THURSDAY, DECEMBER 9, 1886

COMPARATIVE ANATOMY OF VERTEBRATES

Elements of Comparative Anatomy of Vertebrates. Adapted from the German of Robert Wiedersheim, by W. Newton Parker. (London: Macmillan and Co., 1886.)

IN examinations for the higher degrees and diplomas in science and medicine, candidates are required to show that they possess not only a knowledge of the anatomy of the chief types of the animal kingdom, but also of comparative morphology. Indeed, with respect to medicine, this latter is the more important, especially the morphology of vertebrates. For some time past English students have found themselves considerably handicapped by the want of a short and concise text-book on this subject, to enable them to meet the requirements of Examination Boards; the text-books available for their perusal being generally of too advanced a character, and better suited for the use of those wishing to make comparative anatomy a lifelong study, than for students whose ulterior aim is the practice of medicine or some of its branches. German students, notwithstanding the numerous works on comparative anatomy published in that country, seem to have been equally as ill off for a suitable text-book as their English *confrères.* So impressed was Prof. Wiedersheim that his "Lehrbuch der Vergleichenden Anatomie," a work well known and appreciated by comparative anatomists in this country, and one of the leading works on the subject in Germany, was not a suitable book for ordinary students of medicine, that before bringing out a new edition of it he published a smaller one, entitled "Grundriss der Vergleichenden Anatomie der Wirbelthiere," expressly to meet their requirements. The number of English students sufficiently acquainted with German to be able to take advantage of this work in the original is unfortunately very small, but to those who could do so it has proved to be of great assistance. So well has the German edition fulfilled the object of its author, that the idea occurred to others besides Mr. Parker, that the translation of so useful a work into English was very desirable in the interests of English-speaking students, though it cannot but be a matter of regret that this should be necessary, and probably would not have been so, were English students as well acquainted with the German language as its importance demands they should be.

Throughout the work before us Mr. Parker has retained the original plan of Prof. Wiedersheim's "Grundriss," but a considerable number of additions to and modifications of the original text have been introduced. For some of these he acknowledges that he is responsible, while others have been inserted on the suggestion of Prof. Wiedersheim, who has also revised the whole work previously to its publication.

The work begins with a general introduction, in which the nature and meaning of comparative anatomy is explained, a short outline of the embryological development and structural plan of the vertebrate body is sketched out, and a table is given containing the general classification adopted by the authors throughout the work, of the principal existing vertebrate groups; there is likewise a second table from H. Credner, showing the gradual development of the Vertebrata in time. This part of the work occupies only 15 pages, and is well illustrated by means of nine woodcuts. It is preceded by a list of general works on comparative anatomy and embryology.

The comparative anatomy of vertebrates, constituting the special part of the work, and occupying 315 pages—the remainder of the book—is dealt with under nine sections, arranged according to the different organs of the body. These are treated of in the following consecutive order: integument, skeleton, muscular system, electrical organs, nervous system, organs of nutrition, organs of respiration, organs of circulation, and urinogenital organs. This part of the work is illustrated by 320 woodcuts, most of which are taken from the German edition, but some are new. After each section is appended a short bibliographical list of the more important and recent works relating to the subject under consideration in the chapter.

In treating each section the plan adopted is to begin with a few general introductory remarks, applicable to the whole of the Vertebrata, on the anatomy of the organ or set of organs to be dealt with in the section, and then to proceed to the consideration of its special characters in the different groups of vertebrates. By two kinds of type being used, one larger than the other, the more essential characters of organs or structures are readily distinguishable by the elementary student from the more theoretical and detailed information regarding them printed in the smaller type. The more important words and passages are further indicated by the use of heavy black and spaced types. The former we think might well have been dispensed with, as the use of so many kinds of types tends rather to confuse than render clear. The use of spaced type for important passages and words, though extensively used in German text-books, is only just beginning to be adopted by English authors and printers in place of italics, on which it is a very great improvement. We must, however, enter a decided protest against the use of clarendon type for any purpose except headings, on account of the blotted and disfigured appearance it gives to the pages and on account of the distraction it produces on the reader. Notes explanatory of the text are frequently added at the foot of the page throughout the whole work; that this should have been done is, we consider, a mistake. The introduction of footnotes into any work, and particularly such a work as the present, is extremely objectionable, and should be resorted to as seldom as possible except for references to other publications, where its use may be permissible. Nor is there any excuse in the present instance why so many footnotes should have been introduced, when by the use of a few lines of the smaller type in the body of the page it could have been avoided.

Throughout the text there is a want of uniformity in the manner in which the different kinds of type are used, which will probably be corrected in a new edition; thus, for example, on p. 49 the word "Snakes" is printed in spaced type, whereas three lines lower down "Lizards," another group of Reptiles, is printed in ordinary type, as are also the words "Birds" and "Mammals" on the next page. There are also some descriptions of structures which might be improved in another edition, so as to make the meaning clearer to the student; as an example of this, the history of the development of hair may be mentioned. The brevity of some of the descriptions is, as the authors state, to some extent made up for by the number of woodcuts, but in some cases we think it would have been well had a few lines more been added, even had it been necessary to curtail some of the small print; thus on the first page surely it would have been well to have devoted a little more space to explaining what is meant by the words "ontogeny" and "phylogeny," terms which are constantly referred to throughout the work. It is true that this is also a fault of the original German edition, but as the translator has not professed to adhere strictly to the German text this is a liberty which he might have taken.

We regret to see the words ecto-, meso-, and endoderm used by Prof. Wiedersheim in the original German changed to epi-, meso-, and hypoblast in the English edition, as we consider the terms used by German and other Continental morphologists preferable to those employed by many English writers. We also traverse the statement in the footnote, presumably Mr. Parker's, that the former terms "are applied to the corresponding layers in the adult animal." The terms are respectively synonymous when applied to vertebrates; the skeleton or muscular system of a rabbit is not spoken of as its mesoderm, but as being of mesodermic or mesoblastic origin.

In describing the homologies of the carpus and tarsus, we quite approve of the position the authors have taken with regard to a subject of much controversy on which further investigations may throw more light, but we think in the general considerations regarding the derivation of limbs from fins the history of the evolutionary changes which have taken place is stated much more definitely than the state of our knowledge justifies. That the theory with which Prof. Wiedersheim's name is connected should be brought prominently forward was to have been expected, but no reference is made to other views, such as those of Gegenbaur and Götte, which, in the uncertain state of our knowledge of the subject, might have been expected. We notice that the pentadactyle form of *Equus* found by Marsh has been omitted in the illustrations of the ancestral forms of the horse's foot, and referred to only doubtfully in the text.

In the section on organs of circulation, the heart and its vessels are excellently described, and the introduction occasionally of coloured illustrations makes the subject as clear as could be desired, but the description of the formation of the circulation in the liver and the modifications of the trunk vessels which have occurred in the evolution of the higher from the lower vertebrates, is very short and meagre.

The criticisms which we have passed, however, are not made with the view of finding fault with an excellent and creditable work, but are expressed in the hope that in future editions it may be made more useful for the purpose for which it is intended.

In conclusion, we heartily thank Mr. Parker for introducing to English students a work which we are confident will prove a great assistance to them in their studies, and by perusal of which they will be enabled to understand the anatomy of man in a much more comprehensive manner than they could from a study of human anatomy alone.

J. G. G.

SCIENCE IN NORWAY

Nyt Magazin for Naturvidenskaberne. "New Journal of Natural Science." (Christiania, 1886.)

THE four volumes of this admirable publication which have been sent to us by the Norwegian publishers, include the twelve numbers printed since 1882, and thus complete the third series of the magazine, which, notwithstanding its title of "New," is the oldest Norwegian publication of its kind.

The subjects treated of in its pages belong, with few exceptions, to the general natural history of Norway, in which department special attention is due to Herr Leonard Stejneger's paper on the "Ornithology of Western Norway," as well as to the various interesting contributions of Dr. Robert Collett. To the latter eminent naturalist, well known for his able work "On the Fishes of Norway" (1874), the magazine is indebted for several communications regarding the number and distribution of various species of fishes, first observed in Norway between 1879 and 1883, while in his papers on the character and species of mammals indigenous to Norway, he has contributed much useful information in reference to the Norwegian beaver (*Castor fiber*). From the author's observations, it would appear that the injury done to the forests by these animals in bringing down trees for the construction of their huts in no way justifies the indiscriminate destruction of the beaver, which had long been allowed to go on unchecked in Norway. This view has of late been so generally accepted that the Norwegian Government have been induced to appoint a close time of nine months in the year, during which the shooting or trapping of the beaver is legally prohibited. In special cases, and in certain districts, the local magistrates may even extend this period to ten years if they see reason to apprehend the extermination of the animal.

Norwegian geology and mineralogy are well represented in these volumes, Dr. Kjerulf having added to his labours of an editor those of a diligent contributor, and besides several short papers on the finer mineralogical specimens derived from the Storvarts and other important Norwegian mines—a subject which is also well treated by Herrn Olsen, Münster, and Knudsen—he has enriched the journal with interesting monographs on the local geology of the country, including notices of the dislocations observable in the Christiania valley; the character of the formations at Mjösen-lake which have been brought to light through recent railway-cuttings; and the inclination of the principal lodes on Ekersund. Dr. Hans Reusch describes at length the fall of meteors observed at Vaage in Tysne Island on May 20, 1884, giving useful tables of meteoric falls, whose dates are well attested, between 1784 and 1884. Besides various other papers, Dr. Reusch contributes some interesting geological notices of the districts of Christiania, Valders, and Viksnes, and considers at some length the evidence afforded by the fjelds of Western Norway, of the duration of the Ice age, and the local extension of glacial action in Norway.

The marine zoologist will find much valuable matter in the interesting reports by Messrs. Danielssen and Koren of the Asteridea, collected in the Norwegian North Atlantic Expedition. These papers are a *résumé* of the complete volume, which will appear later on as part of the Collective Report of the Expedition. Of the 20 genera and 40 species collected, 4 genera and 11 species are new to science. Numerous specimens of the Pedicellaster found in West Greenland, and described by Dr. Sladen as new, to which he gave the specific name of Palæocrystallus, is identified by Dr. Danielssen as *P. typicus* of Sars. Extreme importance attaches to the discovery and careful examination of a specimen of an asteroid—unfortunately the only one secured—which differs from others of the family by having a central dorsal appendage, generally erect, but capable of motion. This curious Echinoderm, to which Messrs. Danielssen and Koren give the name *Hyaster mirabilis*, is conjectured by them to represent a larval or developmental stage of the Crinoidea, and after a careful study of this stalk-like appendage they hazard the conjecture that further investigations may lead to the discovery that the Asteridea are in fact developed from the Crinoidea. Equally interesting, if less important, is the re-discovery of the Greenland "Clusterpolyp" of Ellis, the "*Zoophytum grönlandicum*" of Mylius. The specimens examined by these earlier naturalists have long disappeared, and for more than a hundred years no others were found. The *Challenger* Expedition brought back several forms of an Umbellula, one of which Prof. Kölliker considered to be of the same species as the lost specimens of Ellis and Mylius; the Norwegian naturalists are of opinion, however, that all the specimens found are mere varieties of *Umbellula encrinus*, to which they ascribe a wide geographical range.

In conclusion, while we desire strongly to recommend the *Nyt Magazin*, it may not be out of place to mention that several of the most interesting papers on local Norwegian geology are written in German, and that the highly important results of the recent Norwegian North Atlantic dredgings are given by Dr. Danielssen in English, under the title of a "Preliminary Report" of the Expedition. The magazine, which is under the joint editorship of Professors Kjerulf, Danielssen, Mohn, and Hiortdahl, is printed in the Latin type now so generally used in the Norwegian press, and is copiously illustrated by well-drawn woodcuts, and excellent plates of the animals described.

OUR BOOK SHELF

Acta Mathematica. (Stockholm. Various dates.)

THIS journal, which has already won for itself the reputation of being one of the leading mathematical journals, not of the North merely, but of the world, sprang into life at the end of 1882, is published at Stockholm, and has all along been under the able editorship of Prof. G. Mittag-Leffler, assisted by all the foremost mathematicians of Sweden, Norway, Denmark, and Finland. Its object is stated to be to gather and publish such mathematical works as contribute to the development of the science by the novelty either of the results obtained or of the methods employed.

The seven volumes which have been issued contain papers by some of the foremost Continental mathematicians: the sole contribution, we believe, in English is furnished by an American writer, Mr. G. W. Hill, and is entitled "On the Part of the Motion of the Lunar Perigee which is a Function of the Mean Motion of the Sun and Moon" (this paper occurs in vol. viii., which is in course of publication). There are in all, in the complete volumes, 107 papers, in almost every department of the science.

It may be in the recollection of our readers that Oscar II., King of Sweden and Norway, who is styled "Special Protector of the Journal," has instituted a great mathematical prize for an important discovery in higher analysis, the particulars of which have appeared in full detail in our columns (vol. xxxii. p. 302); the prize works are to be published in the *Acta*.

The Methods of Glass-Blowing. By W. A. Shenstone. (Rivingtons, 1886.)

NOT only the student who is entering, or has just entered, that mystic land of chemical research, but also the ordinary student of chemistry who wishes to be more than a mere beginner, or a book-chemist, will hail with great joy the appearance of this little book on glass-blowing. We have not many good professional glass-blowers in this country, and, as the author says, it is a difficult if not impossible thing to get any instruction in glass-blowing; and, as a result, the great bulk of chemical students are as dependent on the dealers in glass ware as the bulk of amateur photographers are on dry plates and other things in that connection.

Most students even in our hardest working laboratories have some time to spare in which they might practise some of the more useful and simple methods of making glass apparatus mentioned and described in this little book.

Apart from the immediate utility of being able to make one's glass apparatus in the laboratory, and the help it is in almost any form of chemical or physical research, it cannot fail to be also indirectly useful to a student on his transplantation to a works or the superintendence of some technical operation, and will give him what is so very desirable, in addition to that of the purely chemical manipulation of analysis, a feeling of confidence in overcoming mechanical difficulties.

In the introduction is a description of a suitable working-place, blow-pipe, and bellows—things which are seldom to be found fit to use in our laboratories—and the blow-pipe flames; after which the varieties of glass mostly used, and the actual operations involved in the construction of most glass apparatus, in which glass tubes are the main parts, are very plainly described, being also in many cases illustrated with diagrams of the different stages. The last chapter is devoted to "calibrating and graduating glass apparatus," operations we think every student who gets as far as quantitative analysis should be able to perform in a decent manner.

We most thoroughly recommend this little book to students who intend to become chemists, and hope the proportion of those who can blow a respectable bulb will soon be increased. At present it is about ·1 per cent.

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Two Hours with a "Subject Index"

THERE has appeared within the year, under the title of "A Subject-Index to the Modern Works added to the

Library of the British Museum in the Years 1880-85," the latest of the series of indexes published under the auspices of our great national library. Having recently had occasion to consult the same with reference to certain biological works, I experienced so much difficulty in finding what I wanted, that I thought it worth while to inquire more fully into the trustworthiness of the volume as an aid to the working naturalist. I append my notes, in the interest of workers in a field the literature of which is already overburdened.

The book is printed in unnecessarily large type, whence there results a ponderous volume of 1044 pages quarto. Upon the immensity of the task before the bibliographer set to compile such a work I need not comment. If the duty be well performed, there can only result a product useful to all, and helpful to the specialist; if otherwise, confusion becomes confounded, and there ensues to the worker loss of time, if not actual disaster.

Printers' errors and minor inaccuracies are to be expected in a work of the kind, and any such compilation must of necessity be faulty. It is not surprising, therefore, to find "travel" for "translation" in recording the title of Scott Russell's work, on p. 1016. Other similar defects could be quoted, but why are the press-marks occasionally omitted? surely they are next in importance to the titles themselves? The compositor cannot be at fault here.

The compiler sets forth his scheme in a short preface, by no means a bad one if fol'owed. One of the chief provisions reads thus: "Headings and sub-headings are in strictly alphabetical order; precedence being given under each to the larger and more important works." It is in the execution of this self-imposed dictum that the compiler is seen at his best. Who is to be the judge of the relative merits of the collected works, and what is to be the standard of comparison? Presumably, the compiler performs the difficult task in person, but it is indeed well that his method is not revealed, for Huxley's "Crayfish" heads the list of general works upon Mollusca (p. 653), and Miss Buckley's "Life and her Children" that upon Micro-organisms. The thing must be a joke! Nothing of the kind!! "Corallinen Algen." brings up the rear of Corals (p. 212), while "Les Batrachospermes" are exalted to an equality with the Batrachians—a truly novel means this of demonstrating the unity of the biological sciences. The aforenamed inaccuracies amount almost to incredibilities, and it is difficult to realise that they are perpetrated in earnest. It is inconceivable that they can have resulted from mere carelessness; but, even were that so, the fact that they exist at all would be sufficient in itself to disqualify the compiler. We can only regard them as the natural outcome of giving to one man the work of half a dozen; they disfigure the work, and shake our confidence in much that remains. A little less pardonable, perhaps, is the relegation of "Der Tasman-Gletscher" to the Column Tasmania.

The choice of headings is often ill-advised. Four works are recorded upon the Polyzoa; these are equally divided between Polyzoa and Bryozoa, to neither of which headings is there a cross-reference. Writings upon organisms in air generally are distributed between sections Air and Atmosphere, Micro-organisms, and Bacilli and Bacteria, with no cross-references. Papers dealing with the broadest generalisations and the subtlest of details are muddled together regardless of system; while under Micro-organisms there is a cross-reference to Infusoria, sole possessor of which department is Kent's well-known Manual. Section Palæontology is especially introspective. It is divided into the sub-heads General, Bibliographical, Collections of Fossils &c., Fossil Fauna, and Flora—a sufficiently inconsistent arrangement in itself. Conspicuous among the general works is Brongniart's "Recherches sur les graines fossiles silicifiées." A knowledge of the publications of his own department ought certainly to be expected of the compiler, through whose hands the covers of the said works must surely pass. But no; for while there has been recorded under the last-named heading Rupert Jones's "Catalogue of Fossil Foraminifera," we look in vain for the companion volumes of Hinde and Lydekker, both of which were published within the period embraced. There is here something akin to contempt for authority! Marsh's "Odontornithes," divorced from Palæontology, finds a home among the Birds.

Having found that the leading tenet of the scheme was violated—that relating to the precedence of important works—I turned next to the second one. It reads: "All books are, so far as possible, grouped together according to their language, in the following order—English, French, German, Italian. . . . There are, however, some deviations from this system—for example, in the history of each country the titles follow each other in chronological sequence, irrespective of language." How the two methods of arrangement thus vaguely formulated are to be simultaneously adopted, we are not informed; and in this ingenious attempt to combine two schemes into one neither has been adhered to—both have suffered. A cursory glance at some of the more important sections, *e.g.* Birds, shows that the conditions have not been in the least fulfilled, so far as pertains to precedence of language; while, to go afield, we find under Clergy, Priesthood, &c., a unique arrangement in which the languages run thus—Spanish, English, German, French, Italian, English, *ad finem*. Where, here, is the professed patriotism? It deserts the author under the inspiration of Clergy, Priesthood, &c., and leaves him reckless. What now of the chronological sequence? One turns instinctively to various historic headings. In none of those examined did I find the exception to be the rule.

