THURSDAY, JANUARY 7, 1904.

THE CRITICAL STATE.

Le Point critique des Corps purs. Pp. viii+255. (Paris: C. Naud, 1904.)

OF late numerous attacks have been made on the commonly accepted theories relating to the conditions which obtain at the critical temperature of pure substances, and though the assailants may have received little support, or even attention, from the mass of their physical brethren, it is time that certain questions relating to the critical state were more definitely settled.

In the opening chapter of this work the author discusses the general case of the evaporation of liquids at temperatures up to their critical point, leading up to the statement, which opens the second chapter, that the theories of Andrews and Van der Waals are insufficient to explain the observed phenomena. For instance, Battelli has attempted to prove that the temperature at which the meniscus disappears in a sealed tube containing alcohol is a function of the concentration of the alcohol in the tube. The experimental results are quoted; they are as follows:—

Date of experiment	Mean density of liquid and vapour in sealed tube	Observed critical temperature
1891	0·3195	236·39
1892	0·3434	237·02
1891	0·3448	236·26
1891	0·3839	235·66
1891	0·3889	235·94
1892	0·4000	236·43

Similar results were obtained in the case of ether, but it is difficult to see how they may be fairly interpreted as supporting the author's views. A very small quantity of impurity would be quite sufficient to account for these abnormal, but by no means concordant results.

The experiments of Galitzin are next quoted to prove that the temperature of disappearance and reappearance of the meniscus is dependent not only on the mean density of the substance in the tube, but also on the dimensions of the latter. Sealed tubes containing ether were heated slowly to 200° C., maintained at that temperature for twenty minutes, and then allowed to cool slowly. A maximum difference of 0·9° C. between the temperatures at which the meniscus disappeared and reappeared again was observed, and as no evidence to the contrary is forthcoming, there is no reason for assuming that the temperature difference is not due to the lagging of the temperature of the liquid in the capillary tube after that of the bath. It is further remarked that, if one repeatedly heats and cools such a tube, the meniscus tends to reappear after each operation at a lower point in the tube. That this is not observed when the tube is shaken is highly significant.

In the succeeding chapters the various methods which have been applied to the determination of the critical constants are described and criticised, theoretical questions being discussed as they occur. Opening with an account of Andrews's experiments, and the development of his method at the hands of Ramsay, Young, and others, the author leads up to a discussion on the application of the modified gas equation to the calculation of the critical constants from the data for the isothermals. As an example, he takes Sarrau's attempt to employ Clausius's equation to calculate the critical constants of hydrogen from Amagat's determinations of the compressibility of that gas. The results are, of course, wide of the mark, but it is interesting to note that Wroblewski, who investigated the isothermals of hydrogen between +100° C. and −182° C., obtained, by means of a similar equation, a very fair approximation of their values.

In chapter vi. the author discusses the effect of the gravity of the substance under investigation on the density at different levels in the capillary tube. Here again our knowledge of the subject is very scanty, and experimental evidence is required to support the theoretical results of Gouy and others who have treated the subject mathematically.

Particularly interesting accounts of special series of researches are given in the succeeding chapters. Olszewski's determination of the critical pressure of ethylene, oxygen, and hydrogen is described in detail, and the theory of the method, which is not dealt with in the original paper, is explained by means of a diagram. This piece of work is important, as it involves a new method for the determination of critical pressures, and gives us the only published experimental data for the critical pressure of hydrogen. Some of the methods described by the author as "élégantes mais pur précises" are interesting, as they furnish suggestions which may be applied to other problems. The behaviour of mixtures, which could not be entirely omitted from the work, is briefly discussed, and diagrams are given illustrating the graphical method of treating the results. A table of critical constants occupies several pages.

The final section of the book deals with the theories which have been put forward to account for the apparent irregularities in the behaviour of pure substances, and the deviation from the simple laws hitherto supposed to govern the phenomena which take place at the critical point. The existence of two kinds of molecules, gasogenic and liquidogenic, which persist in the vapour phase, was first suggested by de Heen, and has recently received support from Traube and others. As was long ago pointed out by Sir G. Stokes, de Heen's theory demands that the pressure of a saturated vapour of a pure substance, like that of a mixture, must be dependent on the relative masses of the liquid and vapour phases, and this is contrary to all experience. Modifications of this theory, involving an idea of a definite equilibrium dependent only on temperature between the two kinds of molecules, may be more easily tenable; but, as the author suggests, the existence of liquidogenic molecules, having only a transitory existence in the vapour phase, and dissociating slowly into gasogenic molecules, would account for most of the phenomena which have been observed.

There are two obvious sources of error in measure-

ments of the kind described in this work. In the first place the substances must be of a very high degree of purity, and as the author justly remarks, there is usually no evidence that this has been the case. In the second, the difficulties experienced in maintaining temperatures which do vary at a greater rate than 0·002° per minute are enormous, and in dealing with substances enclosed in thick-walled capillary tubes, the temperature difference might be in some cases of the same order as the observed abnormalities were the temperature less steady.

Whatever may be the fate of the new theories or the opinion as to the value of some of the experiments on which they are based, we are indebted to the author for collecting and arranging this mass of information, and for bringing the points at issue so clearly before the scientific world. M. W. T.

THE B.M. HAND-LIST OF BIRDS AND CATALOGUE OF EGGS.

A Hand-List of the Genera and Species of Birds. Vol. iv. By R. B. Sharpe. Pp. xii+391. (London: Printed by Order of the Trustees, 1903.)

Catalogue of the Collection of Birds' Eggs in the British Museum (Nat. Hist.) Vol. iii. By E. W. Oates and S. G. Reid. Pp. x+349; 10 plates. (London: Printed by Order of the Trustees, 1903.)

WHEN the publication of the valuable "Hand-List" was commenced, it was considered that the work would be completed in four volumes. The fourth volume is, however, before us, and the author's task is far from being ended. This, as stated in the preface by the director of the Museum, is due to the unexpectedly large amount of space occupied by the Passeres (or Passeriformes, as the author prefers to call them), the number of named species of which group has been largely augmented during the progress of the work. Accordingly, in order to keep the present one of moderate dimensions, it has been decided to complete the work in five, in place of four, volumes. The fifth and concluding volume, it is satisfactory to learn, is in a forward state, and will probably be issued shortly.

Our opinion of the high value of this work having been already expressed in our notices of the earlier volumes, it need not be repeated here, although we must again state that it would have been an improvement had the dates of publication of the generic names been introduced. We are, moreover, debarred from criticising the right of certain forms and groups to specific or generic rank, for the author in this instance has been bound to follow the arrangement adopted in the "Catalogues."

All that remains open to us in the way of criticism is in relation to geographical and topographical names, and even here there is not much with which to find fault. We venture to think, however, that the author uses the term "Himalayas" or "Himalaya Mountains" in somewhat too wide a sense. Possibly he may be justified in including Kashmir in the "Himalayas," although scarcely in the "Himalaya Mountains," but there is no justification for calling Ladak (p. 147) a part of that system. Then, again, on p. 149 we find Murree (Murri) described as being in the *eastern* Himalaya. The author's spelling of that name—as Murri—is, moreover, without justification. Many years ago the Indian Government decreed that the names of well-known places were to be spelt in the old-fashioned way. If this ruling be followed, Murree is the proper orthography; if, however, the Hunterian system be followed, it should be Mari; Dr. Sharpe's "Murri" is neither one system nor the other.

If the proof-reading had been done a little more carefully, certain discrepancies in the printing of names might also have been avoided. We should not have had, for instance, in one place Amur-land (p. 138) and in another Amurland (p. 339), or Somali Land (p. 12) and Somali-land (p. 293), or Szechuen (p. 8) and Sze-chuen (p. 322), or Damara Land (p. 22) and Damara-land (p. 331). Again, we believe that Gansu (p. 321) and Kansu (p. 323) are one and the same. Finally, we do not like the phrase (p. 259) "Arctic and Subarctic regions of both hemispheres," which, although no doubt etymologically correct, sounds somewhat ambiguous.

In regard to the third volume of the "Catalogue of Birds' Eggs," the most notable feature is its dual authorship, or, to be precise, that it is written by Mr. E. W. Oates, assisted by Captain Savile Reid. The explanation of this is to be found in the preface, where it is stated that, owing to the ill-health of Mr. Oates, it had been found necessary to entrust the completion of the work to other hands. In the case of this volume the MS. was left in a forward state by Mr. Oates, and has been revised, together with the proofs, by Captain Reid, who has also incorporated in the text references to recently acquired specimens.

The present volume commences with the parrots, and includes the whole of the so-called "picarian" birds, together with a considerable number of the passerines, that is to say, from the Pteroptochidæ and Formicariidæ to the bulbuls (Pycnonotidæ). From what has been written above, it is scarcely necessary to add that the plan followed in this volume is the same as in its predecessors. Now that a change of authorship has taken place, we may suggest that the value of the work would be decidedly increased if the characteristics of the eggs of the different families and genera were given in some detail in the volume yet to come. As it is, no regular rule seems to have been followed in this respect, and it is therefore quite impossible to gather of what value are egg-characters in classification.

The exquisite plates illustrating this volume are, like those in its predecessors, reproduced from sketches by Mr. H. Gronvöld. Although the number of the plates is somewhat less than in vol. ii., the number of eggs figured is (owing to their smaller size) much greater. It may be added that small eggs, like those figured in this volume, form much more attractive octavo plates than is the case with the larger ones depicted in the earlier volumes, and whichever of the two authors is responsible for the grouping of the specimens figured he is to be congratulated, from an artistic point of view, on the result. As a rule, eggs

which have not previously been figured are selected for illustration.

The total number of species catalogued in this volume is 907, and the number of eggs 8474; the latter are, however, very unevenly distributed among the various species, of many of which there is but a single egg in the collection. This is the case, for instance, with three out of the four species of "frog-mouths" catalogued, and likewise with many of the kingfishers, cuckoos, and humming-birds.

The collection is especially rich in eggs of the common cuckoo, associated in a large number of cases with the clutches laid by their involuntary foster-parents. After remarking on their variability in size, the authors state that the cuckoo's eggs likewise present a considerable range of diversity in colour and the character of the marking, although the great majority approach in these respects to the eggs of the meadow-pipit and skylark. Eggs of this type constitute the great bulk of the series in the collection. Some, however, like those associated with the eggs of *Ruticilla phoenicurus*, are blue, while one closely resembles that of a chaffinch. Curiously enough, cuckoos' eggs from hedge-sparrows' nests are of the ordinary type, and show no tendency to become blue. Altogether, the collection includes cuckoos' eggs taken from no less than forty-one different species of birds, ranging in size from a shrike to a fire-crest.

Did space permit, many other interesting points connected with öology might be mentioned; as it is, we must bring our remarks to a close with the expression of our opinion of the great interest of this unique work. R. L.

MODERN SCIENCE POPULARISED.

New Conceptions in Science. By Carl Snyder. Pp. xii+362. (London and New York: Harper and Brothers, 1903.) Price 7*s.* 6*d.* net.

IN the absence of any preface, it is necessary for the reader to form his own opinions as to the aim or object of the book considered as a whole. This, evidently, is to arouse an interest in scientific work among unscientific people by telling the story of the discoveries of the day in unscientific language. We have here portraits of the man that weighed the crown of King Hiero, of the man that broke the atom into ions, of the man that caught and fought the deadly microbe, and other pioneers of science introduced in terms somewhat suggestive of those we have used above. Several of the illustrations show the discoverers at work in their own laboratories, and remind us that this book hails from the same land which in recent years has flooded our breakfast tables with portraits of literary men writing articles by the side of revolving bookcases.

We have spoken of the book as being written in unscientific language, but it would be better to describe the language as unconventional, unorthodox, and very funny to an English mind. As instances, we may quote "chips of atoms" as applied to corpuscles; Marconi is described as having "since the Salisbury Plain trials with kites, taken to the water wholly," and, later on, it is said of him, "Then the tireless experimenter looked out over waste seas, saw in fancy the foggy banks of Newfoundland and said confidently 'That's the next.'" Again, "The Hertz-waves have had a sort of Messianic history. They had been foretold." "This scale" (speaking of Centigrade) "is in universal use throughout the world save in two backward countries called England and the United States." (The author forgets that there are certain enlightened countries which still use Réaumur's scale.) "If like this mechanical eye our eyes were sensitive to these electrical waves, then we might watch the progress of a play in Buenos Ayres or have witnessed the struggles at Peking." "Those who were reared to the ideas of Clerk Maxwell, regarding electricity as a wave and wobble in the highly hypothetical ether, have not failed to implant upon the new theory their collective feet." Light and other waves are stated to "clip through space at 184,000 miles per second." "If, as Prof. Dolbear picturesquely remarks, we could some way get a 'kick' on the ether, space navigation would be easy. It does not seem impossible that we shall be able to do this within another hundred or two hundred years."

The book is not confined to physical science alone. It contains a chapter on Prof. Loeb's discovery of artificial parthenogenesis, another on the nature of life, in which is suggested the possibility of reversing the life processes and growing backward, and a chapter headed "The Spirit Rappers, the Telepaths and the Galvanometer." Seriously speaking, the most important chapter is undoubtedly that dealing with "America's Inferior Position in the Scientific World." In it, among other points, the author urges the necessity of founding an institution like our Royal Institution in America, and directs the attention of his fellow countrymen to their general backwardness in research. We over here are apt to think of the American man of science as being pretty well off in view of the large number of universities existing in the United States, and the large number of chairs attached to each of them, which should result in the individual professors having far more time for research work than they have in this country. If, however, the author succeeds in impressing on his fellow countrymen the need of devoting further endowments for the furtherance of research work pure and simple, the book will not have been written in vain. The danger is that the important part played in science by long formulæ involving dx's and dy's, inverted deltas and signs of integration will be overlooked. G. H. B.

APPLIED PSYCHOLOGY.

Outlines of Psychology: an Elementary Treatise with some Practical Applications. By Josiah Royce, Ph.D., LL.D., Professor of the History of Philosophy in Harvard University. Pp. xxvii + 392. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 4*s.* 6*d.* net.

THE number of persons who are anxious to study psychology in order to make themselves more efficient as teachers is already large, and is happily

increasing very rapidly. This book is designed to introduce them to the study of the subject, and may be warmly recommended to them, but it is worthy of the attention of the professional psychologist also. The special features of the book are the freshness and clearness of the treatment, and the novel arrangement of mental phenomena under the three heads sensitiveness, docility, and initiative. Prof. Royce thus ignores the traditional divisions of the subject, which, though merely survivals from the old and misleading faculty-psychology, have largely determined the mode of treatment of most modern writers. By so doing he is enabled to treat every mental process as a whole having cognitive, conative and affective aspects.

Though not himself an experimenter or a physiologist, Prof. Royce fully and generously admits the importance of physiological and experimental psychology, and recognises that the advance of the subject represented by this book is largely due to modern work by those methods; his sketch of the functions of the nervous system and his numerous references to physiological considerations are altogether admirable and judicious, and he shows how greatly experimental methods have furthered our analysis of mental processes.

Here and there throughout the chapters practical deductions of the first importance to teachers are clearly and soundly drawn; for example, it is admirably shown how "differentiation of the simultaneous slowly results from the repeated acts, and from the powers of discrimination which have been cultivated in connection with them," and there follows the maxim, "Undertake to systematise this differentiation of consciousness through fitting series of successive deeds."

One of the most novel features is the treatment of the feelings. While agreeing with Wundt in regarding the classification of feelings into the two groups, pleasant and unpleasant, as very inadequate, Prof. Royce does not accept that author's six classes, but regards feelings of quiescence and of restfulness as two classes of antagonistic feelings correlative with the pleasant and unpleasant. In the chapter on the conditions of mental initiative, the importance of this distinction is fully illustrated. It is there forcibly shown how "mental initiative" depends upon "a certain overwealth of persistent activities" not immediately adaptive and not necessarily pleasant, and it is asserted that "all such activities are characterised by the feeling of restlessness. In their physical aspects they are examples of the 'tropisms' of Loeb." This last statement is difficult to accept. In the introduction Prof. Royce shows that he has been much impressed by the phenomena of "tropism" as manifested by lowly organisms, and he seems to feel that the conception of the "tropism" is of great importance for psychology. But the later references to the subject do little to justify the expectations thus aroused. In the case of the "overwealth of persistent activities" which are so important for mental growth, it would seem to be truer to say that they are examples of "irritability," the fundamental property of all living substance, and to treat them as examples of "tropisms" is not warranted by any considerations advanced in the book or known to the present writer.

The concluding chapters deal with varieties and abnormalities of minds, and many valuable hints are given as to the special treatment of individuals demanded of the teacher and parent. Among all the many books on psychology, there is none that within so small a compass, can give more insight into the life of the mind, and none that can be studied by schoolmasters with greater or equal advantage to their professional efficiency. W. McD.

OUR BOOK SHELF.

Animal Studies: a Text-book of Elementary Zoology for Use in High Schools and Colleges. By David Starr Jordan, V. L. Kellogg, and Harold Heath, of Leland Stanford Jr. University. Pp. 459; 259 figures. (New York and London: Appleton and Co., 1903.) Price 5*s.* net.

THIS is an interesting and delightful text-book of elementary zoology, combining some parts of "Animal Life" and "Animal Forms," in the same series, with new material on classification, extinct forms, geographical distribution, special adaptations, instincts, and economic value. Beginning with chapters on the conditions of animal life and the principles of classification, the volume takes a survey of the most important classes from Protozoa to mammals. Then follow chapters on life-histories, the struggle for existence, adaptations, animal communities, commensalism and parasitism, protective resemblances and mimicry, the special senses, instinct and reason, and so on. When we compare a school-book on geography of a quarter of a century ago with the best modern school geography, we seem to breathe a different atmosphere, and so it is when we compare the natural history for schools which was in circulation twenty-five years ago with this lively, up-to-date, well thought-out, beautifully illustrated, and, in short, well adapted modern school text-book of zoology.

