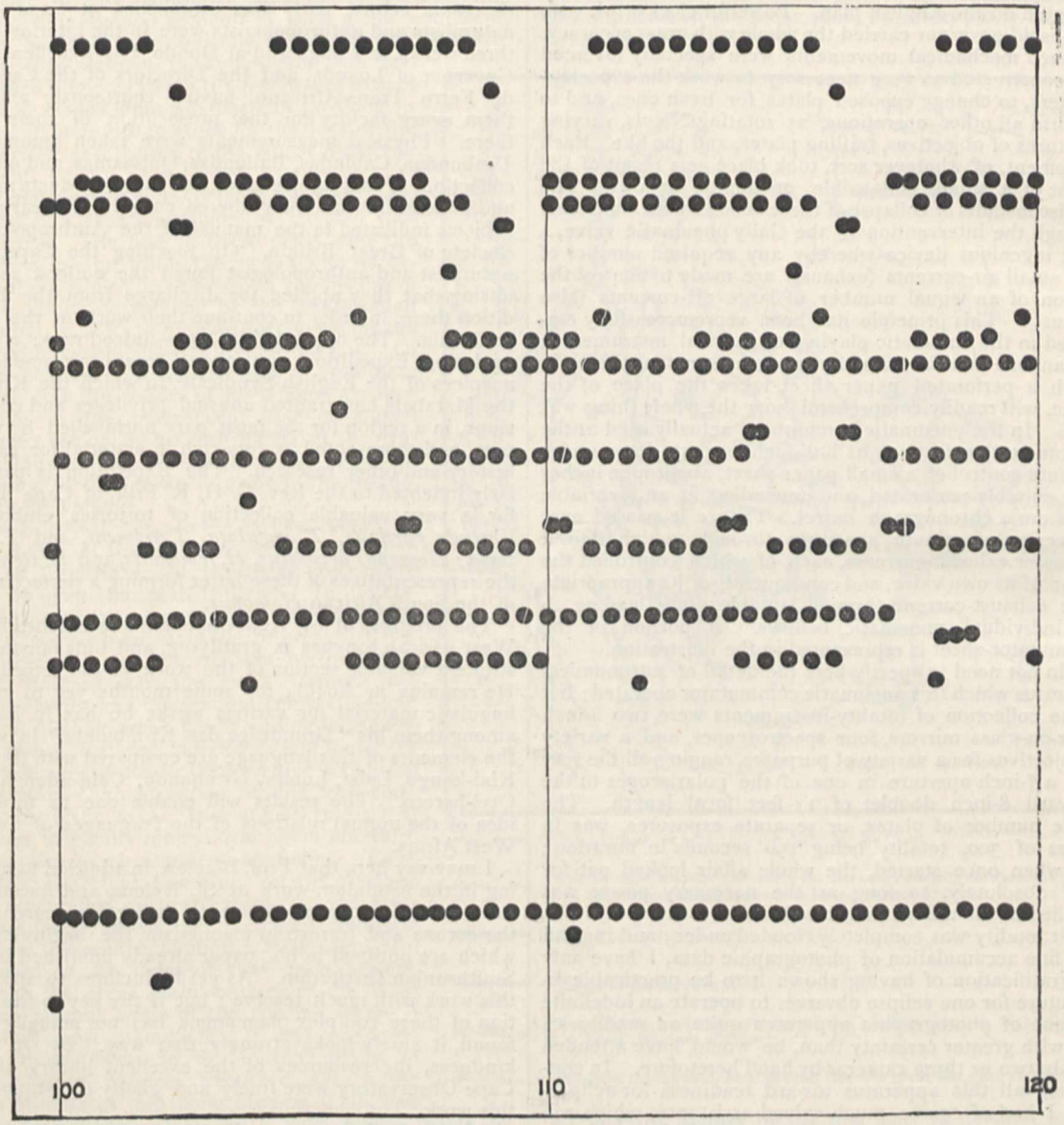
The *Pensacola* left New York on October 16 last; called at the ports of Horta, Fayal, Azores, November 2-3; San Vicenti, Cape Verdes, November 10-12; St. George's Parish, Sierra Leone, November 18-20; Elmina, Gold Coast, November 26-28; São Paolo di Loanda, December 6-7; Eclipse Bay, Cape Ledo, December 8-27; again at Loanda, December 28-January 6; Cape Town, January 17-February 6; St. Helena, February 20-March 10; and arrived at Ascension six days later, which port she will probably leave about April 10.

Now to some of the results.

At all these stations except Cape Ledo, the magnetic elements have been carefully investigated by Mr. Preston, of the U.S. Coast and Geodetic Survey. Also he had an additional magnetic station at Cabiri, about 45 miles interior from Loanda, whither he went for the immediate eclipse period.

The short time available before the eclipse made it impracticable to begin the gravity-determinations until Loanda; there Mr. Preston swung the Peirce pendulums, and again at the Royal Observatory, Cape Town. At St. Helena two complete swings were obtained, the one at a sea-level station near the Castle, Jamestown, and the other at Longwood, elevation 1750 feet. It was not

thought practicable to re-occupy Foster's station at Lemon Valley. Here at Ascension the sea-level station at Garrison is already complete; and, as I write, Mr. Preston and Prof. Bigelow are taking quarters near the summit of Green Mountain for the second station, near the spot occupied by Foster sixty years ago, elevation between two and three thousand feet. Auxiliary magnetic work is undertaken at both these upper-level island stations. Between Ascension and New York but one prolonged stop is at present contemplated—at Bridgetown, Barbados—where magnetics will be done, and gravity-work, if practicable. Also, Bermudas may be included, but that is perhaps unlikely. In addition to the bearing of this work on terrestrial physics and geologic theories, it is worthy of note, in passing, that all these stations, including Washington, where swings are made both before the departure of the Expedition and after its return, lie within a narrow great-circle belt, which can at



Control-sheet of the Pneumatic Commutator between the 100th and 120th seconds of Totality.

any time be continued on through the United States and Canadas and Alaska, forming an extraordinary stretch of gravimetric survey.

Regarding the eclipse and the stay of the astronomers at Cape Ledo, it has to be said, to our great regret, that the direct photo-heliograph of 40 feet focal length was the only instrument with which eclipse-records could be secured. These were photographs of the partial phases, over 100 in number, obtained between clouds. The instrument was built under the immediate supervision of Prof. Bigelow, and has, among other peculiarities, a skeleton tripod-mounting which will be fully figured in the definitive report of the Expedition. It has been proven practicable to dispense with the heliostat mirror, always the weak point in the horizontal photo-heliograph; and to manipulate readily a camera long enough to produce a 4½-inch solar image direct: and this, too, by means of a mounting easy to transport and to set in position. The photographs were taken in groups of ten, on circular plates of 22 inches diameter. The apparatus auxiliary

to these rotating plates made the whole automatic, the driving power being compressed air under electric control. A form of sand-clock was found most efficient for counteracting the diurnal motion.

For the total phase our preparations were even more elaborate. What I attempted was nothing short of the complete automatic operation of all the photographic instruments, whether photometers, spectroscopes, cameras, or polariscopes. Over a score of these instruments were securely adjusted upon an immense polar axis, split, and mounted on the English plan. Powerful clock-work with a Repsold governor carried the whole with great accuracy. All such mechanical movements were specially invented and constructed as were necessary to work the exposing-shutters, to change exposed plates for fresh ones, and to perform all other operations, as rotating Nicols, varying apertures of objectives, trailing plates, and the like. Each movement, of whatever sort, took place as a result of the thrust of a small, collapsible, pneumatic bellows. The precise instants of collapse of these bellows were controlled through the intervention of the Gally pneumatic valve, a most ingenious device whereby any required number of very small air-currents (exhaust) are made to control the motion of an equal number of large air-currents (also exhaust). This principle has been very successfully employed in the automatic playing of musical instruments; and anyone familiar with the modern forms of these, in which a perforated paper sheet takes the place of the music, will readily comprehend how the whole thing was done. In the pneumatic commutator actually used at the African station forty-eight half-inch currents were under absolute control of a small paper sheet, about nine inches wide, suitably perforated, and unwinding at an invariable rate from a chronograph barrel. Thence it passed over the series of minute apertures through which flowed the lesser exhaust-currents, each of which controlled the action of its own valve, and consequently of its appropriate large exhaust-current, through suitable pipes leading to the individual pneumatic bellows. A portion of the commutator-sheet is represented in the illustration.

I do not need to specify here the detail of astronomical apparatus which this pneumatic commutator operated; but in the collection of totality-instruments were two 8-inch silver-on-glass mirrors, four spectroscopes, and a variety of objectives for a variety of purposes, ranging all the way from a ¾-inch aperture in one of the polariscopes to the Harvard 8-inch doublet of 13 feet focal length. The whole number of plates, or separate exposures, was in excess of 300, totality being 190 seconds in duration; and when once started, the whole affair looked out for itself absolutely, so long as the necessary power was supplied at the main exhaust-bellows.

But totality was completely clouded under; and instead of a fine accumulation of photographic data, I have only the gratification of having shown it to be practicable in the future for one eclipse observer to operate an indefinite amount of photographic apparatus quite as readily as, and with greater certainty than, he would have attended to only two or three cameras by hand heretofore. In converging all this apparatus toward readiness for eclipse-day, I had of course much valued assistance, which will be fully acknowledged elsewhere; and I need only mention here Prof. Bigelow, Mr. Davis, and Mr. Van Guysling, who were specially helpful in devising required movements and practically constructing them.

The totality-area in West Africa appears to have been unusually overcast. Auxiliary observers at Cabiri had clouds; at Cunga, clouds; at Dondo, clouds; while at Cazengo, Oeiras, Muxima, Kakulu, and Bom-Jesus it was cloudy too. Also, about 15 miles out at sea, in the path of central eclipse, whither the *Pensacola* had gone in the hope of additional results, the sky-conditions were perhaps slightly better, but still so bad that it is doubtful whether the true corona was seen at all.

Lest I weary anyone who may be reading this with too long a statement of our work, I omit here all account of the natural history of the Expedition, only saying for the present that Messrs. Brown, sent out by the U.S. National Museum, have been actively engaged in collecting at all the ports made by the *Pensacola*, and their materials will, I dare say, be competently discussed on the return of the Expedition. More about this later. At Ascension, opportunity for trawling is now for the first time available, and so far with fair success. While the main eclipse party was established at Cape Ledo, naturalists and anthropologists were in the interior about three weeks, at Cunga and at Dondo, His Excellency the Governor of Loanda, and the Directors of the Caminho de Ferro Trans-Africano, having courteously afforded them every facility for the prosecution of their work there. Physical measurements were taken among the Umbundus, Cabindas, Bailundas, Quissamas, and others; collections of folk-lore, fetishes, and mind-products made; and general information gathered concerning a variety of subjects indicated in the manual of the Anthropological Society of Great Britain. On reaching the Cape, both naturalist and anthropologist found the outlook so promising that they applied for discharge from the Expedition there, in order to continue their work in the Cape peninsula. The opportunities were indeed rare: a great exploring Expedition was about organizing, under the auspices of the English Syndicate, to which the King of the Matabele has granted unusual privileges and concessions, in a region for the most part untravelled by white men, and represented as very rich in material for natural history and other research. The Expedition is particularly indebted to the Rev. G. H. R. Fisk, of Cape Town, for a very valuable collection of tortoises, embracing *Testudo pardalis*, *T. angulata*, *T. trimeni*, and *T. tentoria*; *Homopus areolatus*, *H. femoralis*, and *H. signatus*, the representatives of these latter forming a perfect series of the South African *Homopus*.

The progress of M. Heli Chatelain's researches in the West African tongues is gratifying, and bids fair to constitute a valuable section of the work of the Expedition. He remains in Angola for some months yet, to gather linguistic material for various works he has in hand—among them his "Grundzüge des Ki-mbundu," in which the elements of this language are compared with those of Kixi-kongo, Luba, Lunda, N-mbundu, Oshi-ndonga, and Otyi-herero. The results will enable one to form an idea of the mutual relations of the languages of Central West Africa.

I may say here that Prof. Bigelow, in addition to assisting in the pendulum-work at St. Helena and Ascension, has been diligently engaged upon theoretic researches on the corona and terrestrial magnetism, the beginnings of which are outlined in his paper already published by the Smithsonian Institution. As yet he inclines to speak of this work with much reserve; but if the key to the solution of these complex phenomena has not actually been found, it surely looks strongly that way. By Dr. Gill's kindness, the resources of the excellent library of the Cape Observatory were freely and gladly drawn upon in this work.

Of the Bulletins, or preliminary publications of the Expedition, thirteen are already issued—one each relating to general matters, to terrestrial physics, to philology, and to localities of scientific interest in St. Helena; two to meteorology and to natural history; and five to the total eclipse.

I reserve for another occasion all account of the important researches which Prof. Cleveland Abbe, Meteorologist of the Expedition, has been sedulously prosecuting for the past five months and over, with improved means, and under rare conditions at sea and on land.

DAVID P. TODD.

U.S.S. *Pensacola*, Ascension, March 27.