The major scheme nullified, the preface becomes a blank; but the details of the superstructure are no more to be relied upon than is the foundation itself. Under Insects, to which the reader is referred from Entomology, there are titles in abundance in which the two catchwords occur; but he looks in vain for references to the fact that the majority of entomological papers are scattered among Coleoptera, Diptera, Hymenoptera, Lepidoptera, Ants, Wasps, Bees and Bee-keeping, and other headings. The Colorado Beetle figures under that heading and under Potato, but not under Coleoptera; while, to complicate matters, a German and an English work upon the subject appear under Potato, the place of the former being, under Colorado Beetle, usurped by a Spanish rival. Fish and Fisheries embraces all branches down to Oyster-Culture, but why not Salmon Fisheries? It appears to suffice that they should take shelter under Salmon, with no cross-references. A special heading is set up for Angling, but several definite works thereon are to be found only under Fish and Fisheries, no references being given under Angling.

Titles of works are not unfrequently repeated, and that unnecessarily. For example: Morris's "Letters about Birds" occurs under Birds (sub-headings—General, and Great Britain and Ireland); Dixon's, Swaysland's, and Watkins's books are not under their appropriate headings; while Patterson's "Birds, Fishes, and Cetacea frequenting Belfast Lough," which should be under Fauna, Local, is misplaced. Under the last-named heading Canon Tristram's "Fauna of Palestine" appears beneath sub-section Italy—the compiler seems doomed to disaster in his relations with the clergy. In one or two cases where comprehensive titles occur, a process of dismemberment has crept in. For example: Romanes' "Jelly-Fish, Star-Fish, and Sea-Urchins" is to be found under Star-Fish and Sea-Urchins, with the title mutilated beyond recognition, but not at all under either Jelly-Fish, Medusa, or Echinoderm; Scott Russell's "Wave of Translation in the Oceans of Water, Air, and Ether," to which allusion has already been made, occurs, also with a misquoted title, under Water, but under neither Ether nor Air and Atmosphere.

Such are the results of an attempt to gauge the working capacity of the "Index" mainly from a single stand-point. I leave other specialists to inquire for themselves. It has been said that this "work proves the ability and industry of its compiler, and that the Trustees are anxious to make the treasures of the great library a success." Granted the good intentions of the governing body and the industry of the compiler; of the rest the reader must judge for himself—I refrain from further comment thereon. It cannot, however, be admitted that the compiler has done his best; errors cannot be avoided where non-technical hands are applied to technical work, but slovenliness is ever intolerable. I submit that a distribution of labour is demanded for the success of the next essay of the kind.

JUSTITIA

The Origin of Species

IN a recent issue of NATURE (Nov. 25, p. 77) Mr. Catchpool writes:—"Is it, or is it not, the fact that allied species, which are confined each to a particular island, prove, when brought together, far less frequently infertile than species, equally dissimilar, which had lived in the same district, might be expected to prove? On the answer to this question depends, as far as I can see, the fate of the theory of physiological selection. Can no one answer it?"

This is a question which has arisen out of the theory of physiological selection itself, and, as Mr. Catchpool was the first to propound that theory, I am afraid he will find that no one as yet is able to answer his question. But it may interest some of your readers to know that I have collected a considerable body of facts tending to show that there is a correlation between fertility of allied species and the fact of their living on isolated areas, as well as another correlation between sterility of allied species and the fact of their living on continuous areas. But it seemed to me undesirable to publish these facts until very largely augmented; and, finding that no observations had been expressly made upon the subject, I read my paper before the Linnean Society for the purpose of inducing naturalists in different parts of the world to try experiments on the fertility of nearly allied species inhabiting isolated areas, as well as to test for degrees of sterility between natural varieties and parent forms on continuous areas. Meanwhile I am myself trying experiments on the mutual fertility of isolated species, as well as upon the sterility of natural varieties with parent forms. Where birds and mammals are concerned, I am using the numberless islands of all sizes on the west coast of Scotland, which are admirably suited to the purpose. Any of your readers in any parts of the world who are acquainted with well-marked natural varieties of birds or mammals which (together with their parent forms) would be likely to thrive on these islands, would greatly oblige me by communicating suggestions.

I may take this opportunity of also requesting any of your readers who may have further remarks or criticisms to make on the theory of physiological selection not to delay their publication. For it is surely desirable that discussion of the subject "on the high *priori* road" should come to an end. Until a large number of experiments shall have been made, any definite judgment upon the theory must be either biassed or premature; and therefore the only influence that can now be exercised by adverse criticism is that of discouraging the work of verification. On this account, and on this account alone, is it worth one's while to answer such criticism. Hitherto I have waited till it should come to an end, and withdrawn the answer previously referred to in these columns as having been in type for the *Fortnightly Review*. When it has come to an end, I will furnish a general reply in the *Nineteenth Century*, and shall then hope to show that whatever "fate" may be in store for the theory at the hands of Nature, at all events it is certain that it has been in no way affected by the assault of naturalists.

George J. Romanes

Heredity in Abnormal-Toed Cats

The calculation made by Mr. J. H. Hodd in last week's Nature (p. 53) of the numerical proportion of the sexes of Mr. Poulton's race of extra-toed cats, in relation to the recurrence of the abnormity, is very interesting as an inferrable deduction from the premises of Mr. Poulton's elaborate tabulation of his observations; but it is, I think, doubtful whether it is not misleading as a generalisation from the facts collected by him. A conclusion arrived at by means of a mathematical method is too absolute an inference, and not necessarily reliable, when applied to purely biological cases, on account of the numerous intervening factors (perhaps mostly unknown, but yet of importance) which are incapable of being appreciated within such an estimate, and which may, in consequence, invalidate the main point under consideration. This appears to be the case on the present occasion; for Mr. Poulton mentions, in describing the kittens of VIII^5 (p. 39), that by far the most highly specialised development of the abnormity he has observed, throughout the entire race, was attained in a *male*—VIII^5 iv. Considering that the large majority of individuals possessing the character are of the ♀ sex, as pointed out by Mr. Hodd, this fact is really very striking. But, at the same time, if the point alluded to by Mr. Hodd were considered as amounting to a principle, we should naturally be led to infer that the abnormity might become equivalent to a secondary sexual character, which is so improbable that it scarcely bears suggestion. Besides, it is necessary to bear in mind that all the observations carried on as yet by Mr. Poulton have dealt *with the ♀ influence alone;* and it may be accounted for by the very reason that all the ♂s have been carefully eliminated from exercising any influence on the race, that the predominant effect, *numerically*, is on the ♀ side; while it is most probable that if an abnormal ♂ were selected (say, the individual just referred to) as a starting-point for experiment with normal ♀s, the result would exhibit a general tendency towards superior persistence of the character operating with greater potency amongst the males than the females. It would be very interesting to experiment in this manner under the isolation happily promised in the Madeiran Islands.

Mr. Hodd's statistical statement is, doubtless, correct in the main, under the restricted provision just suggested, only one must not attach too great importance to it. The preponderance in number of the ♀s over ♂s is, indeed, still more noticeable when the ratio of each sex to the total number of the thirty-six cats is considered. Thus it appears that of twelve ♂s $13\frac{8}{9}$ per cent. are normal, and only $19\frac{4}{9}$ per cent. abnormal; whilst of the twenty-four ♀s $19\frac{4}{9}$ per cent. are normal, as many as $47\frac{2}{9}$ per cent. are abnormal. It is perhaps a little premature to place entire reliance upon so small a number, but it will prove interesting to compare the statistics brought out in Mr. Hodd's letter with a larger number in time to come.

In considering such a close and carefully detailed analysis as that presented by Mr. Poulton, it is of no little interest to find, on referring to that wealth of facts and principles, "The Descent of Man," that these results are in complete accord with, and confirm the laws of inheritance formulated by Darwin, if the strictures imposed by him, as if in anticipation of future observations, are duly regarded; and as his remarks apply to the present subject very directly,—although bearing more especially upon sexual selection in general,—I cannot do better than quote some of the more pithy:—"Why certain characters should be inherited by both sexes, and other characters by one sex alone, namely by that sex in which the character first appeared, is in most cases quite unknown. We cannot even conjecture why with certain sub-breeds of the pigeon, black striæ, though transmitted through the female, should be developed in the male alone, whilst every other character is equally transferred to both sexes; why, again, with cats, the tortoiseshell colour should, with rare exceptions, be developed in the female alone" ("Descent," 2nd ed., p. 232). It is curious that the cats under observation happen to be tabby-tortoiseshell, and the remark made by Darwin (p. 230), that "as a rule it is the females alone in cats which are tortoiseshell, the corresponding colour in the males being rusty red," fully obtains in the present case, since the ♂s are, unless tabby, sandy-coloured, but never tortoiseshell. It is furthermore important to notice that the sandy individuals have the supernumerary digits as fully developed as any of the ♀s in the same litter.

Darwin's explanation of the persistence of abnormal characters is on the lines of the theory of pangenesis, as follows:—

"It is in itself probable that any character appearing at an early age would tend to be inherited equally by both sexes, for the sexes do not differ much in constitution before the power of reproduction is gained. On the other hand, after this power has been gained, and the sexes have come to differ in constitution, the gemmules (if I may again use the language of pangenesis), which are cast off from each varying part of the one sex, would be much more likely to possess the proper affinities for uniting with the tissues of the same sex, and thus becoming developed, than in the other sex" (p. 232). On p. 237 we find the further remark:—"The presence of supernumerary digits, and the absence of certain phalanges, must be determined at an early embryonic period, ... yet these peculiarities, and other similar ones, are often limited in their transmission to one sex: so that the rule that characters developed at an early period tend to be transmitted to both sexes here wholly fails."[1]

And, in conclusion:—"Characters of the parents often, or even generally, tend to become developed in the offspring of the same sex, at the same age, ... in which they first appeared in the parents. *But these rules, owing to unknown causes, are far from being fixed.* Hence, during the modification of a species, the successive changes may readily be transmitted in different ways; some to one sex, and some to both; some to the offspring at one age, and some to the offspring at all ages. Not only are the laws of inheritance extremely complex, but so are the causes which induce and govern variability" (p. 240).

It is quite remarkable, though it is not at all surprising, how closely Mr. Poulton's facts fit into these deductions of Darwin's, drawn, as they were, from such few instances that they seem to be little less than preconceived ideas.

But, as it may be due to a one-sided influence in special

[1] This is a point which perhaps requires further evidence.

cases that an effect is found to have clung with so much persistence to one sex, I am inclined to believe that, upon the experiment being made as I have suggested, that the other sex will produce similar results in regard to the numerical proportion of the sexes, and a strong point in favour of this opinion lies in the fact that, as I have myself seen, a sandy-coloured ♂ kitten, apparently bearing the stamp of the normal ♂ parent, was found to bear the development of the supernumerary digits in a marked degree.

WILLIAM WHITE

55, Highbury Hill, N., November 22

Algebraic Notation of Kinship

WITH reference to Mr. Davison's letter in NATURE (vol. xxxiv. p. 571), I wish to point out that the subject of algebraic notation, not only for kinship, but for kinship and affinity, has been pretty fully discussed in several papers which I contributed to the Royal Society of Edinburgh, and especially in a paper entitled "Analysis of Relationships of Consanguinity and Affinity," which, at the request of Mr. Galton and Dr. Tylor, I contributed to the Anthropological Institute (*Journal* of the Anthropological Institute, August 1882). Some idea of the nature of that paper may be got from a statement of the several tables which are appended to it. Table I. gives the notation for the general relations of the first five orders, states the general and singular meaning of each, and classifies them according to index, sign, and grade. Table II. shows how these general relationships are divided into ultimate species. Table III. gives all the possible relationships of a man to a woman, and of a woman to a man, within the first five orders; and such relationships as exclude marriage according to the laws of England are marked with an asterisk. Table IV. gives the consanguineous relationships of the first five orders grouped in lines and species, the agnatic system being formed by the extreme terms on the left, and the uterine system by the extreme terms on the right. Table V. gives strict definitions of the English terms of relationship.

Besides the algebraic notation, I also developed a graphical notation. In the paper referred to, I apply the graphical notation to show the descent of property according to the English law.

Prof. Jevons took much interest in these papers, and it was his intention to give the elements of the analysis in a new chapter of his "Studies in Deductive Logic," but death snatched him from us in the midst of his scientific labours.

ALEXANDER MACFARLANE

University of Texas, Rustin, Texas, November 15

Seismometry

IN the last number of NATURE (p. 75) there appears a letter by Prof. J. A. Ewing, referring to a note in a previous number (p. 36), apparently a summary of a communication from Prof. Milne. As I have some interest in this question, and have reason to believe from remarks made in a letter lately received from Prof. Milne that the matters referred to by Prof. Ewing cannot be those to which Prof. Milne referred, I should be glad if the original communication could be published.

Prof. Ewing's letter and indeed several of his recent publications, including the description of his instruments in NATURE, are decidedly calculated to mislead those not familiar with the seismological work which has been done in Japan. For example, he says, or leads one to infer, that he introduced horizontal pendulums in seismology: now that is not the case. It is needless for me to say that horizontal pendulums have long been known as a means of obtaining nearly neutral equilibrium; and in particular, with reference to Japan, they are referred to by Prof. Milne on page 25 of vol. i. part 1 of the *Trans. Seis. Soc. Japan*, in a paper which was read in Prof. Ewing's presence several months before Prof. Ewing's instrument was heard of. What Prof. Ewing did introduce was a particular form of horizontal pendulum, very particularly described by him in some of his early papers, as involving a "new principle" (now apparently abandoned by him), and he used two such pendulums to write two components of the earth's motion on a *continuously* moving plate. Records on moving surfaces were not new then, even in Japan, as they are referred to in papers published by other investigators before Prof. Ewing arrived in the country, but there was this difference in these older methods, that the plates were automatically started by the earthquake; and Prof. Ewing, after his experience, has now adopted this plan.

Prof. Ewing mentions also in his letter that his apparatus writes three components of the motion, but he does not say that the most difficult of the three—namely, the vertical component—is written by an instrument which I introduced and described before the Seismological Society of Japan, first in May 1880, and afterwards in a modified form in April 1881. Prof. Ewing's instrument is professedly, as his first description (*Trans. Seis. Soc. Japan*, vol. iii.) clearly shows, a modification of my second form, and is, what he seems persistently to have shut his eyes to, almost identical with my early form.

As to Prof. Ewing's statement in the last sentence of his letter that "there is nothing better to take their place," we can hardly be expected to take *his* judgment on this point.

THOMAS GRAY

7, Broomhill Avenue, Partick, Glasgow, November 30

[Nothing essential was omitted from Prof. Milne's letter.—ED.]

Botanical Lecture Experiment

THE following simple lecture-experiment may interest teachers of botany. It is described by Georg Klebs in his paper "Ueber d. Organisation d. Gallerte bei einigen Algen u. Flagellaten," published in the most recent part of *Unters. a. d. bot. Inst. z. Tubingen*. A description of the experiment I give in Klebs's words, translated:—"It is easy to demonstrate, by addition of a watery solution of phenolphtalein, that Algæ make the water in which they live alkaline when they are fixing carbon in light. In proportion as the fixation of carbon proceeds, the water gradually assumes a deep red tinge, which gradually disappears when light is excluded." The explanation given is:—"The Alga takes up not only the CO_2 absorbed in the water, but also in part that which is in combination in acid carbonates, in consequence of which alkaline combinations arise; in darkness, owing to respiration, the reverse process takes place."

I have a vessel with water containing phenolphtalein in which Cladophora has grown for nearly three weeks, and there is daily a reddening of the water, its rapidity being determined by the brightness of the day; during the night the colour disappears.

BAYLEY BALFOUR

A Lecture Experiment on the Expansion of Solids by Heat

MR. MADAN's description of a device for showing that metals and solids expand when exposed to heat is very interesting, especially as such an arrangement, but with important modifications, is capable of giving very excellent scientific results, results which are only surpassed by M. Fizeau's method. One necessary alteration is the substitution of a spring-pressure for the weight on the strip of metal. This and other points will be made quite clear by a perusal of a short description contained in my paper, "A Strain-Indicator for Use at Sea," read before the Institution of Naval Architects. The numerous tables and diagrams there given would, I am afraid, hardly interest your readers, but the repeated experiments in Table I. would be a subject of interest, as they show how well the experiments agree amongst themselves. The errors, though small, are due, in my opinion, not only to the difficulty of reading the dial (each unit being equal to about half an inch, and the second decimal therefore about 1/200 inch), but also to the difficulty of reading the exact position of the weight on the steel-yard of the testing-machine. Far more accurate results are obtained when, instead of a jockey weight being run out, small weights are added one by one.

You will also notice that the instrument gives very good records on paper (see launching strain diagrams and railway bridge diagrams), and in this shape it could, I think, be used with advantage for recording changes of temperature.

C. E. STROMEYER

Strawberry Hill, Middlesex, December 2

Meteors and Auroras

IN the *Proceedings* of the Paris Academy of Sciences published in NATURE for November 4, at p. 23, a relation between showers of shooting-stars and auroras is noted. In this vicinity on April 14, May 8, July 27, and November 2, very fine auroras were visible, and upon each occasion shooting-stars of unusual brilliancy were observed in the northern heavens whilst the aurora was at its height.

M. A. VEEDER

Lyons, New York, November 24

THE GUTHRIE MEMORIAL FUND

A COMMITTEE has been formed, under the presidency of Prof. Huxley, to raise a memorial fund in honour of the late Prof. Guthrie, F.R.S. Prof. Guthrie endeared himself to a large circle of friends by his simple character and wide sympathies. Unfortunately, as his time was exclusively devoted to teaching and to scientific research, the provision for his family is far from adequate. A slender income is furnished for his widow by a policy of insurance settled upon herself, but this will not enable her to provide for the education and maintenance of her step-children. The ages of the children dependent upon her are twelve, fourteen, and seventeen years respectively, and their case is the more sad because, until a late period of his life, Dr. Guthrie had every reason to be satisfied that they were sufficiently provided for.

Under these circumstances it will be felt by all who value his memory, as well as by those who only knew him through his scientific labours, that any sum which is gathered as a memorial of his life must necessarily be devoted to placing his children as nearly as may be possible in the position they would have occupied but for his untimely death.

Subscriptions may be sent to the Honorary Treasurer, Major Macgregor, R.E., Science Schools, South Kensington Museum, London, S.W.; or to the Honorary Secretary of the fund, Mr. C. Vernon Boys, at the same address. Cheques to be crossed "Messrs. Cox and Co."

In addition to the gentlemen named above, the Executive Committee consists of Capt. Abney, Prof. W. G. Adams, Prof. Roberts-Austen, Walter Besant, Prof. G. Carey Foster, Dr. J. H. Gladstone, W. J. Harrison, J. Power Hicks, Prof. J. W. Judd, Prof. A. W. Reinold, and Prof. Balfour Stewart; besides whom there is a General Committee, comprising Prof. W. E. Ayrton, Shelford Bidwell, Walter Bailey, T. Lauder Brunton, W. H. M. Christie, Prof. Clifton, Conrad Cooke, Prof. Crookes, Warren De La Rue, Prof. Dewar, Colonel Donnelly, General Festing, Prof. G. Forbes, Prof. Fuller, R. T. Glazebrook, Prof. Goodeve, Dr. Hopkinson, J. Norman Lockyer, Sir John Lubbock, Bart., Prof. MacLeod, Prof. J. Perry, Prof. Poynting, Prof. Rücker, Dr. W. J. Russell, Prof. W. A. Tilden, Prof. S. P. Thompson, Prof. Thorpe, and Dr. Alder Wright.

It is satisfactory to hear that already a considerable number of subscriptions have been received, but it is hoped that when the necessity for the existence of such a fund shall become better known there may be a large increase in the number.