We quote, in illustration of its educational value, one example:—"At one time we had two adult monkeys, 'Bob' and 'Jocko,' belonging to the genus Macacus, neither with the egg-eating instinct, and a baby monkey, 'Mono,' of the genus Cercopithecus, whose inherited impulses bore a distinct relation to feeding on eggs, just as the heredity of Macacus taught the others how to crack nuts or to peel fruit. To each of these monkeys we gave an egg, the first that any of them had ever seen." The result of the experiment was in the highest degree instructive. Mono cracked the egg against his upper teeth, made a hole in it, and sucked it. "Then holding the egg-shell up to the light and seeing that there was no longer anything in it, he threw it away." He treated all subsequent eggs in the same expert fashion, while "Bob" and "Jocko" treated their eggs like nuts, and therefore ineffectively.

We recommend this book strongly; it is simple but not superficial, it is both interesting and instructive; it is written with an educational perspective. It is particularly desirable in elementary books that every general statement should be critically scrutinised, and the standard of accuracy in this volume is a high one. We are not, however, prepared to accept every statement, *e.g.* that fur-seals "absorb the water needed through pores in the skin." J. A. T.

Das Zeisswerk und die Carl-Zeiss-Stiftung in Jena. Ihre wissenschaftliche, technische und soziale Entwickelung und Bedeutung, für weitere Kreise dargestellt von Felix Auerbach (Prof. a.d. Universität). Pp. vi+124. (Jena: Gustav Fischer, 1903.)

THIS short popular account of the optical works in Jena will be of interest to a wide circle of readers. Of the successful application of science to industry no more striking illustration can be found than in the history of the Zeiss firm, with its aim of "scientific exactness and perfection of workmanship," while to many the description of the present organisation of the undertaking, and the socialistic features of the charter under which it is now controlled, will no less appeal.

The early efforts of Carl Zeiss towards the improvement of the microscope, his adoption of Abbe as scientific partner, and the revolution in the optical theory of the instrument due to Abbe's work, are dealt with in some detail. The need, emphasised by Abbe's investigations, of greater variety in the character of optical glass, to render possible the removal of the chief defects of lens systems, led to the foundation, in 1884, of the glass works of Otto Schott, and from this year we may date an enormous advance in the construction of optical instruments, with a further development of the Jena industry. This brings us to an account of the existing organisation, and a description of the main departments, with details and illustrations of many of the most important and best known instruments, as well as of the workshops and buildings.

The latter part of the work deals with the social and socialistic aspects of the present system of administration. In 1891, some four years after the death of Carl Zeiss, Abbe devised his rights of property in the optical and glass works to the undertaking itself, and originated the statute, under which, after receiving in 1896 the legal sanction of the Duke of Saxony, the "Carl-Zeiss-Stiftung" is now controlled. Particulars are given of the statutory standing of the employés, the system of profit-sharing, the regulation of hours of work, the pension scheme, as well as of institutions founded for the benefit of the workmen, and benefactions to the university and to the town.

In addition to Carl Zeiss and Abbe other personalities connected with the undertaking, Schott, Czapski, Straubel, Pulfrich, &c., are briefly characterised, and with these names may be also mentioned that of the old foreman, August Löber, to whom the firm is indebted for many improvements in technical detail.

Reasons Against the Theory of Evolution. By Thomas Woods, M.D., M.R.C.S.L., L.R.C.S.I., &c. Pp. viii+52. (London: W. R. Russell and Co., n.d.)

THE author of this booklet may have perfectly definite convictions as to the truth or falsity of the theory of evolution, but he has hardly succeeded in making his attitude towards the doctrine clear to his readers. His object, the preface informs us, is to notice some occurrences, said to be due to evolution, the contrivances for which must have been pre-arranged, and therefore could not have been the result of accidental circumstances. "If," he proceeds, "Evolution results from 'circumstances and surroundings,' pre-arrangement, of course, cannot have occurred, and if it can be shown that such pre-arrangement has in *any* instance taken place the whole thing must fall." This can only mean that the author considers himself in a position to disprove the existence of evolution *in toto*. But, on the other hand, we read that "if we regard Evolution as *one* of the means made use of, . . . we may not err." We do not see how these statements are to be reconciled.

Considering, however, the title of the essay, and the whole tone of the author's remarks, we shall probably be doing him no injustice if we put him down as a root and branch opponent of the theory as commonly understood. His leading argument appears to be this:—facts such as the grouping of the planets of the solar system, the freezing and boiling points of water, and, in the organic world, the provision made by nature for the welfare of unborn offspring, with other similar conditions, seem to stand in definite relation with the existence of life on the earth; these conditions must have been pre-arranged, and therefore evolution is impossible. It is scarcely necessary to point out that the argument is a *non sequitur*. In estimating the evidence for and against evolution, it is absolutely immaterial to inquire whether the conditions under which it is supposed to have taken place are or are not the result of "pre-arrangement." Dr. Woods claims in an appendix to have anticipated Favre and Silberman in laying the foundations of thermochemistry. It is unfortunate that in entering the lists of biological controversy he has omitted to acquaint himself with the elementary conditions of the evolutionary problem.

Lessons in Physics. By Lothrop D. Higgins, Ph.B. Pp. vii+379; with plates and diagrams. (Boston, U.S.A., and London: Ginn and Co., 1903.) Price 4*s.* 6*d.*

IT is rather difficult to "place" this book. At the end there is a glossary in which (amongst more difficult ones) words are defined such as these:—absorb (to take in), alter (to change), constant (always the same), detect (to find out), enlarge (to make larger). Apparently, then, the pupil is not expected to be certain about words of two syllables. We, accordingly, look for great simplicity in the text, especially as the author in his preface trusts that the explanations "have been made with a care which should render them unusually clear and simple." We open the book at random at the first section on magnets, and find the following definition as the first sentence:—"A Magnet is a body so acted upon electrically that it has the power to exert magnetic force."

We open on p. 319, and we find Ohm's law based upon the relative values of E.M.F. and current in the primary and secondary of an induction coil.

We open again at p. 250, and learn, in explanation of the rainbow, that "the sunlight passes through some thin clouds whose particles of water refract the rays, and the spectrum is formed on other clouds or reflected to the eye."

The first 120 pages, on mechanics, appear to be the best part of the book. There are several remarkably pretty plates.

The Certainty of a Future Life in Mars. Being the Posthumous Papers of Bradford Torrey Dodd. Edited by L. P. Gratacap. Pp. iv + 266. (New York: Brentano's, 1903.)

THE planet Mars has been the subject for many works of fiction, and in the present volume we have another addition to the list.

The main idea of the train of thought in these pages is that upon each planet the possibilities of development just attain to the margin of the next higher step in mental evolution. Thus in Venus the period of *sense* develops to the possibility of the period of *science*, but does not attain it. On the earth the period of *science* develops to that of *spirit*, while the latter is only reached in the planet Mars. On this assumption souls of different degrees move from planet to planet.

The chief characters in this story are Mr. Dodd, his wife and son (the author of these papers). The father and son work out a system of wireless telegraphy, and

after the death of the former, whose soul is transported to Mars, they get into communication with each other.

The posthumous papers consist of the record left by the son, who describes all their experiments, hopes, failures, successes, and, lastly, the extra-planetary wireless messages he received.

Those interested in this class of fiction can spend a pleasant hour or two over these pages.

On the Lakes of South-eastern Wisconsin. By Prof. N. M. Fenneman. *Bulletin* viii. of Wisconsin Geol. and Nat. History Survey. Pp. xv+178. (Madison, Wisconsin: Published by the State, 1902.)

THE preface and the introduction announce the object of this work. It is intended as a guide to the teacher of geology, and shows how the shores of these lakes may form beautiful illustrations of the principles of wave, current, and ice action. The first chapter gives a general account of the origin of such lakes, and the second is devoted to a general and more or less theoretical discussion of the geological agents at work. After this the lakes are taken up one by one, and it is shown how the various features of the shore have arisen. There are many very good and aptly chosen photographs, which bring out clearly the points mentioned in the text, and make the book interesting even to those who cannot see the lakes for themselves.

Most of the book is devoted to the features of the shores, but it is also shown how the hydrographic maps may be used to decipher the origin of the basins, and in the case of Lake Mendota there is an interesting discussion of the results obtained by dredging, which are said to indicate currents below the wave-base. The unpublished work of the director of the Survey, Dr. Birge, on the temperature of these lakes is also said to confirm these conclusions. We shall look forward to the publication of these temperature observations. E. R. W.

Malessere Agrario ed Alimentare in Italia. By Italo Giglioli, Direttore della R. Stazione Agraria di Roma, &c. Pp. lxxxii+797. (Portici, 1903.)

IN this work Prof. Giglioli has attempted a detailed survey of the agricultural state of Italy in comparison with other nations. He considers one by one the various branches of the industry, the production of wheat, maize, rice and other cereals, wine, fruit, olives and silk, eggs, butter, cheese and the many minor branches of rural activity which are possible in the climate of Italy. In each case a comparison is drawn between the conditions of the past and those which prevail to-day both in Italy and the chief competing countries. Both as an ardent patriot and a man of science, Prof. Giglioli is troubled by the increasing poverty of the rural districts as compared with the towns, especially when one travels out of the favoured northern provinces of Lombardy and Tuscany into middle and southern Italy. He indicates how the actual production of the land is declining, so that Italy with all its traditional farming skill and with the vast possibilities of its climate is coming to be more and more dependent upon other nations for food which could be grown within its own borders if only more intensive methods of cultivation were resorted to. Aggravated as the case is in parts of Italy by the poverty of the people and their entire dependence upon agriculture, the problem is one which all the west European States are being called upon to face; how can agriculture, which is a primitive industry, live in a highly civilised State against the competition of the great areas of virgin soil like Argentina or the North-West? To English economists who want an enlightened and temperate review of the situation in a nation not unlike our own we commend Prof. Giglioli's book.

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.*]

Does the Radio-activity of Radium depend upon its Concentration?

SOME experiments have recently been made to test whether the radio-activity of radium is influenced by the continuous bombardment to which it is subjected by its own radiations. In an article in this Journal on radium (April 30, 1903) Prof. J. J. Thomson suggested that the radio-activity of radium may possibly depend upon its degree of concentration, and that a given quantity of radium, diffused throughout a mass of pitchblende, may be less than when concentrated in a small mass. In order to test this point, measurements of the radio-activity of radium bromide were made when in the solid state and when diffused throughout the mass of a solution more than a thousand times the volume occupied by the radium compound.

Two tubes, closed at one end, were taken, in one of which was placed about a milligram of pure solid radium bromide and in the other a solution of radium chloride. The tubes were connected near the top by a cross tube, and the open ends were then sealed by a blowpipe.

Measurements of the radio-activity of the radium were made by means of an electroscope. The tubes, fixed on a stand, were placed in a definite position near an electroscope and the rate of discharge observed. This was due to the β and γ rays emitted by the radium, since the α rays were completely absorbed in the walls of the tube. By placing a lead screen 6 mm. thick between the tubes and the electroscope the rate of discharge was due to the γ rays alone.

After measurements of the activity had been made, the glass apparatus was tilted so as to allow the radium chloride to flow into the arm containing the radium bromide. This dissolved the radium, and part of the emanation was released and distributed itself throughout the tubes.

No appreciable change of the radio-activity of radium was observed over a month's interval. If the rate of production of the emanation, or the excited activity caused by it, had varied during the interval, a corresponding change would have been observed in the rate of discharge due to the γ rays, for other experiments have shown that the amount of γ rays is proportional to the amount of emanation present, provided measurements are made several hours after the introduction of the emanation into a vessel, in order to allow the excited activity to reach a maximum value. The rate of discharge due to the γ rays was somewhat diminished, but this was due to an increased absorption of the β rays by the solution, and not to a change in the rate of emission of these rays. On account of the great penetrating power of the γ rays, the increased absorption due to the presence of the solution was negligible.

Since, after solution, the radium bromide was diffused through a mass of solution at least 1000 times the bulk of the solid radium bromide, we may conclude that a distribution of the radiating matter over a thousand times its original volume has no appreciable influence on its radio-activity.

This experiment shows that, over the range investigated, the radio-activity of radium is not influenced by its own intense radiations. This result is in agreement with previous observations, for neither the radio-activity of any active product nor the rate of loss of its activity has been found to be affected by its degree of concentration.

It is thus improbable that the energy given out by radium is due to an absorption of an unknown external radiation which is similar in character to the radiations which are emitted. Experiments are in progress to test whether still further dilution of the radium solution produces any alteration in its radio-activity. E. RUTHERFORD.

McGill University, Montreal, December 18, 1903.

Relative Motion and Conservation of Energy.

I HAVE received a letter from a correspondent which has led me to think that certain points connected with elementary dynamics are very obscurely put forward in text-books and in elementary class teaching generally. Of these the following may be taken as examples:—

(1) A river is flowing at three miles an hour. If two steamers are ascending the river, making headway at the rate of three miles an hour, one propelled by the action of paddle wheels or a screw, and the other pulling itself up by means of a chain laid along the bed of a river, the former will have to exert twice the horse-power of the latter, although the resistance overcome and the distance travelled in any given time are the same in both cases. Why is this?

(2) If a man is standing in an express train going at sixty miles an hour, he will have to perform exactly the same amount of work to throw a body of mass 1 lb. forwards with a relative velocity of sixty miles an hour as if he threw it backwards with the same relative velocity.

Yet in the former case the kinetic energy of the mass is increased from 121 to 484 foot pounds, while in the latter it is decreased from 121 foot pounds to zero. The actual work done by the man is in every case 121 foot pounds. This result has the appearance of being in contradiction with the principle of work.

I have known many Cambridge lecturers who, when they attempted to solve problems of a similar character, arrived at very different results. I am able to account for the apparent contradictions of the principle of conservation of energy, although I did not learn to do so from text-books. The majority of readers of NATURE are also, doubtless, competent to explain them in their own way and to their own satisfaction. But a student reared on the conventional text-book cannot fail to think (if he exercises his thinking powers at all on the subject) that the laws of dynamics must be at fault somewhere. G. H. BRYAN.

The Universities and Technical Education.

HAVING just read Prof. Perry's address on "Oxford and Science," I am tempted to give my own views on technical education for the Government service, and especially for the service of India, with which I have been connected since 1869. My qualifications for this discussion are chiefly that I was Director of the Imperial Forest School at Dehra Dun, in India, for five years, and Deputy Director of that school for four years, and during those nine years I always instructed the students personally in one of their branches of study. The excellence of the Dehra Dun Forest School has lately been recognised by the French Government, which has decided to send its Tonquin and Cochin China foresters there to complete their technical training, after having learned European forestry at Nancy.

My experience in India has been that men who have taken university honours degrees in science make the best scientific Government servants, but need special training at a technical college to complete their education for the public service, just as candidates selected for the Indian Medical Service, after receiving a thorough European medical training, complete their education at Netley. The Government of India fully recognises the advantages of a university training for its administrative and judicial service, commonly known as the Indian Civil Service, of which it is the most important branch, also for its Educational and Geological Departments, and the head of the Indian Meteorological Department always comes from a university. Why not also candidates for its Engineering and Forestry Departments? For these important departments, at present, boys are recruited chiefly from the public schools, where they may or may not have acquired the rudiments of scientific knowledge. Surely better candidates could be obtained if the age-limit were raised, and men trained in science and who have obtained an honours degree at a university were taught the technical part of their business at a well equipped Government college, such as the Royal Indian Engineering College, Coopers Hill.

At present there is too much overlapping of studies at technical colleges, and immature students are hurried through their preliminary scientific studies and have not the necessary time to devote to subjects which will form their future life-work. The London medical schools are instances of this. With the best clinical instruction available at the London hospitals, each of these institutions maintains with difficulty a more or less complete staff to teach botany, physiology, &c., which should be taught at a central university. There would be a great saving of expenditure at technical colleges, and much greater efficiency, were the scientific education which is a necessary preliminary to technical knowledge acquired under the distinguished guidance of university professors. By passing through a university, candidates for the higher posts in the Government service would experience the excellent social atmosphere of the university by mixing with men who are preparing for all the different professions and positions in life, and would have a much broader training than is possible at a purely technical college, where there is always the danger of narrow views, and of the overcrowding of subjects of instruction.

I hear that men who have taken a degree at Cambridge in the excellent mechanical school there are readily admitted without paying fees to complete their technical training in large engineering workshops, and surely a wider knowledge of engineering could be obtained at a Government college, such as Coopers Hill, than at any private engineering workshop, where the work done must be of too special a character for Government service. The University of Cambridge does not contemplate being able to turn out finished engineers, but only men preliminarily trained for engineering, neither does it contemplate educating practical foresters, but merely men who have obtained a diploma in the theory of agriculture and forestry. There is a demand in the colonies, as well as in India and Egypt, and by some foreign countries, for English-speaking professors of engineering and forestry, as well as for trained engineers and foresters, and at present the supply of such men is quite inadequate, and frequently these appointments are given to foreigners, simply because properly trained men from our country are not available.

Forestry can be admirably taught at Coopers Hill, with 14,000 acres of the Windsor Forest at our doors, and with examples of forests at Alice Holt Wood, in the Chiltern Hills, and elsewhere, easily accessible by train. The splendid forests of the north of France are within a day's journey, while, after a six months' practical training in the German forests, no forester in the world can be better equipped than are our students. Were our first year students university men instead of schoolboys, America and the colonies would be tempted to send us more students, and one of the finest technical colleges in the world might be easily established.

Coopers Hill, January 1. W. R. FISHER.

Prof. Johannsen on Heredity.

I SHOULD be glad if you would allow me space for some remarks on two recent reviews of Prof. Johannsen's "Erblichkeit in Populationen," in the last issues of *Biometrika* and of NATURE (December 17) respectively, the former signed by Prof. Pearson and Prof. Weldon.