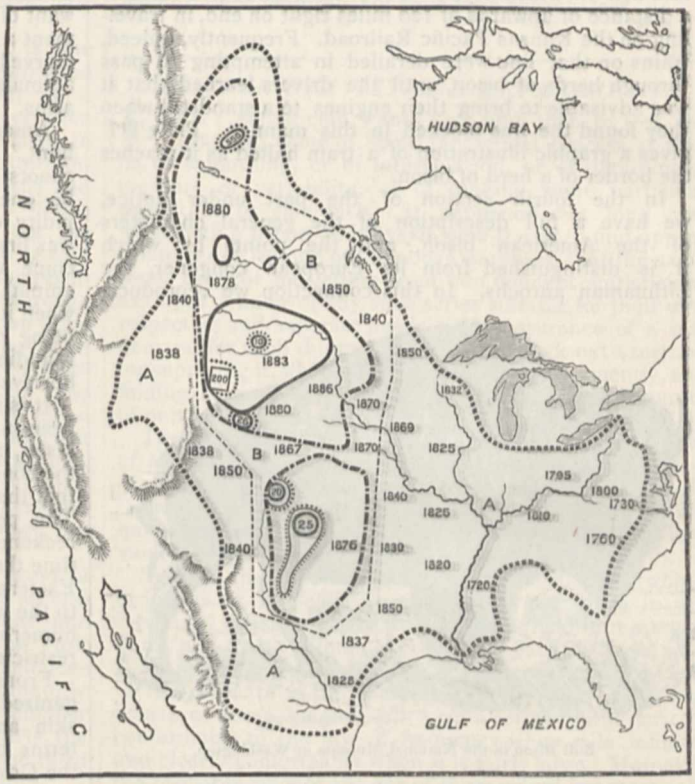
THE EXTERMINATION OF THE AMERICAN BISON.[1]

IN the whole course of the history of man's relations with the lower animals, no sadder chapter will ever be written than that which tells of the practical extinction of the bison, which, only a short twenty years since, wandered in countless thousands over the vast prairies of the northern half of the American continent. This mournful story—mournful alike to the naturalist, to the sportsman, and to the trader—the author of this memoir recounts in such a full and lucid manner as to have practically exhausted the subject. Indeed, this memoir, in conjunction with Mr. J. A. Allen's monograph of the recent and extinct American bisons, does all that can be done in the way of literature to atone for the loss of the animal itself as a feature of the North American continent.

The memoir before us—which, we should say, is issued as a separate volume—is divided into three parts. The first of these deals with the life-history of the bison, the second with its extermination, while the third gives the history of the Expedition despatched by the Smithsonian Institution, in 1886, to procure specimens for the National Museum before it became too late. Of this Expedition the author was a prominent member, and the results of his labours are now exhibited in the magnificent case of stuffed specimens set up by his own hands in the National Museum at Washington. An excellent illustration of this group is given in the frontispiece to the volume.

After briefly alluding to the earliest records of a knowledge of the existence of the American bison by Europeans, Mr. Hornaday proceeds to notice its geographical distribution. In illustration of this important part of the subject a map is given, showing not only the original distributional area, but also the division by the Union Pacific Railway into the great northern and southern herds, and the gradual contraction and isolation of their areas, finally ending in the few spots where scattered individuals still linger on. For the benefit of our readers we give a reduced reproduction of that portion of this map comprising the bison area. Our author states that the bison originally ranged over about one-third of the entire North American continent. Thus, "Starting almost at tide-water on the Atlantic coast, it extended westward through a vast tract of dense forest, across the Alleghany Mountain system to the prairies along the Mississippi, and southward to the delta of that great system. Although the great plain country of the West was the natural home of the species, where it flourished most abundantly, it also wandered south across Texas to the burning plains of North-Eastern Mexico, westward across the Rocky Mountains into New Mexico, Utah, and Idaho, and northward across a vast treeless waste to the bleak and inhospitable shores of the Great Slave Lake itself."

About a century and a half ago, when the greater part of North America was still an unknown region to the white races, it would appear that the bison had about attained its maximum development; and the author suggests that if it had been left undisturbed it would probably have crossed the Sierra Nevada and the Coast Range to reach the fertile plains of the Pacific slope. This enormous range would also in course of time have probably given rise to local races, of which there is an actual example in the so-called "wood-" or "mountain-buffalo"; and in the opinion of the author it is probable, if things had been left to themselves, that, while the bisons in the neighbourhood of the Great Slave Lake would have developed an extra amount of hair, and thus tended to resemble the musk-ox of the Arctic regions, those in the warm regions of the south would tend to lose their hair, and attain a condition resembling that of the Cape buffalo and the Indian gaur. The appearance of the white man on the scene soon, however, put a stop to Nature's processes.



Boundary of the area once inhabited by the bison.

Approximate boundary between the area of desultory extirpation (A) and that of systematic destruction for robes and hides (B).

Range of the two great herds in 1870.

Range of the herds in 1880.

Range of the scattered survivors of the southern herd in 1875, after the great slaughter of 1870–73.

Range of the northern herd in 1884, after the great slaughter of 1880–83.

The third section of the first part is devoted to the consideration of the former numerical abundance of the bison. Here the author considers that the current accounts of the extraordinary number of these animals are not in the least exaggerated. Thus he observes that "it would have been as easy to count or to estimate the number of leaves in a forest as to calculate the number of buffaloes [the author frequently employs this American misnomer for the bison] living at any given time during the history of the species previous to 1870. Even in South Central Africa, which has been exceedingly prolific in great herds of game, it is probable that all its quadrupeds taken together on an equal area would never have

[1] "The Extermination of the American Bison." By W. T. Hornday. From the Report of the U.S. National Museum for 1886–87. Pp. 369–548, Pls. i.–xxii. (Washington: Government Printing Office, 1889.)

more than equalled the total number of buffalo in this country forty years ago." As an instance of these enormous numbers, it appears that, in the early part of the year 1871, Colonel R. I. Dodge, when passing through the great herd on the Arkansas, and reckoning that there were some fifteen or twenty individuals to the acre, states from his own observations that it was not less than 25 miles wide and 50 miles deep. This, however, was the last of the great herds; and Mr. Hornaday estimates that the number of individuals comprising it could not be reckoned as less than four millions. Many writers at and about the date mentioned speak of the plains being absolutely black with bison as far as the eye could reach; and Mr. W. Blackmore tells of passing through a herd for a distance of upwards of 120 miles right on end, in travelling on the Kansas Pacific Railroad. Frequently, indeed, trains on that line were derailed in attempting to pass through herds of bison, until the drivers learned that it was advisable to bring their engines to a standstill when they found the line blocked in this manner. Plate III. gives a graphic illustration of a train halted as it reaches the border of a herd of bison.

In the fourth section of the part under notice, we have a full description of the general characters of the American bison, and the points by which it is distinguished from its European congener, the Lithuanian aurochs. In this connection we reproduce,

Bull Bison in the National Museum at Washington.

on a smaller scale, the author's figure of the bull bison mounted in the United States National Museum, since he tells us that many of the figures to be met with do not give by any means a fair idea of the grand proportions of the animal, being taken either from domesticated or from badly-mounted specimens. The height of this bull is upwards of 5 feet 8 inches at the withers. The author remarks, however, that the specimens obtained by the Smithsonian Expedition were above the average height, since they were the fleetest and strongest examples of the race, which had escaped from the slaughter of the great herds by their endurance and speed. It is also remarked that these bison were of extreme muscular development, and showed no traces of the large amount of fat so characteristic of the members of the great herds when they were comparatively undisturbed upon the open plains.

The following sections treat of the habits, food, and disposition of the bison—subjects into which we need not enter on this occasion. In the eighth section we have a full discussion as to the economic value of the bison, in the course of which it is shown what a severe financial loss the States have sustained in permitting its extermination. Some very interesting observations then follow as to the number of herds or individuals of bison—either pure or half-bred—now existing in captivity in various parts of the States, and in other countries. From this it appears that on January 1, 1889, there were 256 pure-bred specimens known to be kept in captivity; while the herd of wild ones, protected by the United States Government in the Yellowstone National Park, numbered about 200.

With the second and most interesting part we come to the proper subject of the memoir—the actual extermination of the bison. The primary cause which has led to this sad result is, of course, the spread of civilization—and more especially railways—over the area formerly sacred to the bison and a few Indians. But as secondary causes the author mentions the utterly wanton and reckless way in which the unfortunate animals were shot down for the sake merely of their hides or tongues; the want of protective legislation on the part of the Government; the preference for the flesh and skin of cows; the marvellous stupidity and indifference to man of the animals themselves; and the perfection of modern fire-arms.

Among the methods of slaughter the so-called "still-hunt," where the hunter creeps up to a herd and shoots one after another of its members, appears to be one of the most deadly, owing to the crass stupidity of the animals themselves. The plan adopted was first to shoot the leader, when the remainder would come and stupidly smell round the body, till another animal assumed the post of leader, and was shot down when it was about to make a move; the same process being repeated almost without end. Riding down, surrounding, impounding, or hunting in snow-shoes, were, however, other equally effective methods of destruction.

It is stated that, in spite of the merciless war which had been in a desultory manner incessantly waged against the bison, both by whites and Indians, for over a century, and the consequent gradual restriction of its area, it is certain that there were several million head alive as late as 1870. The period of desultory destruction may be roughly reckoned as extending from 1730 to 1830. During that time the bison had been completely driven away from the Eastern United States, and also from the districts lying to the west of the Rockies (where it had never been very numerous); and the area had thus become practically restricted to that inclosed by the broken line on the map.

From 1830 to 1888 is reckoned as the period of organized and systematic slaughter for the sake of the skin and flesh; and the author does not measure the terms he employs with reference to the supineness of the Government during this period. He gives a detailed account of the various expeditions which were steadily playing upon the great herd occupying the area indicated on the map; and the gradually increasing demand for "buffalo-robes." The real beginning of the end was, however, the completion in 1869 of the Union Pacific Railway, which completely cut the bison area in twain, and divided the great herd into a southern and a northern moiety.

The history of the southern herd is very short. Its central point was somewhere about the site of the present Garden City in Kansas; and although its area was much less than that occupied by the northern herd, it probably contained twice as many animals, the estimated number of individuals in 1871 being not less than three millions, and probably nearer four. The completion of the Kansas branch of the Union Pacific in 1871, which ran right through the head-quarters of the southern herd, was the immediate cause of its destruction; and we are told that the chief slaughter, which began in 1871, attained its height in 1873. So wanton and wasteful, indeed, was the destruction during this period that it is said that every single hide sent to market represented four individuals slain; and the description given by the author on p. 496 of the condition of the country owing to this frightful slaughter is almost sickening. The author observes that "it is making a safe estimate to say that probably no

fewer than 50,000 buffaloes have been killed for their tongues alone, and the most of these are undoubtedly chargeable against white men, who ought to have known better." Over three and a half million individuals are estimated to have been slaughtered in the southern herd between 1872 and 1874. In the latter year the hunters became alarmed at the great diminution in the number of the bison, and by the end of 1875 the great southern herd had ceased to exist as a body. The main body of the survivors, some 10,000 strong, fled into the wilder parts of Texas, where they have been gradually shot down, till a few years ago some two or three score remained as the sole survivors of the three or four millions of the great southern herd. Bison-hunting as a business definitely ceased in the south-west in 1880.

Almost equally brief, and equally decisive, is the history of the great northern herd. The estimated number in this herd in 1870 is roughly put at a million and a half, ranging over a much wider area than the southern herd. The portions of the herd in British North America appear to have been exterminated first. Previously to 1880, the Sioux Indians had made an enormous impression on the numbers of this herd in the States of Dakota and Wyoming; but the beginning of the final destruction of the herd may be said to date from that year, which was signalized by the opening of the Northern Pacific Railway, running right through their area. In that year the herd was hemmed in on three sides by Indians armed with breechloaders, who enormously reduced its numbers. A rising market for "buffalo-robes," in 1881, stimulated a rush on this herd, till "the hunting-season which began in October 1882 and ended in February 1883 finished the annihilation of the great northern herd, and left but a few small bands of stragglers, numbering only a very few thousand individuals all told." It was long thought that a large section of the herd was still surviving, and had escaped into British territory, but this proved to be a mistake.

"South of the Northern Pacific Railway, a band of about three hundred settled permanently in and around the Yellowstone National Park, but in a very short time every animal outside of the protected limits of the Park was killed; and whenever any of the Park buffaloes strayed beyond the boundary, they too were promptly killed for their heads and hides. At present the number remaining in the Park is believed by Captain Harris, the Superintendent, to be about two hundred, about one-third of which is due to the breeding in protected territory."

It is curious to notice that even the bison hunters themselves were unaware of the extinction of the northern herd in the spring of 1883; and costly expeditions were actually fitted out in the autumn of that year to arrive at the bison country and find that the "happy hunting-grounds" existed no longer.

Such very briefly is the mournful history of the extermination of the two great herds of American bison. Scattered individuals or small droves still exist here and there in the more secluded parts of the country, in addition to those preserved in the Yellowstone. The pursuit of them is, however, unremitting, and the author considers that the final disappearance of every unprotected individual is but a question of time. In 1889 some twenty bison were seen grazing in the Red Desert of Wyoming, which narrowly escaped destruction. We have already mentioned the survivors of the southern herd still lingering in Texas; but there is strong evidence of the existence in the British district of Athabasca of a herd of "wood-buffalo," estimated at upwards of 550 in number. Exclusive of those in the Yellowstone, the number of wild bison existing in the United States on January 1, 1889, is given as 85. Finally, the whole census of living examples of the American bison—both wild and tame—at the date mentioned, gives only 1091 individuals.

That the Government of the United States will do all they can to increase and preserve the herd in the Yellowstone Park goes without saying; but the warning of the author that without great care, and unless (if this be possible) crossed, they will gradually deteriorate in size, should not be overlooked.