VOLCANIC ERUPTION IN NIUA-FU, FRIENDLY ISLANDS

SIR J. H. LEFROY has forwarded to me a small packet of volcanic dust, together with an extract from a letter written by Mr. Coutts Trotter, F.R.G.S., and has requested me to examine the former and append my remarks upon it to the more important parts of Mr. Trotter's letter. This document is dated on September 24, 1886, "on board the ss. *Suva*, a few miles south of the Island of Niua-foou" (or Niua-fu, one of the Friendly Islands). After speaking of an expedition to Fiji, Mr. Trotter proceeds:—

"Meanwhile I got into a little steamer to visit the windward island of the group, and was persuaded to come on in her to Tonga. There I found that news had just come of an awful volcanic eruption in the Island of Niua-foou above mentioned, and my steamer was chartered to go and make inquiries and give relief. . . . We started at once, and arrived off the island before dark yesterday. No trace of fire or smoke, and I was much chaffed for my 'disappointment.' But on landing this morning we ound the damage done was substantial enough, an eruption of dust and stones and water having gone on for eighteen days, and two-thirds of the island smothered or greatly injured. The island is some forty or fifty miles round, all volcanic, no beach anywhere, and landing difficult, and a lake of brackish-bitter water occupying perhaps a fourth or more of its extent. There are at all events three small islands in the lake, one with a lake in its centre. I suspect this lake is the remains of the crater and eruption to which the existence of the island is due, later eruptions being cause for the small island craters. The present eruption began apparently near one end of the lake. I saw three or four craters there—one covered with a green sulphurous scum; and another, just beyond it, which I could not in the time I had actually visit, very deep, and full (a friend tells me) of mud and water. Near it is a little rounded mountain of 'earth,' some 200 feet high, formed by the present eruption, and projecting far into the lake; at the other end of the lake is a fresh accumulation, as I was told, of pumice, but it looked to me from where I stood more like an accumulation of black sand. The whole island has been in a disturbed state for some three months and a half, the dates of the principal disturbances coinciding remarkably with those which are going on in other parts of the world—earthquakes on June 8 and 11, which I think are the dates of the first New Zealand outbreaks,[1] again on August 12, ditto. This of course is not wonderful, but the final catastrophe here took place on August 31, which we understand was the exact date of the recent American earthquake.[2] It was preceded for twenty-four hours by earthquakes, . . . and went on for ten days, I am told, without intermission, then two days quiet interval, then going on again for nearly a week—terrific thunder and lightning for twenty-four hours incessantly. The column of steam rose, they say, several thousand feet, anyhow immensely higher than a hill 7600 feet high, which I ascended, and whence I had a bird's-eye view of the lake and crater. Showers of stone accompanied it; these fortunately fell straight, or nearly straight, back. They were red-hot, with masses of dust attached, and as they fell left the dust behind, which produced the effect of a fiery tail. The great mischief was done by the dust, which, as the wind shifted, carried destruction in every direction. In one village which I entered, the shower only lasted an hour and a half, but the ground was deeply covered, the blades of grass even now only beginning to peep through, and every coco-palm ruined for the present, the branches hanging withered and almost perpendicular, and the young central shoot sticking out by itself. If they get rain, the trees will recover and bear again in three years, but otherwise are likely to die. But in other districts the houses are buried, and along the coast large extents of forest, scrub, or bush, and, what is more immediately serious, the yam beds. They have just been planted, and any that were above ground will be killed, even if the latest planted may push through and flourish. Wonderful to say, no one was killed, although many very old people have died since from fear and exhaustion. They all betook themselves to the upper parts of the island for safety, and perhaps with reason, for the last two volcanic outbursts both took place on the coast-country near the shore. These (respectively nineteen and forty years ago) were both lava eruptions. I saw the craters and the lava-streams from them down to the sea on the west coast as we steamed along to-day; the lava of the earliest being hardly invaded yet by vegetation —not a blade of green on the later, which runs far out into the sea, like the rough substratum for a big embankment or breakwater. According to native tradition, the last eruption of a kind similar to the present took place from very nearly the same spot in the lake seventy-two years ago, the old people having childish recollections yet. The

[1] The first outbreak was early on the morning of June 10. See NATURE, vol. xxxiv p. 301.

[2] The principal shock was on Tuesday night, August 31. See NATURE, vol. xxxiv. p. 470, and vol. xxxv. p. 31.

lake is a great depth, so that this hill of 200 feet or more rising from the bottom represents a vast amount of solid matter, to say nothing of the thick deposits of dust all over the island. The lake was still bubbling in places, and things are by no means settled down yet. At Vavau, where we touched two days ago, they had just had a very severe earthquake, and shocks are still going on at Niuafoou (vertical, *I was told*, but my informant's wits were much shaken by recent events) daily on the level ground near our landing-place, from which it is inferred that the danger is not over. Strong gases too are perceptible rising from the ground near the coast, which is always where they apprehend most danger, and an outburst of lava. I suppose the solid matter coming up through the deep lake is pulverised into the (to life) comparatively harmless dust. During the earthquake of August 12, the captain of a ship at anchor found that, whereas he had paid out twenty fathoms of chain over-night, he had only eight fathoms under him in the morning. I never saw such big coco-nuts anywhere, though the trees are not exceptionally big, indeed there seem to be no very fine or old trees of any kind on the island, which favours the theory of a modern origin, for the soil is very fertile. The name means New Niua, the Old Niua being probably the neighbouring Keppel Island or Niua-tobu-dabu. I wish I could give you a better or fuller and more interesting account of the whole affair, but the visit was a very hurried one, and, in fact, I had not more than two hours on shore. Still it may interest you, as it is written on the very spot: no other account is likely to reach England. I send a pinch of 'sand' from the crater. "C. T."

This "sand" or "dust" is a very dark-brown—almost black—colour. When examined with a lens it seems composed mainly of fragments of glass, and has a slightly speckled aspect, owing to the mixture of lighter and darker fragments; one or two glassy-white fragments may also be noted. When some of the dust is placed under the microscope, it is seen to consist almost wholly of fragments—some rudely polygonal in shape, others flattish chips—of a brown glass; the former being the commoner. The majority of the bits vary from about ·01 inch to ·03 inch in diameter, and the latter measurement is but rarely exceeded. Minute chips are also present, but they do not form at all an important constituent in the mass. A conspicuous characteristic is the (apparently) entire absence of the tiny pellets of "cindery" scoria, so frequent a constituent of volcanic dust, and of the fine pulverulent material, the presence of which commonly makes it needful to mount the dust on a slide before it can be properly studied. I have found no difficulty in examining this Niua-fu dust, and even the finer chips—often less than ·001 inch in diameter—by simply spreading it over a sheet of glass. The glass fragments, even when very minute, have a tinge of brown: when about ·01 inch in thickness, they are fairly translucent, and a rich olive-brown in colour; but as they approach ·03 inch in thickness they become opaque, light only passing through the thinner edges. Small cavities, spherical, or egg-shaped, are not infrequent, but the glass is remarkably free from microlithic inclosures. No granulation of the colouring-matter is perceptible, as a rule, with a magnification of 150 diameters; opacite dust and trichites (especially the latter) are very rare; and of other microlithic inclosures I have only seen an occasional lath-shaped crystallite (? feldspar). I have not identified among the fragments either biotite, augite, or hornblende; so that if any of these minerals are present they must be very rare. The clear glassy fragments mentioned above are feldspar—probably labradorite. They do not in number exceed about 2 or 3 per cent. of the whole. Many of the flatter brown-glass fragments exhibit ropy folds or the remains of a cellular structure, evidencing that they are due to the destruction of a very vesicular glass, while the more solid polygonal fragments may be the detritus of the thicker parts of the same or of a more uniform glass. The strong brown colour of the fragments reminds me of specimens of the more glassy lavas of the Sandwich Islands in my collection; and like them I should, from microscopic examination, consider the rock a basalt-glass (tachylyte) with a silica percentage, which was probably above rather than below 50. This view accords, I find, with Cohen's statement concerning the lava of Niua-fu, which, judging from his description, is very similar to that above described (*Neues Jahrb. für Min.* 1880, vol. ii. pp. 36 and 41); he says that it is almost identical in composition with the "basalt-obsidians" (*i.e.* tachylytes) of the Sandwich Islands. It contains 50·74 of silica; their analyses show from 50·82 to 53·81.

While the above was passing through the press, I received from my friend Dr. S. Rideal a determination of the specific gravity of the volcanic material (powdered to get rid of cavities). The specific gravity is 2·726. As the feldspar is included, and it is slightly the lighter, the specific gravity of the glass itself must be a little higher, about 2·73. Hence we need not hesitate to call it a tachylyte. The average of six Sandwich Island glasses is 2·71 (see Judd, *Q. J. G. S.*, xxxix. 444).

T. G. BONNEY

FOURTH ANNUAL REPORT OF THE FISHERY BOARD FOR SCOTLAND

THE Report of the Fishery Board for Scotland increases each year, not only in size, but in interest for the general public, as well as for those readers whom it specially concerns; and, unlike ordinary Blue-books, its pages are to a large extent devoted to scientific papers which appeal to many not directly concerned with the fishery industry.

The herring-fisheries continue to be most productive. A very striking feature of the summer herring-fishery of 1885 is, that many in-shore grounds, where herrings were previously found in great abundance, but which had recently been all but deserted, were restored to their former fertility. The increase of the herring-fishery in the Shetland district, which now ranks as the most important in the country, still continues, greatly to the improvement of the condition both of the people and of their boats. The fish are of finer quality than those taken on other parts of the east coast. The takes of other sea fish and salmon were also very large. The gross total estimated value of the sea and salmon-fisheries for Scotland was 2,859,822*l.* 15*s.* The Board have already expressed their regret that so many tons of sprats are annually used as manure. Could they be transmitted to populous districts at a reasonable rate, they would be a cheap and valuable addition to the food-supply, or, where this was impracticable, preserved as anchovies as in Norway, or as sardines as in Canada. The importance of utilising the by-products of the fisheries is now widely recognised. Papers by Dr. Stirling and Mr. Haliburton give an account of certain economical products obtained from fish, and experiments are being made on a fairly large scale by Mr. Sahlström at Aberdeen, which may, it is hoped, lead to some practical results. Investigations on whitebait by Prof. Ewart and Mr. Matthews showed it to consist almost entirely, and at all seasons, of young sprats and young herrings, varying according to the season of the year and the place of capture. It might, therefore, be advantageous for the Firth of Forth and other in-shore waters to send supplies of whitebait to the English markets.

The Scientific Committee of the Board had the assistance of Mr. Brook, Prof. Stirling, and Mr. Duncan Matthews, of Aberdeen; Prof. McIntosh, of St. Andrews; Prof. Greenfield and Dr. Gibson, University of Edinburgh; the Rev. A. M. Norman, D.C.L. of Durham; and Mr. Haliburton, of University College, London. Though the Marine Laboratories at Tarbert and St. Andrews admitted of several important inquiries being initiated, the Board is still greatly hampered for want of proper boats, and throughout the year the limited amount of dredging and field-work done was rendered possible by boats supplied by Prof. Ewart. It is to be hoped that arrangements will be made by the Admiralty, which will admit of the superintending vessels undertaking a complete survey of the spawning-banks and assisting in work of a like nature when required. A small steamer has already been provided for trawling experiments and other work on the east coast. At the Rothesay Aquarium the spawning of the cod was studied by Prof. Ewart and Mr. Brook, who generally confirmed the observations of Sars, and gained further information as to the natural and artificial fertilisation of the eggs, and their buoyancy before and after fertilisation in different kinds of water. The appendix contains part ii. of a paper by Mr. Brook on the development of the herring. Experiments made in artificial fertilisation of herring eggs appear to justify the following conclusions:—

(1) The ova retain their vitality, and are capable of being fertilised from forty to forty-eight hours after the female is dead. In the experiments performed, forty-eight hours seems to be a little outside the limit at which the eggs are capable of being fertilised, but it is probable that temperature may have an influence on the vitality of the ova. (2) The spermatozoa do not retain their vitality for nearly so long a period. Three hours appears to be the limit indicated by the above experiments. (3) The egg capsule never separates from the yolk excepting under the influence of spermatozoa. It would appear that when the ova and spermatozoa have partly lost their vitality a partial separation of the egg membrane from the yolk may take place, although the ovum is not truly fertilised. Experiments proved conclusively that the egg capsule is not permeable to water until after it has been penetrated by spermatozoa. (4) The egg membrane is covered with a viscous secretion when the ovum leaves the oviduct, which serves for the attachment of the ovum. This viscous layer gradually hardens in sea-water. Active spermatozoa are able to penetrate this layer some hours after it has set, but this power appears to be confined to the first twenty-four hours after deposition. (5) There is no collection of germinal protoplasm at the surface of the yolk in the ripe ovarian ovum, nor is a germinal disk ever found so long as an ovum remains unfertilised. The formation of the germinal disk cannot be made out in living ova, and its true nature can only be determined from a study of sections. Investigations on the formation of the blastoderm, and examination of a large number of sections, lead to the conclusion that the animal pole of the ovum gives rise to the ectoderm. In many forms the animal pole at the time of the formation of the segmentation cavity consists only of true archeblast cells. In the herring, and probably some other forms, the animal pole receives an addition of cells from the parablast prior to the formation of the segmentation cavity. The primitive hypoblast, which is almost entirely derived from the parablast (*i.e.* from the vegetative pole), gives rise to the mesoderm, and the secondary hypoblast (endoderm) remains as a single row of cells in connection with the parablast.

If these conclusions are correct, the similarity between the development of teleosteans and amphibians (*Rana*) cannot fail to be noted. The derivatives of the animal and vegetative poles are in both cases practically identical. The secondary segmentation (budding) in the parablast of teleosteans must then be regarded as the necessary consequence of the relative distribution of protoplasm and yolk in the vegetative pole. The primitive hypoblast, as here described for the herring, is precisely homologous with that of Amphioxus. In both cases the primitive layer gives rise to mesoderm, notochord, and true endoderm. The position here brought forward is one advocated by Mr. Brook over a year ago, but from the nature of the material then at his disposal he failed to observe the details of the process. Quite recently, Dr. Ruckert, who has been studying the behaviour of the parablast in Elasmobranchs, has come to conclusions practically identical with those here advocated for Teleosteans.

The question, "Are herring ova likely to develop normally on the deep off-shore fishing-banks?" is discussed by Prof. Ewart in a way which shows that the Board aims at practical results as much as mere scientific investigations.

Until comparatively recent years nearly all the herring taken in summer were captured by small boats within a few miles from the shore. In 1852, *e.g.*, immense herring shoals reached the Moray Firth to spawn on the Guillam and other in-shore banks. Since 1852 the fishing boats have greatly increased in size, and owing to the introduction of cotton nets, each boat has added greatly to its catching power.

As the boats have increased in size and sea-worthiness, the fishermen have proceeded farther and farther to sea in search of the herring shoals, and now the greater number of the herring are taken from forty to sixty miles from the coast. It is often alleged that it was owing to the herring deserting the in-shore grounds that the fishermen proceeded to sea in search of the shoals, and also that it is because the fishermen disturb and break up the shoals early in the season that they no longer or seldom visit their old spawning-grounds. There is no doubt that during the last fifteen years comparatively few herring have been captured during the summer over the in-shore banks of the Moray Firth; but whether this is the result (as is alleged) of the fishermen intercepting and breaking up the shoals before they have had time to reach the in-shore ground it is impossible to say. It is, however, a question of great interest, and one which could in all probability be easily settled. If the fishermen were to refrain from fishing for one year in the various districts along the east coast until the fish had reached maturity, this problem would most likely be solved. In all probability the herring would be found as abundantly as in former years in the in-shore waters, and the fish captured would be larger and riper than those taken early in the fishing-season of former years from the corresponding shoals.

That the takes during recent years have consisted chiefly of small fish (so-called maties), will be evident by a reference to Reports of the Fishery Board. It is generally admitted that the great depression of the fishery industry which now prevails would, to a great extent, have been prevented if half of the small herring (the maties) had been left in the sea. Many of those who account for fewer herring being captured in-shore, by saying it is impossible for them to run the gauntlet of the thousands of nets that are night after night drifting across their path, assert that the eggs are incapable of developing in deep water, and that in course of time the off-shore shoals will diminish or disappear. Of this there is in the meantime no evidence. As a matter of fact, for all we know there may have been immense shoals of herring spawning on the banks which lie at a distance of from thirty to sixty miles off the Scottish coast for centuries.

The existence and continuance of off-shore shoals will, to a great extent, depend on whether the herring are able to reproduce themselves without visiting the in-shore spawning-banks, and the success of the herring industry will depend on whether the herring shoals, which are invaded annually by our fishing fleet, continue to spawn sufficiently near the coast to render their capture a profitable enterprise for our fishermen. For this it is necessary to have large shoals moving in limited areas, and these are only found on the east coast during the winter and summer spawning-seasons. If herring ova are capable of hatching in deep water (say from 60 to 100 fathoms) it may be taken for granted that any of the many gravel-coated banks of the North Sea may serve as spawning-beds. The North Sea is remarkably shallow, there being only one small area near our shores (generally known as the "Pot," and lying two to five miles off Fraserburgh), where a depth of 100 fathoms is reached. The most certain way of proving whether herring ova hatch or not in deep water would be to dredge herring spawn from one of the off-shore banks in an advanced stage of development; but, after several unsuccessful attempts to do this, it occurred to Prof. Ewart that the question might be practically settled by depositing fertilised eggs in specially constructed hatching-boxes in deep water. This was done in the "Pot," but without result, as a storm swept away all traces either of buoys or boxes. The Moray Firth being in many respects unsuitable for this experiment, Prof. Ewart turned his attention to the West Coast, and found a comparatively sheltered spot in Loch Fyne, with a depth of 104 fathoms. To insure success, a small tank was constructed of thick slate slabs firmly bound together by iron rods. The tank, though only about 20 inches square, weighed nearly 2 cwts. In the top and in two sides of this tank small windows were made about 6 inches square. Each window was carefully fitted with a teak frame, across which a single layer of horsehair cloth was stretched. These windows admitted a sufficient current of water to pass through the tank. All the necessary preparations having been made for depositing the tank during last autumn. Mr. Brook, who was engaged at the Fishery Board Tarbert Station during the autumn, undertook to obtain eggs and superintend the sinking of the tank in the 100-fathom water. Eggs were obtained on September 11 from herring caught in Kilbrannan Sound in water varying from 8 to 12 fathoms. All the eggs were placed at first in the laboratory in water which had an average temperature of 54° F. Most of the eggs kept in the laboratory hatched out on the 19th, while others only hatched on the 24th, thirteen days after fertilisation. On the 16th, one of the glass plates, coated with eggs, was introduced into the tank above mentioned, which was immediately conveyed to the middle of the channel, and deposited in 98 fathoms water, about three miles off Tarbert. The surface temperature was 54° F., the bottom temperature was 49° F. The bottom around the tank was chiefly composed of mud. On the 24th—*i.e.* thirteen days after fertilisation, and eight days after the eggs were deposited in 98 fathoms water—the tank was raised. On examining the glass plate, it was found a number of the eggs in the centre had been destroyed by a fine coating of mud, which had entered through the hair-cloth screen, while those near the margins contained vigorous embryos almost ready to hatch; in a few cases hatching had taken place. The average bottom temperature while the eggs were deposited was 49°·3 F.; the average surface temperature, 54° F.,—the difference being 4°·7. The difference of 4°·7 during the eight days which the eggs were deposited delayed hatching for about five days. This experiment clearly shows that the only difference between the hatching of herring ova in deep and shallow water is one of time; hence we are safe in concluding that if herring deposit their eggs on suitable ground, in any depth of water not exceeding 100 fathoms, they will undergo development. It is conceivable, however, that the depth of the water in which the eggs are deposited may have some influence on the time of spawning—in other words, on the fishing-season; and the immature condition of the fish caught n August during recent years may to some extent be accounted for in this way. If the herring which formerly spawned on the in-shore banks of the Moray Firth in from 10 to 20 fathoms water now spawn off-shore in from 40 to 60 fathoms water, the hatching will be delayed for several days, and maturity will not be reached as early as formerly. This is an argument in favour of beginning the herring-fishing later in the season than at present. It may be objected that the fry, if hatched out in deep water, would never succeed in reaching the surface; and supposing that they could, the necessary food might not be found forty to sixty miles from shore. Observations, however, show that the young herring are likely to have little difficulty in ascending 200 fathoms before the yolk-sac is exhausted, and that though no one is yet well acquainted with the food of the fry, there can be no doubt about the richness of the surface fauna beyond even the fifty-mile line.