I find it difficult to understand Prof. Johannsen's book in the sense in which the reviewers have, apparently, read it. In both notices it is stated that, if the author's views were correct, the correlation between mother and daughter plants should be perfect. As I take it, however, Prof. Johannsen's view does not imply, and is not consistent with, such a hypothesis; he believes, and adduces evidence to show, that within the pure line "Der Rückschlag ist vollkommen, ganz bis zum Typus der Linie," and explains the result on the hypothesis that the germ-plasm structure (or whatever we may term it) for the pure line is constant, the variations purely somatic. Neither the existence of zero correlation between parent and offspring nor the assumed somatic character of variations, within the pure line, is consistent with perfect correlation between parent and offspring for the race at large. This misunderstanding, in my view, is fundamental.

With reference to the concluding paragraph of the review in NATURE, it may be pointed out that Prof. Johannsen undertook the definite task, clearly stated, of elucidating the nature of intra-racial heredity by the study of heredity within the pure line, *i.e.* the offspring of one self-fertilised individual. He has shown that the intensity of heredity between the first two generations sprung from such a single individual may be vanishingly small, although it is quite sensible within the race at large. The result is of great importance both as regards the theory of heredity and the practice of breeding, and the work cannot be termed in any sense a failure.

One would, certainly, wish that Prof. Johannsen had employed more advanced statistical methods, and one may

(as I do) dissent from some of his conclusions; but the methods he has used are legitimate and sufficient for his immediate purpose, and, in my opinion, the work as a whole is one of the most stimulating contributions to the study of intra-racial heredity published in recent years.

December 22, 1903. G. UDNY YULE.

WITH regard to Mr. Yule's view that there is a fundamental misunderstanding in our notice of Prof. Johannsen's book, we must direct attention to the problem at issue summed up in the words "Der Rückschlag ist vollkommen ganz bis zum Typus der Linie." The character selected for measurement by Prof. Johannsen either fully determines the type or it does not, *i.e.* in the latter case it may be subject to somatic variations having no influence on offspring as Mr. Yule suggests. If it does determine the type, then the correlation between the parent and the mean of the offspring should be perfect, and this it certainly is not. If it does not determine the type, the correlation might be imperfect because the character of the line would not be perfectly known. But since the parental character is in this case not perfectly known, it is clearly impossible for Prof. Johannsen to determine the type, and thus his experiments must fail to show whether the "Rückschlag" is perfect or not. This point is referred to in the reviews cited by Mr. Yule, but it seems to have escaped his notice.

In the next place Mr. Yule *asserts* that Prof. Johannsen has shown that the intensity of heredity between the first two generations sprung from a single individual may be vanishingly small. This is precisely what he has failed to do. To deal with heredity the *same* character must be selected in two successive generations, and this, as pointed out in the review in question, Prof. Johannsen has not attempted.

The remainder of Mr. Yule's letter being neither a reasoned defence of Prof. Johannsen's book nor a criticism of our review calls for little comment; it will command from the reader just that degree of assent which he may be accustomed to give to mere opinion very authoritatively stated. Mr. Yule's estimate of the value of Prof. Johannsen's experiments and statistical methods differs widely from that expressed in our review, but nothing is gained either in criticism or controversy by the mere posing of a rival *ipse dixit*. THE REVIEWER.

The Heat of Radium.

A NUMBER of years ago I published a theory of the formation of the elementary bodies, based on polymerisation and its reversal. The numerics ("atomic weights") of the elements show an increasing accordance with that theory as time goes on.

Of our existing system of numerics the polymerisation points are comprised in the expression $n\,15$; they are, 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180, 195, 210, 225, 240. As chemical change in general exhibits a great tendency to run down, we may fairly assume that most of the earlier reversals have already occurred, and that such as remain will be associated with elements of high numeric.

It is clear that polymerisation must involve the emission of heat, and I am strongly disposed to regard radium (Ra=225) as the product of a "stoff" in the act of polymerisation, the reversal being well indicated by the discharge of helium (He=4).

It is interesting to notice that Sb (=119·5) and Sm (=149·9) are extremely near polymerisation points. It would be worth while to examine compounds of these bodies for emitted heat and gaseous or other matter.

The emanation phenomenon would also appear to be in some way related to the same points. It is, for example, stronger in V (=238) than in Th (=231·7). Both these bodies, and the substances they emit, should be derived from a hitherto unknown polymer (=240) undergoing reversal into simpler bodies. EDMUND J. MILLS.

January 4.

Rocket Lightning.

MY attention has been directed to a letter in your issue of October 22, 1903, describing certain flashes of lightning that were visible on July 22. In many respects the flashes corresponded with flashes seen by myself and friends at the same hour on the same evening, but the discrepancies are remarkable. For instance, Mr. Everett, in the letter referred to, saw flashes "bearing a strong resemblance to ascending rockets, a luminous trail shot up about as fast as, or rather faster than, a rocket," whereas we saw flashes that appeared with about the ordinary rapidity. There certainly was a strong suggestion of ascension, but vertical lightning flashes quite commonly exhibit this appearance, which sometimes at least is due to an optical illusion.

The bearing of the flashes as seen by us, from the verandah of a house in Camac Street, was N. 143° W., and as the Sibpur College bears, from our position, N. 86° W., about 16,500 feet distant, it would be quite easy to calculate the position of the flashes if Mr. Everett had noted their bearing accurately. His description of the bearing as "in the S.S.W." suggests that this is only intended as a general indication of the direction. If S.S.W. were the exact direction, the flashes could only have been 10½ miles distant from Mr. Everett and 12 miles from us, but if the direction were the next point of the compass, S.W. by S., the flashes were 50 miles away. This greater distance is probably nearer the truth, because if the flashes were only 10 or 15 miles distant thunder would have been audible.

Again, the angular altitude of the highest part of the flash is given by Mr. Everett as "15° or so," which does not agree with our observation of 10° or a trifle under, perhaps nearer to 9°. At a distance of even 30 miles there should have been no observed difference of maximum altitude between Mr. Everett's observation and ours.

In other respects the observations tally precisely. The vertical flashes appeared repeatedly in the same position against a background of clear sky, so clear that a star, ζ Centauri, was visible at an altitude exceeded by the flash.

Mr. Everett falls into an error in supposing that the lightning "must have occurred at a spot above the Sunderbunds." The direction of the Sunderbunds is not westerly, but easterly from the Sibpur College, and the flashes must have been over some part of the Twenty-four Perganas if not more than 25 miles away, over the Midnapore district if more than 35.

As to there being "not a score of men in all Bengal who would take a serious interest in such lightning if they did happen to see it," I am not aware of the precise number, and can only vouch for three, the manager of a railway, another competent observer, and myself, who observed together, but I should not be surprised if the flashes were also seen by other observers equally able to record their observations accurately. W. A. LEE.

Calcutta, December 10, 1903.

I GATHER from Mr. Lee's account that he only witnessed one kind of lightning, whereas my son's letter describes two kinds altogether different in appearance. The inference would seem to be that the less brilliant and more unusual kind was not visible in the centre of Calcutta, though visible at Sibpur, probably owing to better atmospheric conditions.

J. D. EVERETT.

11 Leopold Road, Ealing, December 30, 1903.

The Recent Leonid Shower.

THE results of the observations by M. Eginitis of the recent Leonid shower indicate that there was another maximum on the night of November 15, occurring several hours previously to that seen by observers situated in or near the longitude of Greenwich. This early maximum was evidently of a very distinct character at Athens, as the observations showed a regular increase and decrease of meteoric frequency before and after the time of culmination (15–16h., local time), the watch having been prolonged for some hours further, or until 17h. 50m. Athens was evidently too far east to permit observers there taking cognisance of the later outburst of meteoric activity that added considerably to the strength of the shower here. The maximum mentioned by M. Eginitis does not appear to have been very noticeable as such to British observers, though it was anticipated here that that event should occur on November 15 at 13h. 30m. G.M.T., the calculated maximum thus falling within the hour, when we allow for the difference of longitude, during which it was actually observed at Athens. The later maximum came altogether unexpected. It is noteworthy that these maxima seem to have been characterised by quite a distinct type of meteor.

Dublin. JOHN R. HENRY.

CENTRAL ASIAN EXPLORATION.[1]

DR. SVEN HEDIN'S latest book possesses an interest for the great world of travellers which is apart from its intrinsic merit as a traveller's record. The blank spaces of the world's map are becoming so narrow; there is so little left for the exploring enthusiast to mark with his pioneer footsteps, that books of this nature must necessarily grow scarcer as the world grows older. This may be one of the last of a grand series which has educated the world (in divers tongues) since the days of Herodotus. The finger of the North Pole still beckons to us, as does that of the South; there are still a few sand wastes in the interior of Arabia, and a few thousands of forest leagues in the interior of South America which have not yielded up their secrets to the keen eye of scientific inquiry—but that is about all. It is the unattractive emptiness of the wildest and most desolate wastes which still remains to be explored, so that the tale which has yet to be told of them will be told by none but men of the true race of the world's heroes of research—men of the stamp of Peary and Sven Hedin—who explore because, to them, the first acquisition of knowledge of the unknown is the one thing that makes life worth living.

The story that is now told by Sven Hedin is one of stirring personal adventure leading to discoveries in a very old world rather than in a new one, and instinct with the interest of human history. He tells it well, introducing to us the companions of his travels one by one, making us acquainted with their weaknesses and their strength, familiarising us with his surroundings, his horses, and his dogs (and even those usually uninteresting brutes, his camels), until we can see the whole of this little Central Asian caravan moving across the deserts and through the mountain defiles as if we were one with them, hoping their hopes, fearing their fears, and deploring with them the loss of those brave helpers who fall by the way. No novel could carry the reader along with the course of its plots and its evolutions until the final dénouement more completely. Sven Hedin is a good English scholar himself, and he is to be congratulated on his choice of a translator. Very few books of travel written, as this is, in diary form avoid the Scylla of dulness without wreck on the Charybdis of untruth. A little poetic licence is usually necessary to enliven the narrative. But here any man who has seen anything of those remote Asiatic fields which Sven Hedin describes, recognises at once the atmosphere of absolute truthfulness in which the drama moves. There is not a risk incurred, not a danger (and the whole record is full of them) escaped, which is not the natural sequel of the daring conception of each phase of the three years' journeying—not one which any traveller could reasonably have hoped to avoid had he marked out for himself Sven Hedin's expeditions with Sven Hedin's courage.

His first enterprise, the voyage down the Tarim River, to its ending in the desert, illustrates the marvellous patience and pertinacity of the man. To most people it would have been enough to glide gently down the stream watching the changing lights and shadows and the glorious autumn tinting of the poplar woods, and to have made a record at the end of each day's run of its general direction and its terminal latitude. This was not good enough for Sven Hedin. Hour after hour he sat at his work in the boat, mapping each turn, each curve, in the twisting, winding stream, noting its depth, the strength of its current and its peculiarities, until sometimes sixteen hours a day of intermittent work was achieved without once leaving his table. If genius is an "infinite capacity for taking pains," then indeed does Sven Hedin possess that desirable attribute. It must be noted, too, that in a desert like that of the Takla Makan, such natural hydrographic features as exist must inevitably change almost from year to year. There is no more permanency about the course of the Tarim River than there is about the "locus" of Lop Nor. All Sven Hedin's magnificent map making may require serious correction within the next few years.

The very centre of interest in Central Asian geography lies in the Lop Nor region. The former existence of a high road across the desert connecting the outlying city of Western China, Sachow (Saitu), with Yarkand and Kashgar by a route skirting the northern spurs and outlying ridges of the Altyn Tagh (Astyn Tagh, according to Sven Hedin) to Cherchen, and

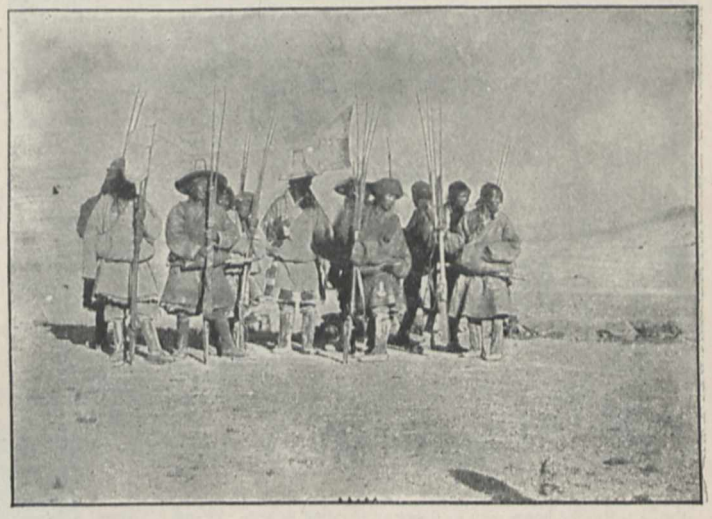

FIG. 1.—Tibetan Soldiers. (From "Central Asia and Tibet.")

thence following the Cherchen River until it again touches the northern foot hills of the Kuen Lun, and thus extends itself to Nia and Khotan, has long been recognised; but we must now accept the theory of a more direct road westward connecting Sachow with the ancient city of Lou Lan, so well described in Sven Hedin's book. Lou Lan was a small and independent State in the early centuries of our era, dovetailed as a buffer between China and the Turkish Hun tribes, who together appear to have rendered its political life as uneasy as more modern buffer States have found such a life to be. That this isolated State existed only by grace of the existence of the Lop Nor Lake is sufficiently proved by its total disappearance when the waters of Lop Nor (the old bed of which lake is placed further north by Sven Hedin than our existing maps show it—about midway between the Altyn Tagh on the south, and the Kurruk Tagh on the north) shifted southward. This was no case of sand burying. The whole water supply of the district gradually withdrew to another position, forming new lakes on the inconceivably flat surface of the desert some fifty miles away; and the extraordinary feature about this move-

[1] "Central Asia and Tibet." By Sven Hedin. Vol. i., pp. xvii+608; vol. ii., pp. xiv+664. (London: Hurst and Blackett, Ltd., 1903.) Price 42s. net.

ment is that the lakes which were so formed appear now, after many centuries, to be in the process of transferring themselves once again to their old place, the place which was assigned to them in early Chinese maps.

It is characteristic of the thoroughness of the work of this great traveller that he actually levelled the land surface between the ancient Lop Nor depression and the Kara Koshun (the present lake bed), and has proved beyond dispute the theory of a migratory, or moving, lake. That Lou Lan was Buddhist is sufficiently attested, not only by the nature of the relics discovered on its site, but by the peculiar construction of those solid brick erections which Sven Hedin calls towers, but of which the photographs quite clearly indicate the nature. They are Buddhist topes or stupas. Thus we have another link in the long chain of Buddhist centres (temples and holy places) stretching from Western China through the deserts, past the group of towns unearthed by Stein, broken for a space by the intervening Himalayas, and then recommencing in the valleys of Gilgit, Darel and Swat, until it ended in the valley of Peshawar.

The last part of Sven Hedin's story is devoted to his gallant but unsuccessful attempt to reach Lhasa. Beyond doubt he was betrayed by the Mongol pilgrims whom he encountered early in his journey. The Lhasa authorities were fully informed, and the attempt was foredoomed to failure. None the less was it a most instructive journey. It hardly needed the evidence of the distinguished traveller to prove that Tibetans possess civilised and humane instincts. They do not necessarily ill-use a casual visitor to their country who can make himself intelligible and agreeable, but they will not admit the European within the gates of their holy city—if they can help it. We now have more material with which to construct the maps of that dreary, storm-swept, inhospitable waste which lies between the Altyn Tagh and the oasis of the Sanpo (Brahmaputra). The identification of the ancient bed of the Lop Nor and the site of Lou Lan; the elimination from our maps of the Gobi Mountains and the eastern extension of the Kurruk Range; the detailed survey of the Tarim River and the determination of the levels of the desert surface south of Lop Nor, together with the results of a vast area of geographical research on the north coast of Tibet, are records of which even Sven Hedin may be proud. To the world at large he is already known as a great geographer and an intrepid explorer. Hereafter he will be recognised as a most fascinating writer even by those who care little for geography.

T. H. H.

FIG. 2.—Ruined house with its doorway standing *in situ*. (From "Central Asia and Tibet.")

WATER SUPPLY AND IRRIGATION IN THE UNITED STATES.

FOR the last fourteen years very great attention has been paid by the Geological Department of the Government of the United States to the water resources of the country, and in acquiring trustworthy information as to the same.

There has recently been issued from the Government Press at Washington fifteen volumes of reports, and water supply and irrigation papers, bearing on the yield of the rivers, the various methods adopted for gauging the flow and obtaining sectional measurements, artesian wells and the flow and yield of underground water, the means adopted for storage, the use of water for the supply of towns for irrigation and for power purposes, and the pollution of rivers from sewage and other causes.[1]

The greater part of these reports is taken up with records of the observations of the staff engaged in measuring the rivers in the different States and obtaining information as to water supply, which, although mainly of use to engineers in the United States, might also be interesting and instructive to those engaged in the water supply of this country.

The report No. 76 by Mr. Pressey on the flow of rivers in the vicinity of New York State is of special interest, as it deals in a comprehensive manner with the methods adopted for obtaining trustworthy information as to the yield of rivers, and gives details as to the methods adopted for obtaining the measurements necessary for the purpose.

The author of this report considers that one of the chief resources of the United States consists in its water. The prominent industrial position of several States is due largely to the abundance of available water, and the rivers with their great water power have been in the past, and will continue to be in the future, a perpetual source of wealth. Contrary to what might have been expected, Mr. Pressey is of opinion that there never was a period in the history of the United States when the development of water power has made such strides as recently, the increase in the utilisation of water power for the period 1890–1900 being 30 per cent., or 472,361 horse power. In the State of Maine the developed power increased 60 per cent.

The rivers as water suppliers are also of inestimable value in the arid regions of the coastal States, where without an artificial supply of water there cannot be any vegetation, and where large areas have been reclaimed and made into agricultural land of great fertility by storing and distributing the water over their soils. This subject was shortly dealt with in the notice in NATURE of April 30, 1903, on the irrigation in the Western States of America, and of the report of the Mexico College of Agriculture in NATURE of August 27, 1903.