The account of the Smithsonian Expedition into Montana, which forms the concluding portion of the volume, although well told, is not of sufficient general interest to need further notice here.

In conclusion, we have to congratulate the author on having brought together such a number of facts in relation to the extermination of the bison, which, if they had not been recorded while they were fresh in men's memories, would probably have been entirely lost.

R. L.

DICE FOR STATISTICAL EXPERIMENTS.

EVERY statistician wants now and then to test the practical value of some theoretical process, it may be of smoothing, or of interpolation, or of obtaining a measure of variability, or of making some particular deduction or inference. It happened not long ago, while both a friend and myself were trying to find appropriate series for one of the above purposes, that the same week brought me letters from two eminent statisticians asking if I knew of any such series suitable for their own respective and separate needs. The assurance of a real demand for such things induced me to work out a method for supplying it, which I have already used frequently, and finding it to be perfectly effective, take this opportunity of putting it on record.

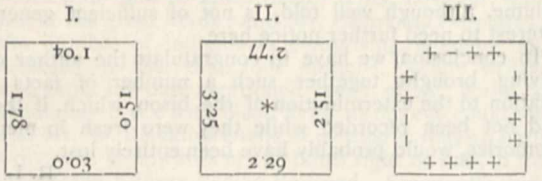
The desideratum is a set of values taken at random out of a series that is known to conform strictly to the law of frequency of error, the probable error of any single value in the series being also accurately known. We have (1) to procure such a series, and (2) to take random values out of it in an expeditious way.

Suppose the axis of the curve of distribution (whose ordinates at 100 equidistant divisions are given in my "Natural Inheritance," p. 205) to be divided into n equal parts, and that a column is erected on each of these, of a + or a − height as the case may be, equal to the height of the ordinate at the middle of each part. Then the values of these heights will form a series that is strictly conformable to the law of frequency when n is infinite, and closely conformable when n is fairly large. Moreover the probable error of any one of these values irrespectively of its sign, is 1.

As an instrument for selecting at random, I have found nothing superior to dice. It is most tedious to shuffle cards thoroughly between each successive draw, and the method of mixing and stirring up marked balls in a bag is more tedious still. A tee-totum or some form of roulette is preferable to these, but dice are better than all. When they are shaken and tossed in a basket, they hurtle so variously against one another and against the ribs of the basket-work that they tumble wildly about, and their positions at the outset afford no perceptible clue to what they will be after even a single good shake and toss. The chances afforded by a die are more various than are commonly supposed; there are 24 equal possibilities, and not only 6, because each face has four edges that may be utilized, as I shall show.

I use cubes of wood $1\frac{1}{4}$ inch in the side, for the dice. A carpenter first planed a bar of mahogany squarely and then sawed it into the cubes. Thin white paper is pasted over them to receive the writing. I use three sorts of dice, I., II., and III., whose faces are inscribed with the figures given in the corresponding tables. Each face contains the 4 entries in the same line of the table. The diagram shows the appearance of one face of each of the 3 sorts of dice; II. is distinguished from I. by an asterisk

in the middle; III. is unmistakable. It must, however, be understood, that although the values are given to the second place of decimals both in the tables and in this diagram, I do not enter more than one decimal on the dice. The use of the second decimal is to make multiplication more accurate, when a series is wanted in which each term has a larger probable error than 1.



In calculating Table I., n was taken as 48. This gives 24 positive and 24 negative values in pairs, but I do not enter the signs on the dice, only the 24 values, leaving the signs to be afterwards determined by a throw of die III. It will be observed that the difference between the adjacent values in Table I. is small at first, and does not exceed 0·2 until the last three entries are reached. These, which are included in brackets, differ so widely as to require exceptional treatment. I therefore calculated Table II. on the principle of dividing that portion of the curve of distribution to which those entries apply, into 24 equal parts and entering the value of the ordinate at the middle of each of those parts in that table. Moreover, instead of entering the three bracketed values on die I. I leave blanks. Then whenever die I. is tossed and a blank is turned up, I know that I have to toss die II., and to enter the value shown by it.

The precise process I follow is to put 2 or 3 of dice I. into a small waste-paper basket, to toss and shake them, to take them out and arrange them on a table side by side in a row, squarely in front of me, but by the sense of touch alone. Then for the first time looking at them, to write down the values that front the eye. If, however, one of the blank spaces fronts me, I leave a blank space in the entries. Having obtained as many values as I want from die I., I fill up the blank spaces by the help of die II.

Lastly, the signs have to be added. Now as $24 = 16 + 8 = 2^4 + 2^3$, it follows that 16 of the edges of die III. may be inscribed with sequences of 4 signs in every possible combination, and the remaining 8 with sequences of 3 signs. Then when die III. is thrown, the several entries along its front edge, which are 4 or 3 in number as the case may be, are inserted in an equal number of successive lines, so as to stand before the values already obtained from the other dice.

The most effective equipment seems to be 3 of die I., 2 of die II., 1 of die III., making 6 dice in all.

Values for Die I.

0·03	...	0·51	...	1·04	...	1·78
0·11	...	0·59	...	1·14	...	1·95
0·19	...	0·67	...	1·25	...	2·15
0·27	...	0·76	...	1·37	...	(2·40)
0·35	...	0·85	...	1·50	...	(2·75)
0·43	...	0·94	...	1·63	...	(3·60)

Values for Die II.

2·29	...	2·51	...	2·77	...	3·25
2·32	...	2·55	...	2·83	...	3·36
2·35	...	2·59	...	2·90	...	3·49
2·39	...	2·64	...	2·98	...	3·65
2·43	...	2·68	...	3·06	...	4·00
2·47	...	2·72	...	3·15	...	4·55

Values for Die III.

+	+	+	+	+	−	−	+	−	−	+	+
+	+	+	−	+	−	−	−	−	−	+	−
+	+	−	+	−	+	+	+	−	−	−	+
+	+	−	−	−	+	+	−	−	−	−	−
+	−	+	+	−	+	−	+	+	+	+	−
+	−	+	−	−	+	−	−	+	+	−	−

FRANCIS GALTON.

THE ROYAL SOCIETY SELECTED CANDIDATES.

THE following fifteen candidates were selected on Thursday last (April 24) by the Council of the Royal Society to be recommended for election into the Society. The ballot will take place on June 5, at 4 p.m. We print with the name of each candidate the statement of his qualifications.

SIR BENJAMIN BAKER, Mem. Inst. C.E.,

Hon. Mem. of the American Society of Mechanical Engineers, and of the Society of Engineers. Hon. Mem. of the Manchester Lit. and Phil. Soc. Has been engaged as an Engineer during the last twenty-five years, in the design and construction of many important works at home and abroad, including the Forth Bridge, and has carried out numerous investigations relating to the strength of materials and of engineering structures generally, and has contributed papers thereon to various Scientific Societies, viz., Proc. Inst. Civil Eng., Trans. Amer. Soc. Mech. Eng., Brit. Assoc. Reports, &c. Author of "A Theoretical Investigation into the Most Advantageous System of Constructing Bridges of Great Span," upon which plan the Forth Bridge and six of the largest bridges in the world have been built.

ROBERT HOLFORD MACDOWALL BOSANQUET, M.A.,

Fellow of St. John's College, Oxford. Barrister. Long and successful devotion to scientific inquiry, as shown by the following list of papers, and the printed copies sent herewith for the use of the Council:—"On an Experimental Determination of the Relation between the Energy and Apparent Intensity of Sounds of Different Pitch" (*Phil. Mag.*, xliv., 381–387); "On Just Intonation in Music; with a Description of a New Instrument for the Easy Control of all Systems of Tuning other than the Ordinary Equal Temperament" (Roy. Soc. Proc., xxi., 131–132); "Note on the Measure of Intensity on the Theories of Light and Sound" (*Phil. Mag.*, xlv., 215–218); "The Theory of the Division of the Octave, and the Practical Treatment of the Musical Systems thus obtained" (Roy. Soc. Proc., xxiii., 390–408); On the Polarization of the Light of the Sky" (*Phil. Mag.*, l., 497–520); "On a New Form of Polariscope and its Application to the Observation of the Sky" (*Phil. Mag.*, ii., 20–28); "On the Hindoo Division of the Octave, with some Additions to the Theory of Systems of the Higher Orders" (Roy. Soc. Proc., xxv., 540–541, xxvi., 372–384); "On the Relation between the Notes of Open and Stopped Pipes" (*Phil. Mag.*, vi., 63–66); "On the Present State of Experimental Acoustics" (*ibid.*, viii., 290–305); "Notes on Practical Electricity" (*ibid.*, xiv., 241–258); "On a Uniform Rotation Machine, and on the Theory of Electromagnetic Tuning Forks" (Roy. Soc. Proc., xxxiv., 445–447); "On Magneto-motive Force" (*Phil. Mag.*, xv., 205–217); "On Permanent Magnetism" (*ibid.*, 257–259, 309–316); "On Self-regulating Dynamo-electric Machines" (*ibid.*, 275–296); "On a Standard Tension Galvanometer" (*ibid.*, xvii., 27–30); "On a Determination of the Horizontal Component of the Earth's Magnetism at Oxford" (*ibid.*, 438–447); "On Electro-Magnets," No. I. (*ibid.*, 531–536); No. II., "On the Magnetic Permeability of Iron and Steel, with a new Theory of Magnetism" (*ibid.*, xix., 73–94); No. III., "Iron and Steel: a New Theory of Magnetism" (*ibid.*, 333–340); No. IV., "Cast Iron, Charcoal Iron, and Malleable Cast Iron" (*ibid.*, xx., 318–323); "Permanent Magnets," No. I. (*ibid.*, xviii., 142–153), No. II., "On Magnetic Decay" (*ibid.*, xix., 57–59); "On the Supposed Repulsion between Magnetic Lines of Force" (*ibid.*, 494–495). With a further list of twenty-seven papers.

SAMUEL HAWKESLEY BURBURY, M.A.,

Barrister-at-Law. Formerly Fellow of St. John's College, Cambridge. Second Classic, and Chancellor's Medallist, and fifteenth Wrangler in the year 1854. Has done much work in Mathematical Physics, espeially in the theories of Electricity and Magnetism and the Kinetic Theory of Gases. Joint author of Watson and Burbury's "Generalized Co-ordinates"; also of Watson and Burbury's "Electricity: Part I. Electrostatics." Author of sundry papers on physical science; for example, the following: Paper in *Phil. Mag.*, January 1876, "On the Second

Law of Thermodynamics in Connection with the Kinetic Theory of Gases"; *ibid.*, 1877, "On Action at a Distance in Dielectrics"; *ibid.*, 1881 (joint author), "On the Law of Force between Electric Currents"; *ibid.*, 1882, "A Theorem on the Dissipation of Energy"; *ibid.*, 1886, "Remarks on Prof. Tait's Paper 'On the Kinetic Theory of Gases'"; "Encycl. Brit." (joint author) Article, "Molecule." Attached to Science, and anxious to promote its progress.

WALTER GARDINER, M.A. (Cantab.),

F.L.S., Fellow of Clare College, Cambridge. University Lecturer in Botany. Rolleston Prize, 1888. Author of numerous papers containing original observations and discoveries in Vegetable Physiology, of which the following are the more important:—"The Development of the Water-glands in the Leaf of *Saxifraga crustata*" (*Quart. Journ. Micros. Sci.*, 1881); "On the Continuity of Protoplasm through the Walls of Vegetable Cells" (Phil. Trans., 1883, and Sachs, *Arbeit. d. Bot. Inst. in Würzburg*, Bd. iii.); "On the General Occurrence of Tannin in the Vegetable Cell, and a possible View of its Physiological Significance" (Camb. Phil. Soc. Proc., 1883); "On the Changes in the Gland-cells of *Dionæa muscipula* during Secretion" (Roy. Soc. Proc., 1883); "On the Phenomena accompanying Stimulation in the Gland-cells of *Dionæa dichotoma* (*ibid.*, 1886); "On the Power of Contractibility exhibited by the Protoplasm of certain Plant-cells" (*ibid.*, 1887); "On the Structure of the Mucilage Secreting Cells of *Blechnum occidentale* and *Osmunda regalis*" (*Ann. of Bot.*, 1887).

JOHN KERR, LL.D.,

Mathematical Lecturer in the Free Church Training College, Glasgow. Discoverer of the optical effects of Electrostatic Stress in transparent solids and liquids; and of the optical effects of magnetism on light reflected from iron.

ARTHUR SHERIDAN LEA, D.Sc. (Cantab.),

Fellow, Lecturer in Physiology, and Assistant Tutor of Gonville and Caius College, Assistant Lecturer of Trinity College. University Lecturer in Physiology. Author of the following papers:—"Ueber die Absonderung des Pancreas" (Heidelberg, 1876); "Some Notes on the Urea Ferment" (*Journ. of Physiol.*, vol. iv., 1883); "On a Rennet Ferment contained in the Seeds of *Withania coagulans*" (Proc. Roy. Soc., 1883); "On the Comparison of the Concentration of Solutions of Different Strengths of the same Absorbing Substance" (*Journ. of Physiol.*, vol. v., 1884); "Some Notes on the Isolation of a Soluble Urea Ferment from the Torula Ureæ;" "On the Digestion of Carbohydrates" (Physiol. Soc., May, 1886, *Journ. of Physiol.*, vol. vi., 1885). Author of the Appendix to Foster's "Physiology." Is distinguished for his acquaintance with Physiology. Is attached to Science, and anxious to promote its progress.