In the Report for 1883, Prof. Ewart called attention to the fact that the German Commission had arrived at the conclusion that the Baltic herring differed sufficiently from the North Sea herring to be worthy of being considered a special variety. It has long been held by fishermen and others that each district has its own peculiar variety. From some 500 specimens examined in 1883, no evidence of the existence of such varieties was found. In order to settle this question finally, Mr. Duncan Matthews has been examining, for a considerable time, samples of the herring captured around the Scottish coast, and now communicates an important paper on this subject. The method of investigation adopted was to take accurate measurements of the length of the head, and of the caudal, dorsal, and anal fins, to note the position of the fins on the body, &c., and, by a comparison of these data with the length of the body, to ascertain the amount of their actual variation, and especially whether these variations were so constant in the herrings of any one or more localities or seasons as to indicate a distinction of races. From this inquiry it seems that there are as large herring now as there were some generations ago, and that, although each district yields large herring, the north-east coast has a slight advantage in this respect over the south-east and west coasts. A table giving the size, &c., of the largest fish examined includes representatives from every fishery district, and shows that there is no practical difference in size between the male and female, nor in the numbers of each of these which were taken. The winter fish are found to be rather larger than those taken in summer, while among the fish commercially termed "maties" there are (1) immature herring, *i.e.* herring which, in addition to being small in size, have undeveloped milts or roes; (2) small herring in all degrees of ripeness up to maturity; (3) small herring which have spawned—small "spent" herring. Hitherto, the size of the fish, rather than the sexual condition, has apparently determined whether the term "matie" should be applied. In the same districts, and even in the same shoals, *large* sexually immature herrings are often found along with *small* ripe, or nearly ripe, herring; hence herring appear not only to vary in size in their fully adult condition, but also to vary in the size at which they reach sexual maturity. It is pointed out that these results, as well as the fact that the undivided ova vary in size in ratio to the size of the fish, are likely to cause considerable variation in the progeny which result from the interbreeding of fish of varying *size* and age. Of the fish caught in the early part of the season, a much larger proportion are immature and small, and probably also younger than is the case later on. The adult fish appear to reach a more advanced stage of ripeness before they approach the spawning-banks. From the measurements made, it is shown that the length of the head varies considerably the extremes being found in herrings of all localities and both seasons, the percentage with the larger size of head being rather greater among the winter than the summer herring; but this difference, like that of the total length, is considered insufficient to prove a racial distinction. The position of the centre of the dorsal fin in a majority of the winter herrings is anterior to the centre of the body, whereas among the summer herrings a large percentage have it behind the centre. In the immature fish, however, the fin-centre is generally anterior to the body-centre. The anal and pelvic fins show a corresponding difference in position. As regards the pelvic fin, however, this condition is limited to the adult and larger young herring, the pelvic fin being found, like that of the sprat, anterior to the dorsal fin in young herring below 60 millimetres in length. The pectoral fin varies very slightly in its relative position on the winter and summer herring. The relative basal length of both the dorsal and anal fins conveys no indication of racial distinction between the summer and winter fish. The dorsal fin is in all the herrings generally longer than the anal; only about 1½ per cent. of the summer herrings, and 7½ per cent. of the winter, having the anal fin longer than the dorsal. Further details are given respecting the number of fin-rays, keeled scales, circumstances of spawning, &c., but which scarcely affect the question of racial distinction. The inquiry, so far as it has gone, tends to prove that there is no racial distinction between the herrings found in the various localities around the Scottish coast. Judging, however, from the more backward position of the dorsal pelvic and anal fins, the doubtfully smaller head, and the slightly lesser size of the summer herrings, more minute inquiries may indicate a slight difference between the winter and summer herrings.

Mr. Brook reports on the herring-fishery of Loch Fyne and the adjacent districts during 1885, and under his "Ichthyological Notes" gives a short account of the rare fishes met with during the year.

Naturalists and fishermen alike have long felt the absence of accurate information as to the spawning period of fishes. In order to have a basis on which to found further investigations, Mr. Brook has prepared a provisional list of the spawning period of various food-fishes. This list brings out the great lack of accurate information on the subject, but gives an idea of the opinions as to the spawning periods held by fishermen and others around our coast. These opinions are in many cases conflicting, and in most cases they will require to be altered. Prof. McIntosh contributes an account of the work undertaken at St. Andrews since the last Report, including notes on the eggs and young of fishes studied during the past year. Recently considerable attention has been devoted by Mr. Wilson to the development of the common mussel, and an account of his investigations up to the present time will be found in the appendix. During the summer and early autumn several attempts were made to fertilise the eggs artificially at St. Andrews. The early stages of development were studied from ova obtained in this manner, while the free-swimming embryos were frequently obtained in pools amongst the mussel beds in the Eden and in other localities. In the Board's last Report it was mentioned that Prof. Greenfield had undertaken to investigate the lower organisms met with in some of our more important salmon-rivers. This investigation has been advanced a step, and numerous forms have been isolated and cultivated by the methods previously described.

Mr. Brook and Mr. Calderwood give the further results of examination of the food of these "useful" fishes, the herring, the cod, and the haddock. Mr. Calderwood also sends notes on the Copepods of Loch Fyne, and on the Greenland shark; Canon Norman reports on a Crangon, some Schizopoda, a member of the order Cumacea, new to, or rare in, the British seas; Dr. Stirling, on red and pale muscles in fishes, and on economic products from fish and corresponding vegetable products; Mr. Haliburton, on the blood of *Nephrops norwegicus*; Dr. John Gibson, on physical observations made for the Fishery Board in the Moray Firth during the autumn of 1883.

Ten plates accompany the appendix. It is greatly to be regretted that the Board has not yet been able to survey some of the fishing-banks, more especially those which are supposed to extend along the western shores of the Hebrides, and that the part of the Report dealing with scientific work is not published separately.

THE ELECTRIC CHARGE ON THE ATOM

ALTHOUGH considerable attention has been given of late to electrolysis and the subjects connected therewith by English chemists, more especially since the Helmholtz Faraday Lecture of 1881, yet some of Prof. Helmholtz's deductions from Faraday's experiments have been curiously neglected.

I refer more especially to the bearing of the facts on the true nature of valency, and I purpose in this paper to point out one or two fairly obvious consequences which follow from the results of Faraday's researches, but which have not, I believe, been stated before.

Prof. Helmholtz has shown that it follows from Faraday's experiments on electrolysis that while a monovalent atom carries to the electrode one charge of electricity a divalent atom carries two charges of electricity. For instance, when we electrolyse potassium chloride, we have each potassium atom delivering a charge of electricity at the one electrode, and each chlorine atom delivering an equal charge of electricity at the other electrode, all monovalent atoms, carrying with them an equal charge of electricity, which we may call the unit charge.

When, however, we electrolyse magnesium chloride, we have two atoms of chlorine set free for one of magnesium, and consequently while each chlorine atom carries its unit charge with it, the magnesium atom carries two units of electricity to the electrode. In fact electrolysis proves that differences of valency mean differences in the electrical charge on the atom. All this is so familiar to us now that I have perhaps repeated it at unnecessary length.

But we have many elements which vary in valency. For instance, copper is capable of forming two series of compounds, in one of which it is monovalent, and in the other divalent, that is, in one of which the copper atom carries one unit charge of electricity, and in the other carries two units of electricity.

We are able, then, under certain conditions to alter the electrical charge on an atom, increasing it by some simple multiple.

There are therefore a special group of chemical reactions, such as the oxidation of the cuprous salts, in which we have not merely combinations between two or more substances, or ordinary double decomposition, but in which, besides such changes, an additional electrical charge is given to, or removed from, an atom. I think it follows from this that all such reactions are of very special interest, and deserve careful study.

For instance, take the case of the saturation of an olefine by chlorine. We must look on this reaction from one of two points of view. Either on the addition of chlorine an additional charge is supplied to the carbon atom, in which case by-products of less saturation are probably formed; or the carbon atom is already fully charged, in which case the double bond is not merely a shorthand statement of a possible reaction, but expresses a physical fact.

There is also another point worthy of note in connection with this addition of electricity to the atom. If we take the case of the two copper chlorides—cuprous and cupric chloride—we find that their heat of formation per chlorine atom is not very different. Now it is well known that the heat of formation of a salt approximates to the heat of formation as calculated from the electromotive force developed when that salt is formed in a voltaic cell.

To put this in other words, we can obtain from the heat of formation of cuprous chloride, or of cupric chloride, an approximate calculation of the difference of electric potential between the copper atom and the chlorine atom in the two salts.

Now, as already stated, the heat of formation per chlorine atom is nearly the same; that is, the difference of potential between the copper and chlorine is nearly the same in both salts. What follows from this?

It follows that, in doubling the electric charge on the copper atom, the potential is not also doubled. This means, therefore, that the capacity for electricity of the atom is increased at the same time. This conclusion is not quite certain, as our information is still too scanty on the actual differences of potential in the case of these two salts; and, further, we do not know what fraction of it belongs to the chlorine atom; but, on the whole, the facts we have point to the above conclusion, and it is at any rate a subject well worthy of study to determine whether the capacity of the atom for electricity can vary or not.

Passing from this, I wish to point out another very obvious but nevertheless important deduction to be made from the facts of electrolysis.

We have recognised that the difference between monovalent and divalent copper consists in the doubling of the charge upon the atom. This again may be due to some profound change in the atom itself, but it is at any rate the obvious and marked distinction; we have copper in both cases, but double the electrical charge in one case over that in the other.

If we searched among the elements, could we find two series of salts more completely different in their nature and properties than the cuprous and cupric salts?

I venture to say that, if we did not know we could derive the same element from both, we should assume them to be derived from two different elements, and assign them very different places in Mendelejeff's table. Many other examples of the same thing will occur to everybody, namely, that alteration of the electrical charge on the atom is accompanied by profound alteration in the nature of its compounds, and is therefore probably the cause of this alteration.

Up to this point I think my deductions are fair and obvious deductions from the facts of electrolysis. I wish now to suggest a possibility, I can call it no more, which if true will considerably alter our views of the facts of chemistry. We have found the importance of alterations of electrical charge in altering the properties of an atom as shown in its compounds.

We already believe that variations in atomic weight are closely allied with the variations in the properties of the atom as shown in its compounds.

Are there, then, two things which condition the chemical properties of an atom, or is there only one?

Let us look again for an instant at the facts of electrolysis, and let us take the electrolysis of hydrochloric acid as our example.

At present we state the facts thus:—Every molecule of hydrochloric acid consists of one atom of chlorine and one atom of hydrogen, the chlorine atom weighing 35·5, the hydrogen atom weighing 1. On passing a current, each molecule is split into these two atoms, each atom carrying a unit charge of electricity.

Is it not just possible that we may some day state the facts thus:—A molecule of hydrochloric acid consists of one molecule of hydrogen weighing 1 combined with 35·5 molecules of chlorine each weighing 1. On electrolysis, the chlorine atoms are split from the hydrogen atom, the chlorine atoms each carrying unit charge of electricity, and the hydrogen atom carrying 35·5 charges of electricity.[1]

If this is the truth, then all the atoms of the elements are of the same weight, and probably are made of the same "stuff," and we have two, and only two, things which condition the properties of the atom—namely, its electrical charge and its electric potential, and Mendelejeff's table becomes a statement of the periodic relationship between these.

In suggesting this vague possibility, I do not wish to obscure the first part of the paper, which consists, I believe, of perfectly legitimate deductions from the facts of electrolysis.

I have purposely avoided giving many examples, as I have been dealing with such familiar and common-place chemical reactions that plenty of examples will at once occur to every reader; and sufficient has, I think, been said to show at any rate the importance of experimental inquiry into this subject, and the probability of considerable modifications of our views of chemical facts in the near future.

The new way of looking on valency, which we owe to Prof. Helmholtz, may, as I have already pointed out, completely alter our conception of the nature of an unsaturated carbon compound, and of the process by which saturation takes place; and probably as investigation proceeds in this department it will become necessary to re-dissolve our chemical facts and crystallise them out in completely new mental concepts, while doubtless the ideas associated with the graphic formula pass away and leave not a wrack behind. A. P. LAURIE

[1] No one need quibble about the 35·5.

MUSIC AND MATHEMATICS

YESTERDAY afternoon meeting at a friend's house a lady visitor to Oxford who was to sing that evening at one of the hebdomadal concerts in Balliol College, and the conversation happening to turn on the gifted mathematical lady Professor in the University of Stockholm, my thoughts shaped themselves, as I was walking home, into the following lines, which, if likely to interest any of your readers, I shall be happy to see appear in the world-wide-diffused columns of NATURE.

New College, November 15 J. J. SYLVESTER

SONNET

To a Young Lady about to sing at a Sunday Evening Concert in Balliol College

Fair maid! whose voice calls Music from the skies
Weaving amidst pale glimpses of the moon
Tones with fresh hues of glowing fancy strewn
And soft as dew that falls from pitying eyes–
Let from their virgin fount those accents rise
That bid sad Philomel suspend her tune,
Thinking the lark doth chant his lay too soon–
Whose else that trill which with her own note vies!
To her whose star shines bright o'er Maelar lake
And thee who beautifi'st glad Isis' shore
Grant! I one joint harmonious garland bind:
Thou canst with sounds our senses captive take–
She the true Muse, fond poets feigned of yore,
Strike Heaven's own lyre, Nature's o'erruling mind.

NOTES

MR. HAROLD B. DIXON has been appointed Professor of Chemistry and Director of the Chemical Laboratories at Owens College, Manchester.

THE *Oxford Magazine* announces that Prof. Burdon Sanderson and Mr. Gotch are going to spend their Christmas vacation at Arcachon, where there is awaiting them a large tank full of torpedoes. It looks forward with interest to the publication of the results of the Oxford physiologists' holiday, remarking that "to the research will be added the pleasing excitement of danger; for if incautiously handled these torpedoes will give the physiologist a shock, compared with which the agonies of scores of vivisected rabbits are as nothing." Of course this is not true.

MR. WILLIAM FAWCETT, one of the assistants in the Department of Botany in the British Museum, has been appointed by the Secretary of State for the Colonies to the post of Director of the Public Gardens and Plantations in Jamaica.

THE Uralian Society of Natural Sciences is arranging to hold a Scientific and Industrial Exhibition of Siberia and the Ural Mountains in 1887, at Ekaterinburg. The Exhibition promises to be of great scientific interest, including sections of geology, botany, zoology, anthropology, and archæology. The anthropology especially will be of the most comprehensive character. It will include a certain number of families of Bashkirs, Kirghizes, Vogones, Ostiaks, Samoiedes, and other half-civilised peoples of Siberia, with their dwellings, and appliances for hunting and fishing, besides models, figures, costumes, &c. There will also be a large collection of prehistoric objects. The grounds around the Exhibition building will be utilised to give a fairly accurate idea of the arborescent vegetation of the countries represented. Delegates from foreign Societies intending to visit the Exhibition will be accorded special travelling privileges, and be received with the greatest hospitality. The Exhibition will be open from May 27 to September 27. The President of the Society is General Ivanoff, and the President of the Exhibition Committee M. A. Miclowsky.

MR. ARTHUR GROTE died on the 4th inst. at his residence in Ovington Square. He was born in 1814. He was a Fellow of the Royal Society and also of the Linnean Society. Mr. Grote wrote a number of papers on subjects connected with botany and natural history, and contributed an introduction to Hewitson's "Descriptions of New Indian Lepidopterous Insects in the Atkinson Collection." He was engaged for many years in Her Majesty's Indian Civil Service.

MR. W. GALLOWAY writes with reference to the recent explosion at Elemore Pit :—"Elemore Pit is one of the Heeltan group of collieries near Newcastle-on-Tyne, which are accounted to be amongst the best and most carefully managed mines in this or any other country. It is under the direct supervision of Mr. Lindsay Wood—a member of the late Royal Commission on Accidents in Mines. The workings are dry and dusty; no accumulation of gas was known to exist anywhere; a shot is supposed to have been fired at the moment the explosion took place, for shot-firing was going on. The explosion appears to have been confined to the in-take air-ways, and to have shot up the downcast shaft, or, in other words, to have traversed a region filled with fresh air without any admixture of fire-damp. These features of this and other similar explosions of late appear to militate somewhat against the views expressed in the Report of the Royal Commission on Accidents in Mines, to the effect that coal-dust alone was a comparatively harmless agent in the absence of fire-damp."

THE following are the arrangements for the lectures before Easter at the Royal Institution :—Prof. Dewar, six lectures (adapted to a juvenile auditory) on "The Chemistry of Light and Photography"; Prof. Gamgee, eleven lectures on "The Function of Respiration"; Prof. Rücker, five lectures on "Molecular Forces"; Prof. Max Müller, three lectures on "The Science of Thought"; Mr. Carl Armbruster, five lectures on "Modern Composers of Classical Song"; and Lord Rayleigh, six lectures on "Sound." The following are the probable arrangements for the Friday evening meetings before Easter :—Sir William Thomson, on "The Probable Origin, the Total Amount, and the Possible Duration of the Sun's Heat"; Mr. W. Baldwin Spencer, on "The Pineal Eye in Lizards"; Mr. Edwin Freshfield, on "Some Unpublished Records of the City of London"; Mr. E. B. Poulton, on "Gilded Chrysalides"; Mr. W. Crookes, on "Genesis of Elements"; Capt. Abney, on "Sunlight Colours"; Mr. V. Horsley, on "Brain Surgery in the Stone Ages"; Archdeacon Farrar, on "Society in the Fourth Century A.D."; Mr. G. J. Romanes, on "Mental Differences between Men and Women"; and Lord Rayleigh, on "Colours of Thin Plates."

AN Edinburgh Correspondent writes :—"Mr. Romanes has just delivered his first course of lectures on the Philosophy of Natural History to a large and appreciative audience, including students from all the Faculties in the University of Edinburgh."

THE Minister of French Postal Telegraphy has sent to Brussels a delegate to arrange for establishing a telephonic line between Paris and that city. The price for the use of the telephone will be five francs for a period of five minutes. It is the first step on record towards an international telephonic system.

A REMARKABLE fire-ball was seen at Stonyhurst College, Blackburn, on December 4, at 9.16 p.m. Although the moon was shining brightly, it lit up the sky like a brilliant rocket. Its course was from 27 Lyncis to θ Gemini, and as it advanced it left a fine streak behind it. Its colour was a bluish-white. At first it moved swiftly, then more slowly, and, before vanishing, burst into several fragments. There was no streak left where the meteor burst, but only in the first part of its course. It was like a horse-tail cirrhus, the bushy portion surrounding the star 27 Lyncis, and thence extending in a narrower streak about 3°. It remained visible for one minute and a half, the part last to fade being that about 27 Lyncis.

WE have received the last number (part 2, vol. iv.) of the *Proceedings* of the Liverpool Geological Society. The presidential address by Mr. Mellard Reade, "On the North Atlantic as a Geological Magazine," is a continuation of the line of investigation sketched out by him in his previous address, which was entitled "Denudation of the two Americas." The papers deal mainly with the geology of Liverpool and the neighbourhood, especially North Wales. A paper by the Secretary, Mr. W. Hewitt, "On the Topography of Liverpool," must be specially interesting and instructive to those acquainted with the present geography of that great city.