The Geological Department has for the last fourteen

[1] Copies of these reports may be obtained through Messrs. King and Son, Great Smith Street, Westminster.

years been engaged in ascertaining the value of the rivers as water suppliers and in furnishing information upon which to base estimates of the available supply. The want of this information has frequently led to the most disastrous mistakes in the construction of hydraulic works. From ignorance of the hydrographic condition of the drainage basin of the stream, and of the region in which the stream is located, engineers have in many cases been misled by the only information available, that of the "oldest inhabitant," which may be trustworthy as to the highest level to which the water has reached in floods, but is frequently very misleading as to the low water conditions of the river. Amongst other instances recorded is one where, after an expenditure of 32,000*l.* in hydraulic works by a town where it was expected the water from a neighbouring river would be capable of developing 14,000 horse power and cause it to become a manufacturing centre, it was found that the estimate had been based upon a miscalculation as to what the river could yield to the extent of 500 per cent.

Even where statistics as to the rainfall are available, these may be very misleading so far as the yield of the drainage area is concerned unless checked by stream measurements. An instance is quoted where a calculation of the minimum yield of a river in one of the States was made independently by five experienced engineers, the quantity varying from 0·20 to 0·40 cubic foot per second per square mile.

The various forms of floats used to determine the velocity of streams are discussed in the report. For reconnaissance works surface floats have been found most convenient and approximately trustworthy. Rod floats consisting of cylindrical tubes or wooden rods 2 to 3 inches in diameter, weighted at the bottom, are considered as more trustworthy than double floats having the subsurface float connected to the upper one by a silk cord.

The current meter, on the whole, has been found to be best adapted to the general measurements made in the United States Survey. One method of using this

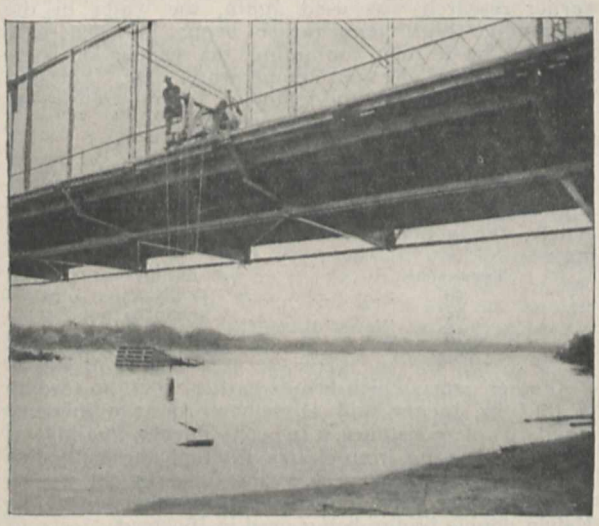

FIG. 1.—Current Meter in Use, Suspended from a Bridge.

in a wide channel is shown in the illustration (Fig. 1). In the second illustration (Fig. 2) the measurements are shown as being taken from a cable having 200 feet span placed across the stream, and supported on the right bank by timber shears 25 feet high, and on the left side anchored to a large buried oak.

As the result of a great number of observations it has been found by the United States surveyors that the mean velocity of a stream is generally found to be at six-tenths of the depth of the water measured from the surface for wide shallow rivers, which figure should be increased to two-thirds in the case of canals and flumes or narrow natural channels. The velocity generally increases from the surface downward to

FIG. 2.—Cable and Car used to Measure Discharge of River.

about one-tenth of the depth, and then decreases to the bottom, where it reaches the minimum.

Where more than one observation was made upon the channel, the ratio between the surface and mean velocities in a stream was found, on the average of a number of experiments in different rivers, to be 0·88 of the mean of the surface velocities taken in the vertical in which the floats were run. Where only one surface float was used in the centre of the river, the coefficient was on an average found to be 0·80. The chances of error are greater where only one float is used. For shallow depths of from 3 to 8 feet the coefficient for the mean velocity varied from 0·92 to 0·82. For large deep rivers, such as the Mississippi, Humphrey's and Abbot's observations gave a coefficient of 0·98.

Measurements are also recorded of the flow of water under ice. The observations were made by cutting holes large enough to admit a current meter. In an ice-covered channel a decided drag occurs at the surface as well as at the bottom. Two points of mean velocity were found to exist in the vertical at about 0·13 and 0·73 of the depth, the maximum being at 0·35 of the depth. The best result was obtained by holding the current meter at two-thirds of the depth and applying a coefficient of 0·95 to the observed velocity at that point.

For providing uniformity in the reports of the various observers as to the quality of the water, the following standard of turbidity was used for field observations. The figure 100 was taken to represent a water containing 100 parts of silica per million, in such a state of fineness that a bright platinum wire one millimetre in diameter can just be visible when the centre of the wire is 100 millimetres below the surface of the water, the eye of the observer being 1·20 metres above the wire, the observation being made in the middle of the day, in the open air, but not in sunlight.

For taking observations a graduated rod with a platinum wire projecting from it at right angles was

used (Fig. 3), on which the graduation mark of 100 is placed on the head at a distance of 100 millimetres from the centre of the wire. When this rod is immersed in water the visibility of the projecting wire at the depth from the surface determines the degree of turbidity according to a scale given in the report. This varies from a turbidity of 7 degrees at a depth of 1095 millimetres to 100 degrees at 100 millimetres depth, 1000 degrees at 21 millimetres, and 3000 degrees at 12 millimetres. When platinum wire is not easily obtainable a clean bright pin will serve the purpose, and where observations cannot readily be made in the stream, a pail or tub filled with the water may be used, the diameter of which should be twice the depth at which the wire is immersed. Where the turbidity is more than 500, that is, where the wire cannot be seen through an inch of water, the water to be gauged should be diluted with clean water, the turbidity being multiplied by the ratio that the total volume of water bears to the water in the mixture.

In report No. 67, on the motion of underground water, by Mr. S. Slichter, it is stated that the lowest theoretical limit at which ground waters can exist is reached when the pressure in the rocks, due to the weight of the superincumbent material, is so enormous

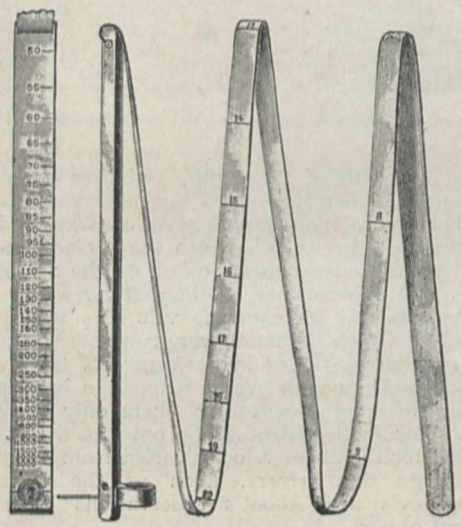

FIG. 3.—Folding Turbidity Stick.

that all cavities and pores are completely closed. This limit, it is calculated, is reached at 6 miles. The land surface of the globe covers 52,000,000, and the water surface 144,700,000 square miles. Taking the average pore space of the surface rocks occupied by water or moisture at 10 per cent., the amount of ground water is estimated at 565,000 million million cubic yards.

On this basis the underground water would be sufficient to cover the entire surface of the earth to a uniform depth of from 3000 to 3500 feet. The ground water is estimated to be about one-third the amount of the oceanic water.

The rate of movement of water through soil and rocks depends on the size of the pores of the water-bearing medium and the pressure gradient or head due to gravity. All rocks are more or less pervious to water. The porosity of quartz sand varies from 30 to 40 per cent. of the bulk. Sandstone rocks fit for building purposes contain from 5 to 25 per cent. of porosity, limestone from 1 to 13 per cent., while granite has about one-half per cent.

The water contained in porous soils and rocks possesses a slow but definite motion, and moves in an underground current for the same reason that water moves in surface streams, flowing from a higher to a lower level.

The flow varies as the square of the size of the grains of soil, and so if the size of the soil grain be doubled, the flow of water is quadrupled.

American experience agrees with the result arrived at by French engineers that the average velocity through sands is about a mile a year.

The general trend of moving underground water under the influence of gravity is into the neighbouring streams and lakes, but the geological conditions may be such as to force the water above the surface of the ground and form springs, or it may take a general course down the thalweg and towards the sea within the porous medium itself, and so constitute an underground stream at great depth and several miles in breadth.

THE WORK OF THE REICHSANSTALT.[1]

THE third volume of the *Transactions* of the Reichsanstalt was noticed in these pages some two and a half years ago. The part under review at present gives an account of the larger researches which have gone on since that date, and affords ample proof of the fact that the staff of the institution has no intention of departing from the high standard of accuracy and excellence we have learnt to expect in their work.

As in the previous volume, the first paper deals with the work of the director of the second division, Dr. Thiessen, who has continued his researches into the dilatation of solids and liquids, and has determined the dilatation of water from 50° C. to 100° C., thus completing his study from its freezing point to its boiling point.

The range from 0° C. to 40° C. had been covered by Chappuis, and the small differences between his results and those of Thiessen were noted in our former article (NATURE, April 25, 1901).

The method of balancing columns employed in the earlier research was used again, the water in the column at high temperature being in each case jacketed by a tube containing the vapour of some liquid boiling at that temperature. Dr. Thiessen shows that above 25° the following formula represents the results with considerable accuracy:—

$$\rho = 1 - \frac{(t-3{\cdot}98)^2}{568290} \cdot \frac{t+343}{t+72{\cdot}75},$$

while, to continue the table given in our previous article, the actual densities found were the following:—

Temperature				Density
56°	...	...	...	0·985243
65°	...	...	...	0·980594
78°	...	...	...	0·973068
100°	...	...	...	0·958380

Another paper which brings earlier work up to date is that by Jaeger and Dieselhorst on the mercury standard of resistance. In consequence mainly of difficulties arising from electric traction, the method of comparing the resistances of the tubes by the use of the differential galvanometer has been abandoned, the Kelvin double bridge being used in its stead.

Calling M the mean of the resistances of four manganin coils of about one ohm resistance, we have the following series of values:—

Nov. 1893	M = 1·001737	ohms at 18° C.		
June 1895	M =	37	,,	,,
June 1897	M =	44	,,	,,
March 1903	M =	48	,,	,,

[1] "Wissenschaftliche Abhandlungen der Physikalisch-Technischen Reichsanstalt," vol. iv. part i.

The greatest difference between the value of M determined by observation on any one tube and the mean is 15·5 parts in one million, while the greatest change that has taken place in the value of any one of the manganin standards of the first division relative to the tubes is 45 parts in one million.

Dr. Scheel has an interesting paper on the expansion of solids, describing a series of experiments using the Pulfrich form of the Fizeau dilatometer. The method leads to results of great accuracy for expansions at temperatures up to that of the boiling point of water; it is interesting to note that for Berlin porcelain, the expansion of which is of importance in connection with its use in the air thermometer, the author confirms the result of Chappuis and Harker. Holborn and Gruneisen had found that at high temperatures, say 600° C., the expansion is much less than would be inferred from a formula extending over a range from 0° C. to 100° C. In this respect the porcelain resembles fused quartz.

In another paper Lummer and Gehrcke discuss in a very complete manner the optical properties of dispersion apparatus of high resolving power, while reference must be made to two papers, on the scattering of particles from heated metallic surfaces, especially those of the platinum group, and on the scattering of particles from kathode surfaces in a vacuum.

It is clear from this brief notice that the range covered is a wide one, and that the Reichsanstalt is still continuing to advance our knowledge in a notable degree.

RECENT GEOLOGICAL OBSERVATIONS IN CAPE COLONY.[1]

WHEN Dr. Edward Brown, in 1669, carried the fame of the Royal Society across Europe, and quietly pursued his antiquarian inquiries, he remarked that there were "Wars at that time when I was in this Country, between the Elector Palatine and the Duke of Lorrain." In a similar spirit, the geologists of the Cape Commission have continued their conscientious work in a land divided and subdivided against itself, merely transferring their activity to the Transkeian Territories, when geological observation became incompatible "with the necessities of Martial Law" (1901 report, p. 4). The course of a struggle which at one time threatened the Empire is referred to as "the military problem"; the serene permanence of scientific work has seldom been more aptly illustrated.

The region to which the assistant geologists were temporarily exiled lay on the south-east coast of Cape Colony, between the Great Kei River and the frontier of Natal, in native territories where military rule was not proclaimed. In the spring of 1901, however, observations had been rendered possible nearer headquarters, in the divisions of Swellendam and Riversdale. These led to some corrections of the map issued in 1897. Messrs. Rogers and Schwarz point out how the possibly Cretaceous Uitenhage series can often be distinguished from the overlying gravels only by the occurrence of fragments of a quartzite in the latter. This quartzite is a well marked rock that caps the Uitenhage series unconformably.

The same authors, who then formed the field-staff of the survey, describe the general features of the lands examined beyond the Skei. Unlike the western portion of the Colony, there are here no folded mountains near the coast, and the moisture-laden air from the sea penetrates in consequence far inland. The rivers come down from the Storm Bergen and Drakensberg ranges, and cut steep valleys through the vast steps formed by successively elevated "coastal plains." From the coast inwards, we may move along the edge of the same stratum, on the line of strike of a great synclinal. Starting from its axis, about the mouth of the Kei River, older and older beds are met with as we go north-east. In Kentani, the first division, the igneous intrusive masses are so abundant as to obscure the stratified deposits of Karroo age, and seem (p. 31) to have eaten up the latter in making a place for themselves in the crust. The variations from dolerite to granite appear to have originated in a single magma. On nearing Pondoland, the Dwyka Conglomerate, of Lower Karroo age, and always important as a lithological horizon, occurs with its characteristic glaciated boulders. The Table Mountain Sandstone of the Cape system comes out uncrumpled from beneath it. The most interesting work done in Pondoland was the more detailed examination of the Cretaceous beds, already brought to notice by Baily and Garden in 1855, and by Griesbach in 1871. The lower layers contain rolled chelonian bones, and were deposited in shallow water. Among the "superficial," or post-Cretaceous, beds of Kentani is (p. 66) a fossiliferous quartzite of fresh-water origin.

The report for 1902 sees Mr. Rogers installed as acting or chief geologist in place of Dr. Corstorphine, who has been tempted northwards. Mr. A. L. du Toit, himself a colonial, as we are happy to observe, joins the staff as an assistant. The main work for 1902 lay in Matatiele, up against the Drakensberg Range, and still in native territories. The intimate connection of volcanic energy with the range is shown by the discovery of a chain of nineteen vents, in addition to five recorded to the south-west by Mr. Dunn as far back as 1878. They are filled with dolerite or agglomerate, the latter consisting largely of blown-up sedimentary material. The lavas that flowed from them, in Jurassic times, over the upper beds of the Karroo system, have been weathered away on the south-east, but are preserved upon the north-west slope. Mr. Schwarz points out (report for 1902, pp. 51 and 60) how the trend of the volcanic line is related to persistent north-east and south-west axes of folding, which have determined in the past the coast-line of this part of Africa. The old eastern continent had receded, by Jurassic times, as far as the line of volcanic vents; a later uplift must have been followed by subsidence, whereby the present Transkeian coast-line was determined. The edge of the Drakensberg plateau may thus be regarded as the crest of a uniclinal fold, the native territories lying on the lower limb.

The strata encountered range down from the "Cave Sandstone," which may be partly of explosive origin, to permo-Carboniferous beds. All these are included in the convenient but too comprehensive Karroo system (p. 103), though the upper zones may be as modern as the Jurassic period. Indications of reptilian remains are already known (p. 32). The "Molteno beds," more recent than the famous Theriodont horizons of the Karroo system, contain thin coals and oil shales. The natives at present use ox-droppings for fuel, and thus deprive the poor soil of a valuable fertilising agent.

Work was also done in the typical Karroo district, south of the Nieuweveld escarpment, where new discoveries of Pareiasaurus have resulted. Considerable pains have been taken to place the collections of the Commission in the hands of specialists for determin-

[1] Cape of Good Hope. Department of Agriculture. Annual Reports of the Geological Commission for 1901 and 1902. (Cape Town: *Cape Times* Ltd., Government Printers, 1902 and 1903 respectively.)

ation, and no one who has seen the development of the reptilian material from its matrix under the care of Prof. H. G. Seeley can regret that certain specimens, at any rate, have travelled across the sea to England. G. A. J. C.

THE CLIMATE OF SOUTH AMERICA.[1]

IN the volume mentioned below, all the mean values of the meteorological elements which constitute the climate of the country in question are brought together, these values being deduced from a long series of observations terminating with the year 1900. When it is mentioned that the country embraces 33° of latitude, the surface of which slopes from the shores of the Atlantic on the east to the snow-clad summits of the central range of the Andes on the west, the reader must not be surprised if he finds great differences in the atmospheric conditions that prevail in the various parts of the Republic.

A thorough knowledge of the changes in the meteorological elements in this the South American portion of the globe will prove of great importance to us dwellers in the Old World, for although we are separated so widely as regards distance, we are intimately connected meteorologically. It is quite within the bounds of possibility that our great dependency India and the region about it (and indirectly the British Isles and Europe generally) may be able to check their long period forecasts on observations made in the Argentine Republic.

In this volume an English translation accompanies the Spanish text, so that the book is available to those who cannot read the latter language. In addition to the numerous tables showing the mean daily and annual variations of the elements, accompanied by an excellent statement in each case, Prof. Davis has given a set of twenty-six plates which illustrate graphically not only these variations, but the mean conditions which prevail over this extensive area.

For many of the elements the monthly and yearly values for each year since the commencement of observation are included, but an omission is made in the case of atmospheric pressure. Recent investigations have indicated that the variations from year to year over the South American continent, more especially about the region of Cordoba, are the inverse of those about the region surrounding the Indian Ocean, that is, when the mean pressure for the year is high in Cordoba it is low in India; the insertion of the pressure values in this volume for one station, namely, Cordoba, would have been very useful.