PERCY ALEXANDER MACMAHON, Major, R.A.,

As author of numerous papers in the *Quart. Journ. Math.*, vols. xix.–xxi., Proc. Lond. Math. Soc., vols. xv.–xix., *Amer. Journ. Math.*, vols. vi.–xi., on various subjects in Pure Mathematics, connected with Invariants, Semivariants, Perpetuants, Reciprocants, Partitions, Distributions, and Symmetric Functions. Associate Member of the Ordnance Committee. Instructor in Mathematics at the Royal Military Academy, Woolwich, 1882–88.

ALFRED MERLE]NORMAN, M.A. (Oxon.),

Hon. Canon of Durham, D.C.L. (Durh.), F.L.S. Eminently distinguished for his researches in Marine Invertebrate Biology, carried on continuously for thirty-seven years. In 1880, Dr. Norman, by the special invitation of the French Government, took part in the deep-sea exploration in the Bay of Biscay, on board *Le Travailleur*, and for his services received, in 1884, the commemoration medal of the Institute of France. He edited, with additions, vol. iv. of "Monograph of British Spongiadæ," by the late J. S. Bowerbank, for the Ray Society. Author, along with T. R. Stebbing, of Crustacean Isopoda of the *Lightning*, *Porcupine*, and *Valorous* expeditions in the Zool. Soc. Trans., 1886; along with G. S. Brady, F.R.S., "Monograph of the Marine and Fresh-Water Ostracoda of the North Atlantic and North-West Europe," Roy. Dubl. Soc. Trans., 1889; "Report on the Crustacea of the Faroe Channel —H.M.S. *Knight Errant*" (1880). Author of over forty other reports published in the Brit. Assoc. Reports, *Ann. and Mag. Nat. Hist.*, *Journ. Conchol.*, *Journ Micros. Sci.*, &c., &c. Chairman of the Jury on Natural History at the Fisheries Exhibition, 1883. Possessor of Collections of the Invertebrate Fauna of the North Atlantic and Arctic Oceans, which are probably unequalled, and are always at the disposal of authors, as may be seen in every work published in Britain on the subject for the last twenty years.

WILLIAM HENRY PERKIN, Jun., Ph.D.,

F.I.C., F.C.S. Professor of Chemistry in the Heriot Watt College, Edinburgh. Formerly Privatdocent and Assistant in the Chemical Research Laboratory of the University of Munich. Distinguished as an Investigator, especially in devising new synthetic methods for the preparation of organic compounds containing closed carbon chains and in studying the properties of this important class of substances. This work has attracted great attention, both in this country and on the Continent. Author, and joint author, of upwards of fifty papers, published partly in the Journal of the Chemical Society, and partly in the *Berichte* of the German Chemical Society. Amongst others—"Condensation Products of Oenanthol," "Condensation Products of Isobutylaldehyde," "Benzoylacetic Acid and some of its Derivatives," "Synthetical Formation of Closed Carbon Chains," "Action of Trimethylene Bromide on Ethylic Acetoacetate, Benzoyl-acetate and Malonate," "Action of Ethylene Bromide on Ethylic Aceto-acetate and Benzoyl-acetate," "Action of Ethylene Bromide on Ethylic Malonate," "Trimethylene Derivatives," "Some Derivatives of Tetramethylene," "Pentamethylene Dicarboxylic Acid," "Some Derivatives of Hexamethylene," "Derivatives of Hydrindonaphthene," "New Synthesis of Naphthalene Derivatives," "Dehydracetic Acid," "Phenylenediacrylic Acid," "Paranitro-benzoylacetic Acid," "Ethylic Diacetyladipate," "On Kamala," and "On Berberine." As a teacher he has been especially successful in suggesting and directing research work, as evinced by the number of papers he has published in conjunction with his students.

SPENCER UMFREVILLE PICKERING, M.A.,

F.C.S. Professor of Chemistry at Bedford College. Distinguished as as investigator of the thermal changes attending dissolution of salts. Author of papers on "The Action of Sulphuric Acid on Copper," "The Action of Hydrochloric Acid on Manganese Dioxide," "Sodium Thiosulphate and Iodine," "Basic Sulphates of Iron," "Sulphides of Copper," "The Constitution of Molecular Compounds," "Modifications of Sodium Sulphate," "Heat of Dissolution of Potassium and Lithium Sulphates," "Calorimetry of Magnesium Sulphates," "Modifications of Double Sulphates," "Multiple Sulphates," "Influence of Temperature on the Heat of Chemical Combination," "Water of Crystallization," "Heat of Hydration of Salts," and others, in all about forty, published in the Journ. Chem. Soc., the *Phil. Mag.*, and the *Chem. News*.

ISAAC ROBERTS, F.R.A.S.,

F.G.S., V.-P. of the Literary and Phil. Soc. of Liverpool. Discovery and publication, by aid of photographic methods, of Nebulæ in Andromeda, Orion, the Pleiades, and Vulpecula. Charting by photography a considerable portion of the stars of the northern hemisphere. Rediscovery of a minor planet by photography. Improvements in the apparatus and methods for giving long exposures in stellar photography. Invention of a machine for accurately charting the stars in a permanent manner by engraving them upon metal plates directly from the photographic negatives. The machine is also adapted for measuring the positions and magnitudes of the stars (*Monthly Notices*, Roy. Astron. Soc.). Determination of the Vertical and Lateral Pressures of Granular Substances (Proc. Roy. Soc., 1884); Investigation of the Movements of Underground Waters in Porous Rocks. Various papers on astronomical and geological subjects (see "Cat. of Sci. Papers, Roy. Soc."). Often finding opportunities of rendering valuable aid to those engaged in scientific research.

DAVID SHARP, M.B., C.M. (Edin.),

President of the Entomological Society of London. Hon. Memb. Inst. New Zealand, &c. Distinguished as an Entomologist, especially for his knowledge of the order Coleoptera, many of the more intricate groups of which he has studied with reference to their structure, classification, geographical distribution, &c.; is attached to Science, and anxious to promote its progress. Author of the following memoirs:—"On Aquatic Carnivorous Coleoptera or Dytiscidæ," forming Vol. II. (Ser. 2) of the Scient. Trans. Roy. Dubl. Soc., 1879-82; "Memoirs on the Coleoptera of New Zealand" (*ibid.*, 1886); and, with the Rev. T. Blackburn, "Memoirs on the Coleoptera of the Hawaiian Islands" (*ibid.*, 1885); besides upwards of one hundred minor contributions to the Transactions of various Societies in England and on the Continent. Has also just completed a memoir on the Dytiscidæ, Staphilinidæ, &c., of Mexico and Central America, being Coleoptera, Vol. I., Part 2, of Messrs. Godman and Salvin's "Biologia Centrali-Americana" (pp. 824, pls. 19), and is now engaged in studying the Clavicornia and Rhynchophora for the same work. Since 1885 he has written the whole of the Insecta (except the Neuroptera) for the *Zoological Record*.

J. J. HARRIS TEALL, M.A.,

F.G.S. Has taken a leading place among the petrographical geologists of this country, having enriched the literature of the science with important original contributions. Among these, special mention may be made of the following:—"The Patton and Wicken Phosphatic Deposit" (Sedgwick Prize Essay, 1875); "Petrological Notes on some North of England Dykes" (*Quart. Journ. Geol. Soc.*, 1884, p. 209); "On the Chemical and Microscopical Characters of the Whin Sill" (*op. cit.*, p. 640); "The Metamorphism of Dolerite into Hornblende-schist" (*op. cit.*, 1885, p. 133); "The Lizard Gabbros" (*Geol. Mag.*, 1886, p. 481); "On the Origin of certain Banded Gneisses" (*op. cit.*, 1887, p. 484). In 1888 he published a valuable treatise on "British Petrography," containing the results of much original research, and presenting for the first time a general review of the microscopic characters of all known British rocks. In the same year he was appointed to the Geological Survey, where he is specially charged with the investigation of the petrography of the crystalline schists.

RICHARD THORNE THORNE, M.B. (Lond.),

F.R.C.P. Assistant Medical Officer to H.M. Local Government Board. Has made numerous original observations in regard to the spread of disease, and especially on an epidemic of typhoid fever, and its dissemination by water at Caterham and Redhill. Author of "The Use and Influence of Hospitals for Infectious Diseases" (Proc. of the Internat. Sanit. Conference at Rome); and of a large number of Reports on Public Health to the Privy Council and Local Government Board. He was appointed along with Sir W. G. Hunter to represent Great Britain at the International Sanitary Conference of Rome, 1885. Is distinguished for his acquaintance with Sanitary Science, as shown by his being President of the Epidemiological Society, Lecturer on Public Health at St. Bartholomew's Hospital, Examiner in Public Health to the University of Oxford, the University of London, and the English Conjoined Board.

WALTER FRANK RAPHAEL WELDON, M.A.,

Fellow of St. John's College, Cambridge. University Lecturer on the Advanced Morphology of Invertebrates in the University of Cambridge. Author of: (in the *Quart. Journ. Micros. Sci.*, 1883-88) "Note on the Early Development of *Lacerta muralis*"; "On the Head-kidney of *Bdellostoma*"; "On the Supra-renal Bodies of Vertebrata"; "*Dinophilus gigas*"; "*Haplodiscus piger*"; (in the Proc. Zool. Soc., 1884) "On some Points in the Anatomy of *Phœnicopterus* and its Allies"; "Note on the Placentation of *Tetraceros quadricornis*"; "Notes on *Callithrix gigot*"; (in the Proc. Roy. Soc.) "Note on the Development of the Supra-renal Bodies of Vertebrates"; "Preliminary Note on a Balanoglossus Larva from the Bahamas"; Note on the last paper; and a Report of Investigations into the Crustacean Fauna of Plymouth Sound, carried on in the laboratory of the Marine Biol. Assoc., in accordance with instructions from a Committee appointed by the Royal Society.

NOTES.

M. EUGÈNE PELIGOT, the eminent French chemist, died at Paris on April 15. He was born on March 24, 1811. In 1832 he was admitted to the laboratory of J. B. Dumas, and three years afterwards he became Professor of Chemistry at the École Centrale. In 1846 he succeeded Clément Desormes at the Conservatoire des Arts et Métiers; and here, until recently, he continued to deliver courses of lectures on general chemistry. He also lectured at the National Agricultural Institute on analytical chemistry applied to agriculture. For more than 40 years he was connected with the French Mint, and at the Hôtel des Monnaies he lived and died. M. Peligot was elected a member of the Paris Academy of Sciences in 1852, and in 1885 he received the dignity of a Grand Officer of the Legion of Honour.

THE death of Dr. F. Soltwedel, Director of the Botanical Station at Semarang, in Java, is announced. He was a very energetic botanist, especially in the direction of applied botany.

WE learn from the *Botanisches Centralblatt* that Mr. Thomas Hanbury, of Mortola, near Mentone, has offered to defray the expense of the erection of a building in the Botanic Garden at Genoa, to provide a laboratory, lecture-rooms, and space for botanical collections. The building is to become the property of the University of Genoa, and will be erected under the direction of Prof. Penzig, the Director of the Botanic Garden; and it is hoped that it will be completed by the time of the International Botanical and Geographical Congress to be held in Genoa at the time of the great Columbus Festival in 1892. It is intended that the new Institute shall bear the name of the "Hanbury Botanical Institute."

DURING his visit to the Canaries, in 1889, made for the purpose of taking observations on the atmospheric absorption of the solar spectrum, Prof. O. Simony, of Vienna, landed upon the lonely rock of Zalmo, near the Island of Ferro, and discovered a very curious lizard, which was subsequently described by Prof. Steindachner (*Anz. k. Ak. Wiss. Wien*, 1889, p. 260) as *Lacerta simonyi*. At the request of Lord Lilford, Canon Tristram has also recently visited the same spot, and obtained some examples of this lizard, which Lord Lilford has presented to the Zoological Society's collection. Simony's Lizard is a fine large species, very dark in colour, but obviously allied to the well-known *Lacerta ocellata* of Southern Europe.

THE fifth of the series of photographic exhibitions at the Camera Club, will be open for private and press view on Monday, May 5, at 8 p.m., and on and after Tuesday, May 6, it will be open to visitors on presentation of card. It will consist of photographs by the late Mrs. Julia Cameron.

THE French Exhibition, which is about to be opened at Earl's Court, will illustrate the arts, inventions, products, and resources of France and her colonies, and will, it is said, include many of the best objects shown at the Paris Exhibition of last year.

AN archæological museum has been established in connection with the University of Pennsylvania. *Science* says it contains—in addition to the American specimens—a fine collection of flints, bronze implements, and pottery from Europe, as well as objects from Asia, Africa, and the South Sea Islands. At the same University a museum of economic botany is about to be formed. It will consist of all kinds of woods, vegetable fibres, grains and drugs, arranged so as to illustrate the processes of manufacture from the raw product, and the various uses to which each material may be put.

THE Marine Biological Laboratory at Wood's Holl, Massachusetts, will hold its third session during the approaching summer. The Institution has been so successful that a library, a lecture-room, and six private laboratories have lately been added to it.

THE following are the arrangements for the science lectures to be given at the Royal Victoria Hall during May:—May 6, birth and death of mountains, W. W. Watts; May 13, London water supply, Prof. Bonney; May 20, how a photograph is taken, Dr. J. A. Fleming.