THE active volcano, Asamayama, appears to be attracting particular attention just now in Japan, probably because it is the loftiest mountain in the country which is in a constant state of activity, and also because it is the nearest to the capital, and is situated in a district long famous for its health resorts. A few weeks since we referred to an anonymous account of the crater, published in the *Japan Weekly Mail*, but a much more careful sketch of it is given by the Japan Correspondent of the *Times* in a letter published recently in that journal. The roar of the volcano, on approaching the edge of the crater, he describes as not unlike the noise produced by the passage of a train across a bridge under which one is standing. There was no shaking, however, but loud hissing and bubbling constantly proceeded from numberless vapour-jets in the inner face of the crater-wall, from its rim downwards. The crater is a rough oval in shape, but the estimates of its size are most conflicting. The Japanese give the circumference as four miles, but this is simply a wild guess. A German explorer set down the diameter at 1100 yards, and an English mathematical professor put it at only 200 yards, "divergences that will illustrate the mental confusion to which some men are liable when in the presence of dread natural phenomena." The writer himself estimated the circumference at 1056 yards, by walking round the windward half of it—it was impossible to pass through the vapours on the lee side—which was accomplished in six minutes, at the rate of about three miles an hour.

ON the very interesting question of the depth of the crater—that is, the depth from the mouth to the surface of the molten matter—opinions vary almost as hopelessly as on the size. No doubt the "vast clouds of the most pungent sulphurous steam," which are described as rising swiftly out of the caldron, render exact observation difficult. The *Times* Correspondent speaks of catching glimpses of the crater-wall at depths which a very moderate estimate would place at 300 feet. But the gradual convergence of the cavity apparent at this depth forbids the acceptance of the enormous profundity for which some visitors have contended, and suggests that the depth can hardly much exceed 500 feet. After a weird description of the appearance presented to the spectator by the volcano at work, the writer concludes by remarking that the present crater is apparently the youngest and innermost of three. Further down on the south-west side are to be seen, along with numerous fissures of unfathomable depth, remains which point to the existence of two former craters, concentric and of large dimensions, and separated from one another by a considerable interval. Possibly the existing cone was formed by the great eruption of 1783.

A TELEGRAM from New York of December 2, states that eight slight shocks of earthquake are reported from Summerville, one severe shock from Columbia, and two slight ones from Charleston. No damage was caused. Dr. Forel writes that earthquakes were felt in Switzerland on November 25 at 3h. at Pontresina and Bernina (Grisons), and again at 3h. 58m. (both Greenwich times) at Pontresina.

ACCORDING to the *Ceylon Observer*, Mr. C. Stevens, a naturalist, has returned to Colombo from a most successful and interesting sojourn amongst the Veddahs, whose district he has thoroughly explored, and with whom he was enabled to establish a closer intimacy than any European ever did before. He has been able to clear up a good many dubious points relating to the manners, customs, and religious beliefs of these veritable wild men of the woods. He has succeeded in obtaining several perfect skeletons, and a number of skulls.

THE *London and China Telegraph* states that a Folk-Lore Society has been established in the Philippines, at the prompting of a Society for the study of folk-lore in Spain. The archipelago certainly presents a wide field for investigation and inquiry in this respect, on account of the diversity of native races inhabiting it. The survivals in the shape of traditions, customs, and observances amongst the primitive tribes still to be found in the inaccessible interior of many of the islands may be expected to throw much light on the early history of the people, and on the origin of many superstitious practices common in more civilised lands.

THE Report of the Public Free Libraries of the City of Manchester, while expressing the deep regret of the Committee at the loss of Sir Thomas Baker, their chairman for nearly twenty-five years, is at the same time a testimonial to the ability and judgment with which the work under his care has been carried on. Additional libraries, a tenfold increase in circulation since the two first of them were opened, and over 4000 volumes withdrawn this year as *worn out*, are proofs of the earnestness of this work. Nor does the increase seem likely to cease, for the extension of the time of keeping open the reading-rooms till 10 o'clock, although it adds to the already long hours of those engaged in their management, is sure, we think, to increase their counter-attraction to the public-houses, and to bring up the number of visitors annually to the libraries to three millions. Two recently incorporated districts also have requested that equal advantages may be extended to them, and help in carrying this out has been liberally supplied by independent public bodies. A remarkably large proportion of books are taken out to be read in the reading-rooms. Boys especially avail themselves of these rooms on a Sunday, nearly twice as many of them attending then as on a week-day; a direct reversal of the practice of other classes. The success of Manchester is the more marked that so moderate a proportion of fiction is supplied to its readers.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus* ♂ ♀) from India, presented by the Countess Dowager of Lonsdale; a Mona Monkey (*Cercopithecus mona* ♀) from West Africa, presented by Miss Bashall; a Domestic Sheep (*Ovis aries*, var.) from West Africa, presented by Sir Albert Kaye Rollitt, F.Z.S.; a Grey-striped Mouse (*Smithus vagus*) from the Tatra Mountain, presented by Dr. A. Wryesniowski; a Poë Honey-eater (*Prosthemadera novæ-zealandiæ*) from New Zealand, presented by Capt. B. J. Barlow, s.s. *Taimu*; a Blue-fronted Amazon (*Chrysotis æstiva*) from Brazil, presented by Miss Joachim; two Tuatera Lizards (*Sphenodon punctatus*) from New Zealand, presented by Dr. E. B. Parfitt; a Cerastes Viper (*Vipera cerastes*) from Egypt, presented by Mr. J. H. Leech, F.Z.S.; a Beisa Antelope (*Oryx beisa* ♂) from North-East Africa, a Rough Fox (*Canis rudis*) from Guiana, purchased; a Red Kangaroo (*Macropus rufus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

CORRECTIONS TO REFRACTION TABLES.—Prof. Cleveland Abbe, in a short note to the *Astronomische Nachrichten*, calls attention to the fact that the reading of the mercurial barometer which is used in the refraction-formula as an index to the density of the air is not a true index to the pressure controlling that density until it is corrected for the effect of the variations in gravity. The correction is accomplished by adding one more factor, g, for gravity, when the formula becomes—

$$R = \alpha \tan z \left(\frac{1 - 0{\cdot}00259 \cos 2\phi}{1 - 0{\cdot}00259 \cos 2\phi_0} \text{ BT} \right)^{A} \gamma^{\lambda},$$

where ϕ is the latitude of the observer, and ϕ_0 of the station for which the tables were computed. Prof. Cleveland Abbe considers that the omission of this correction for gravity may partly explain the origin of small systematic differences in the declinations of different star-catalogues, though such differences, so far as they are due to refraction, must also be caused by local irregularities in the distribution of pressure and temperature, which produce effects equivalent to slight inclinations of the horizontal planes of equal density. The systematic changes in his distribution, due to change of season, must introduce an annual variation in refraction similar to the effect of parallax, and it will occasion a difference in the refractions north and south of the zenith, which may often attain an appreciable amount.

COMET FINLAY (1886 *e*).—The following ephemeris by Dr Krueger, for Berlin midnight, is in continuation of that given in NATURE of November 25 (p. 85):—

1886	R.A. h. m. s.	Decl. ° ′	log r	log Δ	Brightness
Dec. 10	22 2 49	13 25·6 S.	0·0074	9·8941	3·1
14	22 23 51	11 9·7	0·0142	9·8909	3·0
18	22 44 58	8 46·0	0·0221	9·8901	2·9
22	23 6 0	6 16·7	0·0309	9·8917	2·8
26	23 26 49	3 44·6 S.	0·0404	9·8958	2·6

The brightness at date of discovery is taken as unity.

COMET BARNARD (1886 *f*).—This object is now visible to the naked eye, and is at its brightest. As it is now visible in the early evening, it should be frequently observed. The following ephemeris by Dr. Aug. Svedstrup, for Berlin midnight (*Astr. Nachr.*, No. 2756), is in continuation of that given in NATURE of November 25 (p. 85):—

1886	R.A. h. m. s.	Decl. ° ′	log r	log Δ	Brightness
Dec. 11	17 6 7	16 20·9 N.	9·8266	0·0004	24·7
16	17 54 19	13 43·9	9·8212	0·0300	22·1
21	18 34 18	10 32·2	9·8266	0·0679	18·0
26	19 6 32	7 13·7	9·8421	0·1084	14·0
31	19 32 32	4 5·2 N.	9·8652	0·1478	10·5

The brightness at date of discovery is taken as unity.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *DECEMBER* 12–18

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on December 12

Sun rises, 7h. 59m.; souths, 11h. 53m. 58·0s.; sets, 15h. 49m.; decl. on meridian, 23° 6′ S.: Sidereal Time at Sunset, 21h. 14m.

Moon (one day past Full) rises, 16h. 34m.*; souths, 0h. 29m.; sets, 8h. 27m.; decl. on meridian, 18° 57′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	6 15	10 43	15 11	18 3 S.
Venus	8 12	12 4	15 56	23 30 S.
Mars	10 10	14 6	18 2	23 1 S.
Jupiter	3 14	8 26	13 38	10 7 S.
Saturn	18 6*	2 9	10 12	21 33 N.

* Indicates that the rising is that of the preceding evening.

Occultations of Stars by the Moon (visible at Greenwich)

Dec.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
14	3 Cancri	6	1 42	2 46	100 237
14	B.A.C. 2731	6½	6 54	near approach	207 —
14	54 Cancri	6½	21 26	22 9	85 181

Dec.	h.	
13	6	Mercury stationary.
13	17	Saturn in conjunction with and 2° 59′ north of the Moon.

Variable Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·2	81 16 N.	Dec. 13,	1 25	*m*
			,, 18,	1 5	*m*
T Arietis	2 42·0	17 2 N.	,, 16,		*m*
S Tauri	4 23·0	9 42 N.	,, 18,		*M*
R Leporis	4 54·4	14 59 S.	,, 12,		*M*
S Cancri	8 37·4	19 27 N.	,, 17,	2 24	*m*
W Virginis	13 20·2	2 47 S.	,, 15,	21 0	*M*
δ Libræ	14 54·9	8 4 S.	,, 16,	4 50	*m*
U Coronæ	15 13·6	32 4 N.	,, 13,	22 15	*m*
β Lyræ	18 45·9	33 14 N.	,, 15,	2 30	m_2
δ Cephei	22 24·9	57 50 N.	,, 16,	4 50	*m*
			,, 17,	19 20	*M*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers

Moonlight interferes with meteor observation during the early part of the week, which is also less fruitful of meteors than are the first few days of the month. Amongst the radiants which have supplied meteors at this season are one in the constellation of the Lynx, R.A. 108°, Decl. 63° N., and one in Quadrans, R.A. 221°, Decl. + 53° N.

THE LAW OF STORMS IN THE EASTERN SEAS[1]

I. IN the Eastern seas the earliest signs of a typhoon are clouds of the cirrus type—looking like fine hair, feathers or small pale white tufts of wool—travelling from the east or thereabout, their direction backing towards the north, a slight rise in the barometer, clear and dry but hot weather, and light winds. This fine weather lasts for days, and the existence of a typhoon at a great distance contributes therefore to the safety of ships at sea,—a fact that is not sufficiently appreciated hy mariners.

The cirrus clouds, which frequently assume fantastic shapes, make their appearance within 1500 miles of the centre of a typhoon, the barometer is generally rising beyond from 600 to 1000 miles of the centre, and the mean of the twenty-four hours' temperature rises in Hong Kong above 81°.

A swell in the sea is noticed within from 300 to 500 miles of the centre, but this depends greatly upon the situation of the nearest land. Halos round the sun and the moon, phosphorescence of the water, and also glorious sunsets appear to be frequently noticed before typhoons.

Within about 800 miles of the centre the sky is generally half covered with cumulus clouds, above which cirro-cumulus are usually seen. South and south-west of the centre, thunderstorms and cumulo-stratus clouds are observed. On approaching nearer to the centre the cloudiness increases, the temperature falls in consequence, and the mercury begins to descend in the barometer. Then the air becomes oppressive from the increasing dampness, a slight haze is observed during the morning hours, and the sky presents a threatening and vaporous appearance. Within 300 miles of the centre the temperature falls quickly owing to the cumulus, roll-cumulus, or nimbus clouds, with which the sky is nearly completely overcast. And meantime the wind has risen and blows generally with the force of a strong breeze about 300 miles from the centre. But this depends also upon the bearing of the centre, the wind being usually strongest in the right hand semicircle. Within 150 miles of the centre the sky is densely overcast with nimbus clouds accompanied by heavy rain, and within 60 miles it generally pours down in torrents, while the wind blows so hard that no canvas can withstand it; but there is no thunder and lightning. The temperature at sea is frequently about 76°, and on shore about 78°.

Within from 2 to 15 miles of the centre the wind either calms down or blow only moderate breezes, and the sky clears, being now covered only by very light clouds. The sea is as a rule mountainous, but in some reports it is stated that the sea had calmed down to some extent when the wind fell. Quantities of sea-birds, and near land also butterflies and other insects, cover a ship situated in the bull's eye of a typhoon. It is possible that the central calm does not quite accurately coincide with the centre of the typhoon.

The angle between the direction of the wind and the direction of the radius (the straight line between the observer and the centre of the typhoon) is, on an average, between 10° and 25° latitude, 43° in front of the centre and 53° behind the centre; between 33° and 35° latitude, 65° in front and 85° behind; and between 10° and 35° it is about 49° in front and 62° behind the centre. The angle appears to be smaller near the shore for off-shore winds, and far out at sea the difference between the angle in front of and behind the centre appears to be small. The following rule for finding, on board ship in the China seas, the bearing of the centre of a typhoon is, therefore, approximately correct: Stand with your back to the wind, and you will have the centre on your left side, but 3 points in front of your left hand; *i.e. the centre bears about* 11 *points from the wind.* If your ship is in a very low latitude the centre may lie as much as 4 points in front of your left hand, *i.e.* bear 12 points from the wind, and if you are in a high latitude it may bear only 9 points from the wind. Once the wind has reached the force of a strong breeze, the average angle between the wind and the direction of the centre does not appear to change at all, but the wind, which blows in great gusts in a typhoon, may oscillate to both sides of the true value. There does not appear to be any foundation at all for the belief that the wind near the centre blows in circles round the centre. To act according to this rule might prove disastrous to a ship experiencing a typhoon.

Very low clouds in a typhoon move with the wind, but if the clouds are high they are frequently seen to move in a different manner, and the following rule may then occasionally be of use: If right in front of the centre, stand with your back towards the direction whence the clouds are coming, and you will have the centre from 1 to 2 points in front of your left hand; and if straight behind the centre you may have it a point or two to the left of the direction in which you are looking.

Once the bearing of the centre has been ascertained, the master of a vessel in a typhoon requires to know in which semicircle, looking in the direction towards which the typhoon is moving, he is situated: If *in the right hand semicircle, the wind will veer, i.e.* shift with the sun; and if *in the left hand semicircle, it will back, i.e.* shift in the opposite direction. But this rule is strictly applicable on board of a vessel only when hove-to, or at any rate proceeding at a slower rate than the typhoon. For a vessel moving at a faster rate than and in the same direction as a typhoon, the rule may be reversed. In case of doubt it may therefore become advisable to heave-to in order to be quite sure of the semicircle in which you are situated. But we have seen that the wind moves in spirals towards the centre, and

[1] By Dr. W. Doberck, Hong Kong Government Astronomer. Reprinted from the *Hong Kong Telegraph.*

it is therefore dangerous to lie-to in a typhoon, particularly before you are sure that the centre is past. Vessels near the coast of China, or in the Formosa Channel, generally seek refuge in the nearest typhoon harbour indicated in the Directory.

The wind shifts faster the nearer the centre you are. If the barometer falls rapidly and the wind does not change its direction, and when the gusts continue to increase in force, your ship is in danger of entering into the central calm of the depression with its mountainous and confused seas, which is by all means to be avoided, as it is the high cross seas that do the most damage, and not the force of the wind. When once you are caught in a typhoon you should make no sail, except what may be necessary to steady the ship, till the gusts continue to decrease in force and the barometer has risen for some time. Very deceitful lulls are reported to occur during the raging of a typhoon. The master of a sailing-vessel is said to have put up topgallant sails after getting into the central calm. Of course he could have had no reliable barometer on board.

In storms encountered in higher latitudes, where the incurvature of the wind is not so great as in a tropical hurricane, the right-hand semicircle is termed the dangerous semicircle, as a ship running before the wind is in more danger of crossing the path of the storm in front of the centre and perhaps be overtaken by it; but in a typhoon there is not much to choose between the semicircles. A dismasted ship is in danger of being carried into the centre from any quarter.

However, the right-hand semicircle is also in a typhoon generally more dangerous than the other, both with regard to the risk of crossing the path in front of the centre, and also, as remarked above, with regard to the force of the wind and consequent greater sea disturbance. A ship experiencing a northerly gale and a falling barometer in the China Sea in the typhoon season is generally in greater danger than another experiencing a south-westerly gale.

When you have ascertained in which semicircle your vessel is situated, you should, if in the right-hand semicircle, keep the wind as long as possible on the starboard tack; and if in the left-hand semicircle, you should run on the starboard tack, or heave-to on the port tack, so as to let the ship come up as the wind backs and run no risk of being taken aback. As explained further on, a typhoon encountered in a low latitude moves so slowly that a steamer or fast sailing-ship has a fair chance of running away from it, but farther north, when the centre proceeds at the rate of thirty or forty miles an hour, it requires careful management even supposing you have ample sea-room.

Typhoons are dangerous on the open sea, but they are still more to be feared in open anchorages or near lee shores. Along the south-west coast of Formosa and elsewhere, a ship must in the south-west monsoon be prepared to run to sea at very short notice, as in some of the harbours you could not lie with any chance of riding out a typhoon. A steamer at anchor should get up steam as soon as the wind rises above the force of a strong breeze, and a sailing-vessel should take down the top-masts. The direction in which the wind is going to shift must early be determined so as to select a sheltered anchorage. If the centre passes very near the anchorage, the berth may have to be changed to the other shore during the lull, before the wind shifts to the opposite quarter.

A ship moored by a single anchor with her head to the wind, will swing with the sun in the right-hand semicircle and against the sun in the left-hand semicircle. If two anchors are dropped, the anchor on the advancing bow should be let go first, therefore a ship in the right-hand semicircle of a typhoon should first drop the port anchor and afterwards the starboard, in order that she may ride with open hawse. And a ship in the left-hand semicircle should first drop the starboard anchor. But ships have to ride with a long scope in a typhoon, and as they are liable to drag the anchors, some prefer to drop the second anchor to veer upon if the first should not hold.

II. The force of the wind and the appearance of the sky do not always furnish a reliable guide to determine how far you are from the centre of a typhoon. The dimensions are different in different typhoons, and near land the strong winds are often so irregularly distributed that in a place near the centre less wind may actually be experienced than at some distance farther away from it. Also the 11-point rule for ascertaining the bearing of the centre fails near some shores if the centre is not near at hand; thus there often blows a steady easterly gale along the southern coast of China when a typhoon is crossing the China Sea, and the gale blows often steady from north-east about the northern entrance to the Formosa Channel when there is a typhoon in a more southern latitude.

The surest of all warnings is furnished by the standard barometer on shore and the compensated aneroid on board ship; you are all right if you can put your vessel on the tack that will keep your barometer rising. But in order to understand the indications of the barometer you will have to keep a regular meteorological register. The master of a vessel who does not look at his aneroid till he is in a typhoon, does not derive half the benefits from his observations that he would have enjoyed had he watched it beforehand. He might perhaps have avoided the weather he is now experiencing, or even have benefited by the favourable winds and sailed round the typhoon. No doubt the time is approaching when underwriters will stipulate that the indications of an aneroid or a marine barometer must be regularly registered on board a vessel insured by them.