For climatological reasons it is necessary to study the readings of many barometers well scattered over a country, hence the statement on p. 45 that "observations of atmospheric pressure, however complete, are of little practical value if confined to a single place. . . ." It is important, however, to bear in mind that complete series of barometric observations at two stations, one set to check the other, are quite sufficient in many parts of the world to study the changes over large areas from year to year.

The publication of this volume will undoubtedly be welcomed by meteorologists and those who wish to make themselves acquainted with the weather of the region surveyed, and the very complete manner in which the information has been brought together in this convenient form should add to its usefulness.

W. J. S. L.

[1] "Climate of the Argentine Republic." Compiled from Observations made to the end of the Year 1900. By Walter G. Davis, Director of the Argentine Meteorological Office. Pp. 154; 26 plates. (Published by the Ministry of Agriculture.)

NOTES.

A CIRCULAR signed by Prof. A. Tonelli and Prof. V. Cerruti announces that it is proposed to erect a memorial in honour of the late Prof. Luigi Cremona, professor of higher geometry in the University of Rome, and director of the engineering school. The fame of Prof. Cremona is world-wide, and his works have exercised a great influence on research in fields of pure and applied mathematics. It is intended that the monument to his memory shall be an international one; and the hope is expressed that all who have been inspired by his discoveries, or have regard for his genius, will contribute to the fund being raised. Subscriptions should be sent to Signor I. Sonzogno, Piazza San Pietro in Vincoli, 5, Rome.

AT a meeting of the Bath Town Council on Tuesday, mention was made of the fact that helium has been found in gases from the largest and perhaps the best known of the city's hot mineral springs, the King's Bath. The deposits that collect in the tanks and pipes at the three springs have also been investigated. A few weeks ago a quantity of the deposit from the new Royal spring was obtained and sent to the Hon. R. J. Strutt, who, in a communication to the Baths Committee, remarks:—"My experiments have led to some conclusions which may, I hope, interest the committee. I have found that the deposit contains radium in appreciable quantities, though I am sorry to say not enough to pay for extraction. It will be remembered that the gas which bubbles up from the springs contains a small proportion of helium. Sir William Ramsay has recently made the most important discovery that radium slowly evolves helium by a spontaneous change. I think there can be little doubt that the helium of Bath owes its origin to large quantities of radium at a great depth below the earth's surface. A little of this radium is carried up by the rush of hot water and is found in the deposit. My experiments promise further interesting developments, which I shall have much pleasure in bringing to the notice of the committee in due course."

A MEETING was held in the house of the Zoological Society on Tuesday to consider proposals for the organisation of zoologists. Forty-one zoologists from England, Scotland and Ireland attended the meeting. The following resolution was carried by a large majority:—"That it is desirable that the zoologists of Great Britain and Ireland be organised for the consideration of all matters affecting the interests of zoology and zoologists, and to take such action as may seem desirable." A committee consisting of Prof. Cossar Ewart, Prof. Bridge, Prof. Hickson, Dr. Scharff, Dr. G. C. Bourne, Dr. Ridewood, and Mr. Cunningham was appointed to draw up a scheme.

WE are glad to see among the New Year honours gazetted by the India Office the name of Dr. W. T. Blanford, F.R.S., who has been made a Companion of the Order of the Indian Empire. Dr. Blanford, whose services to Indian geology and zoology are known to all our readers, joined the Geological Survey shortly before the outbreak of the mutiny, and is one of the few civilians entitled to wear a Mutiny medal.

ON New Year's Day we had the pleasure of inspecting a series of the well-known animal photographs of the Messrs. Kearton now being exhibited to the public at 175 Bond Street. All these reproductions from the original photographs have been considerably enlarged, although not to such an extent as to impair the sharpness or blur the

details. The owners are to be congratulated, not only on the general character of the exhibition, but likewise on the fact that none of the photos have been "touched up." Mr. Cherry Kearton specially prides himself on the photo of a great crested grebe on her nest, which took seven days' watching before it could be secured.

SIR WILLIAM RAMSAY, K.C.B., will, we learn from *Science*, give a course of lectures during the summer session at the University of California on "The Constituents of the Atmosphere and the Emanations from Radium."

THE year 1905 being the tenth anniversary of Röntgen's discovery of the X-rays, it is proposed to commemorate the occasion by holding in Berlin a Röntgen congress, together with a Röntgen exhibition. Information regarding the arrangements will be obtainable from Prof. R. Eberlein or Dr. Immelmann, of Berlin.

A SPECIAL meeting of the Berlin Geographical Society will be held on January 13 to greet the members of the German Antarctic Expedition and receive the report of Prof. E. von Drygalski on the course and results of the expedition. An address will be given by Prof. Vanhöffen on the fauna of south polar regions.

ON Tuesday next, January 12, Prof. L. C. Miall will commence a course of six lectures at the Royal Institution on the "Development and Transformations of Animals." On Thursday, January 14, Mr. G. R. M. Murray will deliver the first of three lectures on the "Flora of the Ocean," and on Saturday, January 16, Mr. J. A. Fuller-Maitland will begin a course of three lectures on "British Folk-Song." The Friday evening discourse on January 15 will be delivered by the Right Hon. Lord Rayleigh, his subject being "Shadows"; on January 22 by the Rev. W. Sidgreaves, on "Spectroscopic Studies of Astrophysical Problems at Stonyhurst College Observatory"; and on January 29 by Mr. D. G. Hogarth, on "The Marshes of the Nile Delta."

CAPTAINS S. P. JAMES AND W. GLEN LISTON, of the Indian Medical Service, write from Simla to point out that the third volume of Mr. F. V. Theobald's work on the Culicidæ contains reproductions of portions of plates which they have prepared for a monograph on Indian Anopheles, and that statements are made in a number of cases without reference to the work of the individual observers upon whose results they are based. We have referred the matter to Mr. Theobald, who writes:—"I much regret that the plates and information to which they refer should have been published without acknowledgment in my book. The omission was due entirely to inadvertence, occasioned by the press of matter calling for record in the work. Steps are being taken to remedy the error."

WE learn from *Science* that the following Bill has been introduced into the U.S. House of Representatives and referred to the committee on coinage, weights and measures:—"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That on and after the first day of January, nineteen hundred and five, all the Departments of the Government of the United States, in the transaction of all business requiring the use of weight and measurement, except in completing the survey of public lands, shall employ and use only the weights and measures of the metric system; and on and after the first day of January, nineteen hundred and six, the weights and measures of the metric system shall be the legal standard weights and measures of and in the United States."

THE Australian mail has brought the report of the meeting of the Linnean Society of New South Wales on November 25 last, from which we learn that the chairman made a preliminary announcement respecting the Macleay fellowships endowment—the late Sir William Macleay's last and crowning benefaction to science. Subject to a life-interest in the principal on the part of his widow, lately deceased, Sir William bequeathed to the Society the sum of 35,000*l.* for the foundation and endowment of research fellowships, tenable by graduates in science of the University of Sydney upon certain conditions specified in the testamentary directions. On October 24, 1903, the executors paid to the Society the sum of 33,250*l.*, which the council has since invested at 4 per cent. per annum. The council does not expect to be in a position to make appointments to the fellowships before about the middle of this year.

THE *Times* publishes the following communication from its Madrid correspondent:—"In anticipation of the total eclipse of the sun of August, 1905, the papers are beginning to urge the Government to include in the estimates for 1904 an item providing for a scientific mission of Spanish astronomers to be sent abroad, in order to study in foreign observatories the latest methods of investigating the phenomenon. For the eclipse of 1900 the Cortes voted 190,000 pesetas, but the measure was taken so late that the money was spent at a loss. It may be mentioned that the zone of about 200 kilometres covered by the eclipse of 1905 traverses Spain from Galicia and Asturias to Valencia and Castellon. The northern coast between Coruña and San Vicente de la Barquera, and the eastern from Valencia to the Gulf of San Jorge will be included in the zone of total obscurity. Observers at Ferrol, Lugo, Oviédo, Gijon, Léon, Palencia, Burgos, Soria, Teruel, and Saragossa will have some four minutes in which to make their observations. Madrid lies to the south of the zone of total eclipse. It would be well if foreign astronomers would lend their sympathy to Spanish students to facilitate the preparations for the most effective utilisation of these precious moments."

WITH the daily weather report for January 1 the Meteorological Office issued a small subsidiary chart showing the total rainfall in 1903 at those stations which report by telegraph, together with the percentages of the average annual fall for the thirty-five years 1866–1900. The chart shows very clearly the general distribution of the rainfall of the year, so far as it is represented by the stations referred to. The greatest fall, 67 inches, occurred at Valencia, 120 per cent. of the yearly average. At Stornoway the amount was 62 inches, 133 per cent. of the average (46·62 inches), this latter value being nearly 10 inches less than the normal fall at Valencia. The smallest falls occurred on the east and south-east coasts of England; at Yarmouth the rainfall was only 24·83 inches, 95 per cent. of the average (26·40 inches). The greatest percentage *excess* was registered in London, the aggregate amount being 38 inches, 156 per cent. of the average annual fall, and at Oxford the rainfall amounted to 142 per cent. of the average. At Greenwich (not shown on the chart) the rainfall for the year was 35·58 inches, being 11·43 inches above the average for sixty years; there were 184 rainy days. The previous largest fall there in this period was 34·01 inches in the year 1852.

SOME of the smaller shell-fish, especially cockles, have recently been found to be grossly contaminated with sewage. These fish form a staple article of diet among the poorer classes, and since they are cooked before consumption, it might be thought that the bacillus of typhoid fever would

be destroyed and the molluscs rendered harmless thereby; but this cooking is a very perfunctory process, and consists in plunging netfuls of the live fish, the shells of which are tightly closed, into a vessel containing boiling water. The immersion of the cold mass immediately lowers the temperature, and when, in the course of two or three minutes, the water begins to boil again, the nets are lifted out. The scalding kills the fish and causes the shells to open, but does not sterilise the contents, and fish that had been kept in typhoid polluted water were found to be swarming with live bacilli after this process of cooking. Prolonged boiling would be effective, but causes the fish to shrivel and spoils them for sale. Dr. Klein suggested that cooking by steam might be found to sterilise efficiently without spoiling the fish as food, and some experiments have recently been carried out for the Fishmongers' Company with a view to test this. Two batches of molluscs were cooked, one for ten minutes and the other for five. The steamer used was a vessel two feet deep, the fish being distributed in three layers on trays, the steam being introduced by a pipe about an inch from the bottom. The results were:—ten minutes, mussels spoilt and useless, cockles all right in upper layer, bottom layer overcooked; five minutes, mussels all right, and also two upper layers of cockles, but bottom layer of cockles less satisfactory. The bacterial results were that the cockles proved to be sterile in all cases. The mussels were also sterile, except some in the top layer steamed for five minutes, which still contained some living spores. As a result of these experiments the Fishmongers' Company feels justified in strongly recommending a substitution of steaming for boiling to the trade.

DISCUSSING the subject of nuclear division without cell division, Mr. Ralph Lillie suggests that mitosis is an incidental consequence of the passage of the chromatin into the strongly acid and chromatic phase. This change, he believes, involves the acquisition by the chromatin of a negative charge of considerable potential, as a result of the inductive action of which there ensues a redistribution of the ions in the cytoplasm with the production of certain differences of electrical potential. To these potential differences are due the appearance of the astral radiations and the diminution of surface tension that leads to cleavage (*Biological Bulletin*, vol. iv. No. 4).

IN a paper in the *Technology Quarterly* (vol. xvi. No. 3) Messrs. C. E. A. Winslow and C. P. Nibecker discuss the significance of bacteriological methods in sanitary water analysis. They consider that the real application of chemistry begins where that of bacteriology ends. When pollution is so gross that its existence is obvious and only its amount need be determined, the bacteriological tests will not serve on account of their excessive delicacy. In studying the gross pollution of streams, treatment of trades' wastes, and purification of sewage, the relations of nitrogenous and oxygen compounds are of prime importance, that is, when pollution is to be avoided because the decomposition of chemical substances causes a nuisance, it must be studied by chemical methods. When the danger is that of infection, and arises only from the presence of bacteria, bacteriological methods furnish the best index of pollution. With regard to methods, the authors express a preference for the use of the fermentation tubes, and of gelatin, and of lactose agar, plates.

THE secretary of the Durham College of Science, Newcastle-upon-Tyne, writes to supplement the remarks respecting the conditions on which women can obtain degrees in the University of Durham, contained in an article on the higher education of women published in our issue of December 24, 1903. Residence in Durham is necessary only for women proposing to take a degree in arts of the Durham University; for Durham degrees in science, medicine, &c., attendance at the Durham College of Science and the University of Durham College of Medicine is the qualification, and there are many women undergraduates at these colleges in Newcastle-upon-Tyne.

IN the December number of the *Zoologist* Mr. A. H. Cocks discusses the length of the period of gestation in the badger, which he is inclined to think is nearer a twelvemonth than the four and a half months assigned to it by Mr. Meade-Waldo.

THE homology and classification of the tines developed in the crown of the antlers of the Carpathian red deer form the subject of an article by Dr. E. Botezat in Gegenbaur's *Morphologisches Jahrbuch* (vol. xxxii. part i.). In an appendix the author records the existence of what he regards as two local races of the species, for which the names *Cervus vulgaris campestris* and *C. v. montanus* are proposed. It may be pointed out, in the first place, that *C. vulgaris* is not the name of the red deer, and, in the second place, that *C. v. campestris* is preoccupied by *C. campestris*, one of the names of the South American pampas deer.

Bulletin No. 41 of the entomological division of the U.S. Department of Agriculture is devoted to an account of the life-history of the codling-moth and the damage inflicted by its caterpillar on orchards. The author, Mr. C. B. Simpson, states that this now cosmopolitan insect was introduced into the North-west Pacific States about the year 1880. On account of the genial climate of this new habitat two overlapping annual broods are now produced, and if proper preventive measures are not taken to keep them in check, the entire apple-crop in many districts is liable to damage. The best remedial measures appear to be arsenical spraying and banding, and by these means the damage to the crop in one case has been reduced from between 40 and 60 per cent. to as low as 10 per cent., while it is estimated that by continuing the process for a few years the injury inflicted by this insect might in any locality be reduced from nearly 100 per cent. to 5 or 10 per cent. The annual shrinkage in value of American apple-crops owing to the ravages of this moth has been estimated at 11,000,000 dollars.

THE seas of Japan, Okhotsk, and Bering have been attracting of late a great deal of attention from both Russian and American explorers. M. P. Schmidt gives now, in a recent issue of the *Izvestia* of the Russian Geographical Society (1903, ii.), a short sketch of the physical geography of these seas, with a list of 133 species of fishes found in them, and their distribution, the list being based both on previous research and the author's own collection, which contains 100 species.

THE hydrographic expedition of M. L. S. Berg, which has collected interesting data concerning the present rise of level of Lake Aral, has also studied the temperature, the currents of the lake and its salinity (specific gravity from 1·0076 to 1·0080 in the middle parts, and up to 1·0084 and 1·0090, occasionally 1·0094 in sheltered bays). The plankton is poorer than in European lakes, and during the hot days it keeps at a certain depth, coming to the surface only in the moonlight. M. S. A. Zernoff, who has studied the Aral collections, has found in them quite a number of forms which had only been met with in the Caspian Sea, and had only lately been described by Prof. Sars. The expedition has also collected ants, lizards, and other specimens of interest to naturalists.

THE *Century Magazine* for January contains an illustrated article on radium by Prof. E. Merritt, and one on radium and radio-activity by Mme. Curie. The extraction and properties of the new element are also described in the *Strand Magazine*, in the course of an illustrated interview with M. Curie.

THE bound volume for 1903 of *Knowledge*, which has now been published, makes a very attractive book. It is profusely illustrated, and, as usual, the astronomical plates are particularly good. The magazine has just been incorporated with the *Illustrated Scientific News*, and the combined journal will be published under the joint title of *Knowledge and Illustrated Scientific News*.

THE second part of vol. ii. of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," being the account of the work carried on and of the collections made by an expedition during the years 1899 and 1900, has been published by the Cambridge University Press. This part, edited by Mr. J. Stanley Gardiner, contains the following three reports:—marine mollusca, by Mr. Edgar A. Smith; the Enteropneusta, by Mr. R. C. Punnett; and marine Crustacea—the spider-crabs (Oxyrhyncha) and the classification and genealogy of the reptant decapods—by Mr. L. A. Borradaile. The third part of vol. ii. is to be published on May 15.

WE have received the second series of vol. viii. of the "Proceedings and Transactions of the Royal Society of Canada," and notice that it contains a full account of the twenty-first general meeting held at Toronto in May, 1902. The presidential address, by Sir James A. Grant, K.C.M.G., had for its subject the universities in relation to research, and constitutes the first appendix to the first part of the volume, which includes the *Proceedings*. The second appendix contains reports from twenty-seven associated literary and scientific societies in Canada, some of the reports being in French. Similarly the section of the *Transactions* dealing with French literature, history, and archæology is given in French. Among papers read before the section concerned with the mathematical, physical, and chemical sciences may be mentioned:—On the stresses developed in beams loaded transversely, by Prof. H. T. Bovey, F.R.S.; researches in physical chemistry carried out in the University of Toronto during 1901–2, by Prof. W. L. Miller; on the existence of bodies smaller than atoms, by Prof. Rutherford; on the absolute value of the mechanical equivalent of heat, by Prof. H. T. Barnes; and the specific heats of organic liquids and their heats of solutions in organic solvents, by Dr. J. W. Walker and Dr. J. Henderson. In the section of the geological and biological sciences twelve papers are included, and among them are two by Prof. D. P. Penhallow on *Osmundites skidegatensis* and notes on Cretaceous and Tertiary plants of Canada. Dr. G. F. Matthew contributes notes on Cambrian faunas, and Prof. A. P. Coleman discusses the classification of the Archæan. The volume contains numerous well executed illustrations, and is an excellent witness to the value of the work in science which is being accomplished in Canada.