DR. H. ROSS has been appointed Lecturer on Botany at the University of Palermo, and Dr. G. B. De Toni Lecturer on Botany at the University of Padua.

MOROT'S *Journal de Botanique* for March 1 contains an interesting biographical sketch of the late M. E. Cosson, together with a bibliography of his numerous contributions to botanical literature.

AT the last meeting of the Scientific Committee of the Royal Horticultural Society, the Rev. C. Wolley Dod gave an account of several diseases of plants in his garden, and commented on the difficulty of finding curative means, or of hearing of other suggestions than burning. He first alluded to a species of smut (Ustilago) on *Primula farinosa*, which appeared to be indigenous, as the plants were collected in Lancashire; and although it was grown with *P. denticulata*, the smut was confined to the former species. *Æcidium ficariæ* had attacked his hellebores. In this case, a drier soil was suggested as likely to prove effective in ridding the plants of the fungus. The "Lily spot," due to *Polyactis cana*, usually appearing late in summer, had been seen in April upon tulips, and apparently the same species on daffodils. It was suggested that a mixture of sulphate of copper and quicklime would prove effective, as in the case of vines. *Puccinia Schrateri* had occurred on daffodils from Portugal, and also upon the common double sorts.

AT the meeting of the Society of Arts on April 23, Mr. W. Whitaker read a paper on "Coal in the South-East of England." Afterwards some remarks were offered by Mr. Topley, Prof. Rücker, Prof. McKenny Hughes, Dr. Archibald Geikie, who presided, and the author of the paper. Dr. Geikie said he thought everyone present must share his feeling of surprise and pleasure at finding that a number of geologists could come together and discuss a question like this with so little difference of opinion, and it might be taken as strong evidence that on this particular question there was nothing to fight about. He knew of no recent instance where a true scientific induction had been followed with such brilliant success as the one now brought forward. It had been discussed more or less academically by geologists for some sixty years, bit by bit evidence had accumulated as they went further and further below the surface, and at last it had been definitely proved that coal existed in the south-east of England. An ordinary observer would have found it almost impossible to imagine, when standing on a sunny day in the south of Kent, that coal was to be found there hundreds of miles from the great coal-fields, and it would be difficult to make such a person understand why geologists should pitch upon such a spot as a likely place for a colliery. Mr. Whitaker had gone over the evidence, and everyone must have realized how the conclusion had been arrived at, and how admirably the inference had been proved by experiment. But, as Prof. Hughes had said, they were very far from having reached a complete picture of the geography of the rocks that underlie the Secondary rocks of the south-east of England. They were groping their way by degrees, and in the process coal had been discovered. He did not imagine there could be any large continuous coal-field there; it could only exist in detached basins (even allowing for overthrusts), separated by uprises of older rocks. Further to the west they knew nothing by actual borings, and in no other way could anything like a map of the subterranean geology be obtained. It might be surmised with some probability that, between Bristol and the areas where borings had been made, there might be more extensive coal-fields than were at all likely to be found in the extreme south-east. They had heard of the wonderful plication of the Carboniferous strata in the west of France, but it must be remembered that not only had the Coal Measures undergone these movements, but the secondary rocks which overlay them had also been crushed, folded, and pushed over each other in the manner which any one might see on the south coast of Dorsetshire; and this process must have considerably thickened the Secondary rocks, the consequence of which was that you might bore through the same stratum sometimes a very long way. It was absolutely necessary that, in the prosecution of this matter, the practical man should go hand in hand with the man of science, otherwise a great deal of time, money, and labour would be wasted.

THE Norwegian Government has laid before the Storthing a proposal to the effect that two-thirds of the cost of the Norwegian Polar Expedition under the command of Dr. Frithjof Nansen shall be defrayed by the State: the conditions being—that the expenses do not exceed 200,000 kroner (about £10,000); that if the expedition proves successful the vessels and scientific instruments used during the voyage shall become the property of the State; and that the Christiania University shall receive such specimens from the scientific collections as the senate shall select.

THE Director of the Observatory at Tusa, in Sicily, noted two short but severe shocks of earthquake at noon on April 15. No damage was caused.

A SHOCK of earthquake was felt at Lisbon on the morning of April 28.

M. E. LEYST, Superintendent of the Observatory of Pawlowsk, near St. Petersburg, has contributed to vol. xiii. of the *Repertorium für Meteorologie* an important investigation upon the influence of the times of reading the maximum and minimum thermometers upon the results deduced from them.

THE Administration Report of the Meteorological Department of the Government of India for the year 1888–89 gives an account of some important changes in the working of the service since January 1, 1889. The change of the hour of morning observations from 10 a.m. to 8 a.m. has accelerated the publication of the Daily Weather Reports, and this result is much appreciated in Calcutta and Bombay. A uniform system of rainfall observations throughout India, and the telegraphing of rainfall information to Simla, enable the Department to prepare comprehensive rainfall charts and tabular statements for each week during the monsoon season. A local Daily Weather Report and Chart is now prepared at Bombay, in order to give early information to the commercial community, in a form similar to the Reports published at Calcutta. The Bombay Chamber of Commerce has contributed liberally towards the expenses of this service. The collection of information from ships in the Arabian Sea and Bay of Bengal is to be extended. This is essential for the investigation of the causes of the origin of storms; and, if sufficient material be collected, charts will be prepared for each day for two or three years. The charts must necessarily appear about three months after date. The work of observation with regard to storms is acknwledged to have been hitherto very defective. A small payment will be made in future for this service, and several valuable series of observations during dust-storms, &c., have already been received. The staff in India being insufficient to discuss the mass

of material which has accumulated during the last 13 years, the Government has wisely given a grant for the discussions of the more important series to be carried out by distinguished meteorologists in Europe. Several important investigations by the Indian staff are in a more or less advanced state of preparation, including an account of the cyclonic storms of August 1888, and of September 13–20, 1888; a paper on the relation of sun-spots to weather, as shown by meteorological observations in the Bay of Bengal from 1855–78; and an account of the storm in the Arabian Sea in June 1887. At the commencement of the year under report, there were 161 observatories contributing regular observations.

M. P. LAFOURCADE, in a paper on the great bustard (*Revue des Sciences Naturelles Appliquées*), says that this bird is becoming very scarce in France, as it can flourish only in large uncultivated spaces. In Champagne and Provence it is never found. The small bustard is less rare.

SOME observations on the brain-weight of new-born infants are given by Herr Mies in a Vienna medical paper. From 203 weighings he found the brains of male children to weigh on the average 339·3 grammes (say 11·9 oz.), and those of females 330 grms. (say 11·6 oz.). The lightest was 170 grms., and the heaviest 482 grms. The brain-weight of the new born infant is to the body-weight as 1 : 7 to 8·5. Only children living at the time of birth were considered.

AT the meeting of the Royal Society of Queensland on February 17, Mr. W. Saville-Kent presented some interesting notes on the embryology of the Australian rock oyster (*Ostrea glomerata*). He mentioned that in connection with the investigation of this subject he had been carrying on a series of experiments with the view of accurately determining the influence upon the embryonic brood that is exercised by the advent of fresh-water floods or other sudden changes in the salinity of the water. Some important results had been obtained. From a series of oysters recently purchased in the market a fully matured male and female were selected for experiment. Portions of milt and ova from these two individuals were abstracted and commingled under precisely the same conditions, and placed respectively in water of three different degrees of salinity. The first admitted was placed in sea-water of the full ordinary strength. In the second there were equal proportions of salt and fresh water, and in the third one part of salt water to three of fresh. As a result, the ova placed in the equal admixture of salt and fresh water exhibited active vitality, and were quickly speeding in their developmental career. Of the ova placed in pure sea-water, but few were fructified, and these developed very slowly. Those, finally, placed in the water containing only a one-fourth proportion of sea-water were entirely deprived of life, and soon began to disintegrate. To this last circumstance Mr. Saville-Kent called special attention. It indicated, he said, the pernicious effect upon breeding oysters that might be exercised by heavy floods, and opened out a wide field for further inquiry.

A PAPER on the fossil butterflies of Florissant, Colorado, by Mr. Samuel H. Scudder, is included in the eighth Annual Report of the Director of the United States Geological Survey, and has now been reprinted separately. The specimens were found "in presumably Oligocene beds." There are altogether seven species, and they all belong to extinct genera. Their general aspect is "distinctly sub-tropical and American, while the Tertiary butterfly fauna of Europe is derived in the first place rom the East Indies, in the second from sub-tropical America, and in the third from home." With regard to one interesting point Mr. Scudder writes as follows:—"In living butterflies, as we ascend the scale of families we find an increasing atrophy of he front legs. In the two lower families, *Hesperidæ* and *Papilionidæ*, they are similar in structure to the other pairs, being normally developed. In the *Lycænidæ* (including in this the sub-families *Lemoniinæ* and *Lycæninæ*) they are atrophied in the male to a greater or less extent, with the loss of the terminal armature, while still perfect in the female. In the highest family, *Nymphalidæ*, with the single exception of the little group *Libytheinæ*, which agrees with the *Lycænidæ*, they are aborted in both sexes, often to an excessive extent. Now, in *Prolibythea* we have the forelegs of the female preserved, and in *Nymphalites* the foreleg of the male; in both cases they agree in all essential points with what we should expect to find in living forms belonging to the same groups, showing that at the earliest epoch at which butterflies are yet known these peculiar differences, marking the upward progression of forms, were already in existence. We must therefore look for the proofs either of great acceleration in development when butterflies first appeared, or of the existence of butterflies at a far earlier period than we yet know them."

IN the yearly report of the East Siberian branch of the Russian Geographical Society, it is shown that the Miocene deposits in the middle parts of the provinces of Tomsk and Yeniseisk are much greater in extent and thickness than has hitherto been supposed. They contain, besides thin layers of coal, a rich flora, samples of which have been secured by M. Klementz. Leaves and needles of *Acer*, *Betula*, *Pinus Lopatini*, *Segusia*, *Sternbergi*, *Glyphostrobus*, *Magnolia*, *Ulmus*, *Populus*, and so on, are found in great quantities, and it seems probable that the Miocene flora of Siberia will prove as abundant and as suggestive of changes of climate as that of Switzerland.

AN interesting and successful experiment in technical education is described in a resolution of the Indian Education Department, granting an increase of over 16,000 rupees in expenditure on schools in Sind. Appended to the resolution is an extract from a letter of Mr. Jacob, Inspector of Schools, in which he gives some details of the practical system of technical education which has been instituted in the Naushahro schools by Khan Bahadur Kadirdad Khan. The industries taught embrace Sind embroidery, tailoring, joining, and cabinet work, smith's work in iron and brass, electro-plating, mason's work, pottery, &c., and the attendance at all the classes is continually increasing. The boys in the workshops are divided into "gangs," each headed by a senior boy who has displayed exceptional skill. The schools are in close touch with the market; and, as orders come in, they are distributed among the gangs, and the profits of the work are divided among the members of the gang in proportions fixed by the teacher, and regulated by the degree of skill possessed by each individual. The industrial school for girls is most popular, and suggests new possibilities in the extension of female education; for it is found that the opportunity of earning money keeps the girls at school up to a later age than has hitherto been usual. Mr. Jacob says that the schools have created an extraordinary interest among the industrial classes, both Mahomedan and Hindu.

IN a paper on the aborigines of Australia, printed in the current number of the Journal and Proceedings of the Royal Society of New South Wales, Mr. W. T. Wyndham speaks of the skill with which the natives use stone implements. "They turn out work," he says, "that you would hardly believe possible with such rough implements. They show great ingenuity, particularly in making their harpoon heads for spearing dugong and fish; instead of shaving the wood up and down with the grain as a European workman would do, they turn the piece of wood for a spear-head round and round, and chip it off across the grain, working it as wooden boxes are turned on a lathe. I have often sat and watched them doing this."

According to an official estimate, there are 170,000 wolves in Russia; and the loss caused by the destruction of sheep and swine by wolves is so great that it cannot be even approximately estimated. The reward paid for each wolf killed is 10 roubles. The number killed in 1889 in the single government of Vologda was 49,000, and in the government of Kasan 31,000. The number of human beings killed by wolves during the year was 203.

Mr. John Murray has issued an abridged and popular edition of Mr. Paul du Chaillu's "Adventures in the Great Forest of Equatorial Africa and the Country of the Dwarfs." While recognizing the work that has been done by later travellers in the regions with which his name is associated, Mr. du Chaillu says, in his new preface, that, so far as he is aware, no white man has been able since his time "to penetrate to the haunts of the gorilla and bring home specimens killed by himself."

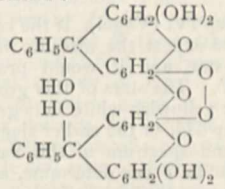
Part 19 of Cassell's "New Popular Educator" has been issued.

We have received "The Medical Register" and "The Dentists' Register" for 1890. Both works are printed and published under the direction of the General Council of Medical Education and Registration of the United Kingdom.

The seventh annual issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland" (C. Griffin and Co.) has been published. It comprises lists of the papers read during 1889 before Societies engaged in fourteen departments of research, with the names of their authors. The work has been compiled from official sources.