On the other hand, it would not be fair to ask the mariners to keep complete meteorological records, such as are kept in the lighthouses out here. Some seamen have a taste for this kind of work and make very useful and fairly accurate observations, but, for instance, the readings of dry and damp bulb thermometers taken on many vessels are of very little use.

The tube of the marine barometer has to be so much contracted to stand the incessant pumping and danger of breakage, that the instrument is sluggish and often reads half an inch or more too high near the centre of a typhoon. Some cheap wooden barometers cannot be registered below a certain height, the cistern being too small to hold the mercury that comes out of the tube. Of course some cheap aneroids are no better, and even a first-class compensated instrument requires to be thoroughly verified, as the scale is never quite correct, but they act nearly as quickly as first-class standard barometers, and for use on board ship the instrument that is quickest in its indications must be preferred. The objection to the use of the aneroid is founded on the fact that its index-correction changes gradually; but then this can be determined and allowed for by reading it off as often as the vessel enters a port, such as Hong Kong, where correct meteorological observations are constantly being made.

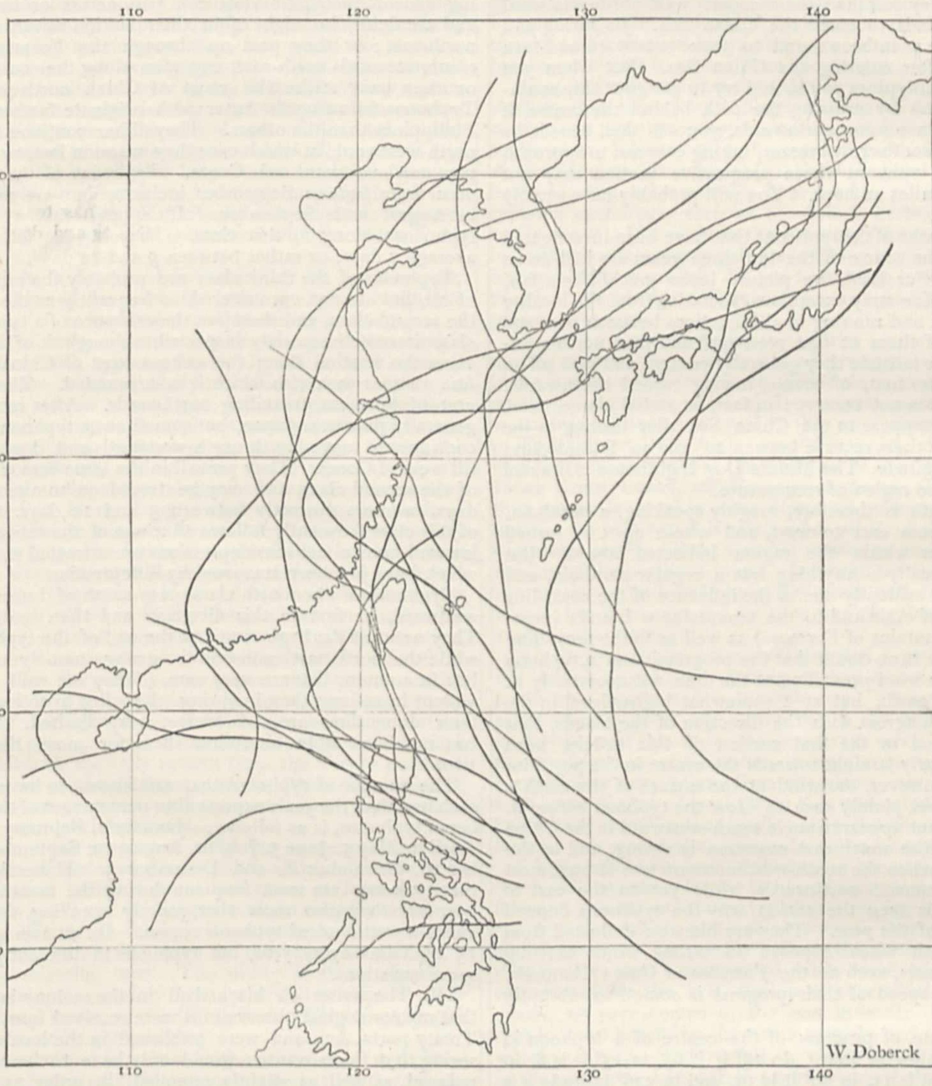
The best hours for making observations are 4 a.m., 8 a.m., &c., up to midnight inclusive. The observations should consist in readings of the aneroid, temperature (this is no use except when the thermometer is placed well forward so as to be exposed to the wind, though in a position sheltered from the sun and the rain), direction and force (0-12) of the wind, direction whence coming of the clouds, amount (0-9) of sea-disturbance, and weather (Beaufort's notation). For further particulars the "Instructions for making Meteorological Observations, prepared for use in China," published in 1883 by the writer, may be consulted.

From 4 a.m. to 10 a.m. the barometer is rising, falling from 10 a.m. to 4 p.m., rising from 4 p.m. to 10 p.m., and falling from 10 p.m. to 4 a.m. It reads highest at 10 a.m. and lowest at 4 p.m. During the approach of a typhoon this regular daily variation may be masked, but it goes on all the same, and must be taken into account when the barometer begins to fall before a typhoon. Thus if it has fallen a certain amount between 10 a.m. and 4 p.m. you must subtract the normal descent between these hours in order to know how much of the fall is due to the approach of the typhoon, and if it were between 4 p.m. and 10 p.m. that it fell, you must add the normal rise for the same purpose.

In many typhoons, the barometer, reduced to 32° Fahrenheit, and to sea-level, does not fall below 28·80 inches. In others it falls as low as 28·50. Lower readings of the barometer appear to be rare, but it has been stated to have fallen much lower. The rate at which your barometer is falling depends upon your approach to the centre, and in consequence upon the rate at which this is travelling. For this reason it is not safe to draw conclusions concerning the amount of wind to be expected from the rate at which the barometer is falling, but to some extent, of course, this may be done. Remember, that, when the barometer has fallen to its lowest reading and begins to rise, you may expect to experience as much bad weather as you have already gone through.

The wind blows from a region where the barometric pressure is higher, towards one where it is lower, being, however, deflected towards the right in a typhoon, and the force of the wind depends upon the difference of pressure between one place and another situated in the direction of the greatest barometric slope or gradient. This is expressed in hundredths of an inch per fifteen nautical miles. Now, the gradient corresponding to a certain force of the wind is somewhat uncertain, particularly when the force of the wind exceeds a whole gale, but on an average a gradient of 0·02 inches in 15 miles corresponds to a force of wind equal to 6 on Beaufort's scale, 0·03 to 7, 0·04 to 8, 0·05 to 9, 0·07 to 10, 0·10 to 11, and where the gradient is above a tenth of an inch in fifteen miles it generally blows with full typhoon force. In low latitudes the gradient occasionally exceeds one inch in fifteen miles.

Curved lines drawn on a map through the places from which the same height of the barometer (reduced) is reported, or between those that report a higher and a lower barometer, are called isobars. The gradient lies at a right angle to the isobar. These are the most important elements in forecasting the weather. Thus during the south-west monsoon the barometer as a rule reads higher over Luzon than along the China coast, the gradient being directed from about south-east towards north-west, indicating southerly winds as prevailing over the China Sea according to the 12-point rule. But when, as occasionally happens in the typhoon season during the south-west monsoon, readings reported from stations along the south-eastern coast of China are higher than those reported from Luzon, the gradient is found to be reversed, being directed towards south-east, thus indicating northerly winds. At such times a typhoon may be expected, and the probability is increased if the barometer is falling in Luzon and rising slowly in Northern China and Japan, and if cirrus clouds have previously been observed to come up from east or north.



Principal Typhoons of 1884 and 1885.

III. Nearly all the typhoons appear to have their origin east or south-east of the Philippine Archipelago, in a part of the ocean south of the high-pressure area that covers the Northern Pacific in the summer season, which part of the ocean is characterised by high sea-surface temperature. Typhoons are sometimes formed in the China Sea, but then they seldom develop much energy, as they usually move quickly northwards and enter the mainland of China or Formosa. Owing to their small dimensions they are easily avoided by such ships as may fall in with them. The sea-disturbance is nothing terrible, and only whole gales of wind were reported in those cases that have been investigated here. If, however, a typhoon of this kind passes northwards up through the Formosa Channel, it soon becomes as formidable as any of those that originate in the tropical Pacific. We have not traced typhoons nearer to the equater than about 9°. But it appears that they may possibly in some cases originate nearer than that to the equator, as hurricanes have been encountered in a lower latitude.

It frequently happens that a vessel encountering a typhoon in, say, 12° north latitude and 135° longitude east of Greenwich, does not experience any strong wind or bad weather till within a hundred miles or so of the centre, and as the typhoons are most violent in that locality, it is very important to look out for the premonitory signs referred to in the first section of this article, taking into account that the dimensions of a typhoon are so small there. On the other hand, they move at so slow a rate that you may run away from them if you are aware of the danger in time, so much more as you may be sure that a typhoon in that locality is directing its course to somewhere about west-north-west or north-west, and most likely in the first-named direction. So it is better to get to the eastward of it. Nearer the Philippine Archipelago the typhoons usually take a more northerly course, moving north-west or north-north-westward. But frequently they continue their course west-north-westward and cross the islands to enter the China Sea. In spring and autumn they have even been found to move westward and turn south-westward after entering the China Sea. But when you are east of the Philippines you should try to get your ship south-east of the typhoon by crossing the path behind the centre, if possible. If you are going northwards, you will then benefit by the fresh south or south-west breezes, taking care not to approach too near to the typhoon, whose progressive motion may not be more than six miles an hour. You will probably have squally and wet weather.

When all the paths of the typhoons that have been investigated by the writer in the course of the last three years are laid down on a map of the Far East, the picture looks much like a fan, the paths, with a few stray exceptions, radiating from the locality referred to above, and running in all directions between west and north, but most of them at first westward and then north-westward. In a higher latitude they generally recurve and pass off to the north-east, after first, of course, having turned northwards. Every typhoon does not recurve; in fact, as stated above, some of them finally disappear in the China Sea after turning to the south-west. The others recurve between 20° and 40° latitude, and 115° and 130° longitude. The Middle Dog Lighthouse is situated in the centre of the region of recurvature.

The normal path is therefore, roughly speaking, a parabola, whose axis lies from east to west, and whose apex is turned westward and lies within the region indicated above. But each path individually is anything but a regular parabola, and the deviations are evidently due to the influence of the coast-line of the mainland of Asia and to the mountainous islands (especially the high mountains of Formosa) as well as to the prevailing winds. For there is no doubt that the progression of a typhoon is the effect of the wind prevailing at the time, not necessarily at the surface of the earth, but at a somewhat higher level in the atmosphere, which agrees with the direction of the clouds, that have, as explained in the first section of this article, been found to move nearly straight towards the centre in the posterior semicircle. If, however, the wind at the surface of the earth is strong, it is at times plainly seen to blow the typhoon before it. The typhoons do not appear to move south-westward in the China Sea except when the north-east monsoon is strong, and in the summer of 1885, when the south-west monsoon was strong, most of the typhoons moved northwards while yet to the east of Formosa. This is then the reason why the typhoons depend upon the season of the year. They are likewise deflected from their previous path when exposed to strong winds blowing out of open channels, such as the Formosa or Corea Channels, in which case the speed of their progress is sometimes abruptly increased.

The average rate of progress of the centre of a typhoon in 11° latitude is 5 miles an hour. In 13° it is 6½, in 15° it is 8, in 20° it is 9, in 25° it is 11, in 30° it is 14, and in 32½° latitude it is 17 miles an hour. The rate of progress does not vary perceptibly in case of typhoons south of 13° latitude, so it is well for masters of vessels to know this, but it is more variable the farther north you go. In 32½° latitude it ranges between 6 and 36 miles an hour, so that you cannot at all be sure that a typhoon, which you may happen to be near, will travel at anything like the average rate of progress in that latitude.

In "Observations and Researches made at the Hong Kong Observatory in the year 1884," the writer suggested the division of typhoons into four classes according to the paths which they usually follow. Of course abnormal instances, such as for instance are presented by the typhoons that originate in the China Sea, occur occasionally in China as well as elsewhere, but they are comparatively rare.

Typhoons of the first class occur at the beginning and the end of the typhoon season. They cross the China Sea and travel either in a west-north-westerly direction from the neighbourhood of Luzon towards Tonquin, passing south of or crossing the Island of Hainan, or, if pressure is high over Annam, they travel first westward and subsequently south-westward. They can generally be followed for between five and six days.

Typhoons of the second class are the most frequently encountered, and their paths can be traced farthest. They generally travel north-westward while in the neighbourhood of Luzon, and either strike the coast of China south of the Formosa Channel, in which case they as a rule abruptly lose the character of a tropical hurricane, recurve in the interior of China, re-enter the sea somewhere between Shanghai and Chefoo (thereby regaining some of their past violence), pass across or near to Corea, and are finally lost sight of in their motion towards about east-north-east; or they pass up through the Formosa Channel, recurve towards north-east, and pass along the coasts of Japan; or they may strike the coast of China north of Formosa. Typhoons following the latter path originate further east of the Philippines than the others. They either continue their motion north-westward, in which case they are soon lost, or recurve and pass north-eastward near Corea. Typhoons of the second class occur from June to September inclusive, but are most common in August and September. It appears that a third of the typhoons belong to this class. They can be followed on an average 7 days, or rather between 5 and 12 days.

Typhoons of the third class are probably the most numerous of all, but are not encountered so frequently as the typhoons of the second class, and therefore the existence of a typhoon of this class is sometimes only suspected, although it of course influences the weather along the eastern coast of China through the fine weather area with which it is surrounded. They pass to the east of Formosa, travelling northwards. After recurving, they generally pass near Japan, but sometimes a typhoon of this class continues to move north-north-westward and does not recurve till west of Corea. They prevail in the same season as typhoons of the second class, and may be traced on an average during 7 days, or more correctly between 3 and 12 days. A typhoon of this class frequently follows after one of the second class. It is a well-known fact that depressions are attracted towards places which have just been traversed by a depression.

Typhoons of the fourth class pass south of Luzon, travelling westward, or first in this direction and then south-westward. They occur at the beginning and the end of the typhoon season, while the north-east monsoon is strong, namely in April and late in autumn, but are very rare. They are said to be more violent in autumn than in spring. Existing in so low a latitude, their dimensions are, of course, very limited. The writer has not been able to follow them for more than a day or two.

The number of typhoons that are known to have occurred in each month of the year, expressed in percentages of the total number of typhoons, is as follows:—January 2, February 0, March 2, April 2, May 5, June 5, July 10, August 19, September 27, October 16, November 8, and December 3. These figures prove that typhoons are most frequent during the month of September, but they also show that, strictly speaking, there scarcely exists a well-marked typhoon season. On an average there are 15 typhoons every year, but typhoons in different years exhibit some variations.

IV. The writer on his arrival in the colony in 1883 found that meteorological observations were received from a few of the Treaty ports, &c., and were published in the local papers; and seeing that these returns would only have to be corrected and reduced, as well as slightly extended, in order to be of great value to the shipping, he took upon himself to effect this. Subsequently, as the official work of the Observatory was fully started, he would have had to give up this purpose had not the Government decided to support it. Thus originated the *China Coast Meteorological Register*, which is published daily from here. It contains, at present, observations of the principal meteorological elements, which are received through the co-operation of the great telegraph companies from Manilla, Bolinao (Luzon), Haiphong, Hong Kong, Amoy, Foochow, Shanghai, Nagasaki, and Vladivostock, but the number of the stations might with advantage be extended. It gives also information about the weather prevailing in the Far East, and more or less rough intimations concerning such typhoons as happen to be indicated by the telegraphic returns, as well as by local observations. Subsequently more or less extensive monthly meteorological returns are received from about fifty land stations in the Far East, and the examination of the log-books of ships calling at this port, as well as observations received from commanders of men-of-war and masters of vessels trading in these seas, furnish a perhaps unequalled amount of material for scientific discussion, the results of which, as far as they go, are from time to time published in the *Government Gazette*. But no funds are available for this work, the Observatory being supposed to make and investigate only local observations, and with reference to weather-intelligence to warn the colony of storms by which it may be threatened, as far as may be possible through local observations. Some distinguished individuals having the welfare of the colony at heart would gladly see the little Observatory extended into a Meteorological Office for the Far East, for which it would be so peculiarly adapted owing to its central position, extensive telegraphic connections, &c.; but where the money is to come from has not yet been suggested. The Meteorological Office in London is allowed over ninety thousand dollars a year. The area in question is considerably larger than the area covered by the United Kingdom. The annual cost of the local Observatory was estimated to begin at ten thousand dollars, and it was remarked that additional clerical help would certainly be needed if it were resolved to undertake a thorough investigation of the monsoons of the China Sea. But actually only about six thousand dollars a year are expended in connection with the Hong Kong Observatory.

The Colony itself is warned by means of the *typhoon gun*, placed at the foot of the mast for hoisting signals beside the time-ball tower. It is fired one round whenever a strong gale of wind is expected here, and two rounds whenever the wind is expected to blow with typhoon force. It will be fired again, if possible, when the wind is likely to suddenly shift round. In 1885 it was fired also as a mail gun, but this practice has been discontinued, and as long as the typhoon gun is not fired in future, one may be sure that no typhoon is expected here. During the approach of a typhoon, and at other times when it appears desirable, special messages are telegraphed from the Observatory to be distributed in Hong Kong in such manner as the Government may from time to time see fit to direct, but as soon as they are issued from here the writer's responsibility in the matter ceases. This arrangement will, however, be found to be of very little use until the Observatory is placed in direct communication with the telegraph offices in Hong Kong, as the connections between the police stations generally break down in bad weather, when there is no boat-communication with the other side of the harbour, and thus the colony may expect that communication with the Observatory will sometimes be interrupted just at such times when the intelligence issued from here would be particularly useful. As soon as direct communication with the telegraph offices is established, the daily returns from the Treaty ports will be telegraphed across the harbour, and the *China Coast Meteorological Register* can then be issued at an early hour, by which its utility will be very much increased.

In the course of the summer of 1884 the writer invented and started a system of *meteorological signals*, which continue to be hoisted on the mast beside the time-ball tower at Tsim-sha-tsui. As these signals could not be hoisted without friendly co-operation with the officials of foreign Governments, they are, of course, unofficial, using this word in the sense in which it is understood by scientific men. The utility of these signals is confined to the shipping and to those interested in ships about to leave the harbour, or out in the China Sea. *The colony itself is warned by means of the typhoon gun.*

A red drum is hoisted to indicated the existence of a typhoon felt in the China Sea in a longitude more easterly than the colony. Steamers, if bound for northern, western, or southern ports, should lose no time in starting, and may then expect more or less fine weather. Those bound for the Philippines should take precautions to avoid the typhoon, and observe the rules set forth in the first section of this article. Sailing-vessels bound for western or southern ports should lose no time in starting, but those that are bound for northern or eastern ports ought to remain in the harbour awaiting further information, as they may expect to fall in with calms or contrary breezes after starting, even should the wind be westerly here at the time. The day after the drum has been hoisted the *China Coast Meteorological Register* should be consulted, taking into account that typhoons east and south east of Hong Kong generally travel at the rate of from six to fourteen miles an hour.