THE determination of the density of chlorine gas is attended with many experimental difficulties, and the figures obtained by different workers vary between 2·448 and 2·491. In the current number of the *Comptes rendus* MM. H. Moissan and Binet du Jassoneix describe their researches on this subject. Three groups of experiments are given, involving seventeen determinations, and the final figure regarded as the most probable is 2·490 at 0° C., a value identical with the figure of Leduc. The chief sources of error to be eliminated are the presence of air in the density flask, the difficulty of completely drying the gas, and the solubility of different gases in liquefied chlorine.

IN a recent number of the *Comptes rendus* it is stated by M. Becquerel that when crystals of hexagonal zinc blende are crushed between glass plates they emit a flash of light comparable with that which is produced by the proximity of a radium salt in Crookes's spinthariscope. It is suggested that in the latter case the positively charged α-particles fracture by their impact the surface of the blende, and that the flashes of light observed are thus caused by a mechanical action on the screen.

THE origin of natural asphalte or bitumen has given rise to much speculation, and the suggestion has been made that it is produced by the destructive distillation of vegetable remains mixed with organic matter, and especially with fish. Another possible explanation is suggested by the production of an artificial asphalte by heating natural petroleum with sulphur. The series of paraffins is not affected by this treatment, but the naphthenes which are present in the petroleum undergo condensation and give rise to bodies which may be regarded as typical constituents of asphalte. Two of these, prepared by the action of sulphur on acenaphthene, $C_{10}H_6\begin{smallmatrix}CH_2\\|\\CH_2\end{smallmatrix}$, have recently been described by Karl Dzieworński in the *Berichte*. The first is a hydrocarbon, $C_{36}H_{18}$ (trinaphthylene benzene), melting at 387° C., which contains no less than ten independent ring systems, and is therefore named decacyclene, whilst the second is a sulphur-compound, $C_{24}H_{12}S$ (dinaphthylenethiophen), melting at 278° C.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Lady Amherst; a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. F. A. Knowles; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mr. G. A. Hanton; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Captain Moseley; a Hairy-rumped Agouti (*Dasyprocta prymnolopha*) from Central America, presented by Mr. John Gordon; two Ring-tailed Coatis (*Nasua rufa*) from South America, presented respectively by Mr. H. Everest and Mr. D. F. Mackenzie; a Water Rail (*Rallus aquaticus*), British, presented by Mr. F. W. Pizzey; a Californian Sea Lion (*Otaria californiana*) from the North Pacific Ocean, seven Indian Fruit Bats (*Pteropus medius*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL CALENDARS FOR 1904.—The "Annuaire du Bureau des Longitudes" for 1904 contains more than 700 pages of useful tables and formulæ, astronomical and physical, including lucid explanations of such matters as the several different calendars, the tides, &c. A new arrangement is inaugurated in this year's publication; instead of giving the customary complete set of tables, &c., only those relating to astronomy, physics, and chemistry are included, and it is proposed to omit the chemistry and physics next year, giving instead full sets of tables relating to general geography, meteorology, and statistics. This alternation will be continued in future "Annuaires."

The "Annuaire astronomique et météorologique," compiled by M. Camille Flammarion, attains its fortieth year of publication in the issue for 1904. It gives a complete account of the astronomical occurrences due this year, and a useful review of the astronomical and meteorological

phenomena of recent years. The current issue contains many illustrations, among which are some good reproductions of photographs and drawings of sun-spots, comets, and planetary features observed during 1903. The charts of the sky and the particulars of interesting phenomena, which are given for each month, will be found very useful by all who are engaged in practical astronomy. The "Annuaire" is published by M. Ernest Flammarion, 26 Rue Racine, Paris, at 1.50 francs (about 1s. 3d.).

The card calendar issued by Mr. Arthur Mee, of Llanishen, under the title "The Heavens at a Glance" contains a very complete set of the tables and a great deal of the information required by an amateur practical astronomer. Being printed on a single stiff card, suitable for hanging on the observatory wall, it is exceedingly handy to use as a source of reference for current astronomical occurrences. Amongst other information the card contains a list of the principal meteor showers, with concise instructions to observers, ephemerides of the planets and lists of double stars, variables and nebulæ. It may be obtained from Mr. Mee, at the above address, for 7d. post free.

THE VARIABLE STAR 1921, W AURIGÆ.—In No. 5, vol. xviii., of the *Astrophysical Journal*, Mr. J. A. Parkhurst, of the Yerkes Observatory, gives the details and results of a series of observations of the variable star W Aurigæ, made by him during the period December, 1898–March, 1903. He determined the position of the variable (for 1900) as R.A. = 5h. 20m. 8·6s., $\delta = +36^\circ\ 48'\ 53''$, and found that the magnitude varied from 9·3 at maximum to 13·8 at minimum. The strong colour of this variable is indicated by the fact that when the visual magnitude was 9·5 the photographic magnitude was only 10·9.

The variations are best represented, according to the curves which Mr. Parkhurst has plotted from his observations, by the following elements:—

Max. = J.D. 2414648 + 276 E.
or December 24, 1898 + 276 E.,

the interval, M–m, being 113 days.

LIGHT ECONOMY IN SPECTRUM PHOTOGRAPHY.—In a paper communicated to the current number of the *Astrophysical Journal*, Mr. J. A. Humphreys describes a number of arrangements used by him in photographing spectra for utilising to the full the light obtained from the light source under examination. He has found that the most generally convenient and effective arrangement, when terrestrial light sources are being used, is to place a spherical reflector behind the source so that the focus of the reflected light coincides with the origin. In this way both the reflected and direct light are utilised, and are together focused on the slit by an ordinary condenser. Comparison photographs, which are reproduced in the article, show that the light reflected through the source suffers but little from absorption, and that the net result of using this arrangement is to obtain lines which would otherwise be too weak to photograph, and to strengthen the weaker lines.

Another method, which may be used with any source when a grating is used as analyser, is to place a pair of inclined plane reflectors between the slit and the grating so that the rays from the top and bottom of the slit are reflected on to the centre of the grating, thereby condensing the light from the whole length of the slit into a narrower plane, and so obtaining a stronger spectrum. In another, but somewhat similar, form, the two plane reflectors are placed near to the photographic plate, so that the parallel rays from the top and bottom of the grating are superimposed upon the rays from the centre. It is found that when long-focus gratings are used the slight lengthening of the path of the rays by reflection does not interfere, practically, with the definition. Many other arrangements, including the use of ellipsoidal and paraboloidal reflectors and cylindrical lenses, are explained and illustrated in Mr. Humphreys's article.

INTENSITY OF THE SUN'S LIGHT.—M. Ch. Fabry has communicated to the Paris Academy of Sciences an interesting paper on the candle-power of the sun's light at sea-level. By an ingenious arrangement, wherein the total solar light is diminished in a known ratio by passage through a slit and then through an ammoniacal solution of copper sulphate, he compared the light with a constant standard light of known candle-power, and, after various corrections, found that at sea-level, with the sun at the zenith, the solar light would be 100,000 times more intense than that produced by a decimal candle at a distance of 1 metre. Supposing that the intensity of the light emitted by different parts of the apparent solar surface is the same, this result shows that the intensity of the light received—after atmospheric absorption—from 1 square mm. of the solar disc is equivalent to 1800 candle-power, as compared with 150–200 candle-power per square mm. emitted by the positive pole of the electric arc.

Taking the amount of heat received per minute from 1 square cm. of the solar surface as 1·5 calories, M. Fabry calculates that the energy consumed per candle-power is about 0·12 watt, but, as the invisible heat rays suffer more by atmospheric absorption, the actual amount of energy used up is probably between 0·15 and 0·2 watt per candle (*Comptes rendus*, No. 23, vol. cxxxvii.).

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1904.

THE following subjects for prizes are proposed for the year 1904 by the Paris Academy of Sciences:—

In geometry, the grand prize for mathematical science (3000 francs), the subject proposed being to perfect, in some important point, the study of the convergence of continued algebraical fractions; the Bordin prize (3000 francs), to develop and perfect the theory of surfaces applicable to the paraboloid of revolution; the Vaillant prize (4000 francs), to develop and study all displacements of an invariable figure in which different points of the figure describe spherical curves; the Francœur prize (1000 francs) and the Poncelet prize (2000 francs), for discoveries useful to the progress of pure and applied mathematics.

In mechanics, the extraordinary prize of 6000 francs, to recompense progress in the direction of increasing the efficiency of the French naval forces; a Montyon prize (700 francs), for the improvement or invention of instruments useful to the progress of agriculture, or the mechanical arts or sciences; and the Plumey prize (2500 francs), for an improvement or invention relating to steam navigation.

In astronomy, the Lalande prize (540 francs), for the most interesting observation or memoir dealing with astronomy; the Valz prize (460 francs), for the most interesting observation made during the current year; and the Janssen prize, a gold medal, for an important work on physical astronomy.

In geography and navigation, the Binoux prize (2000 francs), for a work dealing with either of these subjects.

In physics, the Hébert prize (1000 francs), for the best treatise or discovery useful in the practical application of electricity; the Hughes prize (2500 francs), for work contributing to the progress of physics; and the Kastner-Boursault prize (2000 francs), for the application of electricity to the arts, industry, or commerce.

In statistics, a Montyon prize (500 francs), for the best study in French statistics.

In chemistry, the Jecker prize (10,000 francs), for work in organic chemistry.

In physical geography, the Gay prize (1500 francs), for a study of the existing variations in the relative levels of land and sea, by means of precise observations, pursued over a fixed portion of the coasts of Europe or North America.

In botany, the Desmazières prize (1600 francs), for a work on the cryptogams; the Montagne prize (1500 francs), for work on the anatomy, physiology, development or description of the lower cryptogams; the de la Fons-Mélicocq prize (900 francs), for the best botanical work dealing with the north of France; and the Thore prize (200 francs), for the best work on the cellular cryptogams of Europe.

In anatomy and zoology, the Savigny prize (1300 francs), for the assistance of young zoologists making a special study of the invertebrates of Egypt and Syria; and the Thore prize (200 francs), for a work on the anatomy of a European species of insect.

In medicine and surgery, a Montyon prize (three prizes of 2500 francs, three mentions of 1500 francs), for discoveries useful in the art of healing; the Barbier prize (2000 francs), for a valuable discovery in the surgical, medical or pharma-

ceutical sciences, or in botany in relation to medicine; the Bréant prize (100,000 francs), for the discovery of a specific cure for Asiatic cholera, or for the discovery of its cause, such that the epidemic can be suppressed. If neither of these be forthcoming, the interest on the capital sum will be given for a rigorous demonstration of the presence in the air of substances playing a part in the propagation of epidemic diseases. The Godard prize (1000 francs), for a memoir on the anatomy, physiology, or pathology of the genito-urinary organs; the Lallemand prize (1800 francs), for the encouragement of work relating to the nervous system; the Baron Larrey prize (750 francs), for a work on military medicine, surgery or hygiene; the Bellion prize (1400 francs) and the Mège prize (10,000 francs), for an essay on the causes which have retarded or favoured the progress of medicine from antiquity to the present day.

In physiology, a Montyon prize (750 francs), for a work in experimental physiology; the Philipeaux prize (900 francs); the Pourat prize (1000 francs), for a study of the physical and chemical changes in respiration induced by high altitudes; and the Martin-Damourette prize (1400 francs), for a work on therapeutical physiology.

Among the general prizes are the Arago medal; the Lavoisier medal and the Berthelot medal; the Montyon prizes (unhealthy trades, 2500 francs and 1500 francs), for a discovery ameliorating the condition of an unhealthy trade; the Wilde prizes (4000 francs, or two of 2000 francs), for a discovery in astronomy, physics, mineralogy, geology or experimental mechanics; the Tchihatchef prize (3000 francs), for exploration in Asia; the Leconte prize (50,000 francs), for a capital discovery in mathematics, physics, chemistry, natural history or medicine; the Jean-Jacques Berger prize (15,000 francs), for a work on Paris; the Delalande-Guérineau prize (1000 francs); the Jerome Ponti prize (3500 francs); the Houllevique prize (5000 francs); the Cahours prize (3000 francs), for researches in chemistry; the Saintour prize (3000 francs); the Trémont prize (3000 francs); the Gegner prize (3800 francs); and the Lannelongue prize (1200 francs).

Among these, the prizes bearing the names of Lalande, Desmazières, Lavoisier, Wilde, Tchihatchef, and Leconte will be awarded without distinction of nationality.

RESEARCH GRANTS OF THE CARNEGIE INSTITUTION.

A LIST of the grants in aid of scientific investigations made by the Carnegie Institution during the fiscal year 1903 is given below. The amount set apart as grants for research during that period was 40,000*l*. From the beginning of the Institution to the end of October, 1903, the number of applications for grants was 1042, and the total sum asked for by the 406 applicants who stated the amount desired was more than 440,000*l*. In addition, the advisory committees recommended grants amounting to 182,300*l*., so that the total sum asked for was about 622,300*l*. It will be evident from this that the present income of the Carnegie Institution can only provide for a small part of the grants requested. The grants made are as follows:—

Anthropology.—For ethnological investigation among the Pawnees, Dr. G. A. Dorsey, Field Columbian Museum, Chicago, Ill., 500*l*.; for obtaining evidence relative to the early history of man in America, Dr. Wm. H. Holmes, director Bureau of American Ethnology, Washington, D.C., 400*l*.; to investigate the precious stones and minerals used in ancient Babylonia in connection with the investigation of Mr. William Hayes Ward, Mr. George F. Kunz, New York City, 100*l*.; for study of oriental art recorded on seals, &c., from western Asia, Dr. William Hayes Ward, New York City, 300*l*.

Astronomy.—For astronomical observations and computations, Prof. Lewis Boss, Dudley Observatory, Albany, N.Y., 1000*l*.; for investigating proposal for a southern and a solar observatory, Profs. Boss, Hale and Campbell, 1000*l*.; for pay of assistants to take part in researches at the Lick Observatory, Prof. W. W. Campbell, Lick Observatory, Mt. Hamilton, Cal., 800*l*.; for a new reduction of Piazzi's star observations, Prof. Herman S. Davis, Gaithersburg, Md., 100*l*.; for measurements of stellar parallaxes, solar photographs, &c., Prof. George E. Hale, Yerkes Observatory, Williams Bay, Wis., 800*l*.; for determining the elements of the moon's motion and testing the law of gravity, Prof. Simon Newcomb, Washington, D.C., 600*l*.; for study of the astronomical photographs in the collection of Harvard University, Prof. E. C. Pickering, Harvard University, Cambridge, Mass., 500*l*.; for pay of two assistants to observe variable stars, Prof. Wm. M. Reed, Princeton Observatory, Princeton, N.J., 200*l*.; for measurement of astronomical photographs, &c., Miss Mary W. Whitney, Vassar College, Poughkeepsie, N.Y., 200*l*.

Bibliography.—For preparing and publishing the "Index Medicus," Dr. Robert Fletcher, Army Medical Museum, Washington, D.C., 2000*l*.; for preparing and publishing a "Handbook of Learned Societies," Mr. Herbert Putnam, Librarian of Congress, Washington, D.C., 1000*l*.

Botany.—For investigation of plant hybrids, Mr. W. A. Cannon, New York Botanical Garden, N.Y., 100*l*.; for study of types of water-lilies in European herbaria, Mr. H. S. Conard, University of Pennsylvania, Philadelphia, 60*l*.; Desert Botanical Laboratory (Mr. F. V. Coville and Mr. D. T. MacDougal, Washington, D.C.), 1600*l*.; researches on the cytological relations of the Amœbæ, Acrasieæ and Myxomycetes, Mr. E. W. Olive, Crawfordsville, Ind., 200*l*.; for preliminary studies on the Philippine flora, Dr. Janet Perkins, working at the Royal Botanical Gardens, Berlin, Germany, 380*l*.

Chemistry.—For a systematic chemical study of alloys, beginning with the bronzes and brasses, Prof. W. D. Bancroft, Cornell University, Ithaca, N.Y., 100*l*.; for investigation of the rare earths, Prof. L. M. Dennis, Cornell University, Ithaca, N.Y., 200*l*.; for investigations in physical chemistry, Prof. H. C. Jones, Johns Hopkins University, Baltimore, Md., 200*l*.; for researches on osmotic pressure, Prof. H. N. Morse, Johns Hopkins University, Baltimore, Md., 300*l*.; for certain chemical investigations, Prof. A. A. Noyes, Massachusetts Institute of Technology, Boston, Mass., 400*l*.; for investigation of values of atomic weights, &c., Prof. Theo. W. Richards, Harvard University, 500*l*.; for continuing investigations on the derivatives of camphor and allied bodies, Mr. J. Bishop Tingle, Illinois College, Jacksonville, Ill., 100*l*.

Engineering.—For experiments on ship resistance and propulsion, Prof. W. F. Durand, Cornell University, Ithaca, N.Y., 824*l*.; for study of aluminium bronzes, Mr. Leonard Waldo, New York City, 900*l*.

Exploration.—For preliminary examination of the trans-Caspian region, Mr. Raphael Pumpelly, Newport, R.I., 1300*l*.

Geophysics.—For investigating the flow of rocks, Prof. Frank D. Adams, McGill University, Montreal, 500*l*.; for investigating the subject of geophysical research, &c., Prof. C. R. Van Hise, University of Wisconsin, Madison, Wis., 500*l*.

Geology.—For study of the fundamental principles of geology, Prof. T. C. Chamberlin, University of Chicago, Chicago, Ill., 1200*l*.; for geological exploration in eastern China, Mr. Bailey Willis, U.S. Geological Survey, Washington, D.C., 2400*l*.

History.—For an examination of the historical archives of Washington, Mr. Worthington C. Ford, Library of Congress, Washington, D.C., 400*l*.