The following note on the words "cold-short" and "red-short" appears in *Engineering* of the 25th ult. Some of our readers may perhaps be able to throw light on the subject:—The words "cold-short" and "red-short" are so expressive that their etymology would seem at first sight to be entirely free from difficulty, but such is not the case. The earliest form of "cold-short" occurs in Philemon Holland's translation of Pliny's "Natural History" (1601) where it appears as "colsar." Vernatt and Whitmore, in their patent for the manufacture of iron granted in 1637, speak of "colshire" and "coleshire" iron, whilst Dud Dudley, in his famous tract "Metallum Martis" (1665), calls it "coldshare" iron. A still further variation appears in the Philosophical Transactions for 1693, in the course of a curious paper, written in 1674, giving an account of the hematite ores of Lancashire, where the writer speaks of "coldshire" and "redshire" iron. Andrew Yarranton, in his "England's Improvement by Land and Sea" (1677), uses the word "coldshore," and in Moxon's "Mechanick Exercises," published in the same year, red-short iron is described as "red-sear." The earliest known instance of "cold-short" and "red-short" is in a rare folio tract of 4 pages bearing the title "Beware of Bubbles," which, though undated, must, from internal evidence, have been issued in 1730. It forms one of a number of broadsides circulating about the time referring to a patent for the manufacture of iron taken out by Francis Wood, the well-known manufacturer of "Wood's halfpence," so unmercifully satirized by Swift in the "Drapier Letters." The words "cold-short" and "red-short" are at the present moment occupying the attention of the editor of the "New English Dictionary on Historical Principles," now in course of publication by the Clarendon Press, and if any of our readers are able to throw light upon the etymology of "cold-short" and "red-short" their suggestions will be gladly welcomed by the editor, Dr. Murray, Banbury Road, Oxford.

A new colouring matter from pyrogallol, $C_6H_3(OH)_3$, and benzotrichloride, $C_6H_5.CCl_3$, is described in the current number of *Liebig's Annalen*, by Drs. Doebner and Foerster, of the University of Halle. When pyrogallol and benzotrichloride are heated to 160° C. in the proportion of two molecules of the former to one of the latter until no more hydrochloric acid is evolved, a fused mass is obtained which dissolves in alkalies with the production of a fine blue colour. The powdered product of the fusion is of a dark brown colour with a greenish metallic lustre. It may be obtained pure from solution in hot glacial acetic acid in the form of dark green crystals, which under the microscope appear as bright red transparent plates by transmitted light. The substance is almost insoluble in water, benzene, or carbon bisulphide, but is more soluble in alcohol and ether, and in hot chloroform. It dissolves in a hot solution of sodium acetate with production of a deep red colour. Caustic alkalies readily dissolve the pure crystals with production of the same blue colour as that yielded by the crude product of fusion. When the solution is just neutralized the colour is a bluish-violet, but the least excess of alkali reproduces the magnificent blue colour. Strong sulphuric acid dissolves the crystals with formation of a soluble sulphonic acid of a fine violet tint. Most metallic salt solutions yield with neutral solutions of the ammonium salt precipitates of the nature of "lakes" of varying composition and of various shades of bluish-violet. The colours produced by salts of aluminium and iron are perhaps the most striking. The yield of the new substance is very good, and generally amounts to about sixty grams of pure crystals for every hundred grams of pyrogallol employed. As regards its composition and constitution, its empirical formula is found to be $C_{38}H_{24}O_{11}$. It evidently contains four phenol hydroxyl groups, for it reacts with acid chlorides and anhydrides with production of compounds containing four acid radicals. The acetyl compound, $C_{38}H_{20}O_{11}(C_2H_3O)_4$, forms bright red crystals, melting at 208° C., which are decomposed by soda with formation once more of a blue colour. The benzoyl compound, $C_{38}H_{20}O_{11}(C_7H_5O)_4$, consists of thin red prisms possessing a brilliant green lustre, and melting to a deep red liquid at 251°. The substance also yields a hydro-reduction product with zinc dust and glacial acetic acid of the composition $C_{19}H_{14}O_5$; this reduction-product forms beautiful long colourless needles of silky lustre, which rapidly reoxidize in air, and especially on heating, to the original compound. Even if the needles are allowed to remain a short time in their mother-liquor they gradually become tipped with red, exhibiting an exceptionally pretty effect. The constitution of this hydro-body is shown to be $C_6H_5CH\langle{}^{C_6H_2(OH)_2}_{C_6H_2(OH)_2}\rangle O$, from which, taking into account the fact that four phenol hydroxyl groups are shown to be present by the mode of reaction with acid chlorides and anhydrides, the constitution of the new colouring matter is concluded to be as follows:—



The name which the discoverers propose for the compound is pyrogallol-benzein.

The additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mrs. Pendry; a Brown Bear (*Ursus arctos* ♂) from Russia, presented by Miss Evelyn Muir; a Bateleur Eagle (*Helotarsus ecaudatus*) from East Africa, presented by Dr. E. J. Baxter; an Elliot's Pheasant (*Phasianus ellioti* ♀) from China, a Cape Weaver Bird (*Hyphantornis capensis* ♂) from South Africa, a Red-eyed Ground Dove (*Pipilo erythrophthalmus*) from North America, presented by Mr. Wilfred G. Marshall; a

Tuatera Lizard (*Sphenodon punctatus*) from New Zealand, presented by Mr. J. Catheson Smith; an Egyptian Ichneumon (*Herpestes ichneumon*) from North Africa, two Grey Ichneumons (*Herpestes griseus* ♂ ♂), two Alexandrine Parrakeets (*Palæornis alexandri*) from India, two White Pelicans (*Pelecanus onocrotalus*), South European, deposited; a Musk Deer (*Moschus moschiferus* ♂) from Central Asia, seven Bearded Lizards (*Amphibolurus barbatus*), three —— Lizards (*Amphibolurus muricatus*), a Gould's Monitor (*Varanus gouldi*) from Australia, purchased; a Barnard's Parrakeet (*Platycercus barnardi*) from South Australia, received in exchange; an Indian Muntjac (*Cervulus muntjac*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on May 1 = 12h. 39m. 6s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 2917	—	—	12 18 50	−18 10
(2) δ Virginis	3	Yellowish-red.	12 50 6	+ 4 0
(3) ε Virginis	3	Yellowish-white.	12 56 42	+11 33
(4) ρ Virginis	5	Yellowish-white.	12 36 18	+10 51
(5) Z Virginis	Var.	—	12 28 12	− 3 49
(6) Comet *a* 1890, May 1	—	—	20 59 31	+30 12
,, ,, 2	—	—	58 23	+31 2
,, ,, 3	—	—	57 10	+31 53
,, ,, 4	—	—	55 51	+32 44

Remarks.

(1) During his spectroscopic survey of nebulæ in 1868, Lieut. Herschel noted that this gave a bright line spectrum. The three principal nebular lines and G were observed, but, as I have before remarked, other lines may possibly be found if carefully looked for. Some of the lines observed in other nebulæ, namely D_3 and lines near λ 559, 521, 517, 470, and 447, may be expected. In the General Catalogue the nebula is described as "Very bright; large, round; very suddenly much brighter in the middle to a nucleus; barely resolvable."

(2) According to Secchi, Vogel, and Dunér, this star has a magnificent spectrum of Group II., all of the ten ordinary bands being well visible. The band near D and the one less refrangible (Dunér's 2 and 3) are very wide, but the others are relatively narrow, though strongly marked. Dunér notices the peculiarity that band 5 (λ 546) is double. This should be further examined; the apparent duplicity may be simply due to the superposition of a strong line upon the dark fluting of lead. As the star is an exceptionally bright one for this group, comparisons with the bright flutings of carbon should be made, with the object of further confirming the cometary character of this group of stars.

(3) This is a star which has hitherto been classed with stars like the sun. The usual more detailed observations are required to determine whether the temperature of the star is increasing or decreasing.

(4) A star of Group IV. (Vogel). If the colour given by Vogel is correct, one would expect the metallic lines to be fairly well developed in this star, and it would probably be no longer classed in Group IV. The stars of this group are usually white or bluish-white, the yellowish-white stars generally falling in the later stages of Group III. or the earlier stages of Group V.

(5) The colour and spectrum of this variable have not yet been recorded, as far as I can determine, and the approaching maximum of May 5 may therefore afford a good opportunity of observing it. The range of variability is from 8·0 to 14·0 in a period of about 219 days.

(6) As this comet is travelling northwards and is gradually increasing in brightness, it may be well to note a few of the chief points to which attention should be directed in spectroscopic observations. The positions given are for Berlin midnight, and are reprinted from NATURE, vol. xli. p. 571.

Observations of the spectrum of a comet at one time only are now of little value, as there can be no doubt that the spectrum is subject to changes with the variations of temperature due to varying distances from the sun. The question now is: What is the precise nature of these changes? From a discussion of all the observations made up to 1888, Prof. Lockyer has laid down what he considers to be the most probable sequence; but as yet there has been no opportunity of testing his views by continued observations of one comet. According to his view, the spectrum of a comet near aphelion is like that of a planetary nebula, consisting simply of a bright line near λ 500. This, it will be remembered, was observed by Dr. Huggins in the comets of 1866-67. As the temperature increases, the spectrum of carbon begins to appear; at first the low-temperature spectrum (perhaps better known as the spectrum of carbonic oxide) makes its appearance, and afterwards the spectrum of hot carbon (commonly known as the hydrocarbon spectrum). The principal flutings in the first spectrum are near λ 483, 519, and 561, and those in the second are compound flutings with their brightest maxima near λ 564, 517, and 473. As the temperature goes on increasing, bright flutings of the metals manganese and lead (λ 558 and 546) are added to those of carbon, the chief effect of their presence being a variation in the appearance of the band near λ 564. With a still further increase in temperature, fluting absorptions of manganese and lead replace the corresponding radiations, and apparently shift the position of the citron band from λ 564 to 558 or 546, according to the preponderance of one element or the other. At the highest temperatures, which are only attained by comets which approach very close to the sun, bright lines of sodium, iron, manganese, and other substances, appear, as in Comet Wells and the Great Comet of 1882. (For further details, see Roy. Soc. Proc., vol. xlv. p. 189.)

For comparison spectra, a spirit lamp, and small quantities of magnesium and the chlorides of manganese and lead are all that are likely to be required, unless complete measurements of wave-lengths are attempted. The chief fluting in the spectrum of magnesium will serve for comparison with the line 500.

Variations in the form of a comet have not yet been associated with spectroscopic changes. A. FOWLER.

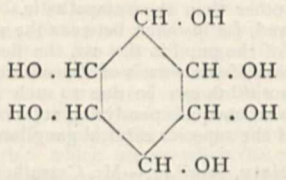
COMETS AND METEOR STREAMS.—In the cases of the Leonides and Andromedes, the annexed comet appears to be at the head of the swarms, and Schiaparelli and others have inferred from this fact that a comet is broken up by tidal disturbances. Other influences besides tidal action may cause it however, and M. Bredichin, in his memoir "Sur les étoiles filantes," showed how meteorites became detached from the central condensation by explosions, and describe orbits that differ according to the value of the initial velocity towards the sun, and the angle made by its direction with the radius vector. In a later communication (*Bull. Soc. Impér. des Naturalistes de Moscou*, 1889, No. 4) the form of the orbits generated by explosions in the comet, and their relation to such meteoritic streams as the Leonides and Andromedes, has been investigated. It is noted that in general the less the eccentricity of the generated ellipse, the more clearly marked are periods of maxima in falls of meteors. With the increase of eccentricity the maxima become less marked, and in the case of a parabolic orbit feeble falls occur each year. The regular periodicity of maxima would favour the formation of a meteoritic stream by a single eruption; in some cases, however, a series of eruptions must have taken place. M. Bredichin thinks that in the Leonid stream a single eruption was excessively preponderant, in the Andromedes a series of eruptions would appear to have occurred. Other cases have also been studied in detail. A meteorite is regarded as a portion of a large comet ejected from the parent mass by an eruption, and an investigation of the number of appearances of bright meteors indicates the connection between them and shooting stars, and, as would be expected, both have maxima when the earth is passing through a meteoritic stream. Although the connection between comets and meteorites is not a matter of doubt, the above investigation demonstrates it from a new point of view. It seems most probable, however, that the disintegration of a meteoritic swarm that has entered our system is caused by tidal disturbances as well as the repulsive action which is the cause of a comet's tail.

STELLAR PROPER MOTIONS.—The number of known stars having proper motions is relatively considerable, but they are much dispersed through astronomical records; M. J. Bossert, however, in the *Bulletin Astronomique* for March 1890 gives an excellent synoptical table of such stars. Many calculations are facilitated by such a table, showing the elements that may vary the position of a star; and in a research on the motion of the solar system it is invaluable. All stars are included whose annual motion is 0″·5 or more. The list has been culled from every known catalogue and astronomical record, but the results

have not been accepted without an examination. Thus it is pointed out that the large proper motion given by Arago in his "Popular Astronomy" for the star in Argus, No. 2151 B.A.C., should be rejected, the comparison of Lacaille's observations with those of Stone and Gould giving, in fact, a motion of about 0″·2 for this star. The magnitude, co-ordinates for 1890·0, proper motion in right ascension and declination, the resultant motion, the direction of this motion, and the authority are given for each star.

OPTICAL ISOMERIDES OF INOSITOL.

DURING the last few months, whilst the brilliant researches of Prof. Emil Fischer on the synthetical production of the glucoses have been attracting so much attention, some very interesting work has been done on a compound which was formerly supposed to belong to the glucose group, viz. inosite. Maquenne, in 1887, showed that this compound, which is fairly widely distributed throughout the animal and vegetable kingdoms, is not a sugar, but a hexahydroxy-derivative of hexamethylene, having the constitutional formula—



It is an alcohol, and in accordance with the usual English nomenclature the name inosite must therefore be altered to inositol.