A red cone pointing upwards indicates that a typhoon exists in a latitude more northern than the colony, or that it is progressing towards the north. More or less persistent south-west winds, at times accompanied by thunderstorms, may then be expected, and ships leaving the harbour are not at all likely to run any risk from the typhoon. Sailing-vessels bound for the north should start as soon as convenient, so as to benefit by the favourable breeze to run through the Formosa Channel and avoid the way round Formosa. By following the latter route a sailing-vessel, moreover, runs the risk of encountering the next typhoon east of Formosa, particularly during the months of August and September.

A red cone pointing downwards indicates that a typhoon exists in a latitude more southern than the colony, or that it is progressing towards the south. As such a typhoon is likely to travel in a northerly direction, ships desirous of avoiding bad weather should await further instructions, or remain in port till the barometer begins to rise. Then the danger is past.

A red ball indicates that the typhoon exists in a longitude more westerly than the colony. Ships starting for northern, eastern, or southern ports may expect breezes from east round by south to south-west. Those starting for western ports run no risk as long as the barometer is rising. If it should happen to fall, they may heave-to, and subsequently, if necessary, take refuge in some typhoon anchorage, such as St. John's harbour, but this will rarely occur. If a vessel in the Formosa Channel experiences an increasing south-westerly gale and a falling barometer, the typhoon has very likely recurved. All you have to do in that case is to lie-to, when the weather will quickly improve, and you may expect a pleasant voyage.

V. As the typhoons during their entire course are nearly always moving northwards, or rather into a higher latitude, a ship situated in the southern semicircle is on the whole in a safer position than north of the centre. East of Luzon typhoons move west-north-westward, or thereabout, and a ship must shape its course so as to reach the quadrant south-east of the centre. As a general rule, they move north-westward in that part of the China Sea between Hong Kong, Luzon, and Formosa, and east of the latter island they generally travel in some direction between north-west and north. So your vessel is safest when south of the centre, where you must heave-to till the weather improves, particularly if bound for one of the northern ports. If bound for the south, you may run across the path in front of the centre with the north-westerly breeze, but if you are not in time you may lose your boats and sustain other damage.

About 30° latitude, between China and Japan, you are liable to fall in with a typhoon travelling in any direction between west-north-west, north, and east-north-east. Here you are as a rule safest when south of the centre, but if the typhoon is travelling north-eastward this is in the dangerous semicircle. However, the investigations of the writer, though he has paid less attention to typhoons near Japan than elsewhere, nevertheless indicate with some degree of probability that the wind is less incurving behind the centre in that locality than elsewhere. North of this latitude you would of course prefer to be west of the centre.

Suppose that after leaving Singapore bound for Hong Kong the south-west monsoon begins to blow fresher and the barometer to fall, and you suspect that a typhoon is raging in a latitude more northern than where you are at present (the phenomena mentioned would not necessarily indicate the existence of a typhoon, if they were not accompanied with some of the other signs enumerated in the first section of this article), you will, of course, set your course to the east in order to sail round the typhoon and benefit by the south-easterly backing to east winds which you may expect to fall in with; but if the season is late in the year, you had better assure yourself that the typhoon is not travelling south-westward, in which case you might possibly be overtaken by the centre. These typhoons are often the cause of high seas even in the Gulf of Siam; but as their progressive motion is usually rather slow, you may heave-to in order to make observations without losing ground perceptibly. Supposing a typhoon in the China Sea does not make itself felt till you have reached a higher latitude, and that it is passing westward in a latitude south of your ship; being in the dangerous semicircle, where the wind is, moreover, stronger than south of the centre, you may have to cross the path in front of the centre to arrive in the anterior left-hand quadrant; or, if the typhoon is yet distant, the wind light, and your ship thoroughly sea-worthy and in good trim, you may possibly put her on the port tack and run north-eastward, but be ready to change the tack as soon as it becomes advisable.

Many of the anchorages along the south-eastern coast of China and the south-western coast of Formosa afford excellent shelter against north-east winds, but would prove to be much worse than the open sea during a heavy southerly gale. If you observe a northerly gale and a falling barometer, by far the surest signs of an approaching typhoon, and appearances are rapidly getting worse, then occasions may possibly occur when you may be under the dire necessity of running southwards with the northerly gale, against the rules laid down by meteorologists, and bring your ship into a most dangerous position in front of the centre. But you may happen to be better off there after gaining ample sea-room, than in the snug anchorage, where your vessel would be smashed against the rocks as soon as she began to drag her anchors when the storm burst upon her from the south, although the south-west storms experienced along the south-eastern coast of China during a typhoon that enters the mainland are as a rule less violent or protracted than the preceding storm from the north.

Suppose that after leaving Hong Kong bound for a northern port you were to ascertain the existence of a typhoon about to cross your course in front of your vessel, and you experience, say, a strong breeze from the west-north-west. If you do not alter your course, you may, from the fact of its subsequently appearing to be a hanging gale and seeing the mercury falling in the barometer, draw the erroneous conclusion that you are on the path of the centre of a typhoon coming down on you from the east-north-east. In such a case it does not appear to be advisable to scud before the wind, it being decidedly wiser to heave-to. Then if the gale is observed to begin to back towards south-west, you may run southwards and shape your course so as to sail round the typhoon. Masters of steamers leaving Hong Kong while the red drum is hoisted generally lose no time in running southwards as soon as the typhoon is observed to have taken a north-western course, and suffer very little delay in consequence.

Steamers bound for Shanghai are, while between Foochow and Ningpo, liable to experience the northerly gales that precede a typhoon of the second class travelling north-westward and about to strike the coast in that locality. Not wishing to expose their ships to the high cross seas round northern Formosa, the masters generally take them into the nearest typhoon harbour in order to wait till the centre has entered the mainland, and then run northwards with the southerly gale.

These few examples will be sufficient, the more so as the further consideration of the subject would lead into details with which the writer is not familiar, being possessed of no further knowledge of navigation than the little that can be gleaned from the inspection of log-books and from occasional conversations with masters of vessels of many years' standing. The writer has invariably found these gentlemen ready to recount their experiences and to communicate any information, as soon as they found that it was required for scientific purposes exclusively. The master of a vessel, after encountering a severe typhoon, has often to undergo the vexation of seeing every manœuvre of his subjected to the comments of those unaware of the hundreds of things he has to take into consideration besides the law of storms, and who were comfortably ensconced in their houses while he was experiencing the typhoon with its fierce gusts, interrupted by the, if possible, more ominous lulls, during which he cannot see three ship's lengths before him, the mountainous waves in which his good ship is but a "cock-boat," the loudest shouting inaudible, drowned in the roar of the tempest, boats and everything movable having been washed overboard, rudder gone, and perhaps one of the masts thumping at her bottom, while the seas threaten at every moment to swamp the ship.

VI. The origin of a typhoon is not quite understood, but appears to be connected with an abnormally high temperature and humidity in some place in comparison with the neighbourhood. Over such a place the hot air expands, ascends, and is thereby cooled. But the heat liberated by the consequent condensation of water-vapour retards the rate at which it cools on rising in the atmosphere, and enables it to rise still further. When the air has risen to a high level, it effects there an increase of barometric pressure, in consequence of which the upper air is set in motion out towards the circumference of the area in question. Thus a fall in the barometer at the surface of the sea in the middle of the hot and damp region is effected, and the surrounding air is impelled in towards the centre. The motions inwards at the surface of the sea, and outwards at a high atmospheric level, are, of course, contemporaneous, and one is assisted by the other. But air in motion is deflected towards the right in the northern hemisphere, owing to the rotation of the earth, except at or very near the equator; whence typhoons do not exist in that locality, for if the wind continues to blow into the depression it is soon filled up. Owing to its deflection towards the right, the wind is caused to move in a curved path in towards the centre, and the centrifugal force, developed in the curvilinear motion, deflects it still further from the straight line leading into the centre. The friction between the wind and the greatly disturbed sea-surface likewise retards the entrance of the air at the sea-surface into the central parts of the depression. But the air at a higher level in the atmosphere is subject to little friction, and escapes therefore at a greater speed from the central high-pressure area at that level. It is, therefore, apparent that once a cyclonal motion is started under circumstances favourable for its continuation, it tends to increase and to spread outwards.

There is, however, this important difference between a typhoon and a tornado, that the latter is taller than it is broad, whereas a typhoon perhaps does not reach above an altitude of four miles, while its horizontal diameter may amount to upwards of a thousand miles. Moreover, it is not at all likely that the centre at a higher level lies vertically above the central calm at the earth's surface, or even that the centres at different altitudes are situated in a straight line. We are, therefore, scarcely entitled to speak of an axis in a typhoon.

The spirals described by the air particles approaching the centre in a typhoon are known as logarithmic spirals, but unless a typhoon is stationary, which is perhaps never the case in Nature, new portions of air are constantly set in motion in front of the centre and others left behind by the typhoon.

As already remarked, the progressive motion of typhoons is evidently caused by the wind prevailing, if not at the surface of the earth, at any rate at a higher level. That the principal part of the disturbance is situated high above the surface of the earth is proved by the fact that the centres of typhoons pass across mountains several thousand feet high, and also by the circumstance that the difference between the temperature at the Hong Kong Observatory and at Victoria Peak is not perceptibly affected by the approach of a typhoon, for we cannot very well assume that the temperature of a vertical column of air is lower near the centre than outside the cyclone. The mountains referred to are situated on islands, and while crossing them the typhoon derives its store of water-vapour from the surrounding sea, for as soon as the centre has entered the coast, and is on all sides surrounded by dry land, it ceases to exist as a tropical storm, and can only be traced in the registers through a slight fall in the barometer, a freshening of the wind, perhaps amounting to a moderate gale at stations crossed by the centre, and wet weather. Inland in China the bull's eye of a typhoon does not appear to be observed.

As the wind blows more straight into the centre the nearer the equator you are, it follows that more air enters the typhoon from the southern semicircle than from the northern, and this is one of the reasons why typhoons nearly always move in a northerly direction. Moreover, the difference increases together with the dimension of the typhoons, which explains why they expand and accelerate their progressive motion at the same time.

The foregoing observations contain the principal practical results of investigations of about forty typhoons, continued during a period of three years. The mariner into whose hands this article may fall is advised to determine for himself the direction in which the centre of a typhoon, which he is experiencing, is travelling; for although typhoons of the classes enumerated are by far the most common, he never can be quite sure that he has not to do with an exceptional case, and quite possibly a case that is not found among the forty typhoons referred to above. By the time that we shall be in possession of full and trustworthy investigations of a couple of hundred typhoons, we may expect to have complete lists of the sub-classes of the four classes of typhoons, and to be better acquainted with cases of rare occurrence, for, after all, the typhoons are of a simpler construction and their paths more regular than is the case with storms in Europe. Typhoons are so violent near their centre that the whole disturbance is evidently ruled thereby, whereas storms in the North Atlantic and in Europe appear to be made up of a lot of local eddies, some of which are by degrees detached from the chief disturbance and form subsidiary depressions. The writer has not been able to ascertain the existence of a subsidiary depression in the China Seas during the last three years, and it is therefore doubtful whether such ever occur.

A great advance in our knowledge of typhoons in the China Sea will no doubt follow on the construction of a lighthouse on the dangerous Pratas Shoal, such as has for many years been talked about. Our storm-warnings would gain still more in value, and the cost of construction need not exceed the loss caused by a single disastrous typhoon.

EARTHQUAKE IN SIERRA LEONE

THE following correspondence has been forwarded for publication by Mr. R. H. Scott, F.R.S., Secretary, Meteorological Office :—

Government House, Sierra Leone, October 29, 1886

SIR,—I have the honour to transmit a copy of a communication received from Mr. J. M. Metzger, Manager of the Western District, in which he reports that an earthquake was felt at Sennehoo, in the Bompeh River, about the middle of last month.

(2) In the third and fourth paragraphs of his letter, Mr. Metzger draws attention to the fact that the shock in question was almost simultaneous with those experienced in other quarters of the globe, and that the latitude of the Bompeh District is within a few degrees of Charleston, America, where their effects lately proved so disastrous.

I have, &c.,
(Signed) J. S. HAY,
Administrator-in-Chief

The Right Hon. Edward Stanhope, M.P.,
&c., &c., &c.

I HAVE the honour to state, for the information of His Excellency the Administrator-in-Chief, that on the return of the District boat from the Bompeh River on the 16th inst., the coxswain reported that he had been informed at Sennehoo that about the middle of last month an earthquake was felt at that place and in the upper parts of the country ; in consequence of which, many of the natives, who interpreted the event as prognostic of coming war, hastened down to the water-side to procure arms and powder in preparation for hostilities, which they regarded as imminent.

(2) The shock is said to have been continuous, accompanied with a rumbling noise as of some heavy-laden cart being moved along, resulting in the cracking and falling down of the mud plaster on the walls of the houses at Sennehoo. What happened in the upper parts of the country is, of course, not known, but the force must have been sufficiently severe to impress the people and influence them as they appeared to have been.

(3) It is remarkable that these vibrations, which seemed to have been extensive throughout the Bompeh District, and which seemed to have been so distinct, are almost simultaneous with those experienced in some places in the Mediterranean Sea, in Greece, and notably at Charleston, on the Atlantic coast of America, where their effects were so disastrous.

(4) The Bompeh, like the Ribbee and Cockborough Rivers, runs into Yawry Bay, which is an arm of the Atlantic, and the Bompeh District, on the eastern side of this ocean, is opposite to, and not many degrees of latitude below, the scene of the late disasters in America.

(5) I think it my duty to make this communication, as the information might possibly be of use to scientists engaged in the study of the facts connected with the range and transmission of these seismic disturbances.

(Signed) JOS. M. METZGER, Manager

Kent, Western District, October 20, 1886

SCIENTIFIC SERIALS

American Journal of Science, November.—The higher oxides of copper, by Thomas B. Osborne. The oxides here dealt with are copper dioxide and copper sesquioxide ; but being unable to continue the subject, at least for some time, the author publishes the incomplete results so far obtained, in the hope that they may be of use to others wishing to continue this line of investigation. —The structure of the Triassic formation of the Connecticut Valley, by William Morris Davis. It is shown that disturbance has taken place after the period of deposition ; that it was not caused by overflow or intrusion of trap-sheets ; that it was not a simple monoclinal tilting ; and that there is evidence for occurrence of unseen faults. The probable character of the disturb ing force, its action on the fundamental schists, with consequent monoclinal faulting of overlying Triassic strata, and generally the area and depth of the disturbance, are questions also discussed in this elaborate paper. — Researches on the lithia micas, by F. W. Clarke. Descriptions and exhaustive analyses are given of the lepidolites of Rumford, Hebron, Auburn, and other parts of Maine, and of the iron-lithia micas of Rockfort granite-quarries near Cape Ann, Massachusetts.—The thickness of the ice in North-Eastern Pennsylvania during the Glacial epoch, by John C. Branner. So far from rising only 2200 feet above sea-level, as hitherto supposed, the ice is shown to have covered the twin peaks of Elk Mountain (2700 and 2575 feet), and no doubt also the Sugar Loaf, Ararat, and the other loftiest summits of this region during the Glacial epoch. A sheet of ice 1500 feet or less in thickness could never have flowed across such a mountainous region, so regardless as the great glacier was of its marked topographical features.—On the time of contact between the hammer and string in a piano, by Charles K. Wead. Owing to the uncertainty attending the theory developed by Helmholtz regarding the action of the hammer on a piano-string, the author has attempted to measure directly the time of contact by a simple process with results here tabulated.—Photographic determinations of stellar positions, by B. A. Gould. This is a reprint of the paper presented at the late Buffalo meeting of the American Association, and containing a brief history of stellar photography, and of the results so far obtained by the author in this department of practical astronomy.—Lucasite, a new variety of vermiculite, by Thomas M. Chatard. A description and full analysis is given of this substance, specimens of which have been found associated with corundum at Corundum Hill, Macon County, North Carolina. It has been named lucasite in honour of Dr. H. S. Lucas, so well known in connection with the Chester emery mine, Massachusetts.—Crystallographic notes, by W. G. Brown. An account is given of certain artificial copper crystals, of artificial crystallised cuprous oxide (cuprite), and of crystallised lead carbonate (cerussite) found under circumstances here described.—On the chemical composition of ralstonite, by S. L. Penfield and D. N. Harper. A comparative table is given of the analyses made by Nordenskjöld, Penfield, and Brandle of this rare mineral, which was found associated with thomsenolite at Arksuk Fjord, Greenland. —Analyses of the thomsenolite by the same chemists.—Mineralogical notes, by Edward S. Dana. Descriptive analyses are given of columbite from Standish, Maine, of diaspore from Newlin, Pennsylvania, of zincite from Stirling Hill, New Jersey, and of some native sulphur from Rabbit Hollow, Nevada, interesting because of its complex crystalline form.

Rivista Scientifico-Industriale, October.—On the cause of the magnetic rotatory polarisation, by Prof. Augusto Righi. Fresnel's hypothesis having been proved inadequate by recent experiment, the author has resumed the subject, with the view of ascertaining whether it may be explained by the reflected or transmitted vibrations of bodies endowed with rotatory power. If the incident polarised ray on penetrating a body is really decomposed into two inverse circular rays endowed with different velocities, the intensity of the two rays must also vary both in the reflected and transmitted light. The ray possessing greatest velocity of propagation, and consequently a lower index of refraction, must possess least intensity in the reflected and greatest in the transmitted light, assuming the two indices to be greater than unity, as in the opposite case the result would be reversed. Hence both the reflected and transmitted ray will become elliptical ; and Prof. Righi has succeeded in determining this ellipticity by employing iron, the body endowed with the greatest rotatory power. The elliptical vibration of the reflected ray is in the opposite direction to that of the magnetising current, while that of the transmitted ray is in the same direction. In a future communication it will be shown that this agrees with the hypothesis of double circular refraction.—On the tests of fatty substances, and especially of olive oil, by Professors G. B. Bizio and L. Gabba. This paper contains a critical inquiry into the methods of testing the purity especially of olive oil, and it concludes that none of the processes now in use are absolutely trustworthy. Even that of Bechi fails to distinguish with certainty between olive and cotton oil.

SOCIETIES AND ACADEMIES

London

Royal Society, November 18.—"A Theory of Voltaic Action." By J. Brown. Communicated by Lord Rayleigh, Sec. R.S.

The difference of potential near two metals in contact is due to the chemical action of a film of condensed vapour or gas on their surfaces. Such a pair of metals is thus similar to a galvanic cell with its electrolyte divided by a diaphragm of air or other gas, and it is the difference of potential of the films that is measured in "contact" experiments; the metals themselves being at one potential.

Experiments with an electrometer having quadrants of the metals under examination, the construction of which was described, were made on the rate of decrease of the difference of potential near two metals in contact, and exposed to the action of the air and of other gases; also where a change in the constituents of the atmosphere surrounding a pair of metals in contact reverses the difference of potential near them in correspondence with the reversal of electromotive force which takes place after a similar change in the corresponding liquid electrolyte used with the same metals as a voltaic cell.

Such reversal takes place with pairs of copper-iron when hydrogen sulphide gas, or ammonia gas, is added to the air surrounding them; with silver-iron, when hydrogen sulphide is added; and with copper-nickel when either ammonia or hydrochloric acid gas is added.

Neutral or inert gases have little or no effect.

Covering the metals with varnish, or immersing them in naphtha, to protect them from atmospheric action, reduced the difference of potential near them considerably, but not to zero.

Drying the atmosphere about a copper-zinc pair by means of phosphoric anhydride in one instance reduced the difference of potential in 173 days from ·66 to ·5 Daniell. Then, on opening the instrument, it rose to ·67 Daniell.

A permanent current was produced by placing the (apparently) dry plates of copper and zinc in close proximity, so that their films were in contact. When the plates were either brought into actual metallic contact, or separated farther apart than a certain distance, as stated the current ceased. This "film-cell" could also be polarised by sending a current through it from another battery.