Palæontology.—For continuation of work on the morphology of Permian reptiles, Prof. E. C. Case, State Normal School, Milwaukee, Wis., 100*l*.; for monographing the fossil Chelonia of North America, Dr. O. P. Hay, American Museum of Natural History, 140*l*.; for continuation of his researches on living and fossil cycads, Dr. G. R. Wieland, Yale University, New Haven, Conn., 300*l*.; for preparing a monograph on the Plesiosaurian group, Prof. S. W. Williston, University of Chicago, Chicago, Ill., 160*l*.

Physics.—For study of certain arc spectra, Prof. Henry Crew, Evanston, Ill., 200*l*.; for aid in ruling diffraction gratings, Prof. A. A. Michelson, University of Chicago, Ill., 300*l*.; for experiments on the magnetic effect of electrical convection, Dr. Harold Pender, Johns Hopkins University, Baltimore, Md., 150*l*.; for research, chiefly on the theory of light, Prof. R. W. Wood, Johns Hopkins University, Baltimore, Md., 200*l*.

Physiology.—For experiments in nutrition, Prof. W. O. Atwater, Wesleyan University, Middletown, Conn., 1000*l.*; for preparing report on the physiology of nutrition, Dr. Arthur Gamgee, Montreux, Switzerland, 1300*l.*

Psychology.—For certain investigations on the anthropology of childhood, Dr. G. Stanley Hall, Clark University, Worcester, Mass., 400*l.*; for researches in experimental phonetics, Prof. E. W. Scripture, Yale University, New Haven, Conn., 320*l.*

Zoology.—For determining the laws of variation and inheritance of certain Lepidoptera, Dr. H. E. Crampton, Columbia University, New York, 50*l.*; for investigation of recent and fossil corals, Dr. J. E. Duerden, Chapel Hill, N.C., 200*l.*; for investigating the blind fishes of Cuba, Dr. C. H. Eigenmann, Indiana University, Bloomington, Ind., 200*l.*; for preparing manuscript and illustrations for a monograph on American mosquitoes, Dr. L. O. Howard, Department of Agriculture, Washington, D.C., 400*l.*; for experiments on the behaviour of lower animals, Dr. H. S. Jennings, University of Michigan, Ann Arbor, Mich., 50*l.*; to making a comparative study of the spermatogenesis of insects and other classes of arthropods, and if possible to determine the specific functions of the different chromosomes, Prof. C. E. McClung, Kansas University, Lawrence, Kans., 100*l.*; for investigations in experimental embryology, &c., in Naples, Dr. E. B. Wilson, Columbia University, New York, 200*l.*; for morphology and classification of deep sea sponges, Prof. H. V. Wilson, University of North Carolina, Chapel Hill, 200*l.*; for maintenance of twenty tables, Marine Biological Laboratory, Woods Hole, Mass., 2000*l.*; for maintenance of two tables, Marine Biological Station, Naples, Italy, 200*l.*

SURVEY OF SCOTTISH LAKES.

READERS of NATURE are aware that in the year 1896 Sir John Murray and the late Mr. Fred. P. Pullar commenced to carry out a bathymetrical survey of the fresh-water lochs of Scotland, but the work was brought to a standstill in February, 1901, owing to the tragic death of the younger collaborator, who heroically lost his life in attempting to save others in an ice accident on Airthrey Loch, near Bridge of Allan. As a memorial to this talented young man, his father, Mr. Laurence Pullar, and Sir John Murray resolved to complete this important piece of work at their joint expense, and in the spring of 1902 the survey was resumed under the personal supervision of Sir John Murray, with the assistance of a staff of young scientific men.[1]

During the season of 1902 one hundred and fifty-five Scottish lakes were completely surveyed, and during the past season two hundred and thirty-one, making a total of three hundred and eighty-six of the Scottish fresh-water lochs completed, including all the larger and more important ones. There still remain, however, a good many small and outlying lochs to be surveyed, but it is anticipated that early next season (1904) the actual work of sounding the Scottish fresh-water lochs so far as practicable will be completed. The preparation of the maps for the engraver has been going on continuously, and the publication of the results of the survey has already been commenced in the *Geographical Journal* and the *Scottish Geographical Magazine*.

In continuation of the work of Sir John Murray and the late Mr. Pullar among the lochs of the Forth and Tay basins, the staff of the Lake Survey commenced operations early in 1902 in the northern portion of the Tay basin, and after surveying the principal lochs in that neighbourhood moved northwards and westwards through Perthshire, Inverness-shire, Argyllshire, Ross-shire, Sutherlandshire, and Caithness-shire, sounding all the more important lochs, like Lochs Tay, Rannoch, Treig, Laggan, Arkaig, Shiel, Morar, Maree, Fannich, Shin, Assynt, More, Naver, Loyal, Hope, and many smaller ones. In the spring of 1903 a start was made with the lochs of the Caledonian Canal (Ness and Lochy) and of the surrounding district, then the staff moved southwards to Loch Awe and Loch Lomond, which were sounded for the sake of comparison with the surveys carried out by the Admiralty in the year 1861. Subsequently the staff was split up into small parties, one party proceeding to the south of Scotland to survey Lochs Doon, Ken, Dee, &c., a second party proceeding to Lewis to survey Loch Langavat and other smaller lochs, while a third party proceeded to Orkney and Shetland to survey Lochs Harray and Stenness, and the numerous small lochs in those islands.

In addition to the routine sounding work, continuous observations of a varied description have been carried out on Loch Ness throughout the past season. In order to study the seiches in Loch Ness, a limnograph, constructed in Geneva under the supervision of Dr. Ed. Sarasin, was set up in the grounds of St. Benedict's Monastery at Fort Augustus (by kind permission of the Lord Abbot), and has been in charge of Mr. E. M. Wedderburn. The records obtained are now being studied and classified, and are likely to lead to interesting results; uninodal, binodal, and multinodal seiches have been recognised, and their duration, periodicity, and amplitude determined.

Continuous observations of the temperature of the water at different depths in Loch Ness have also been carried on by Sir John Murray, Mr. Watson, and other members of the staff since July. The temperature changes have been studied systematically—first, by means of platinum resistance thermometers with Callendar's recording apparatus, installed by the Cambridge Scientific Instrument Co., at a cost of several hundred pounds, from a yacht anchored in 300 feet of water off Fort Augustus, and connected with the shore by an electric cable; second, by means of ordinary reversing thermometers at Fort Augustus and from a steam yacht, which during several weeks made numerous cruises throughout the length of the loch. Difficulties have cropped up with reference to the working of the electrical thermometers, but the observations made thus far have shown that the waters in Loch Ness are in constant motion, even down as far as 300 to 400 feet. The motion of the upper waters in Scottish lochs has been already studied by Sir John Murray, who advanced the theory that a wind blows the surface water before it, and so causes a slope of the upper isothermals down towards the lee shore. The investigations in Loch Ness confirm this theory, whilst adding some restrictions for this particular case. But the chief interest attaches to the study of the motion of the deeper isotherms, which have never before been studied with care. These isotherms have been found to be swinging in a periodic fashion, with a natural period of about three days. It is supposed that we have here an internal seiche, with the separating surface determined by the greatest change of temperature with depth, the restoring force being given by the difference of density between the warmer upper and the colder deeper waters. The investigations indicate that this internal seiche is started by gales or winds of a strength above the average.

Many biological observations have also been made in Loch Ness and neighbouring lochs by Mr. James Murray, Mr. Scourfield and others, by means of various kinds of townets and drag-nets, with the view of obtaining some insight into the relation between the habits and distribution of the different planktonic and benthonic organisms and the varying physical conditions.

All these limnological investigations have been carried out under the immediate superintendence of Sir John Murray, who took up residence at Fort Augustus from the beginning of July until the end of October, and arrangements have been made for the continuance of the temperature and seiche observations under the charge of Mr. Watson, and of the biological observations under the charge of Mr. James Murray, throughout the winter.

[1] The field staff consisted of Mr. T. N. Johnston, first assistant and zoologist; Mr. James Parsons, chemist; Mr. T. R. H Garrett, geologist; Mr. John Hewitt, zoologist; Mr. James Murray, assistant zoologist; and the following gentlemen took part in the field work for longer or shorter periods during the summer of 1902, viz. Mr. R. M. Clark, Dr. J. Sutherland Black, Sir John Jackson, Mr. D C. McIntosh, Mr. James Walker, and Mr. D. J. Scourfield. After the completion of the first season's work, Mr. Parsons and Mr. Garrett received appointments in Ceylon and Borneo respectively, and their places on the staff were taken by Mr. R. B. Young and Mr. R. C. Marshall; in addition, Mr. E. R. Watson and Mr. E. M. Wedderburn joined the staff early in 1903, and in July, when Mr. Young left to take up an appointment in the South African College, Mr. J. H. M. Wedderburn took his place on the staff. The office work in Edinburgh is in charge of Mr. James Chumley, secretary and subeditor, with the assistance of Mr. Robert Dykes.

THE SENESCENCE OF ORGANS AND ITS INFLUENCE ON PATHOLOGICAL PHENOMENA.

A PAPER by Prof. R. Wiedersheim on the senescence of organs in the phylogenetic history of man and its influence on morbid phenomena has been published in the *Politisch-anthropologischen Revue*, II. Jahrgang, Heft 6 (Thuringische Verlags-Anstalt Eisenach und Leipzig).

In emphasising the fact that in many cases organs, or tissues, which are spoken of as vestigial, and are considered to be functionless, may in reality play an important part in the physiological balance of the organism, the author points out that the same is true not only of those parts which are degenerating, but also of those which, though at present of comparatively little importance in the ordinary sense, are in a state of progressive development, or have undergone a change of function.

Pathologists have long recognised the fact that tissues which have been arrested in development during ontogeny are likely at certain times to give rise to pathological conditions, and Prof. Wiedersheim maintains that one is justified in speaking of the old age and senile degeneration of organs, or tissues, in a phylogenetic sense, just as one uses these terms in the case of individuals. He believes that in many cases there is evidence that certain phylogenetic stages in the development of organs, or tissues, are less resistant than others to pathological changes, just as in the individual the tissues are less able, at certain ages, to resist baneful influences arising within or outside the body. A large number of examples are given to show that organs phylogenetically very old are often prone to various diseases, such as carcinoma, &c.

The question is discussed as to why organs which have reached this form of old age are retained, and the conclusion is arrived at that they have no selection-value, and therefore do not affect the preservation of the species.

Organs, or parts of organs, which are in this sense phylogenetically aged are compared by the author to the aged members of a community, who may roughly be divided into two classes—one containing those who conform to the arrangements made for them by the community and take little or no interest in what is going on, the other containing those aggressive individuals who oppose improvements and progress. Society experiences trouble from the members of this latter class, and similarly those phylogenetically aged structures which we have inherited from our ancestors may, if they retain sufficient vitality, seriously affect the vital equilibrium of our bodies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. PAGEL has resigned his chair of naval architecture in the Berlin Technical School, on his appointment to the post of technical director of the German Lloyd.

DR. H. GRASSMAN has been appointed professor of mathematics at Halle, Mr. F. C. M. Störmer professor of pure mathematics in the University of Christiania, and Dr. H. Veillon professor of physics and chemistry at Basle.

A COURSE of ten lectures on enzymes and their actions will be delivered by Dr. W. M. Bayliss, F.R.S., at University College, London, on Wednesdays at 5 p.m., beginning Wednesday, January 13. The lectures are open to all internal students of the university without fee, as well as to qualified medical men, on presentation of their cards.

A MEETING of medical graduates of Oxford engaged in teaching in London was held on Tuesday to consider the vacancy in the regius professorship at Oxford caused by the resignation of Sir John Burdon Sanderson. The chair was taken by Sir William Church, president of the Royal College of Physicians. It has been suggested that the present reader in pathology should be appointed regius professor of medicine, so that the emoluments of the chair of medicine might be made to supplement the income of the reader in pathology. A statement setting forth reasons against this proposal has been sent to all medical graduates of Oxford for signature, and the following resolutions were passed at Tuesday's meeting:—"That in the opinion of this meeting the regius professor of medicine should be a physician who is representative of medicine in its widest sense." "That it would be detrimental to the best interests of medicine in Oxford if the regius professorship were converted into a professorship of any one branch of medical study."

SCIENCE does not occupy a prominent place in the new educational monthly entitled *School*, the first number of which has just been received from Mr. John Murray, but the contents include much matter which should stimulate interest in education as a whole. In summing up his impressions of American education, obtained during the recent visit of the Mosely Commission, the Rev. T. L. Papillon remarks, "what has struck me most in the little that I have been able to see of American education is first of all the attitude of the whole people towards public education, and their recognition of it as a prime necessity of national life, for which hardly any expenditure can be too great; next its eminent practical and popular character." Lord Avebury contributes some early recollections, including his Eton days, when the whole course of instruction consisted of Latin and Greek, with one lesson a week in geography. "Neither arithmetic, modern languages, science nor drawing were regarded as essential portions of education, and they did not enter into the school course." There are also articles, among others, on the late Mr. Herbert Spencer and on the education of the engineer.

A SUBJECT which deserves careful and sympathetic investigation by the Board of Education was brought before public notice in the *Morning Post* of December 29, 1903, and dealt with in a leading article. As will be within the knowledge of most readers of NATURE, there are at the Royal Colleges of Science of London and Dublin two classes of students, those, namely, who pay fees, and those who hold scholarships, studentships, or exhibitions, and have been selected by the Board of Education by competition or otherwise. Many of these "Government" students hold what are called national science scholarships. Until 1901 these national scholars received during the forty weeks in the academic year an allowance of thirty shillings a week, out of which the great majority of them had to find board, lodging, clothes, books and apparatus—for the national scholars, of whom there are sixty, come almost exclusively from the lower middle classes, and are without any private means. Since 1901, this weekly allowance has been reduced to twenty-five shillings a week. This reduction in value of the national scholarships has, very naturally, given rise to much dissatisfaction, and early last year a petition, drawn up by the Students' Union, was signed by all the national scholars in the Royal College of Science, London, and on the advice of the council of the college was forwarded to the Board of Education. A reply to this petition, signed by Mr. F. G. Ogilvie, was received in due course, and it contains the statement that "in fixing the present rates the Board were of opinion that an allowance of *1l.* 5*s.* per week would be a sufficient supplement to the resources of the students to whom scholarships were awarded to enable them to devote their whole time and energy to the prosecution of their studies during the period over which the courses at the Royal College of Science would extend." The suggestion that national scholars have private resources upon which they can draw is certainly based upon a misapprehension; for only very rarely do such scholars receive any allowance from home or friends, and we believe that all the national scholars at present at the Royal College of Science are without private means. There can be no doubt that for a student to live within a reasonable distance of the college at South Kensington, and with comforts sufficient to enable him to perform his work properly, he must spend more than twenty-five shillings a week. The attempt to work earnestly and for long hours every day, and at the same time to pay his way on the amount of his present allowance, must lead to needless irritation, and in many cases to real hardship and permanent injury to health. The only satisfactory solution of the difficulty which has arisen would seem to be the establishment of suitable halls of residence for all scholarship holders, in which that corporate life which is so important a part of university life may be enjoyed by these young men who are studying science for their own and their country's benefit.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19, 1903.—"On the Nematocysts of Æolids." By G. H. **Grosvenor**, New College, Oxford. Communicated by Prof. W. F. R. Weldon, F.R.S.

The nematocysts of æolids were discovered by Alder and Hancock in 1843. As early as 1858 Strethill Wright communicated to the Royal Phys. Soc. of Edinburgh the results of some observations which seemed to prove that these nematocysts were not developed in the body of the æolid, but derived from its cœlenterate prey. This paper, though republished in the *Microscopical Journal* four years later, seems to have been entirely overlooked, and the nematocysts of nudibranchs have been generally supposed to be developed *in situ*, and have often been quoted as an inexplicable example of homoplasy or even as evidence of a close relationship between Mollusca and cœlenterates. C. O. Glaser has, however, recently supported the opposite view.

The evidence brought forward in the present paper in support of Strethill Wright's view is as follows:—

(1) Not only are the nematocysts of æolids and Cœlenterata identical in plan and in mode of discharge, but each of several distinct types occurs in both groups.

(2) The nematocysts of æolids vary from individual to individual within the species, and even in the same individual there may be nematocysts characteristic of two or more distinct genera or families of cœlenterates.

(3) Whenever it is known on what cœlenterate an æolid has recently fed, the nematocysts of the two are found to be identical. Also the nematocysts in the fæces are always indistinguishable from one of the kinds, at least, in the cnidosac.

(4) Those æolids (Janidæ, Fiona, and *Calma glaucoides*) which are known to feed on non-cœlenterate prey have no nematocysts.

(5) Nematocysts and other indigestible bodies have been observed to pass through the ciliated canal from the cavity of the gastric gland into the cnidosac.

(6) Strethill Wright's most conclusive evidence was derived from an experiment of feeding an æolid on a hydroid with nematocysts different from those in the cnidosacs of the æolid. This experiment has been repeated several times, always with the result that the new nematocysts very soon appeared in the cnidosacs of the æolid. In one case three specimens of *Rizzolia peregrina*, with only small pip-shaped nematocysts (6·5 μ) in their cnidosacs, were fed on *Pennaria Cavolinii*, a hydroid with very distinct ovoid nematocysts of two sizes (25 μ and 7 μ). After about a month of this diet the pip-shaped nematocysts were almost entirely replaced by those of Pennaria. These latter were enclosed in cnidocysts in the ordinary way.

Though the nematocysts of æolids are derived from their food, they discharge the threads on extrusion from the cerata into sea-water, and there can be little doubt that they are used as weapons of defence. But an important, and probably the original function of the terminal openings of the cerata is the elimination of the indigestible nematocysts, which, on account of the diffuse character of the digestive system, cannot easily be got rid of through the anus only.

The fact of their discharge when extruded naked into the sea-water from the cnidosacs of an æolid proves that nematocysts work without the intervention of living protoplasm. A study of the conditions of discharge of nematocysts in cœlenterates and æolids, and of their behaviour in various solutions, leads to the conclusion that we have to do with a phenomenon of osmosis.