M. Maquenne has recently examined a compound obtained from the manna-like exudation of one of the Californian pines (*Pinus lambertiana*), and termed β-pinitol. He found that its formula is $C_7H_{14}O_6$, and that on heating with hydriodic acid it is resolved into methyl iodide and a substance which has the same composition as inositol, and resembles it in most of its properties, but melts at a higher temperature and rotates the plane of polarization to the right ($[\alpha]_D = 65$), inositol being inactive. It is therefore called *dextro-inositol*. Almost simultaneously, another French chemist, M. Tanret, obtained from quebracho bark (*Aspidosperma quebracho*) a sugar-like compound to which he has given the name quebrachitol. It has the same formula as β-pinitol, and on treatment with hydriodic acid yields methyl iodide and an inositol which can only be distinguished from the foregoing by its action on the plane of polarized light, which it rotates to the left to the same extent as the first compound does to the right, and must therefore represent the *lævo-inositol*. Both these compounds crystallize with two molecules of water in hemihedral crystals, and are very soluble in water.

MM. Maquenne and Tanret then jointly examined the effect of mixing concentrated solutions of equal weights of the dextro- and lævo-compound, and obtained an inactive inositol, which is much less soluble in water than either of its constituents, and melts at a higher temperature (253°), without previously becoming plastic. From its mode of formation, its constitution must resemble that of racemic acid, and the name *racemo-inositol* has therefore been given to it. It is not identical with the inactive inositol previously known, and the latter must therefore have an analogous constitution to mesotartaric acid.

We have therefore the interesting result that inositol, a derivative of hexamethylene, exists in four different forms, corresponding exactly to those of tartaric acid.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Buchanan, the University Lecturer in Geography, announces a course on "Oceanography," to begin at 2.15 p.m. on Wednesdays. The subject will be "The Distribution of Land and Water on the Globe."

The Council of the Senate have published a report in which they withdraw their original proposal (October 22, 1888) to suspend for 10 years from 1890 the augmentation of the contributions of Colleges to the Common University Fund prescribed by the present statutes, by way of relief to the depressed finances of some of the Colleges. They propose now to discriminate between Colleges that are financially depressed and those that are not. The latter will receive no relief under the new plan, the former will be allowed to make up their University contributions by devoting one or more Fellowships to University purposes. This proposal seems to have been much more widely approved than the former, and is signed by nearly all the members of the Council of the Senate.

The Special Boards for Physics and Chemistry, and for Biology and Geology, propose a new departure in the conduct of the second part of the Natural Sciences Tripos, with regard to which there are likely to be differences of opinion. Hitherto all the work considered by the examiners has been carried on at the time of the examination under their supervision, and under equal conditions for all candidates. The proposal now is to give credit for work in practical chemistry carried on before the examination in the University or College laboratories. The regulations recommended are :—

"In the second part of the examination, every candidate in chemistry may present to the examiners, at the commencement of the examination, a record of the chemical work which he has carried out in the University laboratory, or in some one of the College laboratories, in some one term. Such record shall be the original notes made from day to day in the laboratory, with the necessary calculations in full, and dated so as to show the work of each day.

"To the record shall be appended a certificate, signed by the candidate and by the superintendent of the laboratory, stating that all the manipulations involved in the work have been *bonâ fide* carried out by the candidate alone, and that the superintendent has watched the progress of the work and believes the record of it to be faithful.

"In estimating the merits of the candidates, the examiners shall give credit for such work.

"This regulation shall be first applicable to the examination for the Natural Sciences Tripos of the year 1892."

The Report is signed by 12 members of the two Boards, the total number of members being 31. The chemists whose names appear are Prof. Liveing, Dr. Ruhemann, and Dr. Tilden.

Mr. J. Pedrozo d'Albuquerque, B.A., Scholar of St. John's College, First Class, Natural Sciences Tripos, 1887–88, has been appointed Government Professor of Chemistry at Barbadoes.

Applications for permission to occupy the University's tables in the Zoological Station at Naples, and in the Marine Biological Laboratory at Plymouth, are to be sent to Prof. Newton, Magdalene College, Cambridge, on or before May 22.

The Newall Telescope Syndicate have issued a further Report, in which it appears that a means has been found for overcoming the threatened financial difficulty. Mr. H. F. Newall, M.A., of Trinity College, University Demonstrator of Experimental Physics, and son of the donor of the telescope, has offered his services as observer, without stipend, for five years, a sum of £500 for initial expenses, and a guarantee of £200 a year for five years for maintenance, provided the University can furnish the balance of the funds required. He also offers to build himself a private house near the new Observatory, if a suitable site can be found. The Sheepshanks Fund is, moreover, able to promise an additional sum of £100 a year after five years from the present date. The outcome of these offers is that the University will only be required to find at present a capital sum of £125, and an annual subsidy of £30. After five years, it may have to build an observer's house at a cost of £800, and provide £150 a year towards his stipend. Mr. Newall has worthily seconded his father's munificence, and it is to be hoped that no further obstacle will arise to the founding of an adequate observatory of stellar physics in Cambridge.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 13.—"The Nitrifying Process and its Specific Ferment." By Percy F. Frankland, Ph.D., B.Sc. (Lond.), A.R.S.M., &c., Professor of Chemistry in University College, Dundee, and Grace C. Frankland. Communicated by Prof. Thorpe, F.R.S.

The authors have been engaged during the last three years in endeavouring to isolate the nitrifying organism.

Nitrification, having been in the first instance induced in a

particular ammoniacal solution by means of a small quantity of garden soil, was carried on through twenty-four generations, a minute quantity on the point of a sterilized needle being introduced from one nitrifying solution to the other. From several of these generations, gelatine plates were poured, and the resulting colonies inoculated into identical ammoniacal solutions, to see if nitrification would ensue; but, although these experiments were repeated many times, on no occasion were they successful.

It appeared, therefore, that the nitrifying organism either refused to grow in gelatine, or that the authors had failed to find it, or that, growing in gelatine, it refused to nitrify after being passed through this medium.

Experiments were, therefore, commenced to endeavour to isolate the organism by the dilution method. For this purpose a number of series of dilutions were made by the addition to sterilized distilled water of a very small quantity of an ammoniacal solution which had nitrified. It was hoped that the attenuation would be so perfect that ultimately the nitrifying organism alone would be introduced.

After a very large number of experiments had been made in this direction, the authors at length succeeded in obtaining an attenuation consisting of about $\frac{1}{1000000}$ of the original nitrifying solution employed, which not only nitrified, but on inoculation into gelatine-peptone refused to grow, and was seen under the microscope to consist of numerous characteristic bacilli hardly longer than broad, which may be described as bacillo-cocci.

Although this bacillo-coccus obstinately refuses to grow in gelatine when inoculated from these dilute media, yet in broth it produces a very characteristic though slow growth.

Nitrification was also induced in ammoniacal solutions by inoculating from such broth cultivations.

March 27.—"On the Progressive Paralysis of the Different Classes of Nerve-cells in the Superior Cervical Ganglion." By J. N. Langley, F.R.S., and W. L. Dickinson.

Summary.—Generally speaking, stimulation of the cervical sympathetic in the dog with minimal effective shocks causes pallor in the lips and gums; with weak to moderately strong shocks, primary pallor followed by flushing; with strong shocks, as shown by Dastre and Morat, primary flushing, but the extent and duration of the primary effect and of the secondary effect, if there is any, vary in different dogs.

In the rabbit and cat, stimulation of the cervical sympathetic always causes, as shown by Bochefontaine and Vulpian, primary pallor in the lips and gums, and the after-flush is not great. The pallor we find is bilateral; the degree of the pallor on the opposite side to that stimulated varies in individual cases, it can be seen in the tongue, as well as in the lips and gums.

On injecting nicotin into a vein, certain of the normally occurring effects of stimulating the cervical sympathetic cease before the others, *i.e.* since all the effects can still be produced by stimulating the fibres running from the superior cervical ganglion, the nerve-cells in the ganglion, which are connected with different classes of nerve-fibres, are paralyzed with different degrees of ease by nicotin.

Arranging the various effects in the order of ease of paralysis, we have:—

Rabbit.

(1) Withdrawal of the nictitating membrane.
(2) Opening of eye.
{ (3) Dilation of pupil.
{ (4) Constriction of blood-vessels of conjunctiva.
{ (5) Constriction of blood-vessels of lips and gums.
{ (6) Constriction of blood-vessels of ear.

In one or two cases, no difference in the ease of paralysis between the bracketed actions has been observed.

Cat.

(1) Secretion from sub-maxillary gland.
(a) { (2) Opening of eye.
{ (3) Dilation of pupil.
{ (4) Constriction of blood-vessels of conjunctiva.
{ (5) Constriction of blood-vessels of mouth.
(b) { (6) Constriction of blood-vessels of ear.
{ (7) Withdrawal of nictitating membrane.

(*a*) Constant differences between these have not been observed.

(*b*) These have not been directly compared, but in separate experiments each has been obtained when (1) to (5) were no longer seen.

Dog.

(1) Dilation of arteries of bucco-facial region.
(2) Movements of eye and opening of eyelids.
(3) Withdrawal of nictitating membrane.
(a) { (4) Constriction of the arteries of gums and lips.
{ (5) Dilation of pupil.
{ (6) Secretion from sub-maxillary gland.
{ (7) Constriction of blood-vessels of the sub-maxillary gland.

(*a*) Differences between these have not always been observed.

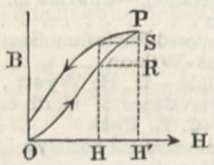
At a certain stage of nicotin poisoning, when stimulation of the sympathetic does not cause withdrawal of the nictitating membrane, but does cause dilation of the pupil, a partial *closing* of the eye is obtained by stimulating the sympathetic.

It will be noticed that in each animal nicotin abolishes most of the effects of stimulating the cervical sympathetic at very nearly the same time. With regard to these, we think that there is only a *primâ facie* case for regarding the differences observed as due to an unequal paralysis of the nerve-cells of the superior cervical ganglion, for it is possible that the differences may be due to an unequal tonic stimulation reaching the parts by nerve-fibres other than the sympathetic. But the greater differences observed, for instance, between the secretion of saliva and the dilation of the pupil in the cat, the flushing of the lips and the constriction of the vessels of the sub-maxillary gland in the dog, we do not think can be due to such a cause, and we attribute them to an unequal paralyzing action of nicotin upon the nerve-cells of the superior cervical ganglion.

Linnean Society, April 17.—Mr. Carruthers, F.R.S., President, in the chair.—Lord Arthur Russell, on behalf of the subscribers to a portrait of Sir Joseph Dalton Hooker, which had been painted at their request by Mr. Hubert Herkomer, R.A., formally presented the portrait to the Society, and in a few words expressed the satisfaction which he was sure would be felt at the acquisition of the likeness of so distinguished a botanist. It was announced that a photogravure of the portrait was in preparation, of which a copy would be presented when ready to every subscriber to the portrait fund.—Prof. P. M. Duncan, F.R.S., exhibited a vertical section through a large coral, *Fungia echinata*, cutting through and across the septa and synapticulæ and the so-called base. The union of the sides of contiguous septa at the base is either incomplete or by means of synapticulæ.—Dr. Edward Fischer, of Zurich, exhibited and made remarks on certain species of *Polyporus* bearing a sclerotium possessing the structure of *Pachyma cocos*, but it was doubtful whether the *Polyporus* represented the fructification of the *Pachyma*, or was merely parasitic on it. Mr. George Murray expressed himself in favour of the latter view.—Mr. J. E. Harting exhibited alive a so-called "singing mouse" which had been captured at Maidenhead a week previously, and which uttered sounds like the subdued warbling of a linnet. He desired to be informed whether the cause usually assigned for the phenomenon was correct—namely, some obstruction or malformation of the trachea. Prof. Stewart stated that he had observed alive, and dissected when dead, a similar specimen, and had found no trace of any organic disease or malformation.—Sir Charles Sawle, Bart., exhibited a specimen of the Little Green Heron, *Butorides virescens*, of North America, which had been shot by his keeper at Penrice, St. Austell, Cornwall, in October last, and which he had sent for preservation to a taxidermist at Bath. Mr. J. E. Harting offered some remarks on the occurrence, and suggested various ways in which the bird might have reached England. He observed that the larger American Bittern, *Botaurus lentiginosus*, had been met with some five-and-twenty or thirty times in the British Islands, and, strange to say, had been described and named by an English naturalist, and a Fellow of this Society, Colonel George Montagu (who obtained a specimen of the bird in Dorsetshire), a year before it was described by Wilson as a native of the United States.—A paper was then read by Mr. Spencer Moore, on some micro-chemical reactions of tannin. In this an account was given of the behaviour of Nessler's test for ammonia upon tannin, which it usually colours almost immediately some shade of brown or reddish brown. The great value of the reagent is held to reside in the rapidity of its action; moreover in none of the many experiments did it fail. Reference was also made to some other new tannin tests, especially to some in which, as in Nessler's fluid, caustic potash furnishes the basis, and which, like that fluid, are very rapid in their action.—A paper by Mr.

E. Saunders, on the tongue of the British Hymenoptera Anthophila, in the absence of the author was read by Mr. W. Percy Sladen, and was illustrated by excellent drawings.