Modifying an old experiment, due to Gassiot, so as to avoid any contact of dissimilar metals, it was shown that, when the zinc plate of the volta condenser was joined to the zinc quadrant of the electrometer and the copper of the condenser to the copper of the electrometer, on altering the capacity of the condenser an alteration of the difference of potential near the quadrants was produced.

In an appendix, Mr. J. Larmor, of St. John's College, Cambridge, points out the difficulty of explaining this last experiment by any hypothesis other than that of some kind of chemical action at the surface of the metals.

November 25.—A paper by Sir Richard Owen, F.R.S., was read, of which the subject was a fossil lower jaw of the large extinct marsupial quadruped which the author, from previous fragmentary specimens, had referred to a carnivorous pouched species of the size of a lion, to which was assigned the generic name *Thylacoleo*, and the probable prey of which had been the larger forms of herbivorous marsupials, which, with their destroyer, had become extinct.

Several species, allied to the kangaroo, but equalling respectively in bulk a rhinoceros, an ox, an ass, had become extinct. The largest existing kind, to be seen in the Zoological Gardens, was named by Dr. Shaw, *Macropus major*. It has escaped extinction by its swiftness and power of concealment in the "scrub." Wombats, also, of the size of fallow-deer, co-existed with the huge kangaroos; the small kinds, capable of concealing themselves in burrows, alone survive.

Remains of the large extinct marsupials, both devourers and prey, are to be seen in the Geological Department of the Museum of Natural History; they are described and figured in the author's work on "Fossil Marsupialia." Their extinction is attributed, with that of the wolf-like *Cynocephalus* and the *Thylacoleo*, to the aboriginal natives of Australia.

Linnean Society, November 18.—W. Carruthers, F.R.S., President, in the chair.—Mr. H. Bury was elected a Fellow of the Society.—Mr. W. H. Beeby showed specimens of *Callitriche truncata*, Gussone, from near Westerham, Kent. The species had long been supposed to be extinct in this country, being only known as British from dried specimens from Sussex in Borrer's Herbarium.—Mr. D. Morris exhibited two enlarged photographs of the Castilloa Rubber-tree of Central America (see *Trans. Linn. Soc.* Botany, 2nd ser. vol. ii. part 9). The larger photograph illustrated the manner in which trees were treated to extract rubber, by a special cut from above downwards. Trees of ten years old and upward are said to yield about eight gallons of milk at the first bleeding. This milk is coagulated by the use of the juice of *Calonictyon speciosum*, and the rubber prepared by washing and pressing. Mr. Morris described the habit and growth of the trees in their native forests, and expressed the opinion that for cultural purposes this rubber-tree may be better suited to the circumstances of planters than any other. It could be utilised as a shade tree in cacao and coffee plantations, and yield at the end of ten years at the rate of twenty shillings per tree in marketable rubber. In British Honduras trees are tapped for rubber every three or four years.—Mr. A. D. Michael exhibited living specimens and preparations of an *Argas*, received from Mrs. Crawford, the State Entomologist of Adelaide, Australia. The insects in question appear to be identical with the much-dreaded *Argas persicus*, Fischer, the bite of which was supposed to cause madness and death.—Mr. H. N. Ridley made remarks on specimens in spirit and drawings of species of *Coryanthes*, viz. *C. macrantha*, Hook., and *C. maculata punctata*. He mentioned that Mr. Rodway, of Demerara, had lately published observations showing that the statement of Crüger, hitherto believed, as to the fertilisation by bees, did not obtain in all the species; inasmuch as in *C. speciosa* he (Mr. Rodway) had noticed that a kind of green fly was the fertiliser.—Mr. Geo. Murray exhibited specimens of *Rhipilia* in spirit from Grenada, West Indies, obtained at a depth of five fathoms.—Mr. W. Fawcett, exhibited coloured drawings of *Hydnora abyssinica* and *H. bogosensis*, sent by Signor Beccari from Florence. They clearly showed the difference between the two species, in colour, and in the former having a book-like process below the apex, and its ramentiferous surfaces have long ramenta at their margins. Both species differ from *H. africana* in the ramentiferous surfaces not extending to the apex.—Mr. C. T. Musson drew attention to a branch of a blackthorn, obtained near Newark, showing a curious malformation of the branchlets.—Dr. Maxwell Masters read a paper on the peculiar conformation of the flowers of *Cypripedium*. The explanation may be sought in the course of development, in the minute anatomy and arrangement of the fibro-vascular bundles, and in the examination of the comparative morphology of the flower; organogeny affords in this case only doubtful testimony, as the flower is irregular from the first. The distribution of the primary fibro-vascular bundles, and of the offshoots from them, affords more conclusive evidence of the true construction of the flower, and if studied in conjunction with the comparative morphology leads to very satisfactory results. By these means it becomes easy to refer the flower to the ordinary type seen in a regular pentacyclic and trimerous monocotyledon, and from which it is reasonable to infer it may have originated. The deviations from the type have arisen from concrescence or inseparation of some parts, inordinate development of others, and complete suppression of a third series. The author cited instances showing numerous intermediate gradations between the ordinary conformation of *Cypripedium* and that of the ideal type trees, proving that what was, at first, a matter of speculation and inference from imperfect evidence, was borne out by actual facts. The illustrations brought forward afforded examples of the reduction of parts and the increased number of parts, in connection with which the author alluded to the special tendency to develop the second or inner row of stamens, as happens in Restiaceæ and Xyridaceæ, while in Iridaceæ the opposite tendency is manifested. Another series of illustrations comprised cases of regular and of irregular *Peloria*, which were of special importance as affording evidence on the one hand of the probable past conformation of the flower, and on the other of the probable course of development in the future.—The fifth and concluding part of the Rev. A. Eaton's monograph of recent Ephemeridæ or may-flies was read. The author says 55 genera and 270 species have been characterised, in addition to 11 nymphs and 19 species of doubtful position; 5 genera and 68 species are new to science.—Mr. J. G. Baker read a paper entitled "Further Contributions to the Flora of Madagascar," in which upwards of 250 new plants, seven of them new genera, gathered recently by the Rev. R. Baron, F.L.S., are described. Of the new genera, one belongs to Menispermaceæ, one to Geraniaceæ near *Impatiens*, one to Rubiaceæ, and two each to Melastomaceæ and Compositæ. Of well-known Cape types, *Pelargonium*, *Stoebe*, *Cineraria*, and *Belmontia* are now for the first time added to the Madagascar flora. The faint affinity of the flora of Madagascar to that of India and Malaya is strengthened by the discovery of the genus *Cyclea*, and of new species of *Alyxia*, *Didymocarpus*, and *Strobilanthes*. Of types of economic interest there are new species of *Dalbergia*, *Macaranga*, *Strychnos*, *Balsamodendron*, and *Garcinia*. It seems that during the last ten years between 1100 and 1200 new plants from Madagascar (29 of which are new genera) have been described in the *Journal* of the Linnean Society and *Journal of Botany*, nearly all of them collected by our own countrymen.

Chemical Society, November 18.—W. Crookes, F.R.S., Vice-President, in the chair.—The following papers were read:—Researches on the relation between the molecular structure of carbon compounds and their absorption-spectra; part 8, a study of coloured substances and dyes, by W. N. Hartley, F.R.S.—Spectroscopic notes on the carbohydrates and albumenoids from grain, by W. N. Hartley, F.R.S.—Preliminary note on the electrolysis of ammonic sulphate, by Herbert McLeod, F.R.S.—The preparation and hydrolysis of hydrocyanides of the diketones, by Francis R. Japp, F.R.S., and N. H. J. Miller, Ph.D.—The action of salicylic aldehyde on sodium succinate in presence of acetic anhydride, by Gibson Dyson.—The reduction of nitrites to hydroxylamine by hydrogen sulphide, by E. Divers, F.R.S., and T. Haga.—Note on some double thiosulphates, by J. B. Cohen, Ph.D.—Preliminary note on the action of triphenylmethyl bromide on ethyl sodio-malonate, by George G. Henderson, M.A., B.Sc.—Action of silicon tetrachloride on aromatic amido-compounds, by Arthur Harden, B.Sc.

Physical Society, November 27.—Prof. W. G. Adams in the chair.—The following papers were read:—On a method of measuring the coefficient of mutual induction of two coils, by Prof. G. Carey Foster, F.R.S. The two coils are for convenience designated by P and S (primary and secondary). The method as originally devised consists of two parts: (1) observing the swing of the needle of a galvanometer placed in series with the secondary coil when a current of strength γ is started in the primary; (2) placing the galvanometer and a condenser of known capacity, c, as a shunt between two points, A and B, of the primary circuit, such that the first swing of the galvanometer needle on completing the primary is the same as in (1). It is easily seen that under these conditions $M = crr_1$, where M is the coefficient to be determined, r = resistance between the points A and B, and r_1 = resistance of galvanometer and secondary coil. The method requires the value of γ to be the same in the two experiments, and facilities for varying r without altering γ. To overcome these difficulties the arrangement has been modified so as to make it a null method. The connections remain the same as in (2), excepting that the ends of the secondary coil are connected to the terminals of the galvanometer through a variable resistance with no self-induction. If p be the resistance of the secondary coil and variable resistance when adjusted, so that, on completing the primary circuit, the integral current through the galvanometer is zero, it is shown that $M = cpr$, where c and r have the same meaning as before. For let A and E be the potentials of the galvanometer terminals at any time, t, q the resistance of galvanometer, y the current through it, and N and L the coefficients of self-induction of the galvanometer and secondary coil respectively. Then considering the path from A to E through the secondary coil we have—

$$A - E = px + L\frac{dx}{dt} - M\frac{d\gamma}{dt}.$$

For path through galvanometer—

$$A - E = qy + N\frac{dy}{dt}.$$

Equating these, and integrating from $t = 0$ to $t = \infty$, we get—

$$p\int_0^\infty xdt - M\gamma = 0.$$

Since $\int_0^\infty xdt$ = charge of condenser,

$= c\gamma r$,

we see that $M = cpr$.

It is easily shown that if $L = M$ then $A - E = 0$ for all values of t. Hence the galvanometer might in this case be replaced by a telephone. By inversion, the method could be used for determining the capacity of condensers in absolute measure if M be known. The author thinks the method will be useful for dynamo-machines, and gave a series of numbers obtained by experiments on different coils, showing that it gives consistent results. Mr. C. V. Boys suggested that, by arranging a switch to change the connections from (1) to (2) in rapid succession, a steady deflection might be obtained, and thought that this would enable very small coefficients to be determined. Remarks by Prof. Forbes, Prof. Adams, and Prof. Perry were answered by Prof. Foster and Dr. Fison.—On the critical mean curvature of liquid surfaces of revolution, by Prof. A. W. Rücker, M.A., F.R.S. The paper is chiefly mathematical, and deals with liquid surfaces of revolution attached to two circular rings, the planes of which are at right angles to the line joining their centres. By "mean curvature" the author designates *half the sum of the reciprocals of the two principal radii of curvature of the surfaces.* Maxwell has shown in his article on "Capillary Action" ("Encyclopædia Britannica"), that, if the film be a cylinder, a slight bulge will cause an increase or decrease in the mean curvature according as the length is $<$ or $> \frac{\pi}{2}$ times the diameter. If $l = \frac{\pi}{2}d$, then a small change in the volume of the surface will modify its form, but will not alter the mean curvature. Thus the mean curvature of such a cylinder is evidently a maximum or minimum with respect to that of other surfaces of constant mean curvature, which pass through the same two rings at the same distance apart, and which differ but little from the cylindrical form. Hence the cylinder may be said to have a *critical mean curvature* when the distance between the rings is $\frac{\pi}{2}$ times their diameter. If the distance between the rings is altered, a similar property is possessed by some other surface. The author's paper investigates the general relation between the magnitude and distance apart of the rings, and the form of the surfaces of critical curvature. If x is the axis of revolution, then the equation to a liquid surface of revolution is given by the expressions—

$$x = \alpha E + \beta F, \qquad y^2 = \alpha^2\cos^2\phi + \beta^2\sin^2\phi,$$

where F and E are elliptic integrals of the first and second kinds respectively, of which the amplitude is ϕ, and the modulus $K = \sqrt{\alpha^2 - \beta^2}/\alpha$ as usual, $\Delta = \sqrt{1 - K^2\sin^2\phi}$, whence $y = \alpha\Delta$, and if $K = \sin\theta$, then $\beta = \alpha\cos\theta$, and since $\alpha > \beta$, α and β are the maximum and minimum ordinates. The results show that as θ increases from 0° to 90°, the surface of critical mean curvature is an unduloid with limits of cylinder and sphere, when θ = 0°, and θ = 90° respectively. When θ passes from 90° to 180°, the surface is a nodoid with limits of sphere and a circle whose plane is perpendicular to the surface of revolution. In the third quadrant the surface is still a nodoid the limits of which are a circle and the catenoid. Finally, in the fourth quadrant the surface is an unduloid, the limits being the catenoid and cylinder. Experiments were shown proving that with cylindrical films, where $l < \frac{\pi}{2}d$, increase of internal pressure produced a bulging, whereas if $l > \frac{\pi}{2}d$, a bulging was produced by decrease of pressure. From this it is evident that if the interiors of two cylindrical films, whose $l < \frac{\pi}{2}d$, be connected, stable equilibrium will result, whereas if $l > \frac{\pi}{2}d$, there will be unstable equilibrium. These facts were illustrated experimentally with great success. After some remarks by Mr. C. V. Boys, the proceedings terminated.

Anthropological Institute, November 23.—Francis Galton, F.R.S., President, in the chair.—The election of Mr. C. W. Rosset as a Corresponding Member was announced.—Prof. A. H. Keane read a paper, by Consul Donald A. Cameron, on the tribes of the Eastern Soudan.—The Assistant Secretary exhibited, on behalf of Mr. J. Olonba Payne, nine symbolic letters (Aroko) as used by the tribe of Jebu in West Africa.—The Secretary read a paper, by Mr. T. R. Griffith, on the races inhabiting Sierra Leone.—The Rev. George Brown gave a brief *résumé* of his paper on the Papuans and Polynesians, the reading of which was adjourned till the next meeting.

PARIS

Academy of Sciences, November 29.—M. Daubrée in the chair.—The medal prepared by the youth of France to commemorate the centenary of M. Chevreul, was presented to the President of the Academy, with some appropriate remarks by M. de Quatrefages. The medal, which is a fine work of art by M. Roty, bears on one side a bust of the illustrious *savant*, and on the reverse his full figure, seated in an armchair, in an attitude of study, with the legend "La Jeunesse française au Doyen des Étudiants, 31 Août, 1786—31 Août, 1886." After defraying the expenses of this and another medal of smaller size, a copy of which will be supplied to all subscribers, the Committee has a large balance in hand, which it proposes to utilise by issuing a complete *Catalogue raisonné* of M. Chevreul's works.—Remarks on the 210th volume of the *Connaissance des Temps* (for 1888), presented to the Academy by M. Faye.—A contribution to the history of the decomposition of the amides by water and the diluted acids, by MM. Berthelot and André. These studies have been undertaken for the purpose of better determining the degree of stability, in presence of the acids, of some typical amides, which play an essential part in the tissues of organised beings, such as urea, asparagine, and others.—Glycose, glycogene, and glycogeny, in relation to the production of heat and of mechanical power in the animal system, by M. A. Chauveau. In this second communication the author deals with combustion and the development of heat in the organs while at work. In this state of physical activity the quantity of glycose which disappears in the capillaries is increased, and is in proportion with the excessive activity of the combustions excited by the play of the organs.—Fluorescences of manganese and bismuth, by M. Lecoq de Boisbaudran. In this preliminary paper three conditions are considered: (1) a single solid dissolvent and two active substances, each fluorescing with this dissolvent; (2) a solid dissolvent and two active substances, of which one alone fluoresces with the dissolvent; (3) two solid dissolvents and one active substance fluorescing with each of the dissolvents.—Treatment of the grape-vine with the salts of copper against mildew, by MM. Crolas and Raulin. Quantitative analyses are given of the amount of copper detected in the products of vines treated by this process. Although the actual quantity is never really dangerous, special precautions are recommended in all cases where the grape is intended for consumption.—On the phosphates and arseniates of silver, by M. A. Joly. The precipitated triargentic phosphate, PO_8Ag_3, obtained by double decomposition, is shown to be amorphous, easily dissolving in phosphoric acid even at a low temperature. The limits are determined within which the concentration of the phosphoric solution should be varied in order to obtain at pleasure the crystallised triargentic phosphate or the diargentic phosphate, PO_8Ag_2H.—On some coloured reactions of the titanic, niobic, tantalic, and stannic acids, by M. Lucien Lévy. Some new specific characters of these acids are described, the reagents employed being substances which nearly always present a phenolic function. Hence reciprocally these latter may in their turn be characterised by the same mineral acids.—On the conditions favourable to the restoration of the elements of the transparent cornea, by M. Gillet de Grandmont. These conditions are shown to be suppression of the suppuration, absolute repose, and absence of all intervening irritation.—On a process for intensifying the normal virulence of the microbe of symptomatic charbon, and restitution of the original activity after attenuation, by MM. Arloing and Cornevin.—Note on some essays in antituberculous vaccination, by M. Vittorio Cavagnis. These experiments were made according to M. Pasteur's method, on some rabbits and guinea-pigs, with but partial success. The author is now endeavouring to ascertain whether this method of vaccination is at all applicable to tuberculosis.—On the conformation of the external reproductive organs in the female of the anthropoid apes of the genus Troglodytes, by M. A. T. de Rochebrune.—Observations on the continuous blastogenesis of *Botrylloides rubrum* (Milne-Edwards), by M. S. Jourdain.—New methods of preparing the crystallised carbonates, by M. L. Bourgeois.—The Uralian Society of Naturalists informs the Academy that it is organising at Ekaterinburg, Russia, a Scientific and Industrial Exhibition for Siberia and the Ural Mountains, which will be opened on May 15/27, 1887, and closed on September 15/27 following.

STOCKHOLM

Academy of Sciences, November 10.—On a recently discovered map of Scandinavia and parts of the North Atlantic, edited, in 1539, by Olaus Magnus, a Swedish Catholic clergyman, by Baron A. E. Nordenskjöld.—On the mineral thorite, from two new localities, by the same.—On the Quaternary strata of the Isle of Gothland, by Herr H. Munthe.—On the development of bi-periodic functions in the series of Fourier, by Dr. C. Charlier.—Contributions to the knowledge of the infloration and fructification of the Scandinavian alpine plants, by Dr. C. Lindman.

BOOKS AND PAMPHLETS RECEIVED

Histoire Générale des Races Humaines: A. de Quatrefages (A. Hennuyer, Paris).—Microscopic Fungi, 5th edition: Dr. M. C. Cooke (Allen).—The Greyhound: H. Dalziel (Gill).—British Dogs: H. Dalziel (Gill).—British Cage-Birds: R. L. Wallace (Gill).—On the Conversion of Heat into Work: W. Anderson (Whittaker).—Lives of the Electricians: W. T. Jeans (Whittaker).—Clark's Transit Tables for 1887: L. Clark (Spon).—A Text-Book of Steam and Steam-Engines: Prof. A. Jamieson (Griffin).—Outlines of Quantitative Analysis: Prof. A. H. Seaton (Griffin).—Studien über Protoplasmamechanik: Dr. G. Berthold (Felix, Leipzig).—Proceedings of the Queensland Branch of the Geological Society of Australasia, vol. i. (Watson, Brisbane).—A New Department in Science: Dr. C. Radcliffe (Macmillan).—The Mystery of God, 2nd edition: T. V. Tymms (Stock).

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