In the development of the cnidocysts two kinds of cells take part; one, the so-called "cnidoblast," ingests and arranges the nematocysts, while others lying between adjacent cnidocysts take part in the secretion of the membranous walls. Both kinds degenerate in the fully formed cnidocyst.

December 13, 1903.—"Preliminary Note on the Resistance to Heat of *B. anthracis*." By A. **Mallock**, F.R.S., and Lieut.-Colonel A. M. **Davies**.

This paper describes a series of experiments made by heating water infected with anthrax to various temperatures for various times, in order to determine the temperature and time necessary for the destruction of the spores.

The infected water was sealed in glass tubes and heated in steam in an apparatus which was designed so that any desired temperature could be maintained and simultaneously recorded.

The highest temperature employed was 120° C. and the lowest 99°.

The longest time for which the temperature was maintained was twenty minutes, and the shortest twenty seconds.

From statements made by good authorities as to the great heat resisting power of the spores of anthrax, it was expected that the temperature required to destroy the spores, when expressed as a function of the time for which the temperature had to be maintained, would form a curve, the temperature decreasing as the time of its application increased.

The authors, however, found that out of 95 experiments in which the tubes were heated to 100° C. or more, in 81 all life was destroyed, and out of the remaining 14 experiments, in which some growth took place after cultivation in broth, 12 had become contaminated. After heating 18 experiments were made at temperatures between 99° C. and 100° C. In 5 of these experiments some growth occurred after cultivation, 4 of these being found contaminated.

The conclusion arrived at is that when anthrax spores are heated in water to 100° C. or more, even for twenty or thirty seconds, their destruction is almost certain.

Chemical Society, December 16, 1903.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The relative strengths of the alkaline hydroxides and of ammonia as measured by their action on cotarnine, by Messrs. **Dobbie, Lauder** and **Tinkler**. When aqueous solutions of cotarnine are treated with alkaline hydroxides or ammonia the alkaloid is changed from the "ammonium hydroxide" form to the "carbinol" form. As solutions of these two forms of cotarnine exhibit very different absorption spectra, it is possible by this means to observe the rates at which this change is brought about by different alkalis. The relative strengths of the alkaline hydroxides as determined by this method are practically identical with those obtained by other physical methods.—Peroxylaminesulphonates and hydroxylaminetrisulphonates, by Mr. T. **Haga**.—An investigation of the sulphazilates and metasulphazilates first obtained by Fremy. Peroxylaminesulphonic acid, by Dr. E. **Divers**. The author shows that the bluish-violet substance produced by the action of sulphur dioxide on sulphuric acid containing nitrososulphuric acid is probably, as has already been asserted by Sabatier, peroxylaminesulphonic acid, the potassium salt of which is described in the preceding paper.—Constitution of nitric peroxide, by Dr. E. **Divers**. It is shown from the results of Haga's investigations that the *mono*-nitric peroxide must have the formula O : N.O, whilst the dinitric peroxide must have the constitution $(NO)_2O_2$.—Halogen derivatives of diphenyl and dihydroxydiphenyl, by Mr. J. C. **Cain**.—Notes on some natural colouring matters, by Messrs. A. G. **Perkin** and E. **Phipps**. The flowers of *Prunus spinosa* contain the two colouring matters quercetin and kampherol. The Japanese dye-stuff "Fukugi" contains a yellow substance closely related to luteolin. A number of derivatives of morin, hesperitin, myricetin and curcumin are also described.—The estimation of methyl alcohol in the presence of ethyl alcohol, by Messrs. T. E. **Thorpe** and J. **Holmes**. The method is based upon the difference in behaviour of these two alcohols towards a mixture of potassium dichromate and sulphuric acid.—Separation and estimation of silver cyanide and silver chloride, by Mr. R. H. A. **Plimmer**. The mixture is treated with boiling dilute nitric acid, and the hydrocyanic acid so liberated distilled off and estimated as silver cyanide.—Estimation of hydroxyl radicles, by Messrs. H. **Hibbert** and J. J. **Sudborough**. A modification of Tschugaeff's method is described.—Diortho-substituted benzoic acids, part v., formation of salts from diortho-substituted benzoic acids and organic bases, by Messrs. J. J. **Sudborough** and W. **Roberts**.—Cis-π-camphanates of *d*- and *l*-hydrindamines, by Prof. F. S. **Kipping**.—Resolution of *dl*-methylhydrindamine, by Mr. G. **Tattersall**.—Isomeric salts of *d*- and

l-methylhydrindamines with *d*-chlorocamphorsulphonic acid, by Mr. G. **Tattersall.**—The four optically isomeric *l*-menthylamines and their salts, by Messrs. F. **Tutin** and F. S. **Kipping.**—Preparation of the tetra-alkyl derivatives of stannimethane, by Messrs. W. J. **Pope** and S. J. **Peachey.** The authors have prepared a number of these derivatives by the interaction of magnesium alkyl haloids with stannic chloride or alkyl derivatives of the latter.—Optically active esters of β-ketonic and β-aldehydic acids, part iv., condensation of aldehydes with menthyl acetoacetate, by Messrs. A. C. O. **Hann** and A. **Lapworth.**—Estimation of the adulterant in citronella oil, by Mr. M. K. **Bamber.**

Geological Society, December 16, 1903.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—The igneous rocks associated with the Carboniferous Limestone of the Bristol district, by Prof. C. Lloyd **Morgan,** F.R.S., and Prof. Sidney H. **Reynolds.** Evidence for the contemporaneous origin of the igneous rocks is given for several localities. At Middle Hope the ejectamenta thin to the east, and lava is only found to the west; at Spring Cove, near Weston-super-Mare, small lapilli were found in the limestone 8 feet above the basalt. At Goblin Combe there is the most characteristic section of ashy beds; the lenticular bands of greenish tuff, the limestone-intercalations, the admixture of lapilli, limestone fragments, and oolitic grains are stamped with the mark of submarine volcanic action; lava closely underlies these breccias and tuffs. There is evidence of only one volcanic episode, which occurred in all cases after the Zaphrentis beds had been laid down, and before the strata characterised by Chonetes and Streptorhynchus were deposited. The lavas are olivine-dolerites or basalts, with phenocrysts of olivine or augite. They are frequently amygdaloidal, and in the variolites highly-altered felspar-phenocrysts occur. The rocks vary in grain. The tuffs are all calcareous, and most are best described as "ashy limestones." The bulk of the lapilli varies from one-hundredth part of the rock to about one-third, and their composition is related to that of the basaltic lavas of the district.—The Rhætic beds of England, by Mr. A. Rendle **Short.** The paper opens with a description of four new exposures of these rocks; one at Redland rests upon Carboniferous Limestone; a second is at Stoke Gifford, with a continuous, well-developed landscape-marble, the insect bed, and no bone bed; a third at Cotham Road (Bristol) yields baryta, celestine, and Naiadita at horizons containing no other fossils; and the fourth, at Aust, has given measurements of the uppermost 13 feet. An account is given of the constituent beds, with reference to the conditions of deposition.

PARIS.

Academy of Sciences, December 28, 1903.—M. Albert Gaudry in the chair.—M. Troost was elected a vice-president for the year 1904.—Researches on the density of chlorine, by MM. H. **Moissan** and Binet **du Jassoneix** (see p. 233).—On some new syntheses effected by means of molecules containing the methylene group associated with one or two negative radicals. The action of epichlorhydrin upon the sodium derivative of acetylacetone, by MM. A. **Haller** and G. **Blanc.** The reaction between epichlorhydrin and sodium acetylacetone is distinguished from the reactions between epichlorhydrin and the sodium derivatives of acetoacetic ester, benzoylacetic ester, and similar compounds by the fact that the chlorine reacts with the sodium, giving rise to products free from chlorine, one of which appears to be $CH_3.C{=}CH{-}CH_2{-}CH.CH_2OH$. This changes spontaneously into a ketone, the constitution of which is under examination.—The potash soluble in the water of the soil and its utilisation by plants, by M. Th. **Schlœsing,** jun.—On the first volume of the photographic catalogue of the sky published by M. A. Donner, director of the Observatory of Helsingfors, by M. **Lœwy.**—Remarks by M. R. **Zeiller** on the work of M. Michel Lévy on the fossil flora of the Tonkin Coal-measures.—Remarks by M. Alfred **Picard** on presenting his report on the Exhibition of 1900.—On the scapular and pelvic hands in the chondropterygian fishes, by M. Armand **Sabatier.**—On the limit of the Jurassic and Cretacean in the eastern part of the Pyrenees, and on the existence of two distinct epochs of formation of couzeranite limestones, by MM. Ch. **Depéret** and O. **Mengel.**—On the influence of the depth of immersion of a vessel on the speed, by M. J. A. **Normand.** A mathematical investigation into the relations existing between the weights of coal, engines, and other load, the maximum speed, displacement, and the exponent according to which the velocity varies in the neighbourhood of the maximum power.—On a property of functions, by M. H. **Lebesgue.**—On linear partial differential equations, by M. J. **Le Roux.**—The convergence of periodic superposed roots, by M. Paul **Wiernsberger.**—On a new system of road traction called *à propulsion continue,* by M. Charles **Renard.** A description of a method of mechanically transmitting the power of a locomotive to a series of attached vehicles, the whole train forming a kind of articulated locomotive. The advantages gained are great precision in steering round corners, and a reduction in the weight of the locomotive, since the tractive power is not limited, as in the usual type, by the adhesion of its wheels.—New electromechanical arrangements of engagement and gradual change of velocity, by M. Paul **Gasnier.** A method of using an electrically driven motor by which its speed can be gradually varied from nothing to maximum as required.—On the extension of the Clapeyron formula to all indifferent states, by M. L. **Ariès.**—On the luminous intensity of stars and their comparison with the sun, by M. Charles **Fabry.** Measurements made on the intensity of the star Vega, near the zenith, in calm weather and at the sea-level, gave a value equal to a candle at 780 metres distance, or $1{\cdot}7\times10^{-6}$ candles. A relation between magnitude of a star as usually measured by astronomers and the candle-power is then worked out.—On the difference of temperature of bodies in contact, by M. E. **Rogovsky.**—On sliding discharges, by M. J. **de Kowalski.**—On a diffusiometer, by M. J. **Thovert.** A modification of an instrument previously described, suitable for volatile liquids. The rate of diffusion is measured by the change in the refractive index of the liquid.—On a new method of preparing some anhydrous crystallised fluorides, by M. **Defacqz.** By heating a mixture of calcium chloride and manganese fluoride, the former being in excess, to 1000°–1200°, crystallised calcium fluoride is obtained, either in cubes or octahedra.—Electrical osmosis in liquid ammonia, by M. Marcel **Ascoli.**—On the dissociation of alkaline carbonates, by M. P. **Lebeau.** Sodium carbonate, heated in a vacuum, is appreciably dissociated, the pressure of the carbon dioxide varying from 1 mm. at 700° C. to 41 mm. at 1200° C. Similar measurements were also carried out with the carbonates of potassium, rubidium, and cæsium.—On the α-amino-nitriles, by M. Marcel **Delépine.**—The combination of saccharose with some metallic salts, by M. D. **Gauthier.**—On the transformation of the primary α-glycols into the corresponding aldehydes, by M. **Tiffeneau.** A study of the mechanism of the transformation of $(CH_3).(C_6H_5).C(OH){-}CH_2OH$ into $(CH_3).(C_6H_5).CH.CH:O$ by the action of 25 per cent. sulphuric acid.—On the nitric esters of the acid alcohols, by M. H. **Duval.** Description of the preparation and properties of the nitrates of acetoxyacetic, lactic, α-oxybutyric, and glycollic acids.—The action of carbon dioxide upon aqueous solutions of aniline in the presence of nitrites, by M. Louis **Meunier.** An aqueous solution of aniline mixed with sodium nitrite gives diazoamidobenzene in presence of carbonic acid. Silver nitrite with aniline gives the silver salt of diazoamidobenzene. There is no reaction between sodium nitrite and aniline in aqueous solution in the absence of carbon dioxide.—On the retrogradation of starch, by M. L. **Maquenne.**—The preparation of hydrogenated alcohols of the aromatic series, by M. Léon **Brunel.** By the action of hydrogen in the presence of reduced nickel at 170°–200° C., phenol gives cyclohexanol, thymol, hexahydrothymol, and carvacrol hexahydrocarvacrol.—On the oxidation of guaiacum by laccase, by M. Gabriel **Bertrand.**—The development of annual plants: study of the mineral bases, by M. G. **André.**—On the culture of sarrasin in the presence of a mixture of algæ and bacteria, by MM. **Bouilhac** and **Giustiniani.**—The evolution undergone by fishes of the genus Atherina in fresh and brackish water, by M. Louis **Roule.**—New facts on the *n*-rays of physiological origin, by M. Augustin **Charpentier.** The emission of the *n*-rays by living bodies is not peculiar to man; it has been found in rabbits, frogs, and other animals. The most important part of the physiological emission of the *n*-rays

appears to take place in the nervous system, especially in the nerve centres.—The determination of the perceptible minimum and the duration of luminous perception in persons of weak sight, by M. S. **Durand.**—On mountain sickness, by M. **Kronecker.**—On the modifications induced in the respiration by the altitude of Mt. Blanc, by M. J. **Vallot.** The relation between the volume of air respired and the time spent at the summit is shown graphically, and also the variation in the weight of air breathed.—On a relation between the work and the so-called statical work equivalent on the ergograph, by M. Charles **Henry** and Mlle. J. **Ioteyko.**—Researches on the *rôle* of the interstitial gland of the testicle. Experimental compensating hypertrophy, by MM. P. **Ancel** and P. **Bouin.**—Phototropism in the higher Artiozoa, by M. Georges **Bohn.**—The action of anethol upon the organism, by MM. E. **Varenne,** J. **Roussel** and L. **Godefroy.** Anethol shows no toxic effects, and may be safely used as a therapeutical agent.—The action of radium upon different tissues, by M. J. **Danysz.** The tissues, and especially the epithelial tissues of young animals, are much more sensitive to the action of radium rays than the tissues of adults.—On a consequence of cross-fertilisation, by M. Leclerc **du Sablon.**—On a true hybrid of chasselas by *Ampelopsis hederacea*, by M. **Grille.**—On the *rôle* of calcium oxalate in the nutrition of plants, by M. **Amar.** The lime (in the form of nitrate) necessary to the constitution of the plant is entirely assimilated up to a certain proportion, depending on the species; above this proportion the excess of lime is eliminated in the form of crystals of calcium oxalate.—On a disease of the leaves of the tobacco plant, by M. H. **Bouygues.**—On the Glacial deposits of the Garonne, by M. L. A. **Fabre.**—The geology of the western Alps, by M. Émile **Haug.**—Contribution to the study of the basaltic rocks of East Africa, by M. H. **Arsandaux.**—On the lakes of the Upper Engadine, by M. André **Delebecque.**—On the relation which exists between the proportion of gluten contained in different wheats and the proportion of total nitrogenous materials, by M. E. **Fleurent.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 7.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—The Revelations of Radium: Dr. G. B. Batten.

FRIDAY, JANUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Transformation of Hansen's Tables: P. H. Cowell.—Note on the Use of Long Focus Mirrors for Eclipse Work: H. H. Turner.—New Double Stars detected with the 17½ inch Reflector during the Year 1903: Rev. T. E. Espin.—Ephemeris for Physical Observations of Jupiter, 1904-5: A. C. D. Crommelin.—The Rotation Period of Saturn in 1903: W. F. Denning.—The "Great" Magnetic Storms, 1875 to 1903, and their Association with Sun-spots, as Recorded at the Royal Observatory, Greenwich, communicated by the Astronomer Royal: E. W. Maunder.—Suggested Connection between Sun-spot Activity and the Secular Change in Magnetic Declination: Mrs. E. W. Maunder.—On the Chromatic Correction of Object Glasses: A. E. Conrady.—The Aurora and Magnetic Disturbance: William Ellis.—*And, time permitting*, Discussion on Methods of Reproducing Astronomical Photographs.

ROYAL GEOGRAPHICAL SOCIETY, at 4.—Adventures in Antarctic Lands and Seas: Lieut. Ernest Shackleton. (Lecture to Young People.)

SATURDAY, JANUARY 9.

ROYAL INSTITUTION, at 3.—Extinct Animals: Prof. Ray Lankester, F.R.S.

MONDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration on the Southern Abyssinian Border: Captain Philip Maud.

VICTORIA INSTITUTE, at 4.30.—Ancestral Worship: Rev. Arthur Elwin.

TUESDAY, JANUARY 12.

ROYAL INSTITUTION, at 5.—The Development and Transformations of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Electrical Re-construction of the South London Tramways on the Conduit System: Alexander Millar.

WEDNESDAY, JANUARY 13.

SOCIETY OF ARTS, at 5.—Navigation of the Air: Eric S. Bruce.

THURSDAY, JANUARY 14.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The City and South London Railway; Working Results of the Three Wire System applied to Traction, &c.: P. V. McMahon. (Adjourned discussion.)—On the Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. Hans Behn-Eschenburg.

ROYAL INSTITUTION, at 5.—The Flora of the Ocean: G. R. M. Murray F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On Various Systems of Piling: Prof. J. D. Everett.—The Differential Equation

$$\frac{\partial^2 V}{\partial x_1^2}+\frac{\partial^2 V}{\partial x_2^2}+\ldots+\frac{\partial^2 V}{\partial x_n^2}=0:$$

H. Bateman.—On the Notion of Lines of Curvature in the Theory of Surfaces: Dr. G. Prasad.—On Groups of Order $p^\alpha q^\beta$: Prof. W. Burnside.

SOCIETY OF ARTS, at 4.30.—The Presidency of Bombay: Sir William Lee-Warner, K.C.S.I.

FRIDAY, JANUARY 15.

ROYAL INSTITUTION, at 9.—Shadows: Lord Rayleigh.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

SATURDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—British Folk Song: J. A. F. Maitland.

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