Physical Society, April 18.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—Prof. Rücker described the results of some recent magnetic work undertaken by himself and Prof. Thorpe in connection with their magnetic survey of the United Kingdom.—Mr. T. H. Blakesley (Hon. Secretary) read a paper, on a theory of permanent magnetism, by M. Osmond. The author stated that iron exists in two distinct physical states, one soft, or "*α iron*," and the other hard, or "*β iron*." The β variety is non-magnetic, and is formed during heating, hardening, or by electrolysis, whilst the soft or α modification is produced by long annealing. In a piece of steel the author considers the β molecules to form a rigid framework in which the α molecules become interlocked under the influence of magnetizing force, and on the degree of interlocking the permanent magnetism depends. By a graphical method it is shown that the permanent magnetism should be a maximum when the two varieties are present in equal quantities. If the proportions of carbon and manganese in the steel are considerable, then nearly all the iron is of the β variety, and the steel is nearly non-magnetic. In hardening a piece of ordinary steel, the surface layers being cooled most rapidly contain more β molecules than the interior; hence for a certain degree of hardness (when the outer layers have more α molecules than β ones) a laminated magnet will be a better permanent magnet than a solid one, but for a much greater degree of hardness the reverse may be the case. Mr. Swinburne asked if the theory would account for the increase of induction which occurs when the circuit of a permanent magnet is closed; most theories founded on the orientation of particles by the magnetizing force seemed defective in this respect. Some time ago he had suggested that the permeability of iron should be tested by first magnetizing it one way, and then at right angles to the first direction; recently he had been informed that no increase of permeability was observed when the experiment was performed. Prof. Perry said he had subjected iron to magnetization in one direction and found the permeability for small forces in a direction at right angles much smaller than he had anticipated; the first magnetizing force was kept constant when the small perpendicular one was applied. Mr. Swinburne thought that for such small perpendicular forces the permeability should be nearly infinite. He also said there seemed to be a sort of angular hysteresis in iron, for if a loose running armature was turned slowly round by hand, it would come back 2° or 3° when left free. The President remarked that, as far as he could see, M. Osmond's theory does not account for the great influence which a small percentage of tungsten has on the magnetic property of steel, and all theories which failed in this particular must necessarily be imperfect. Mr. Blakesley pointed out that the ordinary hysteresis curves showed that a small superimposed magnetizing force in a direction different from the primary one produced only a small change in the induction, and hence would give a small



permeability. For example, the increment HH′ (see diagram) causes an increase RP in the induction, whilst an equal decrement H′H produces only a change PS.

Geological Society, April 16.—J. W. Hulke, F.R.S., Vice-President, in the chair.—The following communications were read:—On the disturbed rocks of North-Western Germany, by Prof. A. von Könen, For.Corr.G.S.—On the origin of the basins of the Great Lakes of America, by Prof. J. W. Spencer, State Geologist of Georgia. From the study of the hydrography of the American lakes, from the discovery of buried channels revealed by borings, from the inspection of the glaciation of the lake region, the consideration of the late high continental elevation, and the investigation of the deformation of old water-levels, as recorded in the high-level beaches, the explanation of the origin of the basins of the Great Lakes becomes possible. The original Erie valley drained into the extreme western end of Lake Ontario—the Niagara river being modern—by a channel now partly buried beneath drift. Lake Huron, by way of Georgian Bay, was a valley continuous with that of Lake Ontario; but between these two bodies of water, for a distance of about 95 miles, it is now buried beneath hundreds of feet of drift. The old channel of this buried valley entered the Ontario basin about twenty miles east of Toronto. The northern part of Lake Michigan basin was drained into the Huron basin, as at present; whilst the southern basin of that lake emptied by a now deeply drift-filled channel into the south-western part of Huron. The buried fragments of a great ancient valley and river, and its tributaries, are connected with submerged channels in Lake Huron and Lake Ontario, thus forming the course of the ancient St. Lawrence (Laurentian) river, with a great tributary from the Erie basin and another across the southern part of the State of Michigan. This valley is of high antiquity, and was formed during times of high continental elevation, culminating not long before the Pleistocene period. The glaciation of the region is nowhere parallel with the escarpments, forming the sides of, or crossing the lakes or less prominent features. During the Pleistocene period, and especially at the close of the episode of the upper Till, the continent was greatly depressed, and extensive beaches and shorelines were made, which are now preserved at high elevations. With the re-elevation of the continent these old water-levels have been deformed, owing to their unequal elevations. This deformation is sufficient to account for the rocky barriers at the outlets of the lakes. Some of the lakes have been formed, in part, by drift obstructing the old valley. The origin of the basins of the Great Lakes may be stated as the valley (of erosion) of the ancient St. Lawrence river and its tributaries, obstructed during and particularly at the close of the Pleistocene period, by terrestrial movements, warping the earth's crust into barriers, thus producing lake-basins, some of which had just been formed in part by drift deposited in the ancient valley. The reading of this paper was followed by a discussion, in which Dr. Hinde, Prof. Bonney, Dr. Irving, Mr. Clement Reid, Rev. E. Hill, Prof. Seeley, Mr. Whitaker, and the author took part.—On Ornithosaurian remains from the Oxford Clay of Northampton, by R. Lydekker.—Notes on a "wash-out" found in the Pleasley and Teversall Collieries, Derbyshire and Nottinghamshire, by J. C. B. Hendy.

Chemical Society, March 20.—Dr. W. J. Russell, F.R.S., President, in the chair.—Prof. J. W. Judd, F.R.S., delivered a lecture on the evidence afforded by petrographical research of the occurrence of chemical change under great pressure, in which he discussed the question as to how far the phenomena observed by the geologist in the study of rocks under the microscope can be explained by the laws that have been experimentally determined by the physicist and chemist.—The following papers were read:—The formation of triazine-derivatives, by Prof. R. Meldola, F.R.S.—Contributions to the knowledge of mucic acid; Part I, hydromuconic acid, by Dr. S. Ruhemann and Mr. F. F. Blackman.—The molecular weights of metals when in solution, by Messrs. C. T. Heycock and F. H. Neville. The authors give the results of their observations on the effect of various proportions of silver, gold, copper, nickel, sodium, palladium, magnesium, zinc, lead, cadmium, mercury, bismuth, calcium, indium, aluminium, and antimony on the solidifying point of tin. Of all these metals, antimony alone behaves abnormally, producing a rise instead of a depression in the solidifying point. In the majority of cases the atomic depression is a number not far removed from 3, the theoretical value calculated from Van't Hoff's formula. Assuming the truth of Raoult's generalization, that the depression produced by a molecular proportion of any substance in the solidifying point of the same solvent is the same whatever the substance, it would therefore seem probable that the molecules of most metals are of the same type, M_n, where n is the number of atoms in the molecule; and if it be supposed that the molecules of zinc, for example, when dissolved in tin are monatomic as in the gaseous state, it would follow that n is unity in the case of many other metals. In the case of aluminium, the atomic depression is so nearly half the average value that it seems probable that the molecule is diatomic. Indium resembles aluminium in producing an abnormally low depression, and it is noteworthy that the value for mercury is also distinctly low.

March 27.—Annual General Meeting for the election of Officers and Council.—Dr. W. J. Russell, F.R.S., President, in the chair.—The President, in his address, discussed the teaching of chemistry to medical students, and drew attention to the

importance of the medical man being well trained in elementary chemistry, pointing out that it was too seldom recognized that the fundamental action of medicines—the origin of their power—is a chemical change, and that if an understanding and appreciation of their effects are to be sought for, the first steps must be to learn the laws which govern chemical change, and the chemical nature of the substances employed. He urged, that in place of the present unsatisfactory system, chemistry should be placed on an equal footing with anatomy, medicine, and physiology, in which subjects the Examining Board of the two Colleges insists that the student shall have studied at a recognized medical school, thus recognizing most wisely the importance of study under efficient instructors and at places properly equipped.

PARIS.

Academy of Sciences, April 21.—M. Hermite, President, in the chair.—On the theory of the optical system formed by a double plane mirror in front of the object-glass of an equatorial, and movable about an axis, by MM. Lœwy and Puiseux. In a previous note (April 14) the authors dealt with the formulæ relative to the employment of one plane mirror movable about an axis. They now study the system obtained by replacing the single mirror by two reflecting surfaces cut on the same block of glass in the form of a prism.—On Weber's law of electrodynamics, by M. H. Poincaré.—On the heat of formation and reactions of hydroxylamine, by MM. Berthelot and André. One of the results of the investigation is to confirm the similarity between ammonia and hydroxylamine, their heats of formation showing only a slight difference. Hydroxylamine cannot therefore be regarded as oxidized ammonia.—On the nutrition in hysteria, by M. Bouchard. The author quotes a work by M. Empereur, "Sur la Nutrition dans l'Hystérie," published in 1876, in which demonstrations of the normal pathological state during hysteria, similar to those described by MM. Gilles de la Tourette and Cathelineau, are given.—Observations of Brooks's comet (*a* 1890) made with the *coudé* equatorial (35 cm. free aperture) of Lyons Observatory, by M. G. Le Cadet. On March 28 the comet appeared as an almost perfectly round nebulosity without any noticeable point of condensation. Its magnitude was estimated as 11'5.—On the actual minimum of solar activity, and the spot which appeared in March 1890 at a remarkably high latitude, by M. A. Riccò. A comparison of the number of spots that appeared in 1890 with the number observed in 1878 indicates that the minimum certainly passed towards the end of last year.—On a transformation of differential equations of the first order, by M. Paul Painlevé.—Construction for radius of curvature in certain classes of curves, notably Lamé's curves, parabolas and hyperbolas of various orders, by M. G. Fouret.—On mica condensers, by M. G. Bouty. The author finds that at ordinary temperatures, and for differences of potential from 1 to 20 volts, a thin lamina of mica opposes an absolute obstacle to the continued passage of electricity through it; also, that residual charges do not appear to depend on the penetration of electricity, so to speak, into the dielectric, but rather on a progressive increase of the dielectric constant.—On the mechanical action of alternating currents, by M. J. Borgman. In a note presented on February 3, the author described a method by means of which it was easy to produce the repulsion of conducting masses by a coil traversed by an alternating, or simply an intermittent current, discovered by Elihu Thomson. To determine the influence of various conditions on this phenomenon, the author has undertaken, and describes a series of experiments made with modified apparatus.—Halos and parhelia observed at St. Maur Park, by M. E. Renou. The relative number of halos and parhelia observed in different years and in different months of the year are given.—On one of the causes of the loss of iron ships on account of the perturbations of the magnetic needle; determination of the amount of deviation for each ship, by M. Léon Devaureix. The author has observed the deviation of the compass during six consecutive voyages from Bordeaux to La Plata, returning by Dunkirk.—Note on the preparation of iridium dioxide, by M. G. Geisenheimer. Iridium dioxide is obtained in fine brown-red microscopic needles by heating potassium iridate in a platinum crucible for an hour with 15 times its weight of a mixture of equivalent quantities of chloride and bromide of potassium. The crystals are isolated by washing first with water and then with aqua-regia. Analysis proves them to be pure IrO_2.—Action of hydrogen peroxide on the oxygen compounds of manganese; Part I, action on the oxides, by M. A. Gorgeu. The author concludes that in the process of decomposition of hydrogen peroxide by the peroxides of manganese, the latter, especially in presence of acids, are themselves reduced to some extent if they contain more oxygen than is indicated by the formula Mn_3O_4, $\frac{1}{2}H_2O$, and that the analysis of hydrogen peroxide should not therefore be carried out by means of the hydrated higher manganese oxides.—Preparation and heat of formation of sodium erythrate, by M. de Forcrand.—Note on the chlorine derivatives of the amylamines, by M. A. Berg. Three chlorine derivatives—namely, monochloramylamine, dichloramylamine, and chlorodiamylamine—have been prepared by the action of hypochlorites on amylamine and diamylamine hydrochlorides. Analyses and descriptions of the properties of the three bodies are given.—On the alcoholic fermentation of inverted sugar, by MM. U. Gayon and E. Dubourg. Following the progress of the fermentation by means of the polarimeter, the authors show that the two components of invert-sugar are attacked with different degrees of rapidity, and that different ferments do not act in the same manner, some attacking the lævulose by preference, others the remaining component.—Note on alcoholic fermentation and the transformation of alcohol into aldehyde caused by *champignon du muguet*, by MM. Georges Linossier and Gabriel Roux.—A geological paper, by M. Stanislas Meunier, gives an account of the results of the lithological and geological examination of the meteorite from Jelica (Servia), 1889.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Studies in Evolution and Biology: A. Bodington (E. Stock).—Glimpses into Nature's Secrets: E. A. Martin (E. Stock).—A Manual of Anatomy for Senior Students: E. Owen (Longmans).—Monograph of the British Cicadæ Part 2: G. B. Buckton (Macmillan).—Fur Seal and other Fisheries of Alaska (Washington).—National Academy of Sciences, vol. 4, Part 2; 3rd Memoir—The Temperature of the Moon: S. P. Langley (Washington).—The Solar Corona: F. H. Bigelow (Washington).—Photographs of the Corona taken during the Total Eclipse of the Sun, January 1, 1889; Structure of the Corona; D. P. Todd (Washington).—National Health: B. W. Richardson (Longmans).—The Function of Labour in the Production of Wealth: A. Philip (Blackwood).—Magnetism and Electricity: W. J. Harrison and C. A. White (Blackie).

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